AVIATION

Fog Loses Its Perils

New Blind Flying Equipment Robs Fog of Its Dangers And Yields Air Schedules Almost Independent of Weather

By J. H. WILLIAMS

TWO LITTLE pointers kept crossed over one tiny spot on an airplane instrument board make possible "happy landings" that are directed by radio when the unseeing pilot and plane are plowing through darkness and fog.

Radio and science have solved the problem of blind landings. Soon the mail will go through regardless of the weather, no matter how low the ceiling.

This latest development in radio aids to aeronautic navigation has completed the chain of devices that now make blind flying practical. With eyes flashing over this little dial and pointers the pilot can swoop down out of fog and complete darkness with mathematical precision until the wheels of his airplane scrape the solid earth of the airport's runway.

Many of our present pilots can remember all too clearly the days when the only thing that helped a pilot fly from one primitive field to another was his own ingenuity and resourcefulness. Night flying was then a gamble with death. With the advent of the air mail and the establishment of regular routes the airways began to be lighted. Powerful electric lights were set up at intervals along the way and the landing fields were equipped with flood lights. Night flying with perfect weather and visibility became possible.

But the weather man was not always kind enough and air traffic suffered from lack of regularity in schedules. This is where radio stepped into the aviation field for the first time. Along with the lights radio beacons were set up at intervals. Simple receiving sets in the airplanes picked up these signals that gave the pilot a point to point method of establishing his position. This allowed him to get through short distances of bad weather as long as he could still see his general landmarks and runways.

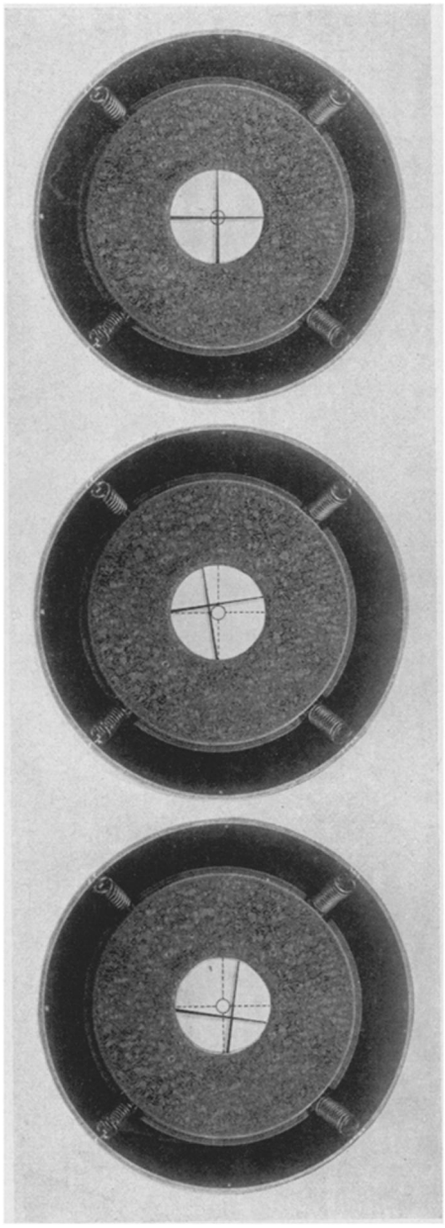
Scientists at the Bureau of Standards next concentrated on better methods of guiding the pilot so that the possibility of becoming lost would be very small. A radio device for direction finding was developed that allowed the pilot either to see or to hear his way along an approximately straight line between two airports. Directional waves broadcast from airports are now picked up in modern airplanes on two vibrating reeds. When the vibrating lines are equal in length the airplane is on its course, a deviation from the true course increasing the deflection of one reed and decreasing the other. Distance indicators actuated by radio waves tell the pilot the distance from various stations.

Within the last year the Bureau of Standards has developed a new transmission-line antenna, called the TL antenna, which sends out highly accurate directional guiding radio waves. Waves from the older loop antennas were subject to a variable rotational effect, particularly at night, due to the action of the ionized layers of the upper atmosphere on the horizontal components of the broadcast wave. The TL system eliminates the horizontally polarized components of the radio wave by eliminating radiation from horizontal elements of the antenna.

Must See Ground

Thus the airways were clear for night flying as long as the runways at the airports were visible. Taking off in absolute darkness was a stunt that a pilot would do if necessary, but landing without seeing the ground was considered an impossibility. This was the stumbling block that halted scheduled flying. Many schemes were proposed that were based on the idea that a meter which would show the height of the plane with great accuracy would allow the pilot to slowly sink to a "pancake" landing after he had been guided to the edge of the field by the directional beacons. The General Electric Company endeavored to put the familiar echo to work. This instrument shot a sound wave down to the ground from the plane and measured the time taken for it to be reflected back. This gave a measure of the altitude. As the plane neared the ground the interval of time between the emission of the sound and the catching of the echo became shorter and shorter, until they combined suddenly into one short note. At that instant the pilot pulled back on the stick and pancaked to the ground.

But this scheme had obvious disadvantages such as lack of directional guidance. Something had to come to



INVISIBLE PATH

Instead of watching the ground as he glides down to the field, the pilot keeps his eyes on this little instrument which is shown above representing three positions of an airplane. The top indication is that the plane is over the runway and on the proper path. The middle indication is that the plane is to the left of the runway and above the path while the position below shows the plane to the right of the runway and below the path.

be added to the range beacons, artificial horizons and other instruments that had made level and accurate directional flying possible under conditions of no visibility.

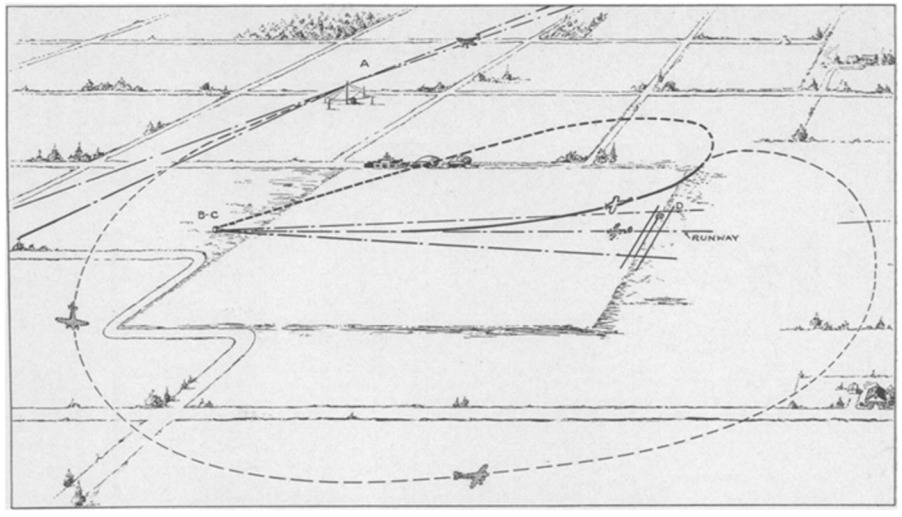
Ever since 1928 scientists from the Bureau of Standards have been working at College Park, Maryland, to solve this problem of finding a simple and effective radio system that would insure foolproof landings under conditions of no visibility.

The new radio apparatus developed by this group of scientists weighs only 15 pounds and was installed and tested at the Newark, N. J., Municipal Airport this year. The system depends upon three elements in order to inform the pilot of his position in three dimensions: height above the ground, direction to right and left, and distance from the runway. These elements are provided by the runway localizing beacon, marker beacons and the landing beams.

The runway localizing beacon informs the pilot of his directional position with respect to the airport and guides the plane over the runway. The low power sending apparatus for this beacon, which is similar to the large inter-airport directional beacons, transmits two radio waves to the pilot from two small directional antennas. These radio waves carry two different sounds or frequencies spreading out from the transmitter like a figure 8. In the top and bottom circles of the 8 a 65 cycle note is broadcast and in the quadrants not occupied by the circles an 87 cycle note is preponderant. There are thus four lines spreading out from the center of the figure along which the two different kinds of signals are equally strong. An instrument on the pilot's instrument board shows him whether the plane is proceeding along a line of equal signal strength. The volume of the signal is automatically controlled so that the pilot does not have to tune or control the instrument in any way.

This directional indicator is the vertical pointer on the small dial that is the key instrument for all blind landing. The pilot simply guides his plane either to the left or right until this pointer stands straight up. Then he is directed along one of those four lines that stick out from the imaginary figure eight. That line is the line of the runway.

The marker beacons tell the pilot how far he is away from the runway. A meter on the instrument board reads this directly up to distances as great as five miles. The needle of this instrument moves across a scale because the receiving set picks up more and more energy as the plane draws closer to the field. As a final step in this distance indication scheme two signals are sent out to the pilot by two marker beacons. The pilot hears the first of these through his headphones when he is 2000 feet from the edge of the airport and the second when he crosses the boundary. Thus the marker beacons tell him how far he has to go before landing.



COMING HOME BLIND

After being guided to the field by the radio range beacon A, the pilot circles the field and then glides down the path marked out in space by the runway beacon B and vertically by the landing beam C.

Follow Two Beams

The radio landing beam is the most important part of the scheme because it keeps the plane on a mathematical curve in a vertical plane which tapers to a perfect three-point landing on the runway. The radio wave from the sending station located at the far end of the field spreads out from that point over a horizontal section shaped like a piece of pie. This high-frequency beam is tilted up from the earth's surface at an angle of 80 degrees. The airplane receiving set picks up this energy and influences the horizontal needle of the master instrument. Airplanes do not fly directly down the beam, but follow a curved path underneath it. This curvature of the plane's path diminishes as the plane approaches the ground so that the path of flight is the line along which the receiver picks up a constantly intense signal from the sending station. There is a balance between the loss of intensity in gliding below the beam and the increase in intensity in approaching the transmitter.

The pilot does not have to tune his set or adjust the volume in any way. He simply keeps that horizontal needle pointing directly across the face of the master instrument and glides down to a perfect landing.

This system has been checked by over a hundred landings where the pilot was completely blinded by a hood pulled over the top of the cockpit. The check pilot in the front cockpit would take control only in case of an emergency. At College Park the system has passed the acid test, for here the runway is only 2000 feet long and 100 feet wide. The runway beacon adjustment was so perfect that a lateral deviation of the airplane from its course when 5 miles away of only 200 feet could be detected and at 4,000 feet 20 feet was discernible. At College Park it is necessary to clear a chimney by only 8 feet to make a proper landing. But a blinded pilot can do it and has done it more than 100 times.

A further test of the practicability of this method and of all the apparatus developed by the Bureau of Standards was a blind flight in a dense fog of a Department of Commerce airplane from College Park to Newark, a distance of 200 miles. James L. Kinney, the pilot, said that he did not see the field until several seconds after he had crossed the boundary, but was confident that he was about to make a perfect landing by using the instruments alone.

Colonel Charles A. Lindbergh, among other prominent pilots, has tested the apparatus by making two blind landings. He expressed (*Turn to Page* 335)

squash-bugs, box-elder bugs, giant water-bugs and the cicadas, often mistermed "locusts," that shrill interminably in the summer trees.

Spiders, centipedes, "thousand-leggers," scorpions, ticks and a number of other frequently rather disagreeable creeping things are lumped together in a rather miscellaneous class called arachnids. All of them differ from the insects in having more than six legs (spiders, with eight, have the fewest), and in not having a head distinct from the thorax or chest, as in insects.

There is one all-inclusive word for this whole array, insects, arachnids, crustacea, and all. It is "arthropods"—Greek for "jointed legs." But the word is itself many-jointed, somewhat harsh-sounding, and a bit professorial in appearance. So it has never found its way into common speech. So we continue to say "insect" or "bug" when we mean arthropod—to the sustained distress of entomological purists.

Science News Letter, November 18, 1933

MEDICINE

Thyroxine Replaced In Treatment of Gland

A NEW chemical preparation that can be used instead of thyroid extract for the treatment of one type of thyroid gland disorder is reported by Dr. A. B. Anderson of University College Hospital, Prof. C. H. Harington of London University and Prof. D. M. Lyon of Edinburgh University in *The Lancet*.

The new preparation has the scientific name 3-5-diiodothyronine. It has been used successfully in the treatment of myxedema, a condition due to underactivity of the thyroid gland characterized by dropsy-like swelling especially of the face and hands, dulling of mental activity, drying and wrinkling of the skin, falling hair and general sluggishness.

Daily doses of the new medicine relieve the symptoms of this disease without producing any ill effects. It is given by mouth and produces results comparable to injections of thyroxine, the thyroid gland preparation generally used to treat this condition.

Science News Letter, November 18, 1933

Snake charmers have no supernatural powers, says a zoologist; they simply understand the psychology of the poisonous snakes.

ASTRONOMY

Aluminum-Coated Mirrors New Aid to Astronomy

STARS THAT are hotter and brighter than science ever conceived, which make our own sun-star look like a candle beside a powerful beacon, have been "captured" in the aluminum mirrors of the Boothroyd expedition, just returned to Cornell University from a mountain peak in Arizona.

For the first time, the ultraviolet spectra of about 80 stars have been photographed, opening up an entire new field to astronomers in the study of stellar matter and stellar temperatures.

This feat was accomplished as the result of a new process developed by two young Cornell physicists, by which chrominum and aluminum can be deposited on glass. The silver-coated mirrors hitherto used in reflecting telescopes have been able to capture the spectrum only as far as the yellow-green region, and were unable to catch the high wavelength of the violet emnations, which tell more than anything else about the temperature and condition of the stars.

Prof. S. L. Boothroyd, head of the Cornell Astronomy Department, who organized the expedition to Arizona to put the new invention to practical test, reported on his return that not only did their spectrograms confirm previous ideas on the hotness of certain stars, but indicated that some of the so-called "dim" stars are in reality brighter, photographically, than those hitherto considered the brightest.

These tremendously hot stellar bodies are called "blue stars," as contrasted with red and yellow stars. They are dim, if not wholly invisible, to the human eye, because their ultraviolet rays escape the eyesight. The aluminum-coated mirror, however, proved much more effective than the human eye.

The Cornell scientists were given cooperation by the Lowell Observatory at Flagstaff, Ariz., and made use of the observatory's mountain station, 11,500 feet above sea level on Schultze Peak, some ten miles north of Flagstaff. This location was chosen because of the clearness of the atmosphere and the comparative absence of dust, which absorbs much of the ultraviolet spectrum at lower levels.

Science News Letter, November 18, 1933

Fog Loses Its Peril To Aviation

From Page 331

his satisfaction with the new aids to aeronautic navigation and said that it was the greatest single achievement in recent aviation history. With the research work being carried forward by the Bureau of Standards, engineers predict that airplane schedules will become increasingly regular and that bad weather will no longer be a reason for delay.

This group of workers has struggled with these problems and has put up a winning fight against Nature's perverseness. Leading them in this battle is Dr. J. H. Dellinger, chief of the radio section of the Bureau of Standards. His principal collaborators have been Harry Diamond and F. W. Dunmore, research scientists at the Bureau. James L. Kinney, the Department of Commerce pilot assigned to this development, succeeded Marshall H. Boggs who was killed in an accident while temporarily assigned to other duties on the West coast. Colonel Clarence M. Young, Assistant Secretary of Commerce for Aeronautics, was the government director of this work under the Hoover administration, and is succeeded by E. L. Mitchell, who will carry on the plans for its coming commercial use. Research will continue, on a lesser scale due to the economy cuts, under the direction of Major J. C. Cone, Assistant Director for Aeronautic Development of the Aeronautics Branch of the Department of Commerce, Dr. L. J. Briggs, Director of the Bureau of Standards, and Dr. Dellinger.

At present the blind landing apparatus is installed only at College Park and at Newark but engineers feel that it is only a matter of time before it will spread over the airways just as the earliest light beacons have done. Then the mail will go through regardless of weather.

Science News Letter, November 18, 1933