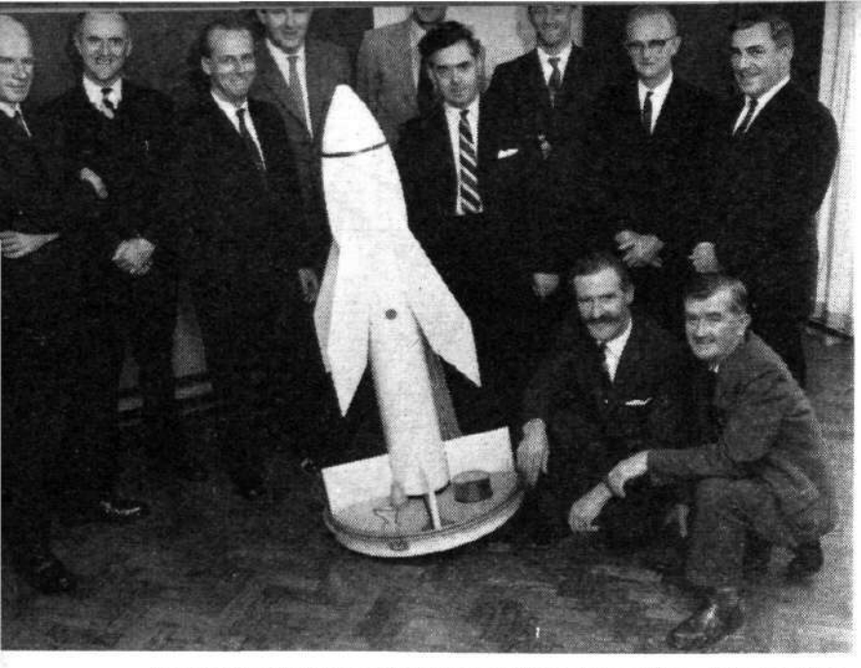
SEACAT . . .



Short & Harland's team chiefly responsible for Seacat (from left, standing), R. M. Armour, assistant chief engineer; T. W. R. Galway, electronics; J. McC Foye, systems; W. T. Galloway, trials; P. Hill, technical sales; A. R. Harryman, general works manager; R. S. Ransom, project design; F. Lowans, works superintendent; P. F. Foreman, chief engineer; (kneeling), W. T. Turner, production superintendent; D. G. Kennedy, chief technician

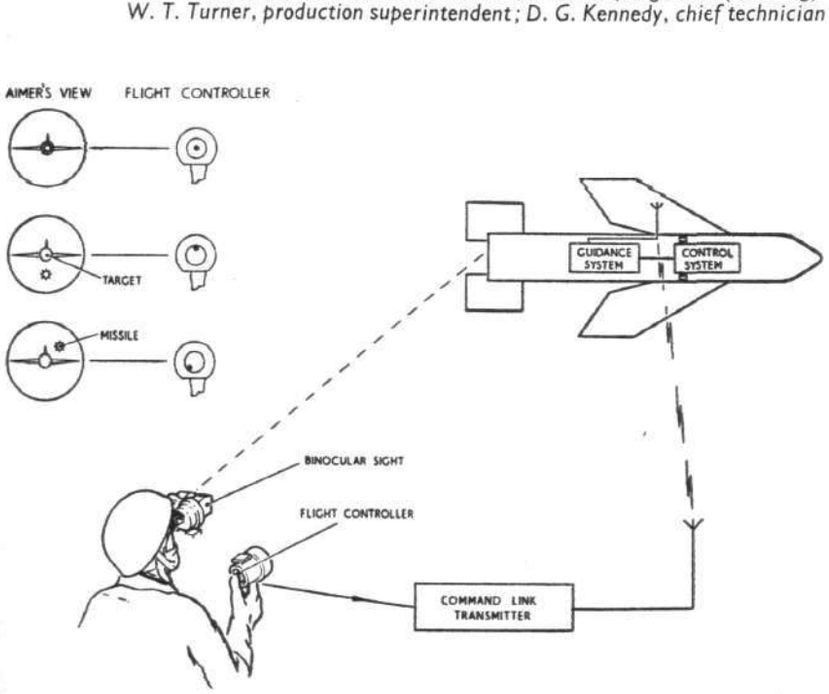
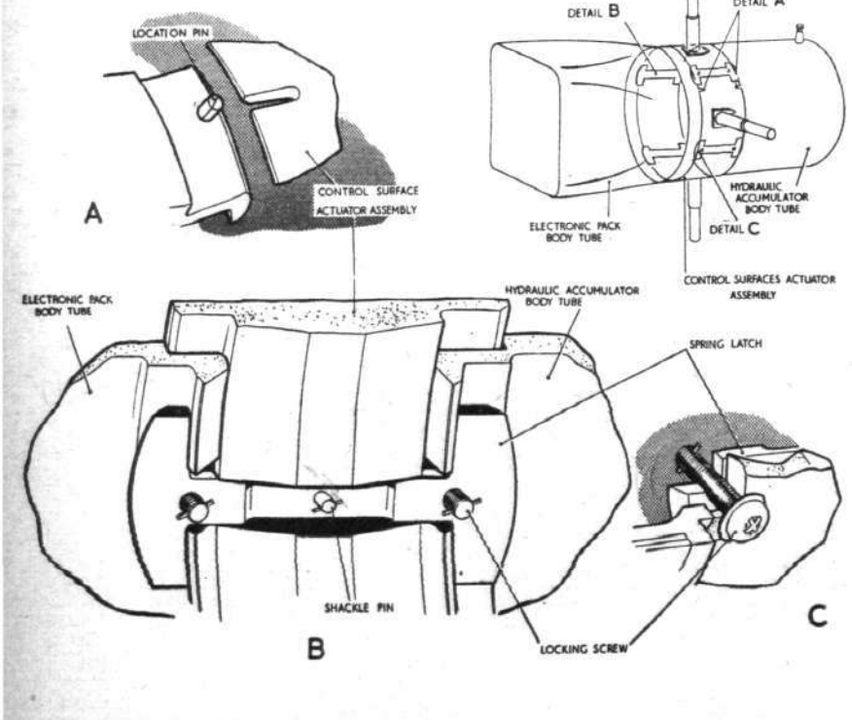


Diagram of the guidance system. Below, wing actuator assembly joints



assembly. It carries the four control-surface drive stubs and the associated electro-hydraulic servo units.

The servo units derive hydraulic power from an accumulator positioned immediately forward of the rocket motor. Gas from the motor enters the accumulator through a non-return valve and exerts pressure on a diaphragm in contact with the OM.11 hydraulic fluid. This system ensures that pressure remains available to move the control surfaces, and thus retain missile manœuvrability, for a considerable period after motor burn-out. Pressurized fluid passes by way of a central distributor and a precision slide-valve in each servo unit to the double-acting jack which positions the associated wing. Fluid expelled from the jack cylinders by the piston movements is exhausted overboard.

The slide valves are operated by electro-mechanical actuators controlled by associated servo amplifiers which receive guidance command signals through the guidance receiving circuits. Automatic roll-stabilization demand signals are also fed into the amplifier from a cordite-driven displacement gyro mounted on the rear of the control-surface actuator assembly.

Seacat is powered by an Imperial Metal Industries solid-propellant rocket motor of the tandem (boost + sustainer) type. The motor casing is of welded high-tensile steel, integrated with the structure of the missile and carrying structural as well as motor loads. The tail fins are bolted to the rear of the motor casing and the hydraulic accumulator forms its front end-closure.

The Seacat director is also manufactured by Short Brothers and Harland. In its simplest form it is hand-operated, and consists of a base fixed to the ship's deck, supporting a rotating "bin." The aimer occupies a fixed seat in the bin and views the target through a wide-angle binocular sight. The latter is capable of independent movement in elevation and azimuth, and is operated by a sight arm trained by two handgrips. In the right handgrip is incorporated a thumb-operated missile control joystick.

As soon as a target is detected by the ship's main radar system its co-ordinates are fed automatically to instruments in front of a control officer standing outside the Seacat director bin. The control officer pushes the director on to the target bearing indicated on his dials, the aimer picks up the target in his binoculars, the missile is fired and the aimer guides it to the target by a radio link with guidance signals governed by the deflections of his joystick control.

When Seacat is fired, the control surfaces are locked in the zero-deflection position by shear pins which fracture and allow the surfaces to move when guidance demands are made. The control systems for pitch and yaw are identical to each other.

The aimer observes the target and missile and operates his joystick so as to bring the missile into coincidence with the target. The pitch and yaw outputs from the joystick are fed into a voltage shaping unit which, as its name implies, processes the signals before they are transmitted to the missile. Such processing is essential in order to achieve stability in the overall control loop. The shaping unit forms the heart of the Seacat system, and the processing carried out by it represents a major step forward in the techniques of manual command-link guidance.

From the shaping unit the signals are fed into the modulator where they are converted into a suitable form for radio transmission. The transmitted signal is picked up by the missile receiver aerials, and their output is fed to a demodulator which reproduces the shaped joystick signals. These signals are restricted in amplitude by the limiting-network unit, and are then fed into the appropriate servo-amplifiers which operate the electro-hydraulic wing actuators. The lateral control demands are limited in order to ensure that sufficient wing angle remains available for roll control.

Roll control is achieved by feeding the output from the roll position gyroscope into the shaping amplifier, where the signal is phase-advanced and amplified. It is then limited in the limiting network unit and fed into the four servo-amplifiers which drive the actuators. Roll stabilization of the missile is achieved by differential movement of opposite pairs of wings.

The Seacat launcher, which is manufactured by Rose Bros Ltd of Gainsborough, Yorks, carries four missiles, mounted in pairs on each side of the guidance transmitter aerial, and is trained and elevated by an electro-hydraulically operated system slaved to the motions of the director. It consists of a rotating platform, mounted on a pedestal bolted to the deck, on which is a central box-like structure containing the azimuth and elevation variable-speed