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COMMUNICATIONS AND BEACONS ON AIR ROUTES.

By Captain Franck,  
Service Technique de l'Aéronautique.

From Rapports du Premier Congrès International  
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## COMMUNICATIONS AND BEACONS ON AIR ROUTES.\*

By Captain Franck,  
Service Technique de l'Aéronautique.

### Need of Communications and Beacons.

The aircraft which undertakes a journey requires information as much before its departure as during the flight. During travel it is necessary to find a route marked by some suitable system of beacons.

Communications.— The information required before departure is chiefly meteorological in nature. For the navigator starts only in case the weather announced to him along the route is such that he can safely undertake the journey with the aircraft and the navigation instruments at hand. Meteorological information consists in the knowledge of the existing weather conditions at different points along the line and in a forecast of the probable weather along the route during the trip. Now the weather can be known and the forecasts made and distributed only when a system of very rapid communication is satisfactorily organized.

When he has decided to start, the air navigator should notify the point of destination and the principal landing fields along the route. The latter would then be able to have the beacons in readiness, in case they are not constantly in operation, and to assist the aviator by all possible means during the trip. During the flight, incidents may occur (such as changes in the weather

\* From Rapports du Premier Congrès International de la Navigation Aérienne, Vol. 1, pp. 110-114.

and difficulty in finding the way) which will make it necessary for the aviator to communicate with the ground. The ground organizations whose duty it is to look out for his safety may have information to send him (sudden and unforeseen changes of the beacon, storm warnings, etc.). Finally, on arriving at his destination, he must notify the airdrome from whence he departed, as well as the intermediate landing fields, so that at any moment they will be posted as to the position of the different aircraft.

The system of communications of air routes must therefore comprise communications on the ground and between the ground and the aircraft in flight. These communications must be reliable and practically instantaneous. On this account it is necessary to employ means designed for this special purpose, to the exclusion of those used for other purposes. The latter means may however be utilized in case of failure of the former and such use should be anticipated and provided for in advance. It is no less true however that the airways need their own system of communications.

Marking. - Aerial navigation can use the methods of sea navigation and also similar instruments, compass and sextant, for example. But while the sea is practically motionless or influenced by regular currents, the air is disturbed by currents which vary almost constantly in speed and direction and which change with altitude. The result is that, when the aerial navigator no longer has a landmark to observe, it is impossible for him to take ac-

count of the possible changes in his drift and to follow precisely the desired route. It is therefore necessary to place more beacons along the routes he must follow. Lastly, it is necessary to give him numerous means for determining his position or for following a well-defined route without losing it, no matter what the weather may be.

Thus the marking of air routes requires day signals, night signals and electro-magnetic or other signals capable of replacing the visual signals in foggy weather.

#### Means Employed to Establish Communications and Beacons.

a) Communications.- The only means of rapid communication suitable for aviation are radiotelegraphy and radiotelephony. In fact, these are the only possible means of communication between the ground and aircraft. On the ground, ordinary telegraphy or telephony could be employed, but their use would require the installation of special direct lines at a prohibitive cost. This method of communication would be of value only if multiple telegraphy and telephony made possible by the use of high frequency on ordinary lines, should become common and thus increase the efficiency of electrical circuits to the point of considerably diminishing the cost of a direct communication by wire. This point has not yet been reached. In France, the system of communication adopted on air routes is the following:

1. Land Communications.- These are maintained by the aid of continuous wave radio sets, with a range of 800 kilometers. These sets may be employed either for telegraphy or telephony, as de-

sired. In practice, land communications are made by telegraphy, thus obtaining greater efficiency.

2. Communications from the Ground to Aircraft.- On the ground sets like those described above are employed. Messages transmitted by them can be received aboard aircraft up to 500 kilometers by telegraphy and by telephony.

On aircraft, the companies use the apparatus found in commerce. The range required depends on the distance between the ground stations with which it is possible to communicate. The routes now in operation can work under favorable conditions with sets having a range of 300 kilometers.

Telephony is very practical for communicating between the ground and airplanes. In fact, it does not necessitate acquaintance with the Morse alphabet. After a little training, any member of the crew can use it, so that it is not necessary to have a radiotelegraph operator on board. On international lines, however, it is difficult for operators speaking different languages to understand each other by telephone.

3. Organization of Communications.- All the important landing fields and all of those where a meteorological station is installed are equipped with a station for land communication.

All terminal fields and all those where meteorological information is gathered are equipped with radio stations for communicating with airplanes.

On a given landing field which needs to communicate both with other fields and with aircraft, these communications may be made

either by means of a single station or two different stations, according to the volume of traffic.

b) Beacons.- 1. Day Beacons. These include route landmarks and markers on the landing fields.

To indicate the routes, the names of the landing fields along the way are marked with large letters. If this is insufficient the names of important places are marked either on the roofs or on the ground. Consideration has also been given to the question of beacons for air navigators in bad weather. For this purpose, captive balloons have been sent up above the layer of clouds during foggy or cloudy weather, but up to the present time this method has not given satisfactory results.

Landing fields are marked in the following manner. The center of each field is indicated by a circle with a diameter of 50 meters in which the name of the field is inscribed.

In certain cases, four lines radiating from the perimeter of the circle indicate the four cardinal points.

The boundaries of the landing field, wherever they are not evident, are marked by spaced lines on the ground, or by disks mounted on low supports. Special markers are placed at the corners of the landing field in order to outline its contour in snowy weather. All of the obstacles which may exist are indicated by red and white pennants.

The direction of the wind is given by a movable landing-T which automatically orients itself. A flag mounted on an elevated support indicates the direction which must be followed around the field.

2. Night Beacons. The marking of routes is accomplished by the aid of special lights. The form of the beam is such that they are visible at an altitude of 2000 meters and at a distance of 40 kilometers with medium visibility. These lights are located in the vicinity of landing fields which mark the route, to indicate their situation. If the number thus installed is insufficient, others are placed between the fields. They emit series of long and short flashes, in different and characteristic combinations.

The installation of very powerful lights at certain important points on air routes has been considered. Two are now being built by way of experiment. It is expected that they will be visible at a distance of 150 kilometers with a transparency of 0.925.

Landing fields are marked in the following manner: Their situation is determined as already mentioned for the marking of routes. Obstacles are indicated by different lights. The direction of rotation is given by a luminous circle; the direction of the wind by a series of lights on the same T used during the day.

The greatest difficulty at night consists in marking the place and direction for aircraft to land. The International Aerial Navigation Convention recommends a method which consists in dividing the landing field by means of lights into three sections: a landing section, a neutral section and a section for departure. But the direction of these sections must be changed whenever the wind changes. It would be necessary, in order to accomplish this, to have quite a large night personnel, or to adopt a system of subterranean electric lights placed under glass and automatically

lighted in a certain order according to the direction of the wind. Such a system is possible, but very expensive.

The French organizations have tested another method for night landing. An oblong portion of the field is illuminated by a series of special searchlights in such a way that the major axis of the geometric figure formed by this illuminated portion lies in the direction of the wind. A red light placed beyond one end of this illuminated portion indicates the direction of landing, in order that all confusion may be avoided. The attached table gives the various signals employed on landing fields by day and by night.

3. Signals for Foggy Weather.- Since visual signals are useless in foggy weather, it is necessary to substitute sound or electro-magnetic signals. The use of the former is very limited, for the noise of the engines prevents their being heard on board. The latter are being investigated.

#### Conclusions.

Regular and reliable aerial navigation is only rendered possible by the use of a suitable system of communications, signals and beacons along the air routes. These routes are nearly all international. The installation of their communications and beacons is therefore an international question and it is of the greatest importance for their development to have the various governments reach a complete agreement concerning the manner of establishing them. It is to be hoped that exchanges of views and discussions will increase between both private and public organizations for the



development of aeronautics in the different countries. This can but help prepare the way for international agreements and hasten their realization.

Translated by the National Advisory Committee for Aeronautics:

Significance of signal	Day signals	Night Signals		Sound Signals
		Lights	Rockets	
		Sent by the Airplanes		
Request for permission to land		Intermittent and indicative signals with one green lamp	Green rocket	
I am going to land		Short intermittent signals with navigation lights	Red rocket	
Distress	N. C. flag signals of the International code and distance signal	S.O.S. with any light	White rockets at short intervals	Continuous sound with any device
		Sent from the Ground.		
Permission to land		Indicative and intermittent signals with green lights (green cross)	Green rocket	
Landing forbidden		Red lights (red cross)	Red rocket	
Turn to the left	Red barrier	Circle of red lights		
Turn to the right	White barrier	Circle of green lights		
Obstacles of less than 15 meters		Isolated red lights		
Obstacles of over 15 meters		3 red vertical lights 3 meters apart		
Entrance to the slip of a seaplane base		Row of 3 lights 1 white between 2 green		