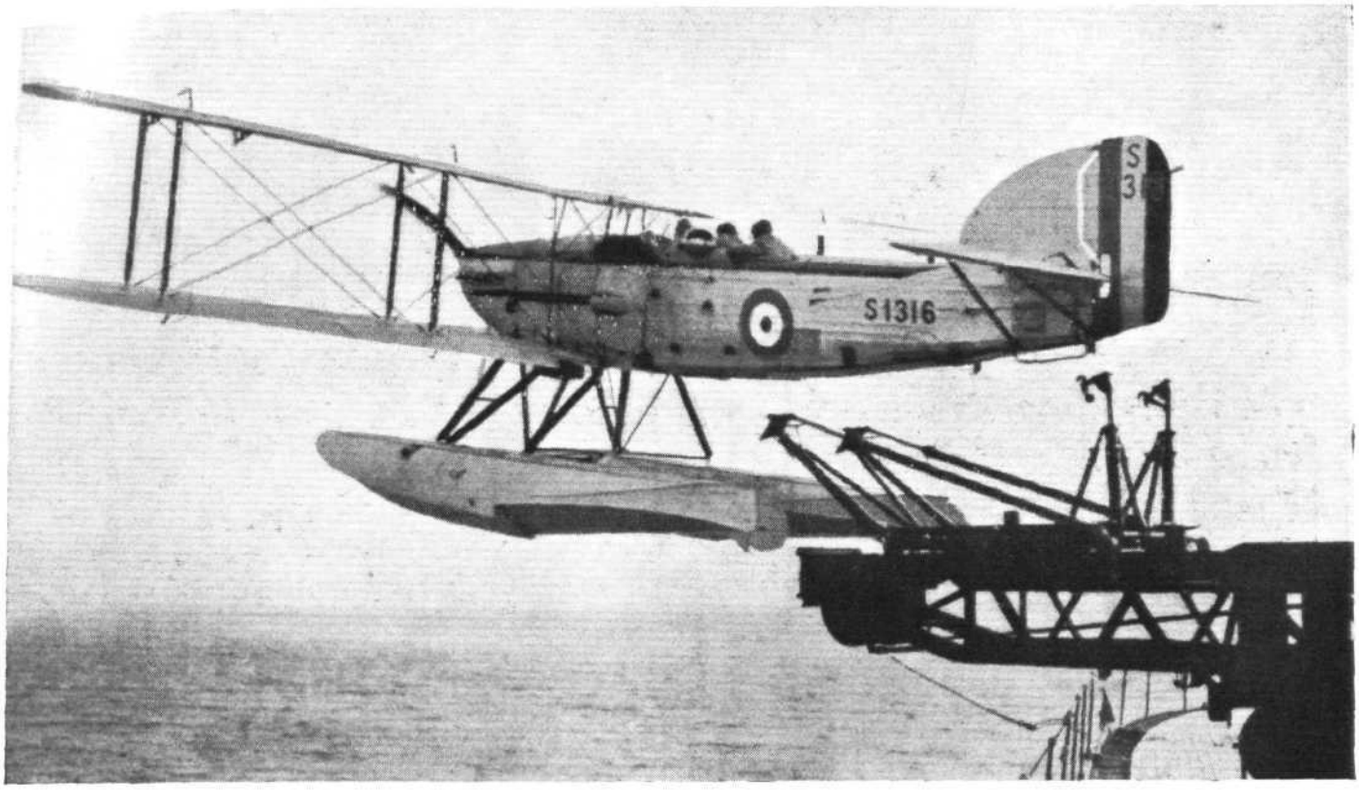


CATAPULT LAUNCHING OF AIRCRAFT: This photograph of a Fairey III F seaplane being catapulted off is reproduced by courtesy of the Admiralty.

AIRCRAFT CATAPULTS

Scottish Firm Markets Two Successful Types

DUE chiefly to a policy of reticence on the part of British manufacturers, the impression appears to have got about that foreign countries have stolen a march on Great Britain in the matter of catapults for launching aircraft. The United States have been experimenting with and making use of catapults for a number of years. France also has produced catapults, and Germany, notably the Heinkel firm, has had on the market for a considerable period a catapult which was used experimentally for the launching of civil aircraft from liners. What Great Britain has been doing has not hitherto been permitted to become known. A short time ago, however, photographs were published (see FLIGHT of October 24, 1930) of a catapult with which experiments in launching had been carried out at the Royal Aircraft Establishment at Farnborough. Now it has become possible, by the courtesy of the Admiralty and of the makers, to publish more detailed particulars of a very powerful catapult manufactured by Mactaggart, Scott and Co., Ltd., of Loanhead, Edinburgh. Actually two distinct types are available—one known as the extending structure type, and the other known as the fixed type, in which the actual trolley used for supporting the aircraft is similar to that used in the extending structure type. The fixed type is intended for operating from ships in which the track rails are fixed to the deck, the actuating mechanism being housed below deck. The following notes will deal mainly with the extending structure type, in which the rails are so arranged that the line of take-off can be adjusted to any angle desired, and is not confined to the fore-and-aft line of the ship.

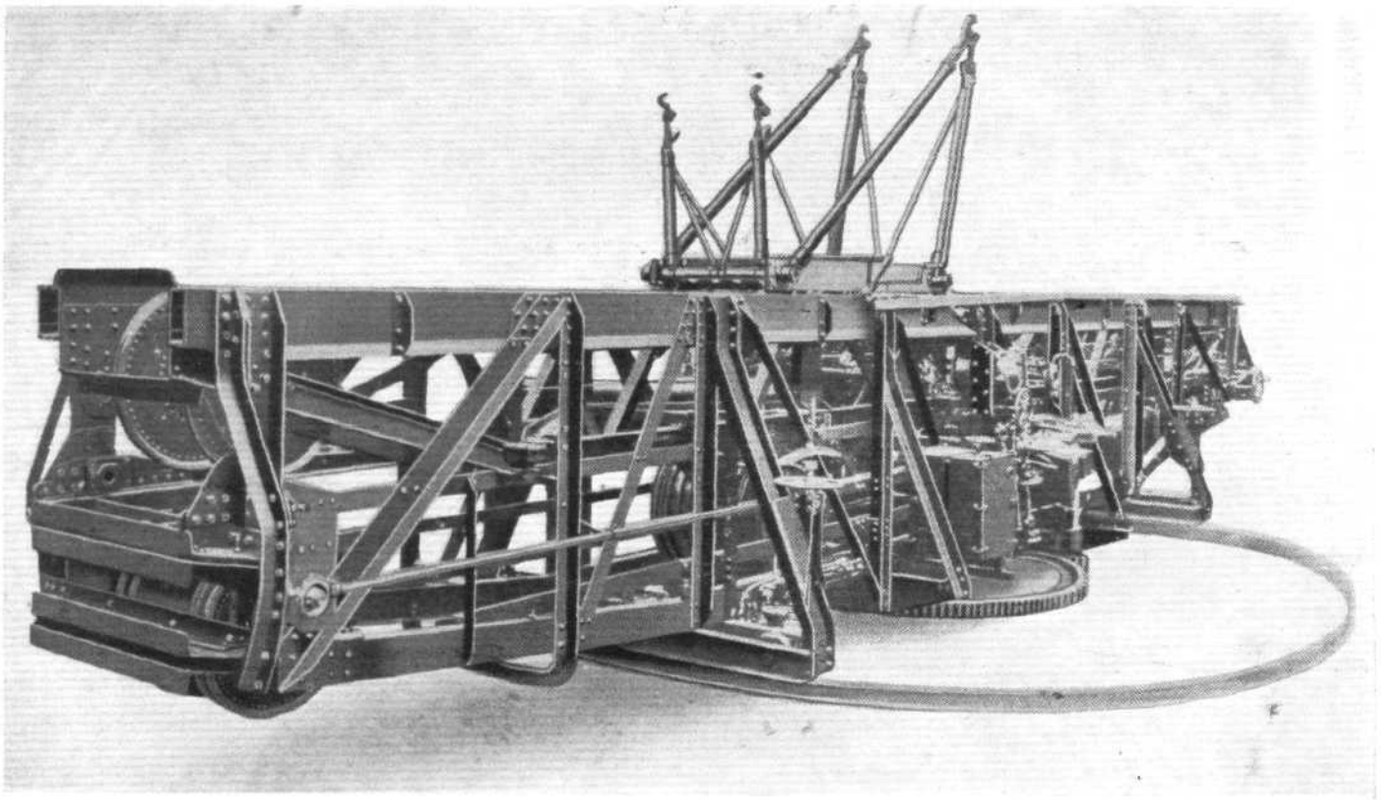
The Mactaggart, Scott and Co. extending structure type of catapult consists of four main parts: the trolley, the main extending structure, the actuating mechanism, and the operating gears. For a total weight of 19 tons, the catapult will launch any type of aircraft, landplane, float seaplane, flying boat, or amphibian. The launching speed varies according to the weight of the aircraft. Thus a machine weighing 8,000 lb. is catapulted off at a speed of 57 m.p.h. A machine weighing 7,000 lb. is launched at 60 m.p.h., while a 6,000-lb. aircraft is launched at 63 m.p.h. The length of the catapult stowed is 46 ft., and the length fully extended is 75 ft. 9 in. The total length of run for the aircraft is 64 ft., of which 50 ft. 6 in. is accelerating travel and 13 ft. 6 in. is retarding travel (the aircraft actually is released during the retarding travel). The mean acceleration obtained depends, of course, on the launching speed. In the case of the 57 m.p.h. launching speed the mean acceleration is 2·15 g. For 60 m.p.h. it is 2·38 g., and for 63 m.p.h. it is 2·62 g.

The Trolley

That part of the catapult on which the aircraft is mounted is known as the trolley, and consists of a rectangular framework of four steel channels carrying the four legs by which the aircraft is attached to the trolley. At each corner of the trolley frame are two wheels mounted on special high-duty roller bearings. The object of fitting two wheels at each corner is that, as the main frame consists of a fixed frame and two moving frames running inside the fixed frame, the wheel track varies according to whether the trolley is on the fixed frame rails or on the rails of the extending frames. When on the latter, the inner wheels support the trolley. When the trolley is over the fixed frame portion, however, it runs on its outer wheels.

At the forward end of th trolley is a pair of struts which terminate at the top in jaws or forks. These forks engage with trunnions on the aircraft. The two struts, or legs, at the rear corners of the trolley frames, similarly end in forks, which support the rear trunnions on the aircraft. Sloping from the tops of the forward struts down to the rear cross shaft are two diagonal members, which are actually telescopic struts with oleo gear incorporated.

When the aircraft is being launched, the thrust is delivered to the aircraft through the front forks. The rear forks serve to hold the aircraft at the correct angle of incidence, and to this end the rear struts of the trolley are adjustable in length. The adjustment provides for a range of incidence from 0 degrees to 12 degrees. To prevent the aircraft from being pulled out of the forks under the thrust of the airscrew while the trolley is stationary or travelling at low speed, detents are fitted which lock the trunnions to the forks. Not until the trolley has travelled a certain distance and has attained a speed at which the acceleration is greater than the



THE MACTAGGART, SCOTT & CO. CATAPULT: View of right side, looking forward. The catapult and trolley are in the "stowed" position.

airscrew thrust are these detents released (automatically), and there is thus no risk of the aircraft being pulled out of the trolley forks prematurely. The gear which releases the detents at the same time releases a locking device on the oleo legs. When the trolley reaches the end of its accelerating travel it is retarded by the actuating mechanism, and the aircraft then flies off as soon as the airscrew thrust begins to work (the thrust is, of course, small during acceleration). As soon as the weight of the aircraft is taken off the forks, the four legs fall down in order not to foul any part of the aircraft. The four tubes which support the aircraft are, by the way, adjustable sideways, while the rear legs are also adjustable fore and aft. Thus, aircraft of various sizes and with different distances between their four trunnions can be launched from the same trolley.

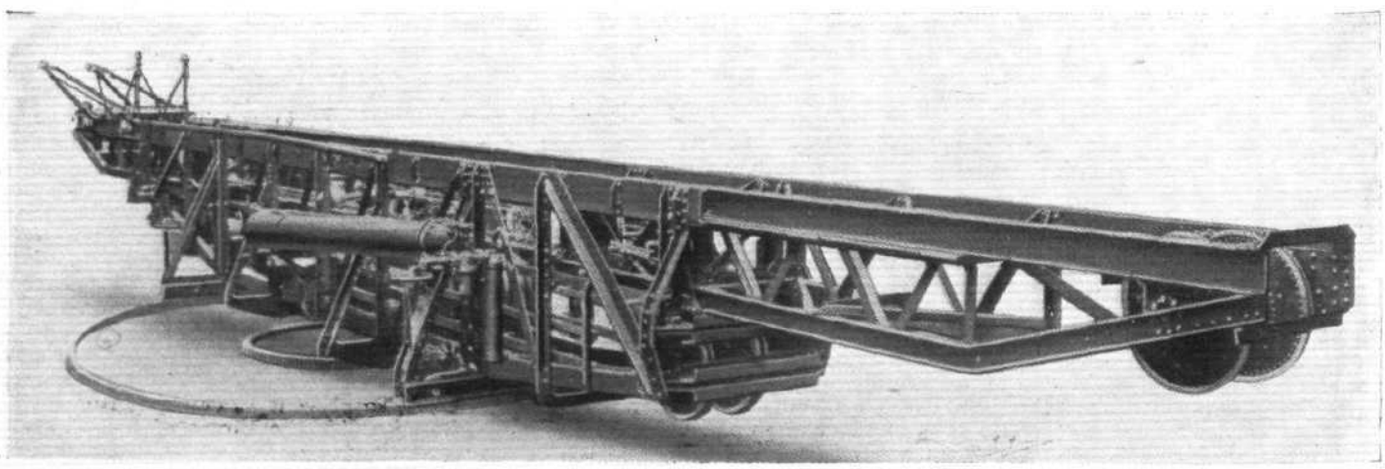
The Structure

As already mentioned briefly, the main structure of the catapult consists of three parts: the main central structure, the forward extending portion, and the rearward extending portion. The whole structure is built up of high tensile steel sections. The central fixed frame is braced outwardly, while the two extending portions are braced internally, so as to provide clearance for the extending portions to travel inside the fixed frame. To facilitate transport, the main central frame is divided in its centre, so that it can be taken to the site or ship in two halves. There it is erected and bolted together. The two extending frames are similar, and each is half the length of the fixed central frame, so that when the catapult is in the "stowed" position, the extending frames are entirely housed within the fixed frame.

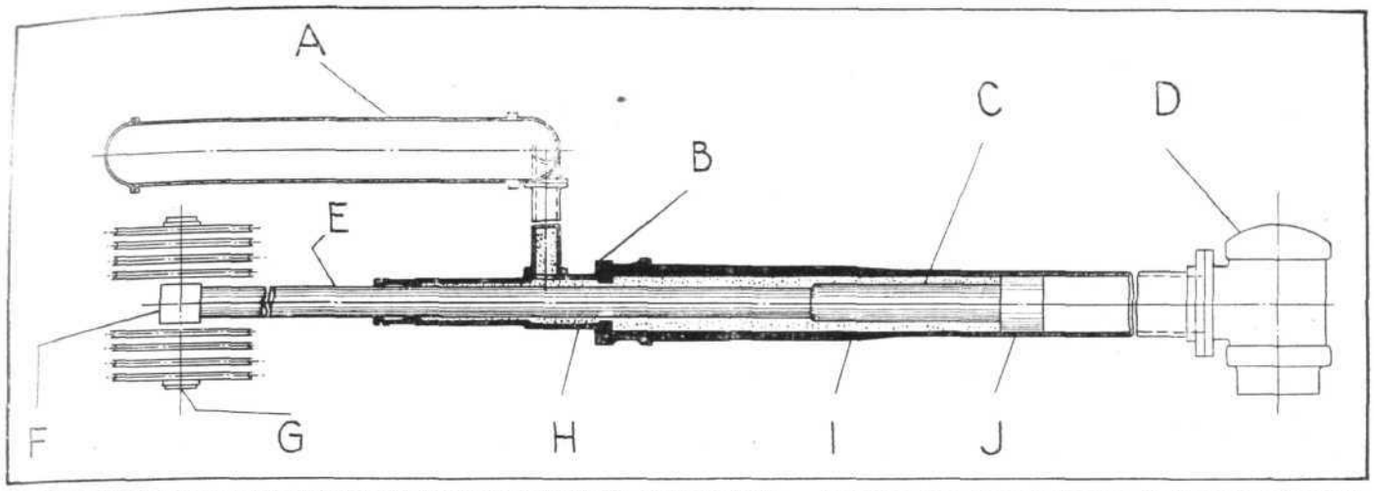
The Actuating Mechanism

The mechanism which transmits the power for catapulting to the trolley is a piston or ram working in a power cylinder. The ram does not, however, work direct on the trolley. It is connected to the trolley by cables running over a series of pulleys in such a fashion that gearing-up is provided, the travel and speed of the trolley being four times the travel and speed of the ram. Actually, there are two sets of cables, one of which, as stated, transmits the thrust of the ram to the trolley, while the other is a retarding cable, and transmits the kinetic energy of the trolley to the ram, during retardation.

The power cylinder is rigidly fixed to the main structure. At one end the ram is attached to the piston, and at the other it carries eight pulleys on a cross-head. Bolted to the



THE MACTAGGART, SCOTT & CO. CATAPULT: View of left side, looking forward. In this view the catapult is extended, and the trolley is at the end of retarding travel.



DIAGRAMMATIC REPRESENTATION OF POWER CYLINDER : A is the receiver cylinder, B the cut-off neck ring, C the tapered sleeve, D the explosion unit, E the ram, F the ram cross-head, G guide rollers, H cylinder extension, I the power cylinder, and J the piston.

power cylinder is an extension carrying a neck ring and stuffing box. The piston is provided with a tapered sleeve, the greatest diameter of which is slightly smaller than the bore of the neck ring. The bore of the cylinder extension communicates with a receiver cylinder or tank. At the rear end the power cylinder terminates in an explosion chamber, and the power for catapulting may be either in the form of the combustion of cordite in the chamber, or it may be in the form of compressed air. The annular space in front of the piston, between the ram and the cylinder walls, is filled with a 50-50 mixture of glycerine and water. When pressure is generated behind the piston (either by cordite or by compressed air) the piston and ram are forced forward, the piston driving the glycerine-water mixture in front of it, and forcing it through the annular space between the neck ring and the ram, and into the receiver cylinder. At the end of the accelerating stroke the tapered sleeve of the piston enters the neck ring, thereby partly blocking the passage of the glycerine-water mixture. The pressure rises and checks the speed of the ram, and, by means of the retarding cable, the speed of the trolley. It is at this period that the aircraft leaves the trolley. The taper of the sleeve is so arranged that constant retarding pressure is maintained in front of the piston. A device known as the " spring release hook " is provided for the cross-head. This ensures that the thrust of the airscrew shall not pull the ram out of the cylinder, and is so arranged that the cross-head is not released until a force is applied to the ram considerably in excess of the airscrew pull.

The Operating Gear

The operating gear consists of four main parts : The training gear, the extending and stowing gear, the screw shaft manœuvring gear, and the air manœuvring gear.

The training gear, used for traversing, consists of a large spur wheel mounted on the ground or on the deck of a vessel below the structure. Engaging with this large spur wheel is a small pinion on a vertical shaft. This shaft is hand-operated through worm gearing, and four men can turn the catapult at the rate of 1 degree per second. As the worm gear is self-locking, the catapult cannot swing, due to the rolling of the ship.

The extending and stowing gear consists of a worm shaft driven by an electric motor, the rotation of the shaft acting on the stowing cables in such a way as to draw the two extending portions of the frame together into the middle of the fixed frame.

The screw shaft manœuvring gear is used for bringing the catapult into the stowed position, an electric motor driving a worm wheel, rotation of which moves the release hook, and hence the ram cross-head and trolley. If desired, the operation of the extending and stowing gear, and screw shaft manœuvring gear, can be done manually.

The air manœuvring gear is used to return the trolley from the forward end of the structure to the firing position, and to manœuvre it on the portion of the structure which is beyond the range of the screw shaft manœuvring gear. It consists essentially in a system of valves whereby compressed air can be admitted either to the receiver cylinder or to the explosion chamber behind the piston.

As mentioned at the beginning of this article, Messrs. Mactaggart, Scott and Co., Ltd., manufacture another model of catapult, in which the rails for the trolley are fixed to the deck of a ship, the actuating mechanism being housed below deck. The trolley is generally similar to that described, as is also the power cylinder. The only operating gear required in this type of catapult is that for running the trolley along the trackway, an operation performed by the power from an electric motor.

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New Japanese Air Representative

HIS many friends in this country will be sorry to learn that Engineer Lieut.-Commander J. Saiki, of the Imperial Japanese Navy, who has been in charge of the Aviation Department at Broadway Court, Westminster, for a considerable period, has been recalled to Japan. Commander Saiki has become a well-known figure wherever any event of importance occurred in the British aviation world, and his departure will be greatly regretted. We are certain, however, that his successor, Engineer Lieut.-Commander M. Ishii, will very quickly become as well known a figure as was Commander Saiki.

Long Flight by Autogiro

ONE of the latest American models of the Pitcairn-Cierva Autogiro, a PCA-2, recently completed what is claimed to be the longest flight ever accomplished on this type of aircraft. James G. Ray, vice-president of the Autogiro Co. of America, flew from Philadelphia to Miami and back, a distance of 2,500 miles. The object of the flight was to take part in the All-American Air Races at Miami, and to demonstrate the machine in several cities along the route. Speaking of the flight, Mr. Ray said : " Generally bad weather was encountered during most of the 2,500 mile trip, although the flight down the Atlantic seaboard to Miami was worse than the return journey. But it was an excellent chance to demonstrate the autogiro's ability to fly close to the ground at very low air speeds without danger of losing altitude. And the machine's performance in this respect made it a comparatively simple matter for me to ' feel ' my way through the fog and rain, and low visibility. Perhaps the worst conditions I met with, when other aeroplanes were forced to keep to the ground because of very poor visibility and the low ceiling, which was frequently less than 200 ft., were between Spartanburg, S.C., and Greensboro, N.C. I was down mighty low then and probably wouldn't have attempted flying at all, if I hadn't known the ' giro's abilities as far as forced landings are concerned. I knew I could get down all right if I had to, and take off again, from any reasonably open space. The weather conditions gave me ample opportunity to test what the 'giro can do under such circumstances." Ray made 12 stops in all during the trip, taking up more than 100 passengers on short flights. On the last lap of the return flight, he flew from Greensboro, N.C., to Pitcairn Field (about 400 miles), the 'giro's home port, near Willow Grove, Pa., in 4 hr. 10 min., landing at the Field at 5 p.m. Monday afternoon.