BLIND-APPROACH PRESENTATION

from port or starboard, or from top or bottom, according to the position in which his aircraft was cutting across the edge of the cone into the conditions of zero visibility beyond.

Now it has already been suggested that it may be possible to provide continuous range presentation in the form of a natural-colour, stereoscopic, cinematograph film reproduction of a perfect approach, which gives a picture of the approaching runway that is true in every respect, *provided that the aircraft is held in the centre of the beam.* Suppose, therefore, that we arrange that this picture shall only be visible to an observer so long as the aircraft does, in fact, remain within a few degrees of the centre of the beam. We shall by this means guard against the possibility of the range picture falsely representing plan-position, or height above ground level, actually obtaining at any instant during the approach; in other words, if the range picture is not a true one, then there must be no picture at all.

The simplest way to achieve this end is to arrange that the picture shall be "blacked-out" progressively, from right or left, or from top or bottom, in the manner described when discussing the imaginary "cone of vision" in the previous paragraph. Fortunately, it is a simple matter to arrange for such a method of indication, since it is only necessary to take our old friends the centre-zero microammeters (normally used to indicate departure from the glide-path or directional transmission data) and, utilizing them in a slightly modified form, to introduce them at some suitable focal point in the optical system of the range picture presentation in such a manner that the deflections of the respective needles cause appropriate "blacking-out" from the edges of the range picture. We have thus succeeded in presenting to the pilot such information relative to the position of his aircraft in the B/A beam that, after the minimum of practice, he will receive the information subconsciously and will automatically tend to make the appropriate corrections on the normal flying controls, while at the same time keeping his attention fixed on the range picture of the approaching runway.

Airspeed and Height

It cannot be denied that, during a normal blind approach, it is desirable to keep a close watch on the A.S.I. lest a too intense concentration on the B/A and other instruments should allow a falling-off of airspeed to pass unnoticed, with horrific consequences. For a similar reason, no pilot can afford not to keep a careful eye on the sensitive altimeter, in case unforeseen distortion of the beam is calmly directing his aircraft into the deck. This being so, it is of little use to provide a splendidly natural method of continuous range and beam position presentation if the pilot is required continually to keep shifting his attention from the range picture to the instrument board. Clearly, matters must be so arranged that the pilot, while keeping his attention concentrated on the range picture, can at the same time see, out of the corner of his eye, the indications of the A.S.I. and the sensitive altimeter.

In operation, the stereograph viewing apparatus which provides the range picture is temporarily located, as will be described later, in a position in front of the pilot's face so that he may look closely and comfortably into the eyepieces whilst remaining seated facing forward in the normal position. Consequently, a simple system of optical lenses can be placed in the bottom part of the apparatus in such a manner that, by suitable adjustment, the dials of any two single instruments located on the dashboard may be "picked out," magnified, and their images projected on to the bottom part of the range picture. Thus the pilot, watching the range picture of the approaching runway and maintaining the aircraft in the beam as previously described, is all the time conscious of the indications of the A.S.I. and sensitive altimeter.

External Form and Method of Mounting

Preliminary investigations suggest that an outer container, manufactured in the form of a box of roughly cubic shape with sides some six inches square, should be of adequate size to accommodate the required mechanism without being too bulky from a practical aspect. The complete apparatus in this form should weigh some six to eight pounds only.

This box is to be mounted by means of a counterbalanced arm in a manner which allows that, while the box is normally stowed flush with the underside of the roof, the pilot may, by reaching up with his right hand, swing it down in front of him, where it becomes automatically secured rigidly in position. He may now look closely through the usual contoured sponge-rubber face-guard provided into the eyepieces of the stereograph viewing apparatus mounted inside. When the apparatus is no longer required, a firm push sideways with the left hand will cause the box to swing back up to the roof, where it once more becomes locked in the stowed position.

Construction

The construction is based on a special design of miniature cinematograph projector, equipped with an integral optical system permitting one observer to obtain a correct stereoscopic view of an appropriate film. This projector is unc the very precise speed control of a governor, which is capable of being pre-set to give any desired basic operating speed and is also capable of being altered automatically while running. An electro-mechanical computer mechanism, linked with both the governor control and the film-track control, serves two purposes. In the first place it measures elapsed time intervals occurring between certain recorded range indications on the film track and certain other range indications received externally by the aircraft, and feeds a proportionate mechanical correction to the governor.

In the second place it ensures repeated synchronization of indicated range with actual range, by a method of mechanical interlock. In a B/A system employing the marker-beacon range-signal method these two functions of the computer are separate and distinct, forming a corrective cycle repeated each time the aircraft crosses a beacon. On the other hand, with a system of continuous range signals, such as could be provided by ground or airborne radar equipment, the two functions are merged into one.

Separate film records are made of daylight correct beam approaches to each B/A runway of any one airport. These records, in the form of small reels of miniature film designed to run for about three minutes and consequently of small diameter and negligible weight, are mounted on a common spindle and may be inserted as a unit into the projector. Subsequently, the film of any particular runway may be pre-selected by means of an external dial. The spools containing the film records of approaches to the runways of any given airport are intended to be issued to airline and other operators, who will ensure that their machines always carry the appropriate spools for the terminal and diversion airports of the route being operated.

Method of Operation

In actual operation, on entering the control zone the pilot will contact control, who will give him the correct runway number for pre-selection and will give him also an estimated approach ground speed, based on knowledge of local wind velocity and direction and on aircraft type and operating weight. The pilot pulls down the apparatus and pre-selects the correct film number and also the initial basic operating speed of the projector motor, by means of another dial calibrated directly in knots. He then pushes the apparatus aside again for the time being.

On leaving the orbit circuit and passing through the approach "gate," the pilot, for the first few moments, controls his aircraft in the beam by