Airplanes and Radio Conquer Fog

Aviation

By James Stokley

Fog on the airlines today! Idling mechanics, impatient pilots straining eyes skyward for hopeful weather signs, passengers with plans disarranged traveling by slower trains and busses, air transport at a standstill in deference to the grey blanket of meteorology.

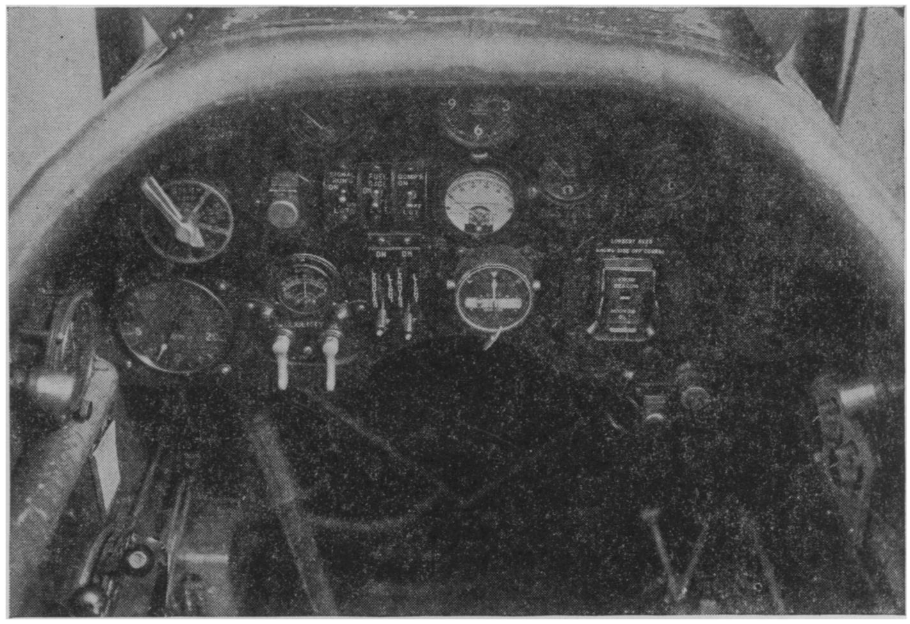
When grey mist now grips the earth, air travel must stop. But the radio is answering the airplane's SOS in remedying this condition.

Invisible beams of radio signals can now be laid through the blinding fog. Upon them the airplane can ride with assurance that it is ploughing a true air course to its destination.

The improved radio beacon for airplanes so recently perfected by the experts of the U. S. Bureau of Standards that it is not yet in practical use is an important step toward the days when airplanes will take off in the densest fog, rise to the proper flying height, make a straight airplane line to the route's terminal and land accurately and safely. Instruments will substitute for the pilot's vision rendered useless by the fog.

The latest of these mechanical sense organs is a small rectangular hole, crossed by a thin, horizontal white line broken in the middle. It is the new addition to the maze of instruments which confront the pilot as he sits in the cockpit. The plane takes off, the radio set is started, the lines broaden in a vertical direction to form white rectangles. The pilot watches them occasionally. Finally, one of the rectangles becomes a little higher than the other, the right one perhaps. Immediately the pilot turns his plane to the left, and the rectangles are again the same size. So simple as that is the operation of the latest type of radio beacon.

The radio beacon enabled the first trans-Pacific fliers to reach Hawaii. But they did not have anything so easy to operate. One man had to keep his ears to the headphones of the radio set. While the plane was on the proper course, he heard a continual hum. When he deviated from the course, the hum changed to a succession of louder and fainter buzzes, and the plane was manipulated until the sound was again continuous. As might be expected, this system required a good bit of skill on the part of the operator.



THE INSTRUMENT BOARD of the Bureau of Standards' experimental plane, showing the reed indicator installed below and to the right

To remedy this difficulty, the government scientists have tried various devices. One was a system of relays operating three lights. A white light appeared while the plane was on the proper course. Deviation to one side caused a red light to shine, to the other, a green light. The trouble with this was that it was too complicated and gave no clue as to how far the plane might be from the proper course. Then there was tried an arrangement of two neon lights. These both shone with a pink glow when on the proper course. Deviation to one side caused one of the lamps to go out. But this also gave no indication of the amount of deviation, because the lamps either glowed brightly, or didn't glow at all.

Another device used was an ammeter, in which the pointer was at the center of a dial when on the correct route, swinging to one side or the other depending on which way the deviation occurred. But this had the serious disadvantage that when anything happened to stop the radio completely, the pointer remained right in the center. The pilot might have no idea that anything had happened, and might think he was still going the right way.

The so-called "reed indicator," which has just been developed, and which was described in the opening part of this article, seems to be the ideal, and is likely to be adopted. Already it has been installed experimentally on two planes, and soon will be in use on a number of others, flying over commercial routes. So far it seems remarkably successful.

All of the radio beacons that have been tried have used the same principle, and the transmitting equipment has remained substantially the same. It is the same fundamentally as the radio compass that enables ships entering New York, or other harbors, to get their position precisely even in a fog. The ship's radio compass takes advantage of the fact that a loop antenna, a coil of wire that takes the place of the more familiar aerial, gives the loudest signals when the direction of the coil is pointed at the radio transmitting station. When the plane of the coil is at right angles to the direction the received signal almost completely disappears.

A loop can also be used for transmitting. Then also the greatest intensity is in the direction of the coil. The radio beacon uses a transmitter with two such coils at right angles. Both use the same wave length but one sends out a note a little higher than the other. If a receiving station, whether on the ground or in an airplane, is on line with one of the transmitting loops, it picks up one note well and the (*Turn to next page*)

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other not at all. On line with the other loop, the other note is picked up well, to the exclusion of the first. If the station is on a line halfway between the two aerials, the two notes are received, and with equal strength.

With the first form of radio beacon, the method was to send out alternate signals from each aerial. The airplane that was flying along the proper route heard first one and then the other with his radio set. When he departed from it one was louder than the other. The latest method, however, consists in sending a signal continuously from both aerials. Two separate wave lengths might be used but that would be more complicated, and would require two sets on the plane. So only one wave length is employed. Over one antenna is sent a note of 85 cycles, which means that it vibrates 85 times a second, while the other one sends out a 65 cycle note.

The radio set on the plane picks up both notes, they are mixed together like two stations broadcasting on the same wave length. If a pair of headphones were plugged in the set, both notes would be heard. But instead of headphones, two vibrating reeds are used. These are thin strips of steel, fastened at one end. If you pluck one, it would emit a twang like a jew's harp. One reed, when thus plucked, vibrates at 85 cycles, the other at 65 cycles. Beneath them are electro-magnets connected to the radio set. When the magnets are energized 85 times a second, the 85 cycle reed vibrates, but the 65 cycle one stays quiet because it is not tuned to that frequency. It has its chance to vibrate when a signal of the lower frequency is received. As it would be hard to detect the twang of the reeds above the roar of the engine, the reeds are mounted on the instrument board so that the pilot sees their free ends, painted white, side by side and against a dark background. When they start to vibrate, the thin line spreads out vertically.

As long as the airplane is the same distance from the direction of each of the two aerials, both notes come in with equal force—the ends of the two reeds vibrate the same extent. But suppose the plane drifts towards one side, perhaps the left. Then the signal from the aerial on that side comes in more strongly, and the left hand reed vibrates more, while the right hand one vibrates less. This appears to the pilot as a lengthening of the left hand line and he knows he is off his course in that direction.

DR. J. H. DELLINGER, head of the Bureau of Standards' radio laboratory, where the radio aircraft beacon has been developed

Most of the tests of this radio beacon so far have been made with an experimental station of the Bureau of Standards at College Park, Md., but if it proves as successful in further tests as it has already, such beacons will probably be a common feature of our future airports. Already the solution of another problem that will arise when in commercial use has been solved. That is in the case of an airport where planes approach from a number of directions. Would it be necessary to have a separate set of aerials for each route? Or could the one pair of aerials be made to turn? Either of these methods could be used, but they would be troublesome and expensive. The Bureau of Standards scientists have developed a simpler scheme—using a device called a goniometer. This is a coupling arrangement between the antennas and the transmitter. Turning a coil of wire within it has the same effect as if the whole antenna system were turned. Thus, in an airport crossed in many directions, a definite schedule might be worked out, by which the pilot would know just when his signals are being transmitted.

Another improvement in aircraft radio that has been worked out in this research is the antenna carried by the plane. Until recently, the usual type of airplane antenna has been a long wire trailing below. It is kept on a reel, and is unwound as soon as the ship is in the air. Before landing it has to be wound in again, or it might catch on some object on the ground. Such an antenna is quite satisfactory for general radio work, as used in European commercial planes, for example, it permits the fliers to keep in continual conversation with their destination or the port they have just left.

With radio beacons, such a form of trailing antenna has a serious objection. Hanging as it does at an angle to the ground it has a directional effect of its own. This is constantly varying, and so introduces serious inaccuracies. The Bureau of Standards scientists have developed a vertical aerial, which consists of a metal pole extending vertically from the cockpit for a height of ten feet and supported by guy wires. A great advantage of the vertical antenna is that it will indicate when the plane is directly over the beacon transmitter, for then the signal stops completely. According to Dr. J. H. Dellinger, head of the Bureau of Standards radio laboratory, the beacon can be located within a hundred feet when the plane is not over a thousand feet above. This would be a most valuable feature in time of fog, and would help prevent such a situation as that of Commander Byrd in the America, when he flew over Le Bourget in Paris in the fog, but could not find the field.

But radio is not the only means of locating a field in fog, for excellent results have been claimed with neon lights. A neon light is a relatively new thing, but it is already common on our streets in the form of the glowing pink tube that advertises all sorts of products from automobile tires to tooth paste. Practically all of the present day schemes of television make use of a similar neon lamp in the receiver, the image that the observer sees being one of glowing neon.

Neon glows almost completely in the red region of the spectrum. Many experiments have shown that the longer rays of red light pass through fog or smoke much better than the shorter waves of blue light. The neon aircraft beacons shine with a brilliant red light that can be seen through layers of fog that ordinary light cannot pene- (*Turn to page* 241)

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trate. Similar lights have been suggested, and actually tried, for use in harbors as guides to ships through fog. The case is different from that of the airplane, however. When the ship is a mile away from such a light, it would have to be seen through a mile of fog, a thing quite impossible even with neon. But fog usually sticks close to the surface of the earth or water, and a few hundred feet up, the air would be comparatively clear. Thus, the pilot of a plane a mile over the field may only have to look through a few hundred feet of fog, and this is quite possible. By having such a light at each corner of the landing field, the pilot can dive down into the fog and make a good landing, even though he can barely see the field until he is almost on the ground.

Another electrical device for guiding airplanes, and that has come into wide use, is the earth inductor compass, also a development of the Bureau of Standards. With the ordinary compass, the electrical connections of the engine, as well as its steel parts, attract the needle. Also the vibration and constant swinging of the plane causes other tremblings of the needle, so it is very uncertain at best. The influence of the magnetism of the engine can be greatly reduced if the compass were placed perhaps ten or twenty feet away from it—in the tail, for instance. But then the difficulty is that the pilot can't see it. There is no way of arranging the ordinary form of compass to read at a distance.

So there was developed the earth inductor compass. It depends on the same principle that make it possible to turn a dynamo with a steam engine and get electricity out of it. That is, if you spin a coil of wire inside a magnetic field, it produces a current. In the dynamo the coil is spun by the steam engine, or whatever is used for power. The magnetic field is provided by electromagnets, called the field magnets, which are energized by the dynamo's own current. Since there must be current to cause the magnetism, and also cause the current, it is necessary to send a current from a battery, or other dynamo, through the field magnets when it is started.

But the earth inductor compass makes use of a magnetic field that is always with us, the same magnetic field that pulls the compass needle toward the north. This is the magnetism of the earth itself. Though this magnetism is rather weak, compared with that of a dynamo, it is possible to spin a coil of wire in it, and to get a current from it. In the compass there are four coils. These are spun by a little windmill device that sticks up from the plane and takes advantage of the rush of air as the plane is in flight. As the coils spin, they come into contact with two brushes, that take off the current they generate.

To produce a current, the wires in the coil must cut across the lines of force of the magnetic field. A line of force is simply the direction in which a freely suspended compass needle will point. Therefore, if the brushes are east and west of the coils, there will be no current. As the coils come into contact with the brushes, they are themselves travelling north or south, and parallel to the magnetic field of the earth. Imagine that the plane is flying east, with the brushes east and west. As long as the pilot continues in the same direction there will be no current, and the needle of an ammeter on the instrument board will remain in the center and read zero. But then the plane turns a little to the north. The spinning coils now touch the brushes while they are crossing the lines of magnetic force, and there is a current. Immediately the needle swings to the north, or right, side of the plane, to inform the pilot that he is deviating to that side, so that he can immediately correct his route.

If he does not happen to be going east or west, the position of the brushes can be changed by means of a switch located just below the indicator. So all the pilot has to do is to set this to the direction in which he wants to travel, and then to fly so that the needle stays in the center. With this compass to give him his direction, with the radio beacon to tell him the course, with the radio telephone to tell him of weather and landing conditions along his route, and with the neon lights to mark the field in all kinds of weather, flying is rapidly becoming as safe as railroading.

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The Leviathan recently set a new speed record for ocean liners by going 27.8 knots an hour which is 36.4 land miles.

Nature Ramblings

By Frank Thone

Natural History

Grizzly

"The grim, taciturn bear, the anchorite monk of the desert."

So Longfellow, in "Evangeline," termed the grizzly bear. And it was a good natural history note, too. Unlike the rather neighborly, really somewhat friendly black bear, the grizzly is a shy, aloof, gruff fellow, who wants no companionship, not even that of his own truculent species. When he comes upon a find of food in the wild, whoever else may be there stands not upon the order of his going, but goes at once. Else, sledgehammer cuffs and baerserk clawings.

The grizzly is distinguished from the black-bear group not only by his much greater size and his iron-gray, sometimes silver-gray, fur, but by a noticeable difference in form. The black bear's shoulders are not appreciably higher than his hind-quarters, but the grizzly always has a pronounced hump. His body builds up to a powerful pyramid of muscle where his neck and forelimbs join on his back—a monument to the deserved dread in which he stands among the other folk of the North American wilderness.

Once numerous throughout the West, the grizzly has now been pushed nearly to extinction. Only a few hundred specimens survive, and these are mostly protected "show" bears in national parks and forests. The largest single group is probably that in Yellowstone National Park.

In spite of his morose disposition, however, the grizzly seldom troubles human beings, and there is scarcely a clear case on recent record of his having taken the aggressive unprovoked. At the Yellowstone "bear-dumps" there are always rangers on guard with high-power rifles, but to date they have never had to fire them in defense of tourist spectators. The bears are content to feed and go their unfriendly way.

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