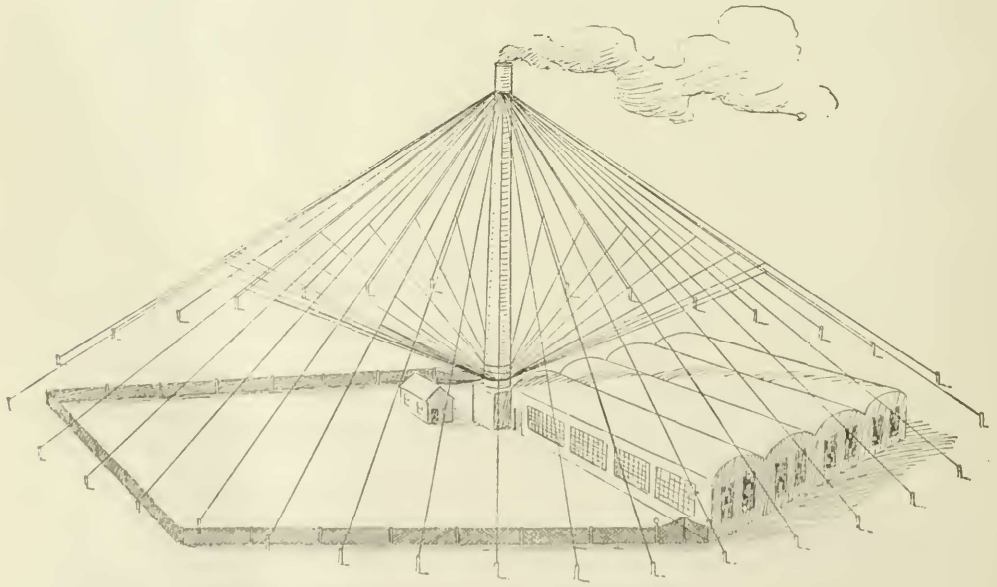
How the Zeppelin Raiders Are Guided by Radio Signals

An ingenious system not unlike that of the flashing light which guides mariners along the rocky coasts

A ZEPPELIN which is sent from Germany to England on a bomb-dropping expedition must travel by the shortest route. Only a limited amount of fuel is carried in order that the load of bombs may be as great as possible. But how does the captain of the ship determine that route? In time of war cities are darkened and all guiding lights are extinguished. The stars may help him. The trouble is that he travels so fast that he would have to read them at least ten times as often as would be necessary on board a ship at sea. Again, the sky may be overcast with no stars visible at all, although a war Zeppelin capable of flying four miles high could escape by rising above the clouds.

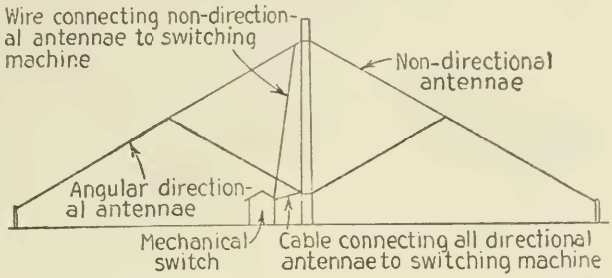
This is very plausible to the lay mind, but perhaps too far from the real facts. Actually the darkening of cities has never prevented finding the route. Rather invisibility of the ground due to "thick" air or actual fog, has. Even then a fairly true course might be steered by "dead reckoning"; i. e., by computing distance and direction from log and compass, and then tracing the results on the map. But the unknown and variable wind-drift prevents this. Measuring the earth's magnetism would prevent getting far astray, but the needed apparatus would be heavy, measurements must be very numerous, and each measurement means extremely difficult and accurate work.

Radio communication was soon found to offer by far the most convenient solution of the problem. The L-49, which recently fell into the hands of the French absolutely intact, had a marvelously complete radio equipment. Even before the war, a passenger Zeppelin, the *Viktoria-Luise*, kept in continuous communication with the Island of Nordeney in the North Sea while scouting near Strassburg on the upper Rhine. That was in 1912. Since then the range of a Zeppelin's radio apparatus has been trebled.



A Telefunken-compass sending station. Factory chimneys frequently serve as aerial supports, as in this case. Germany thus effects a saving of metals valuable for other war needs

On page 451 and following of the March 1916 number, POPULAR SCIENCE took up and discussed at considerable length two radio directional systems, the Bellini-Tosi and the Telefunken, by which ships at sea could find their way along coasts and into harbors in spite of fog or blinding storms. It is this apparatus which has evidently been adapted extensively to war Zeppelins.



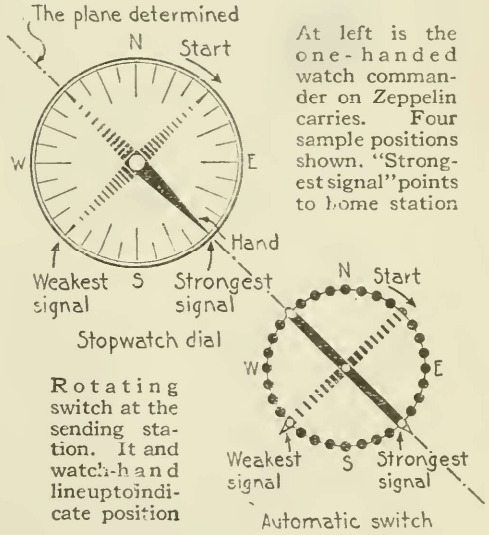
Section of Telefunken-compass sending station. Sixteen such sets form the aerial shown on page 632

In wireless, parallel antennae give the strongest signals; those at right angles, the weakest. It is this principle which makes all radio direction-finding possible.

In the Bellini-Tosi system the moving station sends signals to a fixed station, and the fixed station, by special apparatus, determines the direction of the sender and thereupon transmits the information to the sender by radio. Under the Telefunken plan, the moving station determines its own position, powerful signals having been sent out from fixed stations along shore. This seems to be the better arrangement, as it is more practicable to have powerful stations on shore than aboard an airship. The signals can radiate out over longer distances, the sending station can be entirely automatic, and on board the airship the commander need only listen for loudest signals (or weakest, whichever he prefers), hold a one-handed stop-watch—hereafter described—in his hand, and he gets his direction almost at once. No doubt the many war Zeppelins which have ventured out over England have used this system. Details of the whole plan are interesting.

The powerful sending stations in Germany have thirty-two very long, slanting antennae radiating from a tall central mast. These antennae are the exact equivalents of the rays to be found on every ship's compass, and, like them, represent the thirty-two fixed points of the compass. A mechanically operated switch connects with opposite pairs of these separate aerials once every thirty seconds. A single telegraphic dot is flashed out at each connection. In this way all points of the compass are reached every half-minute.

Any German aircraft, whether it is a Zeppelin or a small reconnaissance biplane, is able to pick up these dots, and by this means it can determine its direction relative to the sending station. No other addition to its regular receiving apparatus is required. However a calibrated pocket stop watch must be referred to. By "calibrated" we mean that the hand of the watch runs like the previously described switch, and that it makes a complete revolution around the dial in thirty seconds. The dial is, of course, marked like that of a navigator's compass with the usual thirty-two points instead of with ordinary minutes and seconds.

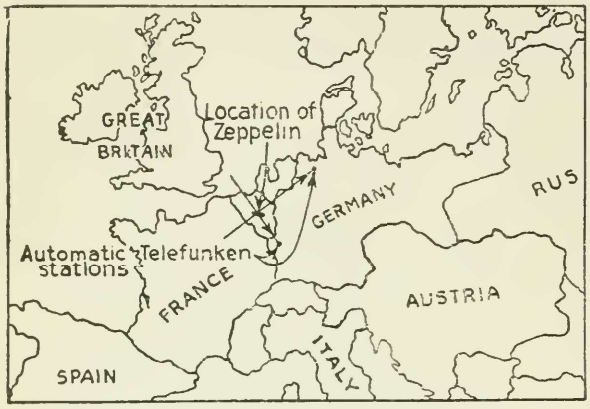


At left is the one-handed watch commander on Zeppelin carries. Four sample positions shown. "Strongest signal" points to home station

Since commander's watch-hand and the sending switch rotate in unison, loudest signal determines plane in which sender is located

Apparently the Zeppelins using the Telefunken-compass are equipped with ordinary non-directional aerials for receiving the signals.

In actual operation the sending station mechanically rotates its switch and sends its dots as continuously as a lighthouse with a rotating lantern flashes out beams of light. But there is a short stop before each new rotation, which commences with the first dot flashed by the north-pointing antenna. During this short stop another but different signal is sent—a non-directional signal which is flashed over all the antennae and which is heard clearly and loudly in any direction. This signal identifies a station by giving its name or its number and supplies the information that in another moment another cycle of dots will be sent out toward east, south, and west, commencing at the north. The aircraft commander thereupon sets the hand of his stop watch to the north. He may press the starting button as soon as he hears the first dot, and the stopping button as soon as he hears the weakest dot, or he may press the button at the strongest dot. In actual practice, he pushes the button at the dot immediately following the weakest (or strongest) signal. The difference in loudness is considerable from dot to dot. Indeed, the loudness progresses or decreases around the circle of the compass, depending upon the direction in which one reads.



Intersecting lines from sending stations tell a Zeppelin commander his position accurately

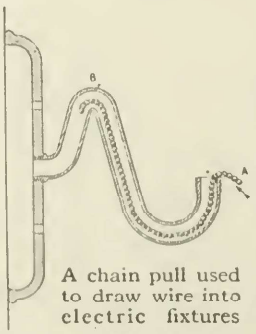
Imagine what a sensation it must be to be up in a Zeppelin high over an impenetrable cloud bank, the sky overhead obscured by the bulk of the gas bag, and for these reasons all the landmarks by which a man ordinarily locates himself obscured. Yet from somewhere beyond the clouds beneath comes that clear radio call indicating that in this direction at least lies a home station. The beacon is welcome. All the Zeppelin commander needs to do now is to tune a bit differently and go through the same performance with another automatic station. In a minute or two he has read on his stop watch dial his direction relative to two different stations whose identity he knows. Drawing lines in these two directions from the locations of these stations on his map, he sees his own location plainly marked on the same map at the point where both lines intersect. More he could hardly demand. But he may repeat the procedure many times in order to check up his location as frequently as the rapid progress of his craft demands.

In peace time the range was intentionally cut down to fifty miles in order to prevent interference with regular wireless traffic. But in war, especially during a raid, a vastly greater amount of current may pass through the switches and the antennae may be worked to full capacity.

Although the Zeppelin's long range Telefunken compass uses the same theoretical principles as the Bellini-Tosi method; that is, that parallel aerials result in loudest signals, the Bellini-Tosi method is apparently ill-adapted to Zeppelins. The Telefunken plan seems probably the one universally used.

Fishing Electric Wires Through Tubes in Fixtures

WHEN fishing wires through a fixture, which has a sharp angle, a piece of chain *A* from a pull chain socket can be used to good advantage. If a wire is used it may get caught at point *B*, while the flexible chain readily passes around this bend. A strong cord can then be attached to the wire which is easily drawn through the fixture.



A chain pull used to draw wire into electric fixtures