

Radiophony to Airplanes a Great Success

A CONSIDERABLE time before the United States entered the world war the Bell Telephone system supplied the American Navy with a wireless telephone outfit designed for communication between an airplane and a sta-

"All this sounds very simple, but it would take volumes to describe the innumerable experiments and heart-breaking failures before the first real successes. So far as the radio part of the equipment was concerned we had an answer in a short time. We had

densers and other apparatus that comprise the transmitting and receiving elements. Working this apparatus under ordinary conditions on the ground, and in a swift-moving and tremendously noisy airplane, were two entirely different propositions. The noise of the engine and rushing air was such that it was impossible to hear one's own voice, to say nothing of the weak signals of the telephone receiver," stated Edward B. Craft, Assistant Chief Engineer of the Western Electric Co.

One of the first problems was to design a head set which would exclude these noises, and at the same time permit of the reception of the telephone talk. A form of aviator's helmet was devised with telephone receivers inserted to fit the ears of the pilot or observer. See accompanying illustration of the helmet with 'phones complete. Cushions and pads were provided for adjusting the receivers to the ears and the helmet fitted close to the face so as to prevent as far as possible, the sound being heard either thru the ear passage or thru the bony structure of the head, which acts as a sort of a sounding board. A helmet, such as that illustrated, was finally developed and was found to solve this portion of the problem. The earpiece finally adopted was made of sponge rubber (made so by blowing air thru it while molten), reinforced by tinfoil, and the receivers themselves embedded therein. These were mounted in a thick leather helmet, to be clamped over the flier's head and ears. It effectually muffles bone transmission also, besides permitting the use of oxygen or gas masks.

Everyone knows how sensitive the ordinary telephone transmitter is to extraneous noises, and it does not require a wide stretch of the imagination to picture how this would act alongside the exhaust of a 200 horsepower gasoline engine. A brilliant line of experimentation finally resulted in a form of a telephone transmitter or microphone, which possess the remarkable quality of being insensitive to engine and



U. S. Army Airplane Pilot and Observer Equipt with Wireless Telephone Sets for Transmitting as well as Receiving Speech. These Sets Are Provided with a Change-over Switch Which Permits the Instruments to Be Utilized as a Regular Telephone Between the Two Birdmen.

tion on land or on a ship. From that time on until this country entered the world-conflict, the Western Electric Company, as a part of its general study, conducted the work of perfecting light, compact wireless telephone sets, which would be available on small vessels and on airplanes. The first successful wireless test between an airplane and the ground after our entry into the war was made with one of the sets designed and completely built by this enterprising engineering organization prior to our entry into the war. The test was made on Langley Field.

On May 22, 1917, Gen. George O. Squier, Chief Signal Officer of the United States Army, sent for Dr. F. B. Jewett, chief engineer of the Western Electric Company, to confer with him with reference to the matter of equipping airplanes with wireless telephone apparatus. At this conference, which was held in Washington, besides Gen. Squier and Dr. Jewett, there were present E. D. Craft, one of Dr. Jewett's principal assistants; Capt., now Col. C. C. Culver, of the Signal Corps, and Col. Rees, of the British Army Air Service. The possibility of providing airplanes with wireless telephone service was discuss, and the reports of the development work being done by the Western Electric Company made by Dr. Jewett were so promising that he was ordered in writing by Gen. Squier to proceed with the development of the system, and to actually equip planes with it.

The Bell system engineers had progress so far at that time that they were able on July 1, 1917, five weeks after the first conference, in a test at Langley Field, to actually demonstrate the working of the wireless telephone between an airplane and the ground. This test also showed that it was practical to operate the system between two or more airplanes in the air.

developed some very successful forms of vacuum tubes and it was a simple matter to assemble them with the necessary coils, con-



Testing the Radiophone Between New York and Washington. A Photograph of U. S. Naval Operators Communicating with the U. S. Navy Department at Washington, D. C., from the Bankers Club in New York, Thru the Radio Telephone. Many of the Country's Leading Bankers Were Present to Witness the Demonstration. Afterward Tests Were Made from this Station to Airplanes and Dirigibles Flying over New York City, Various Orders Having Been Successfully Sent to the 'Planes.

wind noises, and at the same time very responsive to the tones of the voice. With these two elements in hand, the problem was apparently solved. The fact remains, however, that three solid months of the hardest kind of work was necessary to iron out all the kinks and get the thing in shape so that it might be considered a practicable device for the everyday use of other than experts, as Mr. Craft points out. The microphone perfected for this work has no mouthpiece, but instead a flat cap having three tiny openings about 1/16 inch in diameter. The voice waves pass thru these onto the diafram easily, but the engine noises swirl round it in other directions and do not enter in sufficient volume to be heard at all.

A typical performance of the radiophone between 'planes and ground will prove of interest. Here is the way it worked at one of the first official army tests at the flying field at Dayton, Ohio, December, 1917, as related by Mr. Craft.

"The 'planes left the ground and after what seemed to be an interminable length of time, we got the first sounds in the receiver, which indicated that they were ready

In our next issue will appear an important article by Nikola Tesla entitled

"TRUE WIRELESS"

In this article Dr. Tesla will make known his views of the propagation of the wireless waves.

ing at various speeds, and the specifications stated this to be from forty to one hundred and sixty miles per hour, the latter figure representing the speed when the machine was diving. The little dynamo, therefore, had to deliver a constant voltage with a speed varying from 4,000 to 14,000 R.P.M.

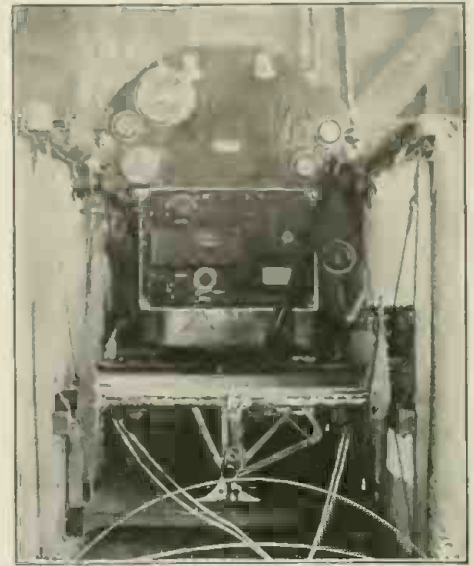
The microphone and receivers used for radiophoning from 'plane to 'plane or 'plane to earth are arranged by means of a switch so that the pilot and observer can converse over the telephone circuit between the pilot and his mechanic with ease, and by throwing a switch can connect themselves with the radio apparatus and talk with the men in another 'plane three or four miles away, or to the ground.

The primary object was to make it possible for the commander of an air squadron to control the movement of his men in the air, the same as a squad leader of infantry does on the ground. For this purpose extra long range is not required, and the distance over which they can talk is purposely limited to two or three miles, so that the enemy cannot overhear, except when actually engaged in combat, and then nobody cares.

The Navy also makes use of these sets in their sea-planes, and here the range is somewhat greater, up to twenty miles in some cases. The Navy has also made use of a modified form of this set in their 110-foot submarine chasers. The chasers hunt submarines in packs, and by means of the radio telephone, their commanders keep in constant touch with each other, thereby greatly increasing the effectiveness of their operation.

Finally, with the formal demonstration completed, pressure was immediately applied to produce the necessary quantity of sets with their multitude of auxiliary and subsidiary parts. From January 1, 1918, to the early summer of that year the Western Electric Company established factories and trained thousands of operatives so that when the armistice was signed the necessary transmitting and receiving tubes for radio telephone sets were being produced at a rate in excess of a million and a half good tubes per year. Improvement in vacuum pumps has resulted in a wonderfully high degree of exhaustion being attained—about one-billionth of an atmosphere.

Altogether thousands of radio telephone sets of different types have been manufactured and delivered to the Army and Navy since the early part of 1918. In spite of the fact that prior to July, 1917, no commercial types of this apparatus were in existence, and some of the fundamental problems had not yet been solved, the resources of this great telephone engineering organization were sufficient to establish



The Wireless Telephone Apparatus (Outlined in White Square) Installed in Cock-pit of Airplane. It Takes up But Little Room and Has Such a Small Weight as to Be Insignificant, Compared to the Lifting Power of the Plane.

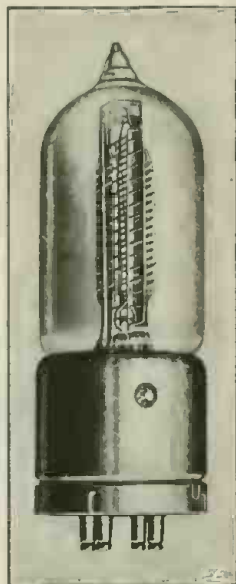
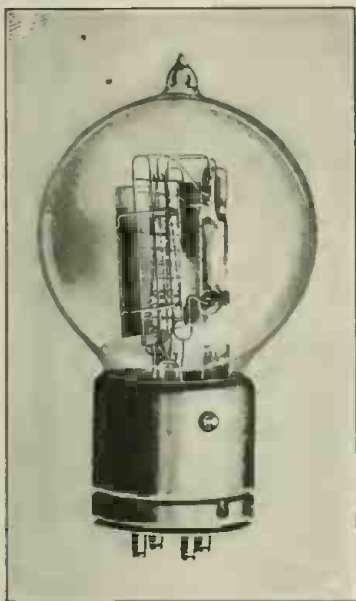
on a commercial basis, within this short space of time, practically speaking, an entirely new art!—Photos Courtesy W. E. Co.

HOW AIRPLANES FIND THEMSELVES BY RADIO.

In his recent lecture before the American Institute of Electrical Engineers at New York Major-Gen. G. O. Squier, in connection with his description of the war's developments in radio apparatus, spoke as follows concerning the problem of aerial navigation:

"One of the principal problems of airplane navigation has been the evolution of a suitable compass, particularly for night bombing work. Magnetic and gyroscopic compasses have limitations at present which make impossible reliable air navigation by dead reckoning.

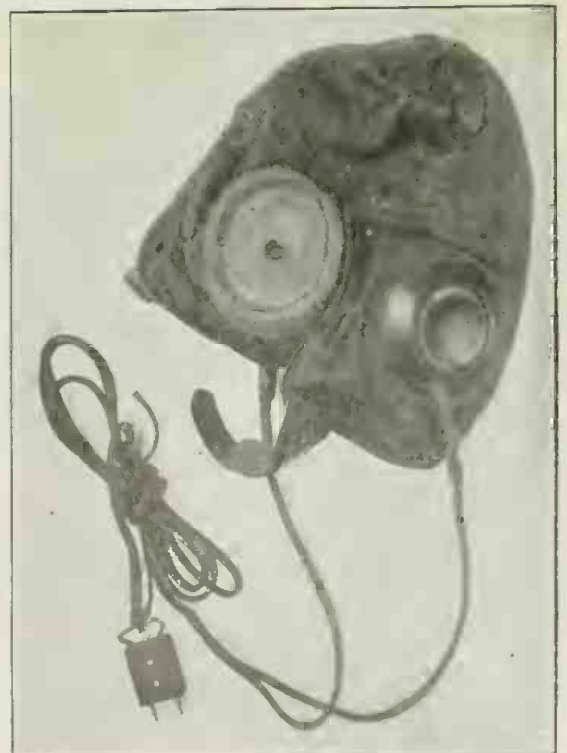
(Continued on page 926)



The Vacuum Tubes Which Do the Work in Radiophoning to and from Airplanes and the Ground. At the Left—the Transmitting Tube; at Right—the Receiving Tube. America Was Turning Out These Bulbs by Thousands Every Day When the Armistice Was Signed, so Rapid Had the Standardization and Production Progress.

to perform. The spectators were only mildly interested, and some seemed to be a bit bored. Suddenly out of the horn of the loud speaker came the words, "Hello, ground station. This is 'plane No. 1 speaking. Do you get me all right?" The bored expression immediately faded, and looks of amazement came over their faces. Soon we got the same signal from No. 2, and the show was on. Under command from the ground the 'planes were maneuvered all over that part of the country. They were sent on scouting expeditions and reported what they saw as they traveled thru the air. Continuous conversation was carried on, even when the 'planes were out of sight, and finally upon command they came flying back out of space and landed as directed."

Electric current must be supplied to operate the wireless set on the plane, as we well know, this current being used to heat the filaments of the vacuum tubes and to operate the transmitter. But the 'planes were already loaded down with all the gear they could carry, and the use of heavy storage batteries was out of the question. The airplane engineers would allow nothing to be connected to their engines, so there was nothing left but to supply a separate radio dynamo, and drive it by a wind propeller, taking its power from the rushing air. Airplanes are in the habit of fly-



Aviator's Radiophone Helmet Fitted with Special Sound-proof Pads and Having the Two Receivers Mounted Tightly Therein. The Receivers Are Moulded in Sponge Rubber. The Helmet is Made of Leather.