Radio---the Eyes and Ears of Aircraft

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MARCONI was transmitting his first feeble signals by radio when the Wright brothers soared in the sky—just twenty-five years ago. To-day these two great inventions have been linked together to give man his swiftest form of communication. The intensive application of radio to commercial aviation is, however, a comparatively new thing, and the marvellous development of this branch of radio owes a great deal to the experiments carried out on military aircraft prior to the war, and the impetus given to wireless in aircraft during the war period.

As early as the South African War two crude Marconi sets were sent out for use from balloons, but it was considered unsafe to use them owing to the possibility of fire from sparks in the induction coils. Experiments were continually carried out, as a result of which at the outbreak of the Great War some 16 seaplanes had been fitted with transmitting apparatus. Although military 'planes were not even fitted with receiving set, military aircraft fitted with wireless were first used for artillery observation at the battle of the Aisne, but the great objection to their use was their weigh and clumsiness. In the two-seater aeroplanes the sets took up the whole of the cockpit rightfully allotted to the observer, so the pilot had to fly and work the wireless above.

In 1915, however, the compact Stirling set appeared, which weighed little over 20lb. Technical improvements were continually effected to enable an increased number of aeroplanes to work along a given front without jamming the signals; to such an extent that at the battle of Arras in 1917 there was one machine in the air to every 400 yards of front, each machine being capable of transmitting without interference.

This was only possible by rigid attention to detail. In particular, by making full use of the range of wavelengths provided by the Stirling transmitter and by the variation in tone effected by the use of the clapper-break.

The great drawback to wireless signalling from aircraft is its susceptibility to jamming, either intentionally by the enemy or by messages sent out from friendly aircraft working near. With the device known as the "clapper-break" it was possible to vary pitch or tone, on the same wavelength which enabled the number of 'planes operating on the same point, to be enormously increased.

THE wireless engineer has been faced with many difficulties peculiar to aircraft. The vibration and noise make it difficult in an aeroplane to hear anything but the engine; the risk of fire, the imperfect protection of the instruments from splashes of oil and the rush of air—all these things complicated the problem.

Again, the matter of shielding the electrical devices on the aeroplane has presented many difficulties. Each spark plug in the engine is a miniature radio transmitting station. The ignition wires, magneto, low-tension wires and their associated parts form an antennae system giving rise to highly damped waves over a wide range of wavelengths.

Imagine a sensitive receiver situated ten feet away from sixteen to seventy-two strong spark transmitters feeding into an antennae radiating on all wave lengths, trying to pick up feeble signals from a station over 100 miles away!

On a well-shielded 'plane practically no interference is noticeable, and a 400-watt short-wave telephone transmitter can be received for 200 miles or more. If no shielding has been installed reception is only possible for about twenty to thirty miles.

SINCE the War the possibilities of radio as an aid to flight have been actively developed, and radio is now being utilised in many directions. Direction-finding stations for grading aircraft along fixed airways during fog and low visibility are being erected in increasing numbers throughout Europe and the United States.

Rotating radio beacons, for furnishing navigational aid to independent flyers are receiving attention. Wireless stations at aerodromes broadcast periodic weather forecasts. On many air routes two-way telephonic communication between ground and the aeroplane has been successfully established. Radio has also been adapted to provide a method of field localising, whereby a pilot can locate a radio station within 100 feet; and radio methods have been successfully tried out in connection with altimeter (height finding) devices.

IT may be interesting to describe briefly the development of directional wireless, which has conferred untold benefits on aerial navigation, particularly in the case of navigation over water and areas of low visibility.

It is impossible to exaggerate the solitude and helplessness of an aeroplane flying in dense fog. Deprived of all landmarks, under incessant strain at the controls, the pilot can only continue flying by instruments, and it is only by radio means that he can be certain of keeping to a given course and locating his landing field.

Several systems are in use; in Europe radio direction-finding stations are maintained by the Governments at the various airports, and each aeroplane carries a transmitting and receiving set. Upon request by radio, two or more direction-finding stations will determine the direction of travel of radio waves from the aeroplane, and by plotting the bearings of the plane from each station the position of the aeroplane can be determined and wirelessed.

Positions found in this manner are accurate to within three miles at 150 miles range.

Another method, which has the advantage of greater secrecy, is for the aeroplane itself to be fitted with direction-finding apparatus. In this method the directional properties of the loop aerial are utilised. The directional property of the loop depends on the difference in phase of the currents set up which vary with the angle the 'plane of the loop makes with the incoming waves. The method of direction-finding commonly used on ground stations is known as the Bellini-Tosi method.

Instead of employing a small rotatable loop aerial for reception of signals and indication of direction, two large fixed loop aerials at right-angles are used and the resulting currents are arranged to produce a magnetic field in an instrument known as a radiogoniometer. A search coil finds the 'plane of the magnetic field in this instrument and indicates on a dial the required direction.

FINALLY, we have the rotating radio beacon. This is a radio transmitting station with a rotating directive antenna, causing a beam of radio waves to sweep constantly around. A special signal indicates when the beam sweeps through the north. A pilot listening for this beacon's signal can determine his direction by the time elapsing between the north signal and the instant the beam is heard with maximum intensity.

THE possibilities of radio in flying have been illustrated in some spectacular trans-oceanic flights. The Southern Cross on its remarkable trip from California to Australia was in touch with the world throughout the trip by means of high frequency (short wave) radio. Any practical scheme of trans-oceanic air service would seem to require directional radio aid.

Exploration by air is another instance where radio must be used. An exploring party takes unnecessary risks if it neglects directional radio aids. This was recognised by Commander Byrd in his recent Antarctic explorations.

The principal and the most insistent use of radio will, however, come with development of regular commercial airways; the reliability and safety of which will depend largely on the radio service.

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