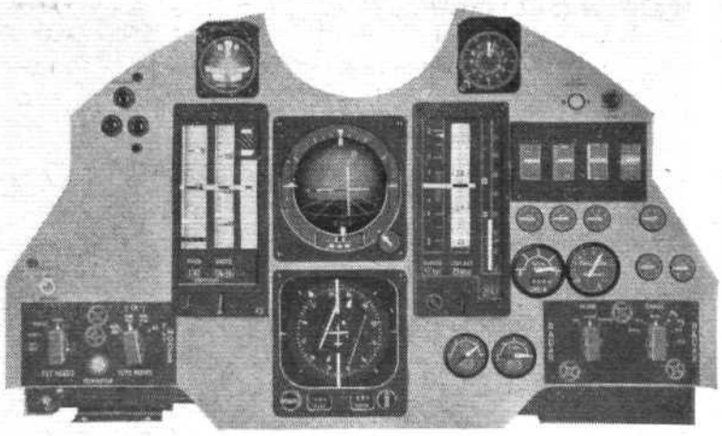
FLYING AIDS . . .

aircraft symbol moved in the Kinalog system, first in the new sense and then in the traditional sense as a turn or climb was initiated and then held stable.

It has long been the dream of the instrument engineers to combine the conventional heading indication with a pictorial map to show the pilot not only which way he is flying but where he is. Innumerable difficulties stand in the way of such a system, not the least of which is that of providing sufficient flexibility to cover an adequate operating area, without filling the cockpit with map, and to find some method of navigation which will give an accurate indication of ground position.

It is certain that no considerable advance in the quality and quantity of instrument information provided will be obtained without the addition of a considerable weight and volume of complex and sensitive equipment. This factor alone weighs heavily against any integrated system since reliability is as important in instruments as in any other part of the aircraft. Already, the introduction of relatively limited integration and director functions has led to an extensive range of miniature stand-by instruments of traditional kinds in order to allow for any failure in the primary system. Thus, the space saved on the panel by integration is often more than taken over by stand-by instruments. The remote gyro and air-data references already occupy additional space elsewhere in the airframe and require suitable power supplies and other services. Miniaturization and extreme reliability are therefore prime requirements.

During the last eighteen months, the considerable amount of information released in America on the Army-Navy Instrumentation Programme, for which Douglas El Segundo and Bell Helicopter are respectively co-ordinating fixed wing and helicopter applications, has shown that the way towards a radically new form of blind-flying and navigation instrumentation is by no means clear. Transparent, flat television tubes mounted in way of the windscreen and combined with various kinds of map

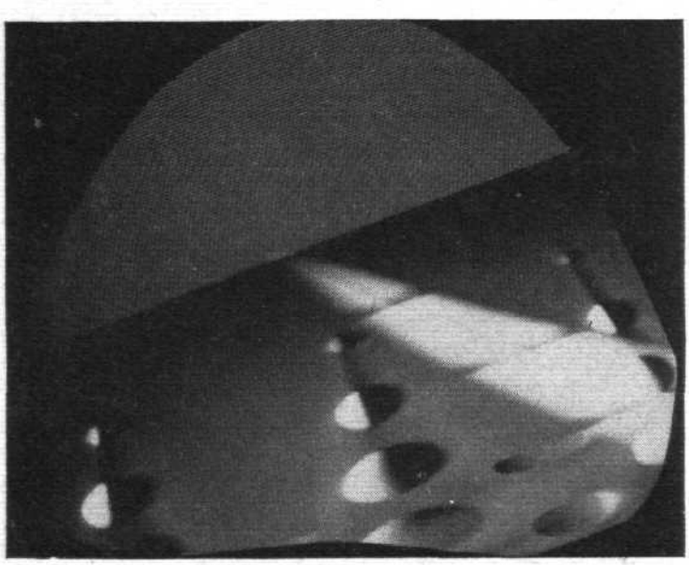


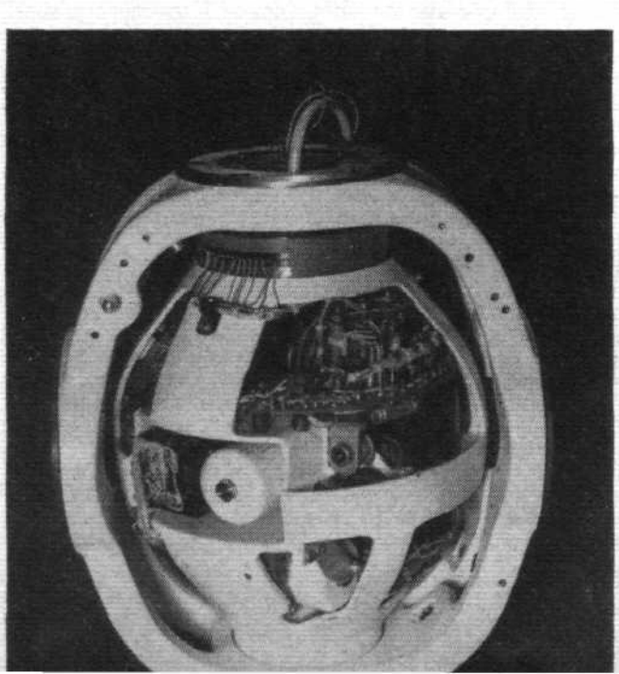
The U.S.A.F. instrument panel to be incorporated in F-106s and F-105s. Plan-position and attitude-command instruments supplied from remote sensors are flanked by tape indicators for speed and height values

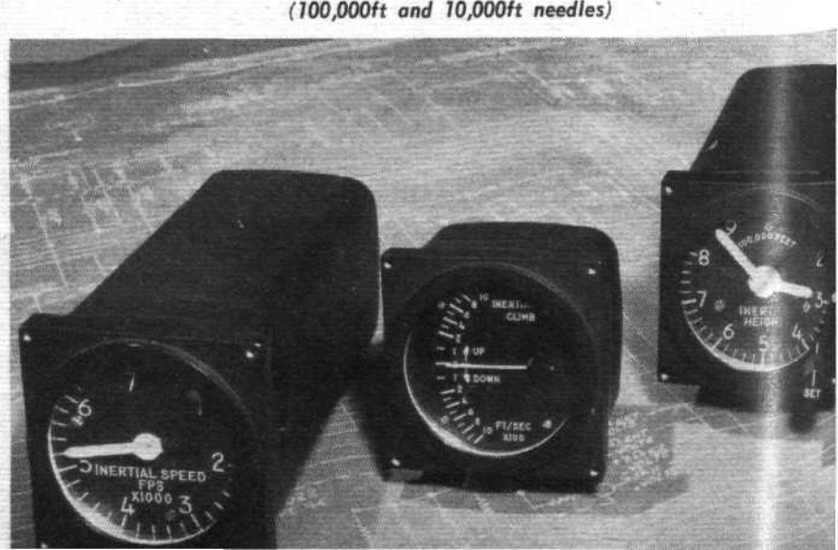
display have taken many forms. In the first instance, an attitude and movement display in the form of a mobile grid reference was presented on the television tube. Then a track and manœuvre-guidance system called Pathway was added. No final result is expected before the early 1960s.

A remarkable development has been the Sperry inertial system designed to provide both instrumentation and automatic navigation for the North American X-15 research aircraft. Because this machine will fly to some extent in regions where the atmospheric density is insufficient to feed normal pressure-sensing systems, the inertial reference, composed of a three-gyro platform with three integrating accelerometers, will supply height, rate of change of height, speed, attitude, heading and positional information. Three of the instruments with their very simple scales and broad indicator needles are shown below. The inertial platform is Schuler-tuned to remain continuously aligned with the local vertical and will initially be monitored and zeroed from a control panel inside the B-52 mother aircraft. Velocity signals derived from an APN-81 Doppler and the B-52's compass system, with the addition of height information derived from the B-52's pressure sensing system and from ground-based radar will all be fed into the X-15's inertial system while the two aircraft are preparing to separate. The platform gyros will be run up immediately after take-off and their performance monitored before separation. After the X-15 begins its free flight the inertial system will function without any further external reference. The whole complex is first being installed in an F-101 for trials and the first system for the X-15 itself was delivered last December.

It is by no means safe to say that the dial instrument has had its day; nor can it yet be claimed that the tape indicator is a fully effective answer to the shortcomings of dials. There seems to be no doubt that the inevitable penalty of providing suitable display configurations and properly accurate information will be greatly increased complexity of equipment and almost entirely remote indication by means of servos and synchros. What the human eye sees through the windscreen on a clear sunny day will not, for some years to come, be pictorially reproduced without penalties of weight and complexity.







Above left, the Pathway track-guidance system on the television attitude display of one of the ANIP schemes. Below left, the Schuler-tuned, three-gyro stable platform made by Sperry for the navigation and instrument system of the X-15. Below are the indicators for inertial speed (ft/sec x 1,000), vertical rate (ft/sec x 100) and height (100,000ft and 10,000ft needles)