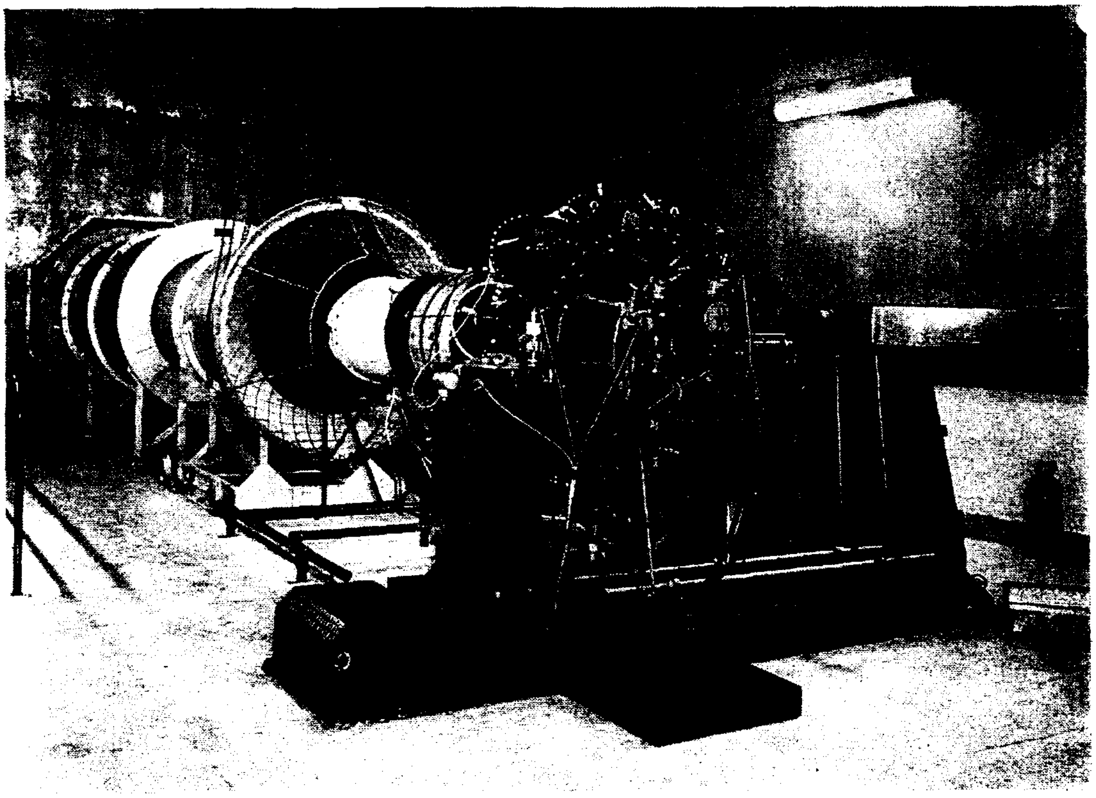


VIEW OF TEST CELL SHOWING THE CURRAN SYSTEM OF ENGINE SUSPENSION

TESTING THE NAVY'S JET ENGINES

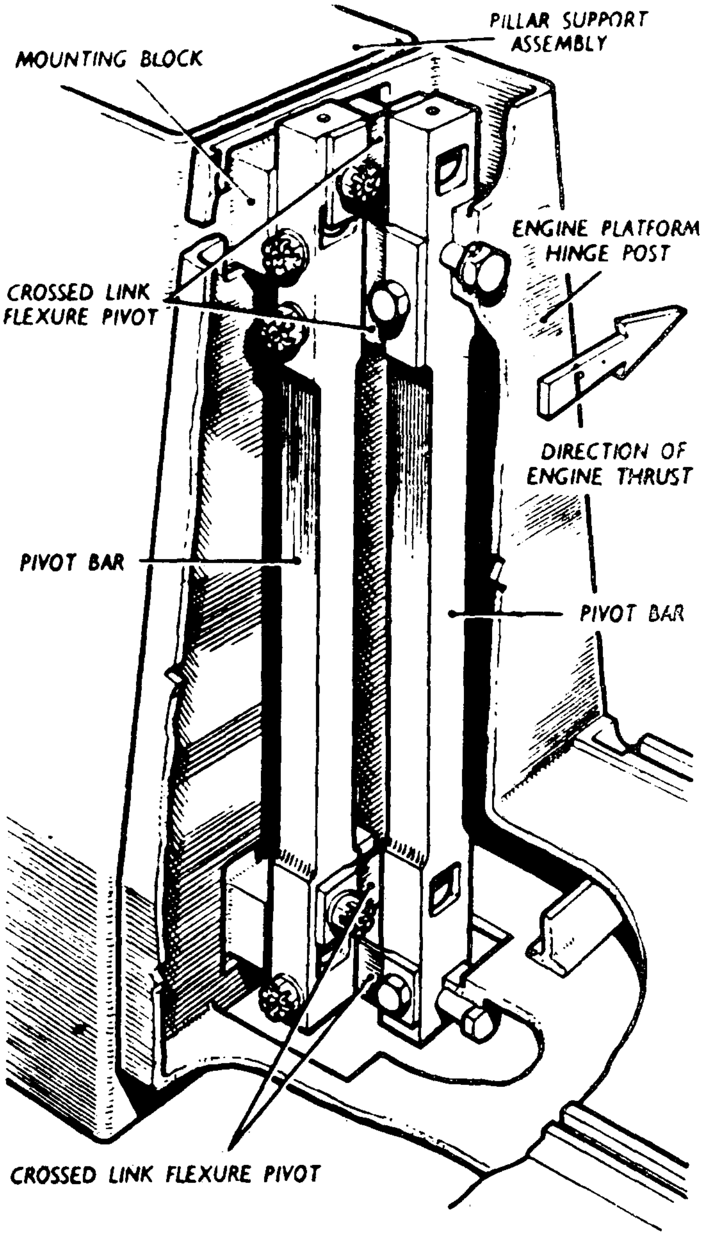
Reproduced from 'The Aeroplane' of August 28, 1953, by courtesy of the Publishers.

With the introduction in recent years of turbine-engined aircraft to the Fleet Air Arm, special equipment has had to be supplied to refuel, maintain and overhaul the aircraft and their engines. Forming an interesting part of this equipment are two new jet test beds at the Royal Naval Aircraft Yard, Fleetlands. These were completed earlier this year by John Curran, Ltd., of Cardiff.

The heart of this installation is a pair of Curran type 'J' (pure jet) test benches. These were developed in co-operation with the Directorate of Servicing Research and Development at the Ministry of Supply. Around the test benches, the company's architect has designed a straightforward layout of building. This, together with two Cullum Detuners of the large Mark 5 type, comprise the Yard's jet test facilities.

Each test bed consists of three sections; the preparation room, the test cell and the control room. As its title implies, the preparation room is where the engine is made ready for test. The engine is then pushed on its transport trolley, into the test cell, which is on the same ground level.

A hoist, running on a rail in the ceiling, is used for transferring the engine to the test stand. This latter consists of an engine platform with suitable supports on which the engine is mounted. The mountings are bolted in T-grooves in the platform and can be moved apart to accept engines of a diameter up to 5 ft 10 in.



DETAILS OF THE CROSSED LINK FLEXURE PIVOTS

The platform is suspended at one side from a pillar support assembly. A pair of crossed-link flexure-pivots at the top and bottom form the actual hinge. These allow the platform to swing in a horizontal plane with a minimum of friction and restraint. A drawing appears above.

When running, the tendency for the engine is to rotate the platform forwards. Such movement however is restricted by the thrust unit. This is bolted to the ground at the other end of the platform to the support pillar. Projecting into the thrust unit from the platform is an arm, the thrust moment from the engine being applied through this arm to a statimeter.

As the centre of the statimeter is twice the distance from the platform hinge-point that the engine is, the thrust on the statimeter is half of the engine thrust. To make allowance for this, the scale of the thrust indicator in the control room is arranged to read double the load that is applied to it by the statimeter. That, briefly, is the Curran method of engine suspension and thrust measurement.

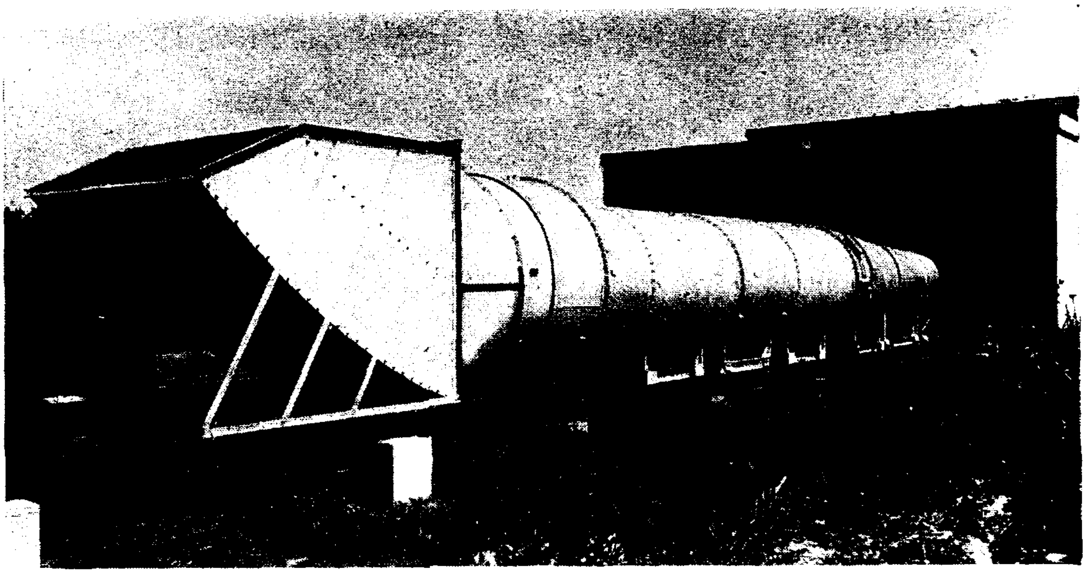
INSTRUMENT CONSOLES IN THE CONTROL ROOM

In amplifying this description, a more detailed account of the job performed by the two platform pivots is needed. Each pivot consists of a pair of flexible steel hinges. One hinge from each pair lies in a direction at right-angles to the engine. These two take the weight of the engine and platform, allowing them to turn in a horizontal plane. The other hinge from each pair lies parallel to the engine. These latter two take care of the vertical overturning moment produced by the engine when running.

Consideration will show that the pair of hinges at the top of the pillar support are in tension, whilst the bottom pair are in compression. As the purpose of the suspension arrangements in any thrust measuring system is to reduce friction to an absolute minimum, the crossed-link flexure-pivots would appear to go a very long way in meeting this requirement. When the engine is not running the weight of it and the platform is taken by four screw-jacks. These are joined by links and can be turned by a hand-operated lever.

The thrust unit begins at the thrust arm of the platform. When the engine is running, forward movement of the platform and the thrust arm is resisted by the statimeter, which is compressed as a result. This latter unit is situated midway along a tube. One end of the tube is held in a ball-and-socket joint in the thrust arm. The other end is held in a similar joint in a small crossed-link flexure-pivot that lies parallel to the thrust arm.

This arrangement allows for self alignment of the tube and statimeter, so that the thrust passes axially through the statimeter. Movement of the pivot block is limited so that it takes the load of the statimeter.



A Cullum Detuner Silencer

During calibration of the thrust-measuring equipment, loads are applied to the thrust unit by means of a lever and weights. The length of the weighted lever-arm, as measured from the pivot block, is fifty times that from the pivot block to the centre of the crossed links. In this way a 10 lb weight on the lever arm applies an effective thrust of 500 lb to the statimeter. As has been mentioned, the thrust indicator dial in the control room reads twice the load applied to it by the statimeter. Therefore the 10 lb gives a reading of 1,000 lb at the indicator.

As the ' J ' type test bed can take engines developing up to 12,500 lb thrust, only 125 lb of weights are needed to perform the complete calibration. A screw-jack and lever are used to tilt the pivot block so that there is no deflection of the pivot links. This condition is indicated by a spirit-level on the pivot block, and is performed before each calibration reading is taken. The calibration procedure is thus a relatively simple one to go through and permits a graph to be drawn showing actual thrust plotted against indicated thrust.

Air for the engine on test is inducted through a series of dog-leg splitters in the upper front part of the bed. Shutters outside seal these off when there is no engine running.

The test cell is lined with sound-absorbing panels. These and the silencer which radically reduces engine exhaust noise, are the work of H. W. Cullum and Co., Ltd. The silencer itself is a large Mark 5 Detuner.

This is similar to the model described in our issue of December 12 last year, and consists of a long circular duct containing sound-absorbent walls. The front part inside the test cell is mounted on wheels so that it can be positioned to suit the various lengths of engine to be tested by the Navy. The exhaust turbine cooling air from the Nene shown installed, is piped along to pass out through the Detuner as well.

Fuel for both test beds is provided from two 12,000-gallon underground tanks. A separate pump house containing filters and pumps supplies fuel along a common pipe to both test cells. Either tank or both tanks can be switched to feed each engine. The test cells both contain a big Streamline filter capable of passing fuel at the rate of 1,800 gallons per hour, and filtering down to 10 microns.

Following each filter are a pair of fuel-regulating valves. These maintain the fuel pressure into the engine at around 12 p.s.i. As both test cells are

The Test Beds with Left-hand Shutters Raised to Show Intake Splitters

supplied in series off the same feed pipe at 25 p.s.i., these regulators ensure that each engine gets a fair share of the fuel. Suitable on/off cocks are fitted in the line.

On the oil system side there is an inhibitor tank. This is primed by a hand pump feeding oil from a barrel. A cock, controlled from the instrument console, can be set at ' off ' or ' inhibiting.' The oil system itself is normally self-contained on the engine.

All the control rods and feed pipes from the control room to the engine, pass along the control duct. The engine end of this duct is attached by a single bolt and Silentbloc to the top of the pillar support assembly. The other end rests in a cavity in the wall below the control room window. This arrangement prevents noise and vibration from being transmitted from the test cell into the control room.

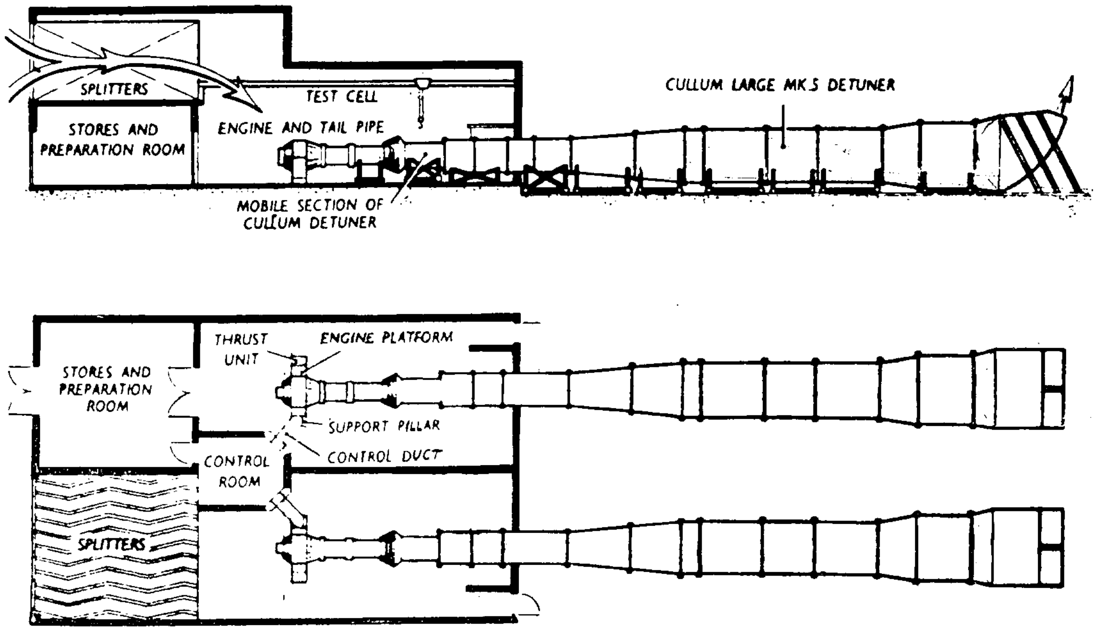
The engine control-runs that pass from the pillar support, across to the engine platform, are connected by self-aligning joints. The purpose of these, and the flexing of the fuel, oil and electrical conduits, is to avoid imposing a restraining force on the platform, in the opposite direction to engine thrust.

On the back of the support pillar assembly is a door on the inside of which are attached the electrical starter panel connections. The door is readily detachable, and a different one, with the correct electrical connections for each type of engine, is available. These can be easily changed in a few seconds.

A mercury bulb thermometer is situated on the side of the control duct for indicating the air temperature in the test cell.

All the levers, switches and instruments necessary for control of the engine are completely contained on the instrument console. Fuel flow is indicated by two Rotameters. One of these reads from 80 to 400 galls/hr or the fuel flow can be switched to pass through the other, which reads from 400 to 1,600 galls/hr.

The normal range of pressure gauges, temperature indicators and electrical switches and buttons is fitted. The main fuel on/off cock and throttle levers are of the Arens type. These have an attachment at the top which allows for locking, or vernier movement, of the lever. Chains hanging from the ceiling control the isolator valves which pass the fuel along a return circuit to the main tanks, when required.



LAYOUT OF TEST BEDS

Engine speed measurement is interesting in that in addition to the normal type of tachometer, there is also a Curran Tachoscope. At the engine end, this device consists of a small 1,600 : 1 gear box that is interposed between the engine tacho-drive and the tacho-generator itself. As the normal drive for the latter unit runs at one quarter of engine speed, it requires 6,400 revolutions of the engine to rotate a cam, inside the Tachoscope, through one revolution.

The cam operates a switch in circuit with a solenoid on the instrument console. This solenoid pulls over a bell crank that consecutively stops and starts a stop watch. In this way a very accurate measure of the time taken for 6,400 revolutions of the engine can be obtained. A further switch on the console opens the solenoid circuit for any number of revolutions of the cam.

By this means the time for any multiple of 6,400 revolutions can be measured. A conversion table is available for translating the time readings into engine r.p.m.

Curran's type ' J ' (pure jet) test bench can be used for testing Derwent 5 and 8 engines, Nene 3's, 101's and 102's, Goblin 2's and 3's, and further adapter sets are being prepared to allow for testing of future types. Such means ensure that the installation will be able to cater for all the types of pure jet aircraft currently in use or projected for use in the Fleet Air Arm. These include the Attacker F.B.2, Meteor T.7, Sea Hawk F.1, Sea Vampires F.20 and T.22, and the Sea Venom N.F.20.