# Arresting RN Aircraft

## DEVELOPMENT WORK AT RAE BEDFORD

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*Arrest of a Vickers-Supermarine Scimitar during RAE trials*

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NAVAL arrester gears are designed and built exclusively by McTaggart Scott & Co Ltd, Loanhead, near Edinburgh, to requirements specified by the Director-General Ships. A prototype gear or gears is supplied to the Naval Air Department, RAE Bedford, for proving and developing. This work is the main concern of the Arresting Section of the Ships Installations Division of Naval Air Department, which is staffed by scientific and experimental officers drawn from the MoA and the Royal Naval Scientific Service.

There are two facilities which exist at RAE Bedford for the proving of arrester gears, and the first of these is the safety barrier and arrester gear proving base. This site is powered by a cordite catapult which can propel a deadload of up to 40,000lb at speeds up to 150kt. The advantage of the base is that a representative impact can be engendered without the use of piloted aircraft and hence more economically and with greater control and reliability.

The second site is the arrested-landing deck, which is a 6,000ft long runway with a pit one-third of the way along its length. In this vault, arrester gears are installed and coupled to centre spans which are stretched across the runway, the whole installation being representative of a ship unit. Aircraft are taxied into these wires; they cannot be flown in, as in the ship case, because of the difficulty of driving a 6,000ft concrete runway along at 28kt. The two main functions of this installation are the confirmation with live aircraft of the gear performance figures established by trials at the proving base, and strength proofing of aircraft, i.e., loading the arrester hook with a force greater than the working load it will receive in service. Aircraft proofing is also necessary for stores and modifications which are added to the aircraft throughout its life.

These, then, are the main tools at the disposal of the Naval Air Department and this article will indicate their use in the evaluation of an arrester gear currently being fitted to HM ships to enable them to operate the new generation of Naval aircraft.

The gear comprises fundamentally an energy absorber and an aircraft/energy absorber link.

Fig 1 shows the primary hydraulic system for an arrester gear. The main ram and cylinder both carry at their extremities a bank of pulleys assembled on a shaft. The main cylinder is anchored and hence the set of pulleys attached to it is referred to as the fixed crosshead. The ram is free to move by compressing the fluid and the set of pulleys at the free end of the ram is known as the moving crosshead. Initially, when the main ram is fully extended the whole system is full of fluid at a pressure of approximately 650lb per sq in. When the aircraft engages, load is transferred to the moving and fixed crossheads via the linking system and the moving crosshead begins to move. This motion forces the fluid in the main cylinder through a control valve which is located close to the fixed crosshead. The control valve is known as a spline valve and is a variable orifice with a wide gap at the beginning of the motion reducing to almost nil at the end of the arrest. In this way energy is converted into pressure and dissipated in heat. The fluid, after being forced through the spline valve, passes to the liquid side of the piston accumulator through a non-return valve. When the aircraft has come to rest the non-return valve is closed by the pressure on the air side of the piston accumulator, which is maintained by air bottles at approximately 650lb/sq in. The aircraft is disengaged; then, to restore the unit to the initial conditions, the resetting valve is opened and the 650lb/sq in from the air bottles acts on the main ram through a line by-passing the non-return valve. The moving crosshead moves back to the reset position, the resetting valve is closed and the unit is ready for another engagement. The piston accumulator is fitted to ensure separation of the air and liquid surfaces so that aeration troubles may be reduced to a minimum.

The spline valve is the decisive factor in the behaviour of the ram and hence the characteristics of the arrest. The spline barrel, that part of the valve which dictates the variation of the discharge orifice, consists of a series of grooves of varying depth cut on the outer surface of a cylinder. Three grooves at either end of a diameter correspond and these serve for one particular range of aircraft weights. By rotating the barrel another pair of three grooves is brought opposite the ports which are connected to the main cylinder. During the arrest the barrel moves axially and the variation of discharge orifice is thus decided by the varying depth of the splines in the spline barrel. This barrel motion is controlled by the telemotor ram which is fixed to the main ram and forces fluid through the transmitter cylinder to the minimum orifice end of the spline barrel. A sectional view of the principal parts of the spline valve is shown in Fig 2.

The spline profiles are so cut that for a given aircraft weight the energy involved in an engagement at the maximum speed anticipated is absorbed in the full stroke of the main ram and spline barrel. At the higher energies the spline barrel movement is asymptotic to the working stroke and to all intents and purposes is fixed over the speed range in which a ship normally operates. If the wrong weight setting is used or the aircraft's relative speed into the gear is greater than gear performance allows there is a

*Fig 1. Schematic diagram of typical arrester gear*

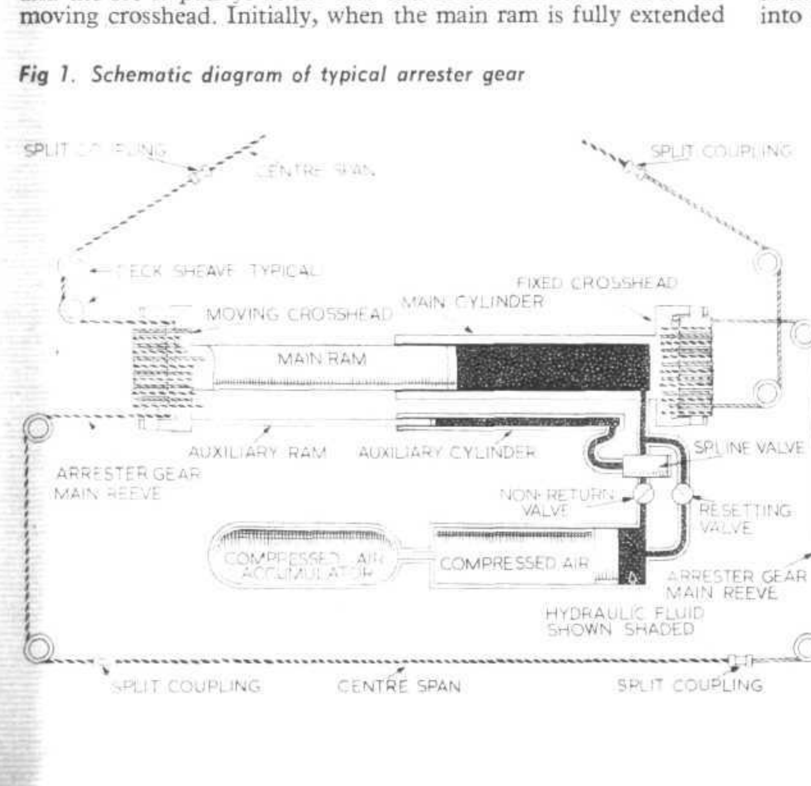


*Fig 2. Sectional view of spline valve*