ELECTRONICS

Counter-Radar Devices

Aluminum foil scattered in the air and electronic jamming both successful anti-radar devices. Our pilots also knew when they were being hunted.

See Front Cover

➤ FIRST CAME radar—then radar countermeasures. Enemy radar had to be killed during the war as well as enemy industrial production and gunfire. How the effectiveness of German and Japanese radar was destroyed by the Allies was revealed to a group of science writers at the Harvard Radio Research Laboratory and demonstrated at the Bedford Army airfield. A little information about the use of aluminum foil had already been made public, but the full story of the various radar countermeasures developed had been untold until then.

Radar countermeasures include anti-radar devices, which are jamming systems that interfere with radar echo. Most of the scientific work in developing radar countermeasures was done at the Harvard Radio Laboratory, a wartime institution under Division 15 of the National Defense Research Committee, and was financed by government funds through the Office of Scientific Research and Development.

Radar installations were the "eyes" of the enemy as well as of the Allies. Approaching planes, surface vessels, submarines and other machines of war were detected and located by radar. Radar was also used to locate production plants, shipping piers, bridges and other structures playing active parts in warfare. Radar not only detected approaching warcraft, but automatically aimed anti-aircraft and other guns at them. Successful anti-radar devices were a number one war essential.

When the Allied radar jamming system was first sprung on the Germans in 1943, it threw their defenses into utter confusion and decreased by 75% the effectiveness of their anti-aircraft guns. In the last days of the wars, both in Europe and the Pacific, the Allied anti-radar devices had made such a boomerang of German and Japanese radar that they often gave up using radar lest it betray them. The photograph on the cover of this SCIENCE NEWS LETTER shows the appearance of typical "PPI" radar scope unjammed, left, and on the right the appearance when partly jammed. When completely jammed, all planes are entirely obliterated. The isolated light spots in the unjammed picture represent targets or objects at different distances and directions.

Anti-radar devices were of two general types: aluminum foil called "window" or "shaff," and electronic detectors and jammers. The use of the foil became known to many during the war, but the extent of its use was revealed for the first time at the demonstration. Approximately 20,000,000 pounds of aluminum foil was dropped in Europe alone. Cigarettes and candy bars in the United States were without aluminum wrappings because the entire production of foil was needed for window.

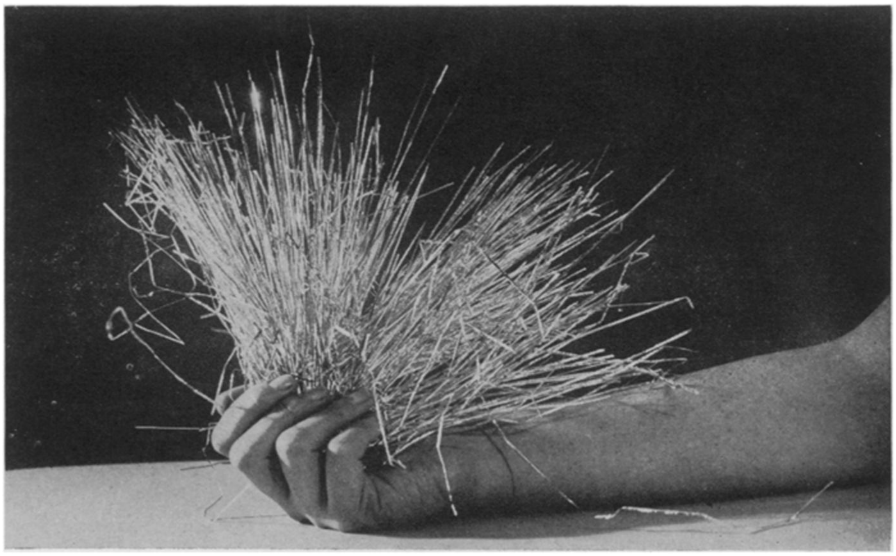
Aluminum foil is an excellent radio reflector and it returns a relatively strong radar echo in proportion to its size. What made it particularly valuable as window, however, was a discovery made by the scientists that its effectiveness is greatly increased when the strips were cut to one-half the radar's wavelength. These "tuned" strips send back a strong echo.

The thin strips of aluminum used are only a tiny fraction of an inch wide and a few inches long. A bundle of 6,000 strips weighs six ounces. A single bundle dropped from a plane, scattering in the air, looks to a radar like three heavy bombers. The science writers watched the scope of a radar in a darkened room while this electronic "smoke screen," or window trail, was distributed by three planes. Following planes in the trail failed to record on the scope, even a half-hour later.

Electronic jammers operate on the simple principle of radio interference, similar to the interference with which most home radio users are familiar when they receive two broadcasts from two stations on the same wavelength. The jammers attacked enemy radar receivers with radio waves from planes modulated by random "noise," which drowned out any audible radio echoes from the radar's target and obliterated all signs of the target from the radar's screen, or scope.

A radar can be jammed, Radio Laboratory scientists explained, only by waves of the same wavelength or frequency. Therefore a basic instrument in radar countermeasures is an electronic detector called the "search receiver" which can be tuned to intercept a radar signal and determine its frequency.

When equipped with directional antenna, this receiver can locate an enemy radar set. These direction-finding receivers have a much greater range than radar itself, and for this reason often proved



STOPPED RADAR—A handful of the aluminum foil which was scattered in the air to blot out radar echo. Photograph by Fremont Davis, Science Service staff photographer.

better than radar for locating the enemy. A radar-hunting operator could locate an enemy radar station long before the radar could locate him.

During the latter part of the war, United States planes and surface vessels often knew by use of these direction-finding receivers when they were being hunted by enemy radar, and they often detected and pounced on the hunters before the enemy radar discovered them. German submarines, they said, eventually stopped using radar to avoid detection by these receivers.

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ELECTRONICS

Anti-Radar Station

Powerful land-based jammer in England blinded German planes following English bombers homeward. Key of device is American special vacuum tube.

➤ IN ADDITION to aluminum foil and air-borne electronic devices to blind or jam enemy radar searching for Allied air and surface warcraft, there was also the ingenious land-base radar countermeasure device known as "Tuba." Information concerning it has been released by the Joint Board on Scientific Information Policy for the Office of Scientific Research and Development and the War and Navy departments.

Tuba was a tremendously powerful jamming transmitter developed for use against German night fighters. In 1942 the Germans were taking a heavy toll of British night bombers, using an airborne interception radar known as "Lichtenstein" for close-range location of their targets.

Against them, the report states, the British found it impractical to use jammers carried in their bombers, because the jammer itself provided a signal which German fighters could use to locate the bomber. A radio signal, including a jamming one, betrays the direction from which it comes, and even though a jammer might blot out a German scope, making it impossible to find the range, the German could find the bomber simply by following the signal.

To meet this problem the idea was conceived of developing a very highpowered jammer in England to blind the German fighters' radar as they flew toward it in pursuit of the homeward-bound bombers. A jammer of this sort obviously would require power a thousand times greater than any previously attained in the frequency range of operations involved, which in itself was 10 times higher than that used for frequency modulation and television.

The problem was solved by the development of a very remarkable vacuum tube developed in the United States, known as the "resnatron." It was necessary to build a resnatron that would be tunable over a wide frequency range because the Germans could change the frequency of their radars by slight modifications. Also it was necessary to find a way to modulate the resnatron's output with the random "noise" necessary for jamming. Both objectives were accomplished, and by January, 1944, a workable instrument had passed its tests.

By June, 1944, the complete jamming system was in operation against the enemy. Its power was comparable with the most powerful United States broadcasting station (50,000 watts), yet the frequency of operation was 500 times as high.

Science News Letter, December 8, 1945

AERONAUTICS

Transoceanic Flying Failures Greatly Reduced

➤ TRANSOCEANIC flying has now advanced to the point where commercial operations may be conducted with flight failures approaching zero, declared Frank R. Canney of Boeing Aircraft Company at the national air transport engineering meeting of the Society of Automotive Engineers in Chicago. He estimated the probable frequency of emergency landings, or "ditchings," on the New York-London flight currently as about one in 16,576 flights.

Mr. Canney cited wartime flying records to prove his point. He reported that total AAF B-29 operations during the war, including combat flying, resulted in only one "ditching" for each 750,000 miles flown.

Increased cruising speeds, improved engine performance, and the operating policy of adopting alternate flight plans whenever trouble begins to develop, make the chances of emergency landings low, he said. Transoceanic flying safety is enhanced, he continued, by use of weatherproofed aircraft equipped with pressured cabins, four supercharged engines, and radio communication.

Flying altitudes of 15,000 to 35,000 feet, he added, enable planes to take advantage of the most favorable winds. Flying speeds of 200 to 400 miles an hour make crossings so brief as to minimize chances of mechanical failures. Engineering requirements for overwater flying differ little, Mr. Canney stated, from those of overland routes.

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