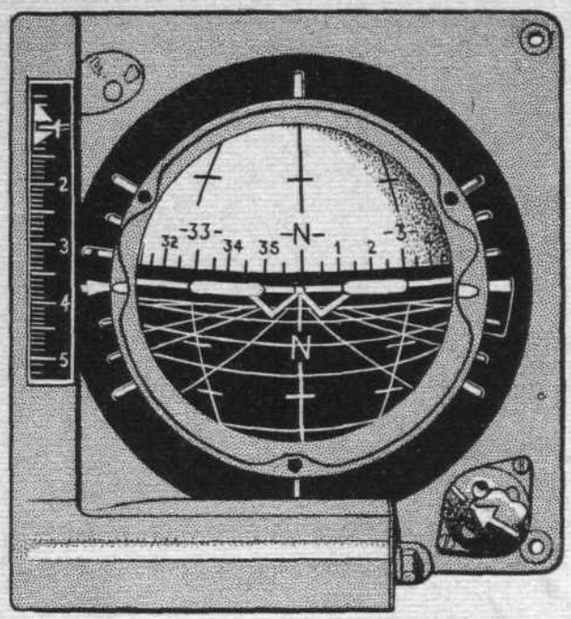


The Lear AJB-3 indicator, with g-indicator alongside. The flat box along the lower edge of the instrument is the g-programmer. A civil instrument would also have I.L.S.-type cross-pointers and a glide-slope needle on the left-hand edge. No g-meter would be required, but a turn-and-slip indicator would be let into the lower edge of the dial.

into pale blue and dark grey halves, representing sky and earth. The latter half is also marked with grid lines disposed to give a perspective effect when viewed by the pilot. A normal compass-heading graticule is engraved round the equator and the 30 deg heading marks are continued as longitude lines over the poles of the sphere. Thus, when going into a vertical climb, the pilot becomes aware of the significance in terms of heading of the aircraft's roll displacement. This is an important feature for loft bombing, because an accurate heading must be maintained during a pull-up to the release angle.

The ball presentation of attitude has been praised by U.S. Navy pilots as being easily read and simple. But such a system is not generally approved in England because, ideally, the pilot should be looking at the inside surface of the ball in order to obtain the most natural impression of manœuvring at very high angles of climb and dive. Seen from the outside of the ball the surface moves downwards as the aircraft nose moves upwards. Similarly, the directional indications move in the unnatural sense, as they do with traditional gyro direction indicators. The British solution is the roller-blind attitude indicator.

Lear are further preparing an extrapolation of the AJB-3 attitude indicator for general civil operations. It will retain the combined attitude- and heading-indicating functions of the bombing instrument, but will also have flight-director cross-pointers together with a small pointer in the left-hand rim giving I.L.S. glide-path indications. A small ball-and-pointer turn-and-slip indicator will be let into the lower rim of the dial. Special internal lighting has been designed with bulbs shining from inside the ball, indications and marks round the dial being illuminated by conventional edge-lighting techniques.

The Lear AJB-3—and probably the Honeywell LABS also—require a planned and timed approach to the target and the execution of a strictly programmed manœuvre leading up to the release point. The whole process is frozen from the moment of pressing the pickle button. The M-1 system, on the other hand, is a great deal more flexible. The barometric pressure height of the target and the characteristics of the aircraft and bomb are pre-set on the control panels. Automatic and continuous sensing devices then assess the barometric height of the aircraft and its angle of dive at the pickle point, at which time the pilot centres the target visually in his gunsight. The computer then solves the equations necessary to establish the distance and relative height between aircraft and target; and the pilot is free to pull up as he likes. The computer will order the release of the weapon at the right moment. The dive towards the target can be made at anything between seven and 75 deg from the horizontal and the pilot's only precision task is to maintain accurate heading. The M-1 weighs about 30 lb and is fitted in the F-84F, F-86, B-57, F-100 and F-101.

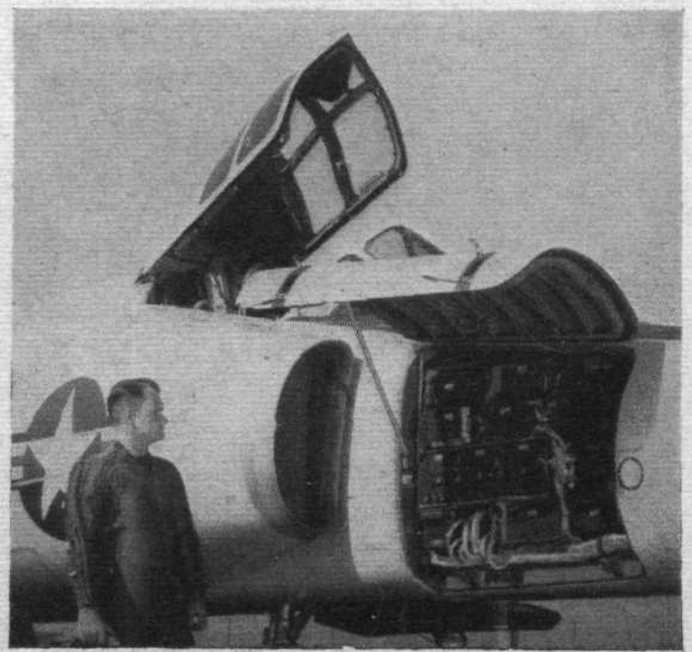
Advantages of the M-1, in addition to its not requiring an initial point and precise pull-up, are that it allows the pilot to attack targets not previously surveyed and to throw the weapon a good deal farther than is the case with LABS. It can also be used at heights as great as 20,000ft. But the minimum height is 2,000ft and this carries penalties in safety and unexpectedness of approach. So that the computation should be correct it is also desirable that the barometric pressure altitude of the target be reasonably accurately known, or that it should be estimated fairly accurately by the pilot if he is making an attack on the spur of the moment.

The central component in making computations for the bomb release is a three-dimensional parabolic cam, operated according to signals from a pitch gyro and pressure-sensing devices. The cam-follower is correctly positioned by a servo which measures the ratio of aircraft and target pressure altitudes, the first of which is obtained from a pressure transducer in the aircraft. The equation is actually solved according to the characteristics of a bomb in a vacuum, the appropriate corrections being derived from wind, bomb shape and aircraft weight values set by the pilot and by accelerometer reading used automatically to allow for the aircraft's angle of attack. The computer then continuously compares the ideal bomb-release angle with the aircraft's actual angle of climb and signals the release when the two coincide. Voltage ratio signals rather than pure voltage values are used in order to avoid the effects of fluctuating current supplies. A secondary cam is followed to actuate a warning light system which tells the pilot when his manœuvre is going to be adequate for effective release of the weapon.

The Mergenthaler Corporation has also published details of a comprehensive test cabinet which allows complete inspection and checking of the M-1 system prior to its installation in the aircraft.

FIGHTER COMPUTER

DURING the past dozen years tremendous efforts have been made in the progressive improvement of fire-control systems of intercepter aircraft. From the simple addition of a search radar, to enable the pilot to find his quarry, systems have become progressively more automatic in function. A major technological advance was represented by the "collision-course" automatic interception evolved for the U.S.A.F. single-seat F-86D. The prime contractor for this system, Hughes Aircraft, of Culver City, Cal, later developed the even more advanced MG-10 fire control for the Convair F-102. This fire-control, in its ultimate form, can take over the complete task of steering the aircraft, effecting an interception, launching the GAR-1 Missiles (or spin-stabilized FFARs) at the optimum point and then bringing the machine back to base. The general principles were outlined in our description of the F-102 in our issue of April 19 last. This photograph (right) is the first to show a newer element in the system, the "Digitair" digital computer, which serves as a central calculating device capable of making 9,600 arithmetical movements per second, or of taking 6,250 basic "decisions" per minute. It leaves the pilot free to monitor the entire mission. "Black box" weight is 120 lb.



The Digitair computer is installed on the port side of the long nose of the Convair F-102A all-weather intercepter. Developed by Hughes Aircraft, and manufactured by them during the past six months, the Digitair is here being inspected by Hughes pilot Robert R. Carson.