

established by a localizer beam, bisecting the runway and extending for several miles to bring the aircraft to the proper runway heading to the airport. The most precise form of instrument approach is the ILS type; the full Instrument Landing System approach consists of (1) a localizer beam, (2) a glide slope, also detected by electronic equipment in the aircraft, (3) marker beacons, (4) approach lights, and (5) runway lights.

Marker beacons, identified by equipment in the aircraft, tell the pilot the distance he is from the airport; the outer marker (OM) is usually 5.5 miles from the end of the runway (located on its center line extension). In many installations there is also a low frequency non directional beacon co-located with the outer marker to facilitate capture of the center line extension and localizer beam.

The middle marker (MM) is located about $\frac{1}{2}$ mile out. (In early ILS systems there was also a boundary marker, on the end of the runway, but this type installation has been discontinued.)

ILS approach lights consist of a high intensity lighting system including the "ball of fire" strobe light installation which facilitates the pilot's transition from pure instrument flying to the visual phase of the landing.

Some airports have more than one approach system. At many airports the pilot will know that there are ADF approaches, localizer approaches, back-course localizer approaches, VOR approaches, and full ILS approaches. When the pilot is approaching the airport of destination on an Instrument Flight Plan, he is informed by the ARTCC of the type of approach being used and that he may expect. This enables him to extract the correct approach plate from his flight kit and place it on a holder for study during the approach and landing. Sometime during the approach the pilot is told to contact the tower for a final landing clearance; after having touched down on the runway he contacts Ground Control for taxi clearance to his ramp.

What About Radar? The widely expressed reliance of laymen upon radar to solve all the problems of air traffic control seems to look upon it as an electronic panacea. Unfortunately this is not the case. Radar is only one part of the ATC system. It is a wonderful tool which makes expeditious handling of traffic easier, but the ATC system is designed so that the entire system cannot fail if one of its parts ceases to function. Radar is not a panacea by any means.

In elementary terms, there are two categories of radar operations: First, is the use of primary radar, in which the radar transmits a radio signal which is reflected from an object almost instantaneously, the "echo" recaptured and measured usually as a blip on a cathode ray tube. There is one advantage of primary radar: it requires no special equipment in the aircraft to reinforce the signal. However, it has some system peculiarities and serious limitations. Frequently aircraft blips will disappear altogether from a radar screen because of some electronic anomaly. The technicians talk about scalloping, ghosting, and interference. For a long time radar operators observed returns from ground targets such as nearby buildings, TV antennas, or trees ("ground clutter," in radar lingo). This was removed from the scope by instituting a circuit which will show only moving targets, called moving target indicator (MTI).

In earlier radar, precipitation areas, thunderstorm cells, and snow showers would create an echo and block out aircraft returns. This was cured by the institution of a system known as circular polarization (CP), which effectively cut out all but the most intense areas, such as the cores of thunderstorms, but showed aircraft targets clearly. The problem with CP is that pilots frequently find themselves steered by controllers right into areas of extreme turbulence simply because the controllers' radar scopes screen out violent meteorological phenomena.

In the last few years, FAA has entered into a great program of using "secondary radar" in aircraft. This equipment, which developed from the military use of similar equipment called IFF (identify, friend or foe), is known as a radar transponder. It reinforces the radar pulse echo and enhances the blip on the radar scope, and by isolating and detecting one of a number of selected codes the ATC can positively identify the aircraft with which he is working. In case of a loss of identity the aircraft can be instantly re-identified by a special identification flare which shows up on the radar screen when the pilot is directed to "squawk ident."¹⁷

¹⁷ The origin of this term is military. Transponder type equipment used for identifying flying aircraft was given the code word "parrot" and pilots were told to "have your parrot squawk ident."