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1st of August. Numerous tests with the apparatus were made, using a Renault signal tank, and great success was obtained. Details were forwarded to the United States and the model was shipped under the first available convoy.

Lieut. Edwards, signal officer of the Tank Corps, advised the division of research and inspection in November, 1918, that the sets as designed at the laboratory could be tried out under actual fighting conditions. Three sets were built for this work. Unfortunately these sets could not be used in battle, as they were finished after the armistice was signed. On December 5, 1918, however, maneuvers were held at Bourg, the headquarters of the Three hundred and second Tank Center, and at these radio tanks equipped with this apparatus were used. Extremely gratifying results were obtained, and all the tank officers agreed that radio communication was the best and most reliable means available for tank work.

The two-way radio loop set was designed in France by the division of research and inspection, Signal Corps, primarily for communication between battalion and regimental headquarters, where previously the only electrical means of communication was the ground telegraph. This latter method of signaling had been much used by our Allies, but had the disadvantage of being heavy and of being difficult to maintain under shell fire. Moreover, its use was seriously limited by natural obstacles of low electrical resistances, such as marshes and streams. Attempts to replace the ground telegraph by radio sets in advanced positions had failed, chiefly because of the difficulty of maintaining antenna under fire.

To overcome this difficulty the British signaling authorities developed a trench radio set using instead of the ordinary antenna a small loop directly connected with the spark gap for transmitting and an antenna laid on the ground for receiving. This set had a range of 2,000 to 3,000 yards and required about 30 watts, power being obtained from storage batteries. The use of a loop for transmitting, designed small enough for use in a trench or dugout, allowed the practical use of radio communication in forward areas for the first time.

A loop set designed to cover a somewhat longer range but still adapted for trench use was suggested in April, 1918, by Capt. Armstrong and developed by Lieut. Priess, of this division. Preliminary experimental work was carried out in the laboratories of the division and two models constructed under his supervision. In this work Lieut. Priess was assisted by Sergt. (First Class) Harold M. Lewis and Sergt. H. W. Howk. The set as finally authorized for reproduction of models for test in the United States was designed to have a range of 5 to 6 miles, and to transmit on two wave lengths, 110 and 140 meters. The complete set consists of three parts—the box containing the set, a storage battery (10 volts and 20-ampere hours) and a bag containing loose parts, spare tubes, and spare plate batteries, each unit weighing under 30 pounds. This set has proved superior to the British set in that tuning is much sharper and the set has a much greater range.

The first two models were tried out by Lieut. Priess in the Toul sector in August, 1918, very satisfactory results being obtained. During these experiments the sets were located at various distances up to

12 kilometers apart, with one, and finally with both stations in dug-outs. The radio officers present at these tests reported so favorably on the apparatus, that arrangements were immediately made to send Lieut. Priess to the United States with the models.

Lieut. Priess left Paris for the United States in September, 1918, to push the development of the loop set, and to use every possible means to put the set as originally designed on a production basis. He immediately took up with the Radio Division at Washington and with various manufacturers the details of the production of 10 of these sets for further trial. At the time the armistice was signed the first United States model of the apparatus had been completed by the E. J. Simon Co., of New York.

The fundamental piece of apparatus for use in listening station work, namely, the SCR 72 amplifier, was made in the United States, and the samples sent over to France proved to be better for this purpose than the French 3-ter amplifier. In order to establish a standard system for use in listening station work, Capt. E. O. Hulbert, of the division of research and inspection, made a complete study of the conditions to be met in this work.

In order to familiarize himself with the methods used by the French Army and with the difficulties which the Allies had encountered in their listening stations, he attended a conference held by French officers in charge of listening stations. Following this, experiments in the research laboratory in Paris were carried out to develop methods for reducing interference and for cutting out disturbing noises. The work included a study of the use of amplifiers, and as soon as the experimental apparatus had been assembled Capt. Hulbert took these to the American sectors north of Toul, at St. Mihiel and in Lorraine, where three weeks' practical work was done to determine the best combination of apparatus.

During this experimental work it was observed that a part of the noises met with at listening stations were due to low-frequency disturbances, such as power lines, motor, and generators. On his return to the research laboratory Capt. Hulbert developed a low-frequency filter to cut out the above types of disturbances. Field tests on this filter were carried out in the country near Paris under various conditions of disturbing noises. These experiments were followed by the manufacture in the model shop of the division of a number of these filters, and upon the invitation of the French authorities Capt. Hulbert proceeded to Flavigny, the general headquarters of the Eighth French Army, with his experimental apparatus. There experiments were made in collaboration with the French officers in charge of the listening stations in that region. Permission was obtained to install the new apparatus in the listening stations, which at that time were handled by French and American personnel.

The system evolved from these experiments consisted of a number of earthed antennas, the SCR-72 amplifiers and the low-frequency filter. This system was found to give better results than the French system. It was also easier to install and to maintain in working order, and it had the further advantage of being more readily adaptable to meet conditions at different stations. Owing to the satisfactory results obtained with this system, it was adopted as standard. The system was used successfully during the six weeks previous to the St. Mihiel attack.