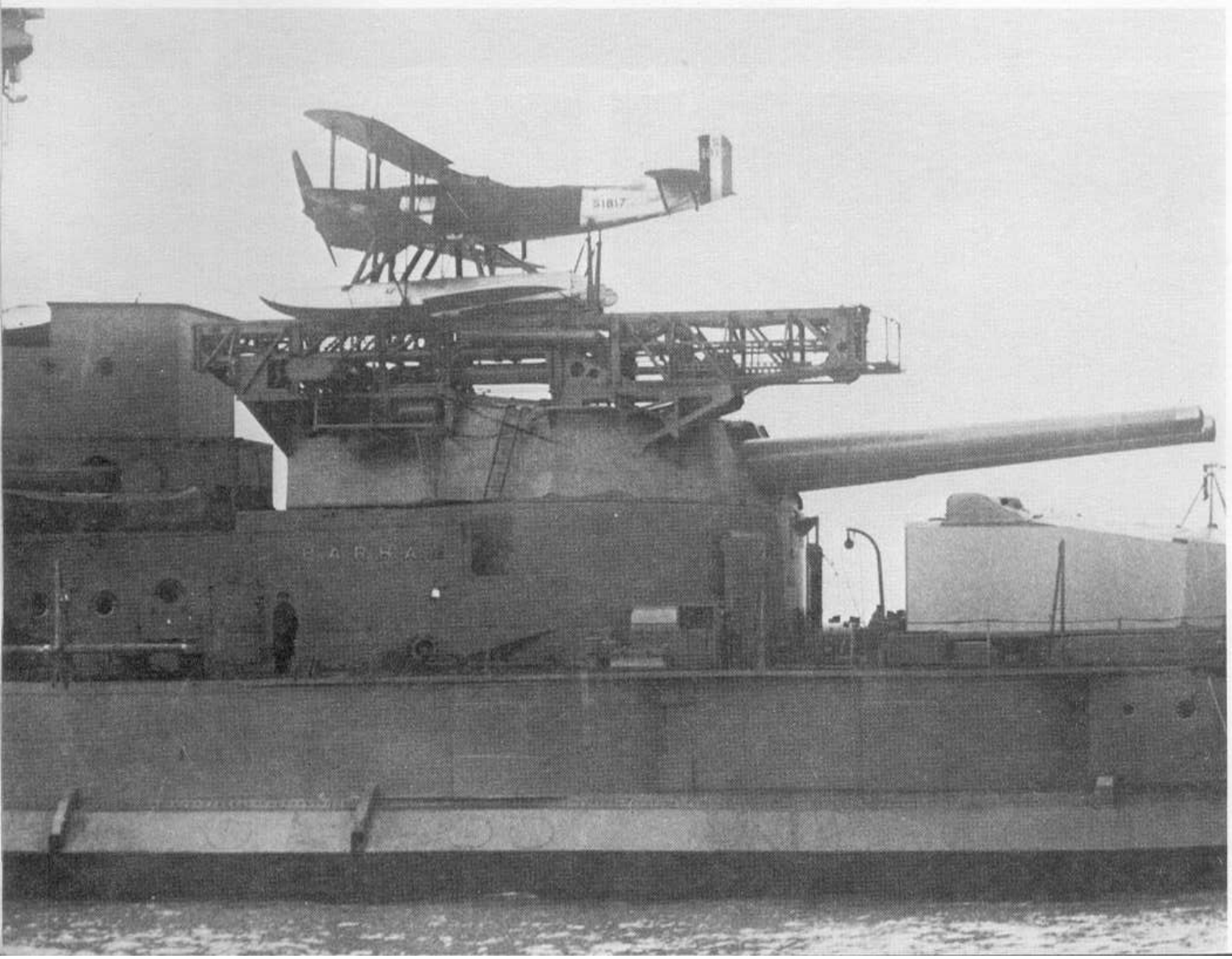
THE MACTAGGART SCOTT SHIPBOARD CATAPULT

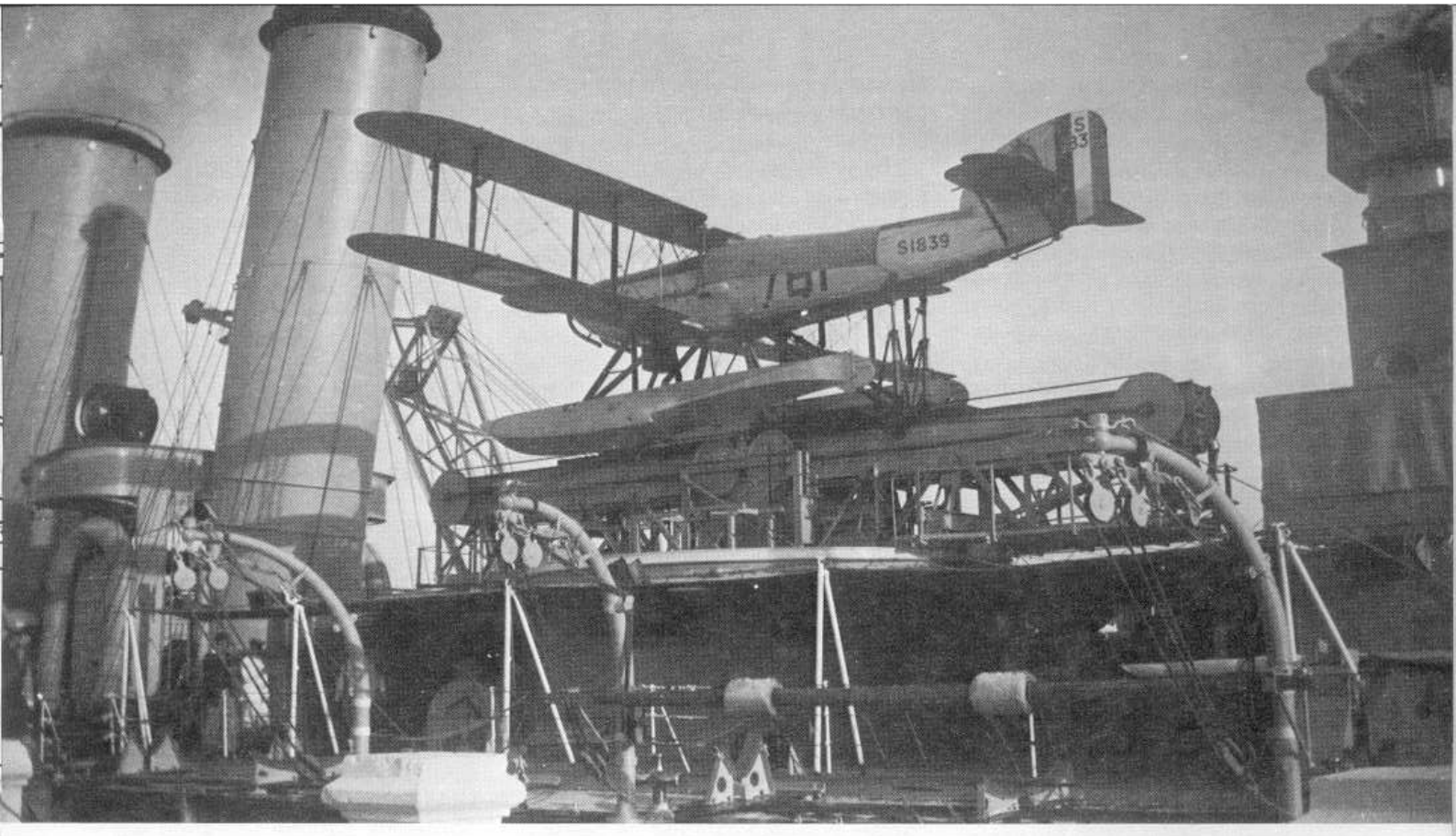
by Harry Woodman

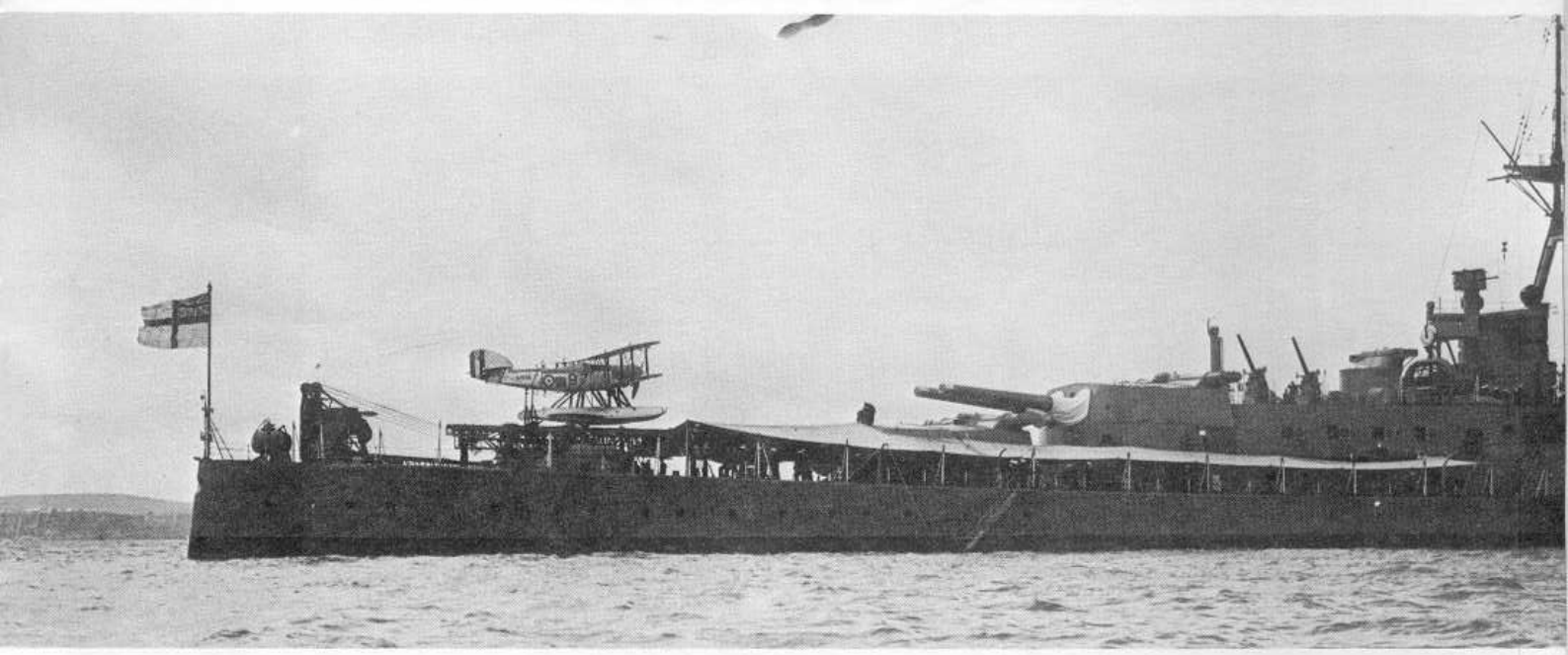
OUTLINE HISTORY

The shipboard catapult had been invented and perfected in the United States before the First World War. The British Admiralty showed some interest in this method of launching aeroplanes at sea and in 1916 a specification was issued for a marine catapult which resulted in two compressed air designs being built and tested. One of these was designed by R Falkland Carey and built by the Waygood-Otis Lift Co, whilst the other was built by Sir W G Armstrong Whitworth Ltd.

The Carey design was tested at Hendon whilst the Armstrong Whitworth structure was installed on an old steam hopper named *Slinger* and tested in the Tyne and at the RNAS station at the Isle of







Opposite: Carey type catapult fitted to 'X' turret of *Barham*, date unknown but probably 1931–32. Seaplane is Fairey IIIF Mk III, as are all the other Fairey seaplanes in this photo group. Note covers over propeller, engine cowling and open cockpits.
Real Photos
Top: Ransome Rapier slider-type catapult fitted to *York* in 1934. Large ship's badge on vertical fin of seaplane can be seen.
NMM B705/34

Bottom: large RAE catapult fitted to quarterdeck of *Hood* during 1929–31 refit. It was removed at the end of 1931 because of vibration problems (the catapult, crane, seaplane and aviation fuel tank must have weighed in excess of 30 tons). There were other reasons for its removal, one of which must surely have been aesthetical!
NMM A298–18

Grain. Neither catapult came up to specifications and the project lapsed, aeroplanes eventually being carried on the larger RN ships on small wooden platforms fitted above one of the main turrets. For launch, the turret was merely turned into wind and the aeroplanes used (Sopwith Camels, Pups and 1½-Strutters) took off with a very short run as their wing loading was light.

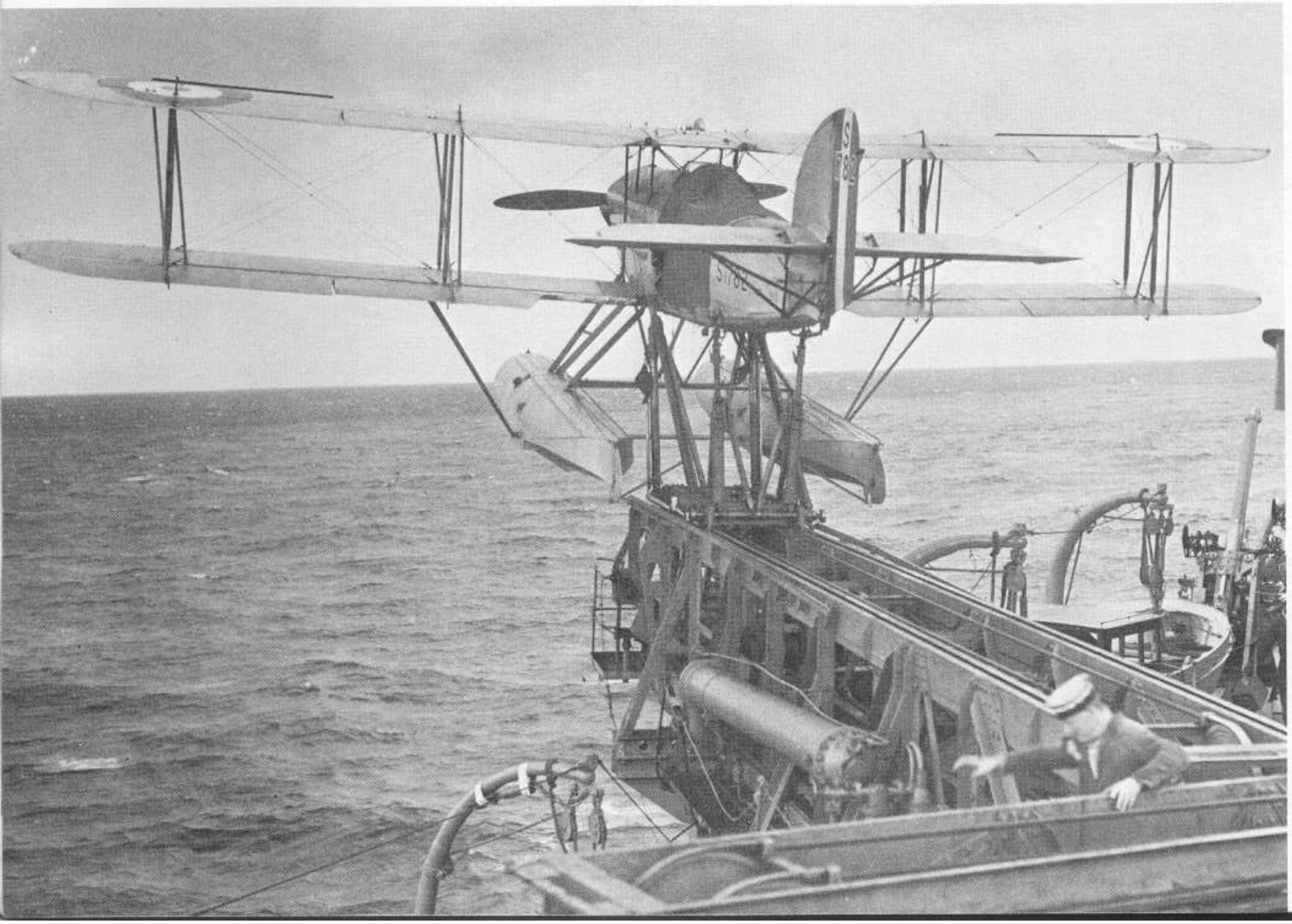
After the war this method became impractical when heavier aeroplanes came into service, and in 1922 another specification was issued by the Air Ministry (shipboard aircraft and their equipment came under the RAF) for a catapult suitable for use on battleships and the larger cruisers. Carey was again asked to design and superintend the building of a catapult at Chatham, whilst the Royal Aircraft Establishment at Farnborough undertook the design and construction of another. Both catapults used the compressed air system for power but the RAE structure employed a series of telescopic pistons or rams to propel the trolley which carried the aeroplane.

The Carey design was virtually identical to the type of catapult being adopted in the US Navy and being fitted to their larger warships. In the summer of 1925 the Carey catapult was installed on board HMS *Vindictive,* a hanger being built in front of the bridge. *Vindictive* was the first RN ship to mount a catapult and on 1 January 1926 she sailed for the China Station on a two-year commission, during which time the catapult was used many times with great success.

The RAE catapult was installed on Farnborough Common where it remained for many years. It was mounted on a turntable and was used for many experiments with aircraft launching. In May 1928 one of the Farnborough-designed catapults was installed on board HMS *Frobisher.*

In 1924 the US Navy tested a cordite-powered catapult on board the USS *Mississippi* with considerable success, and this method became standard in the US Navy. Cordite had many advantages over compressed air and in May 1928 the RAE catapult was modified to take a cordite charge. After a successful series of tests a cordite catapult was installed on board HMS *York.* Further RAE developments resulted in more powerful designs which could be folded, a great advantage on board ships which were not designed to accommodate such a bulky piece of equipment.

One RAE catapult of the folding type was fitted to HMS *Kent* whilst another, the largest type available, went to HMS *Hood* where it perched for a short time on the spacious quarterdeck along with the necessary crane and an ugly aviation fuel tank. A few catapults of the Carey type were produced, and one of these was installed on board HMS *Barham;* similar catapults were also fitted to HMS *Resolution* and *Royal Sovereign. Barham's* catapult was

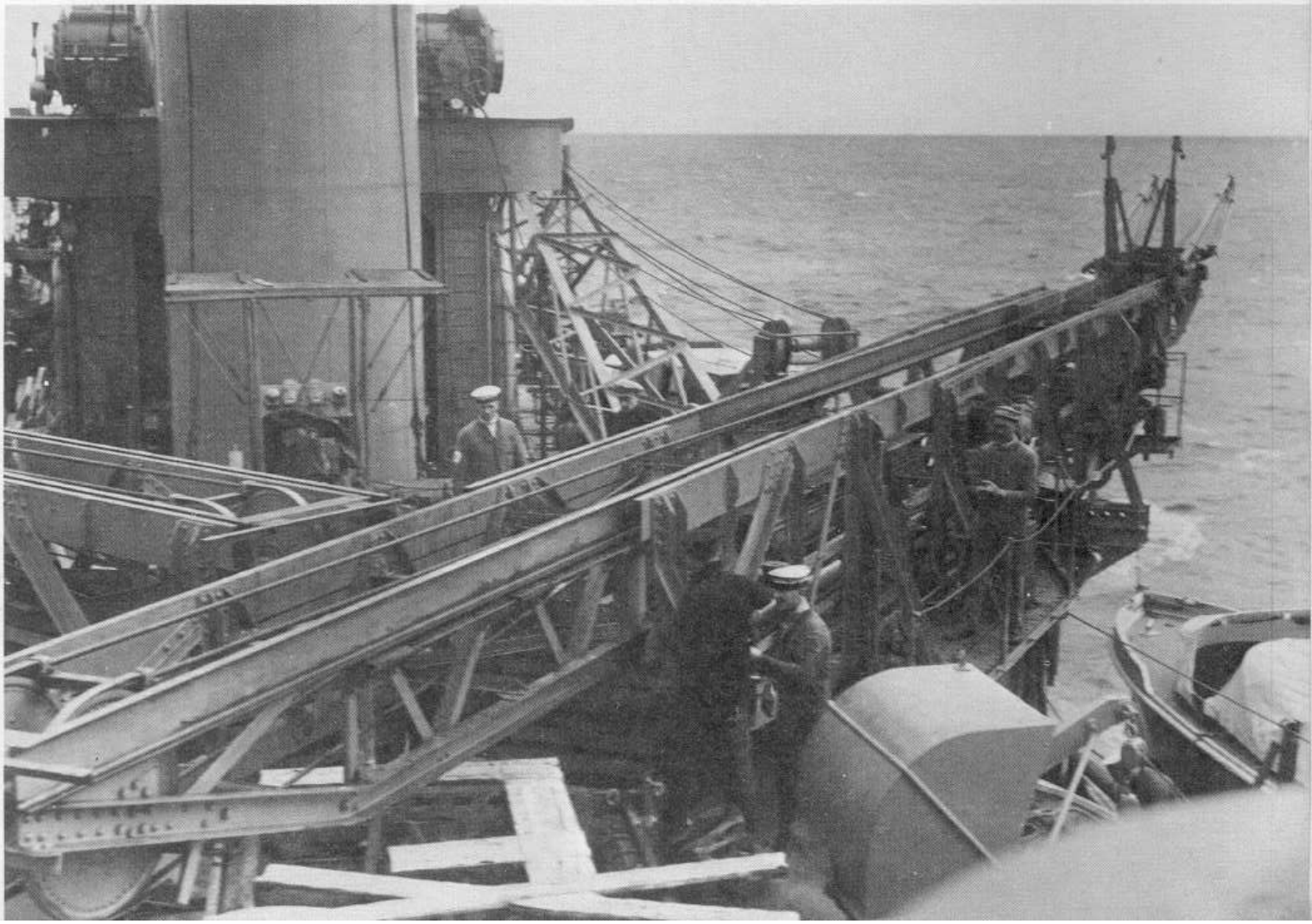


Opposite: one of *Exeter*'s seaplane on the port catapult pushed to the end of the structure to allow room for the launching of the other machine from the starboard catapult, the extended rear portion of which can be seen at the bottom of the picture. Note the jury struts on the Fairey between floats and wings and between wings, supporting the large flaps, a design feature of Fairey aircraft of this period. *Flight International 11638*
Below: an uncluttered view of *Exeter*'s starboard catapult after launch of seaplane; note the trolley at the end of the runway. The man in dark clothing is one of the RAF crew carried on all RN ships which had aircraft on board.
Flight International 11639

attached to the roof of 'X' turret whilst the other two ships mounted them on their quarterdecks.

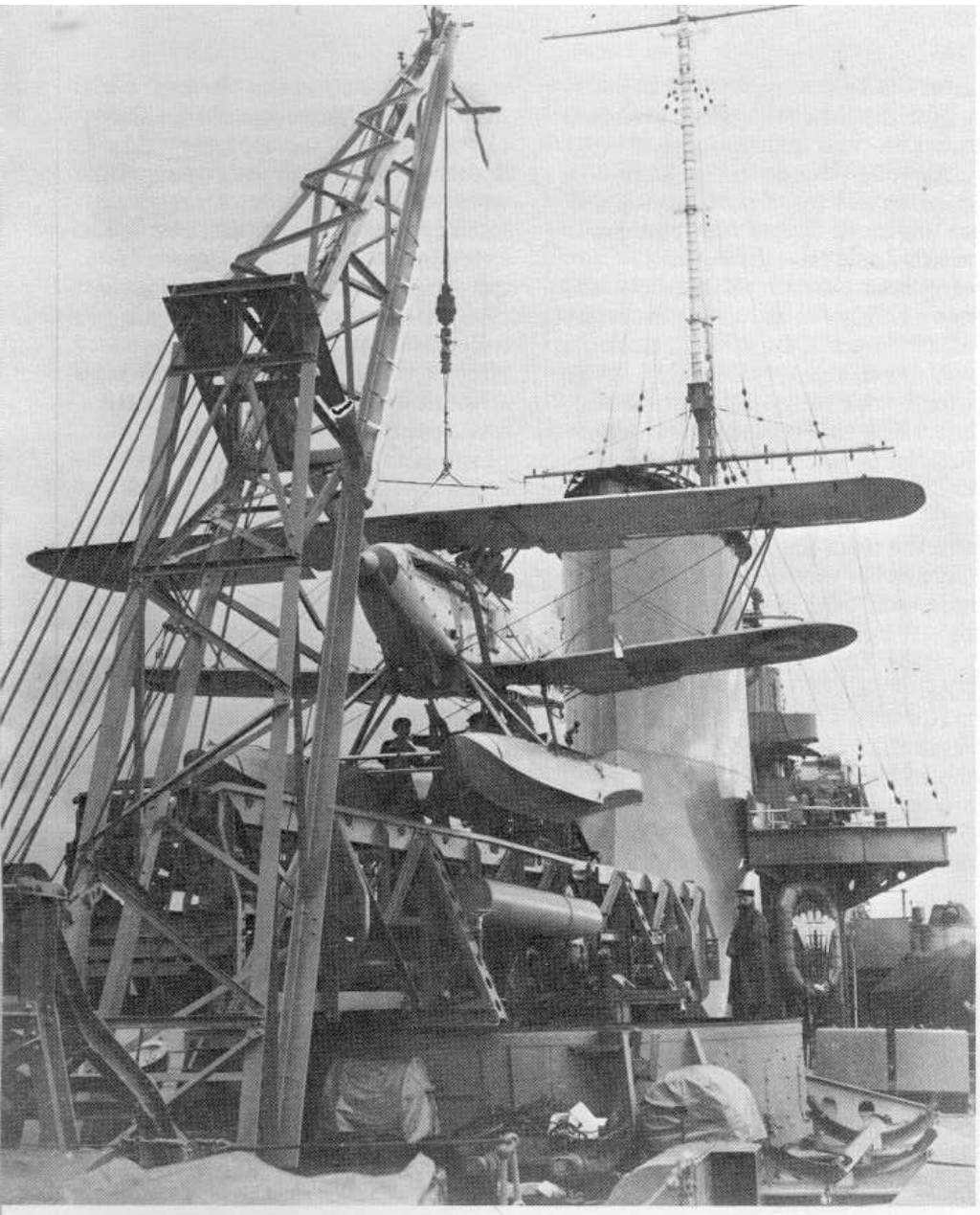
Although these structures gave good service for a number of years an improved design was required which could launch heavier aeroplanes and which could be made more handy for mounting on cruisers where turret and quarterdeck fitting was out of the question. One design which came into limited use in the late 1920s was a model built by Ransomes and Rapier Ltd and known as the 'slider' type. It was particularly compact when stowed, and the main feature was that the large upper section slid aft over the base whilst the launching carriage shot forward. One of these was fitted to HMS *York*, replacing the earlier RAE type.

The Royal Navy continued to fit catapults to its larger ships, and by the end of 1936 29 capital ships and cruisers carried catapults, many being fitted to the older vessels during refit. By far the most common type was that known as the 'Forbes' produced by Mactaggart Scott and Co, Station Ironworks, Loanhead, Scotland. All of this firm's catapults were based on the same principle: a main central structure and two extending portions. The centre of the structure was mounted on a pivot fixed to the deck and, at the ends, rollers were fitted which ran on a circular track. Special 'grippers' screwed up by hand-wheels securely locked the catapult in any desired position and prevented it swinging in a seaway. The two extending portions were half the length of the central section and when the catapult was stowed they retracted into this. In later catapults the two extending parts were of unequal length, the fore section being longer than the aft. The trolley which carried the aeroplane ran on rails on the top of the main upper girders of the three sections. Mounted on the trolley was a superstructure which carried the aeroplane. The superstructure consisted of two pairs of legs



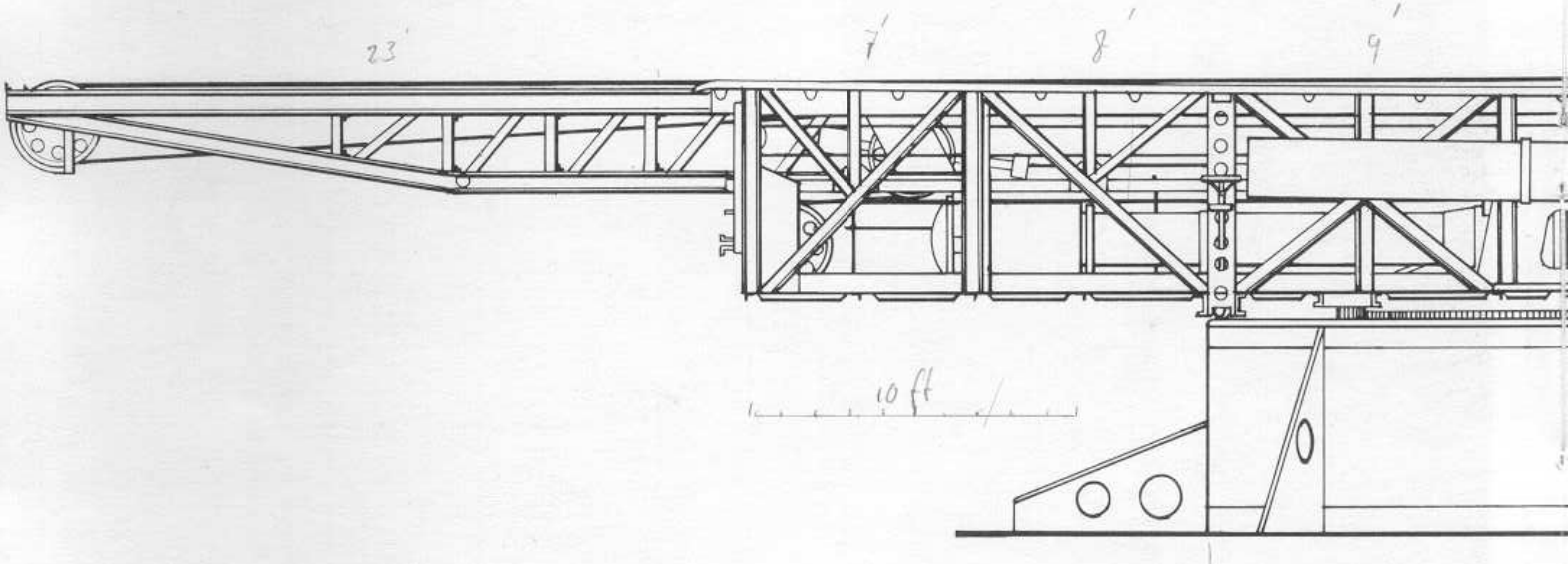
mounted on cross-shafts: the front pair of legs were provided with jaws at the top and separate oleo struts were carried from the jaws to the rear cross-shaft of the trolley; the rear legs supported the aeroplane and were shorter than the front pair. The jaws in each case held the aeroplane by means of lugs which were built into the airframe at the appropriate points.

The actuating system consisted of a power cylinder in which worked a piston and a ram. By means of a system of pulleys mounted on roller bearings the ram was connected to the trolley by cables so that a four-to-one multiplication of the ram speed was obtained, ie the travel and speed of the trolley were four times the stroke and speed of the ram. The damping system consisted of a space in front of the piston; at



Left: Hawker Osprey Mk I being mounted on trolley on board *Leander* anchored in the Forth in 1934. This is a good picture of the crane (note padded fore section to prevent damage to seaplane whilst manoeuvring). Large tank on right of structure is the receiver for the damping fluid of water and glycerine.
Flight International 10872S

Below: full side view of catapult with Walrus on cradle. Compare side view of trolley with that shown in three-view. The latter shows standard form of trolley up to time Walrus appeared. An extra pair of supporting legs were fitted as shown here from central cross-shaft to upper joint of rear member.



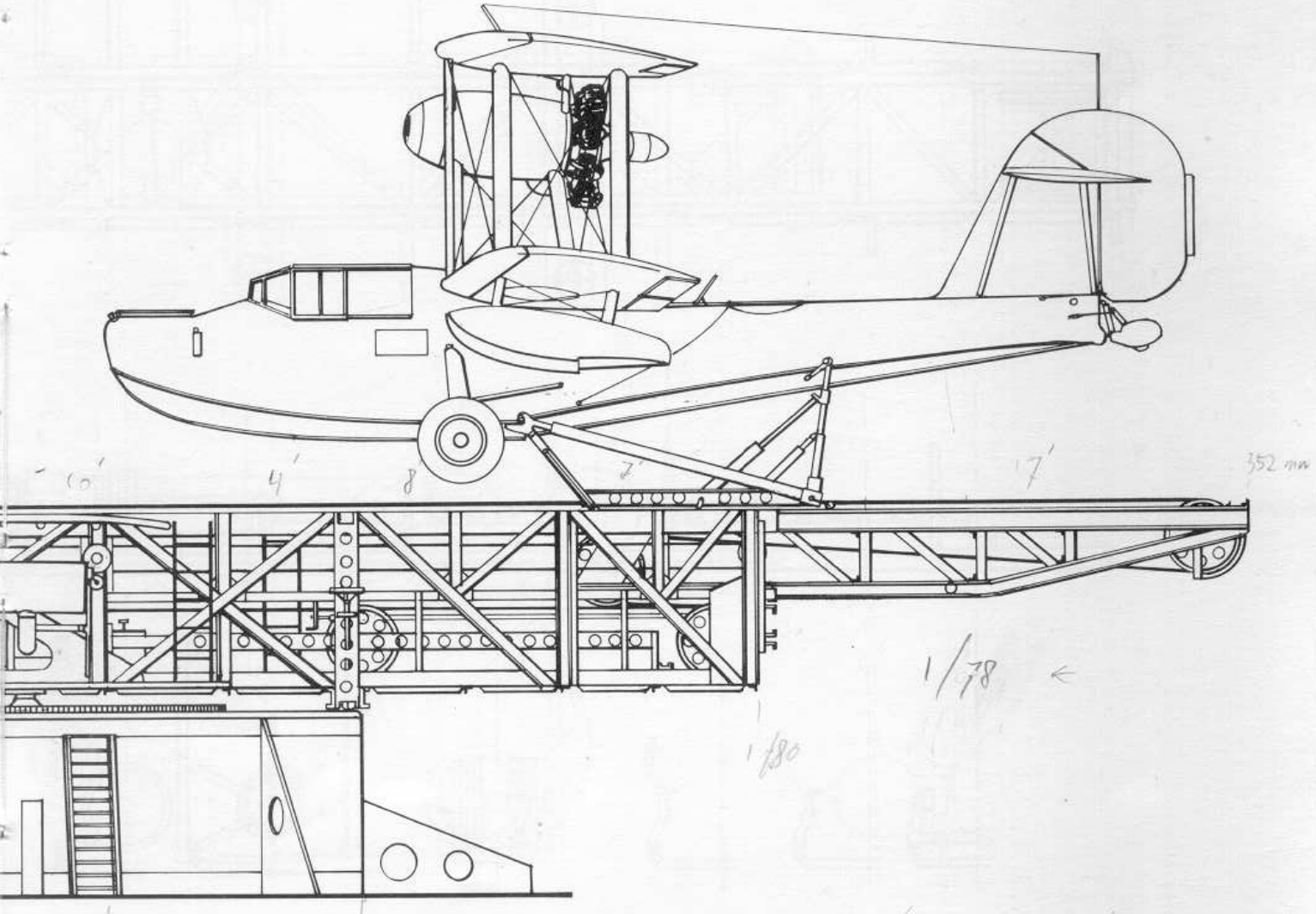
the end of the accelerating stroke caused by the explosion of cordite in the rear chamber a quantity of fluid (mixture of half water and half glycerine) was compressed into the space and retarded the ram. The fluid passed into a special elongated tank fitted to the side of the catapult.

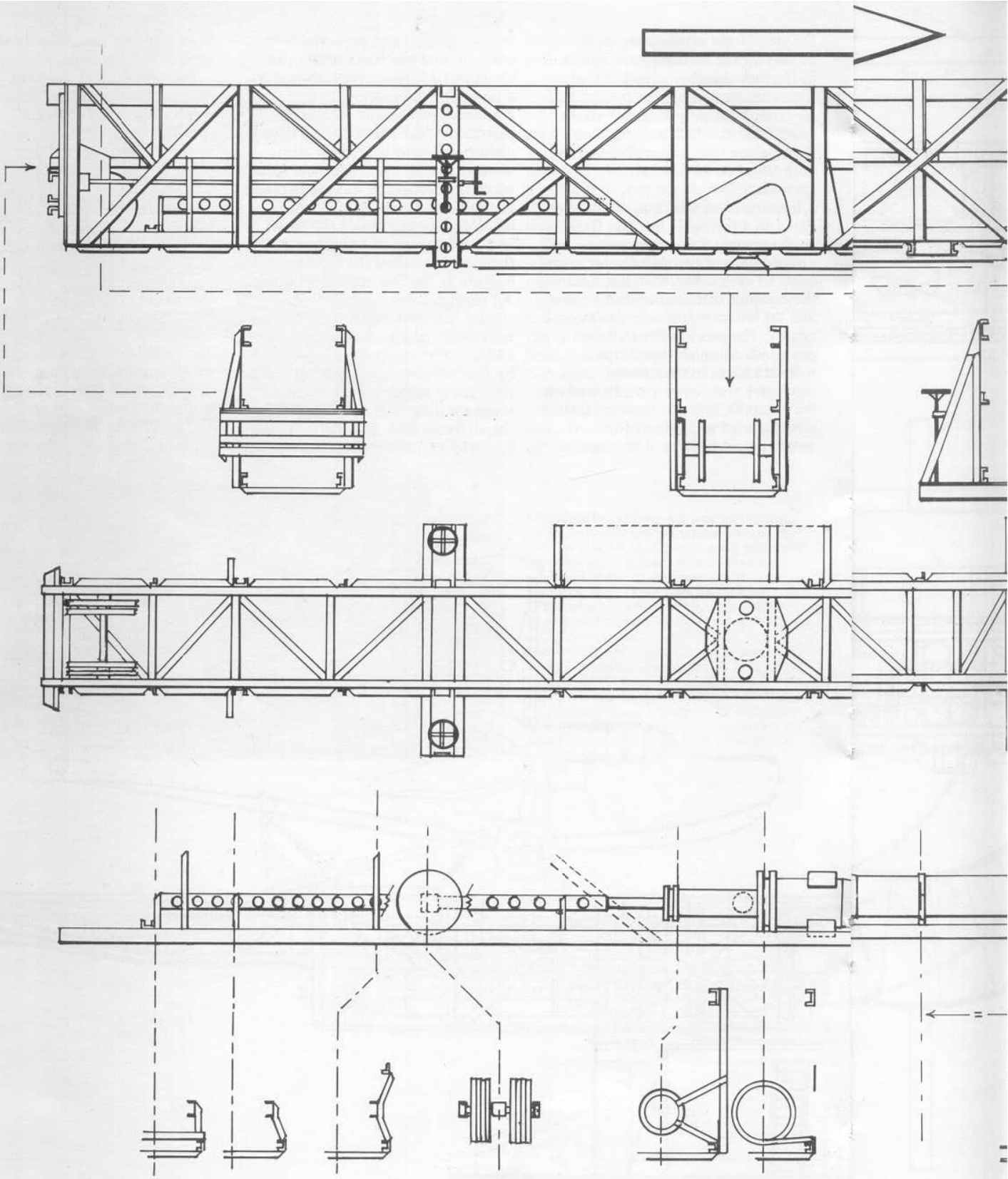
In some cases the catapult was not fitted to a turntable but was fixed, a good example being the two catapults fitted to HMS *Exeter* at an angle to each other. Installed near the catapult was the necessary crane, and the aviation fuel was also stowed nearby. Hangars could not be provided, although later ships included these in their design. As a result the aeroplanes were stowed on the catapult, open to the elements, nose forward and tail aft for aerodynamic reasons. The engine or engine cowling and propeller were covered, and machines with open cockpits had these areas covered by a tarpaulin. To support the comparatively fragile machines against the hazards of their exposed positions a number of jury struts were attached, these being removed when the aeroplane was made ready for launching. The struts were usually placed between the floats and lower wings, the ailerons and flaps, and between the fuselage bottom at the rear, to the tailplane. All moving sections such as the rudder, ailerons, flaps and elevators were held rigid by clamps, and in addition the aeroplane was secured by the 'holding down gear', literally that, for it consisted of a series of ropes running from certain points on the airframe such as wingtips and the half way points, fuselage bottom, float tops and occasionally the nose, to rings on the deck.

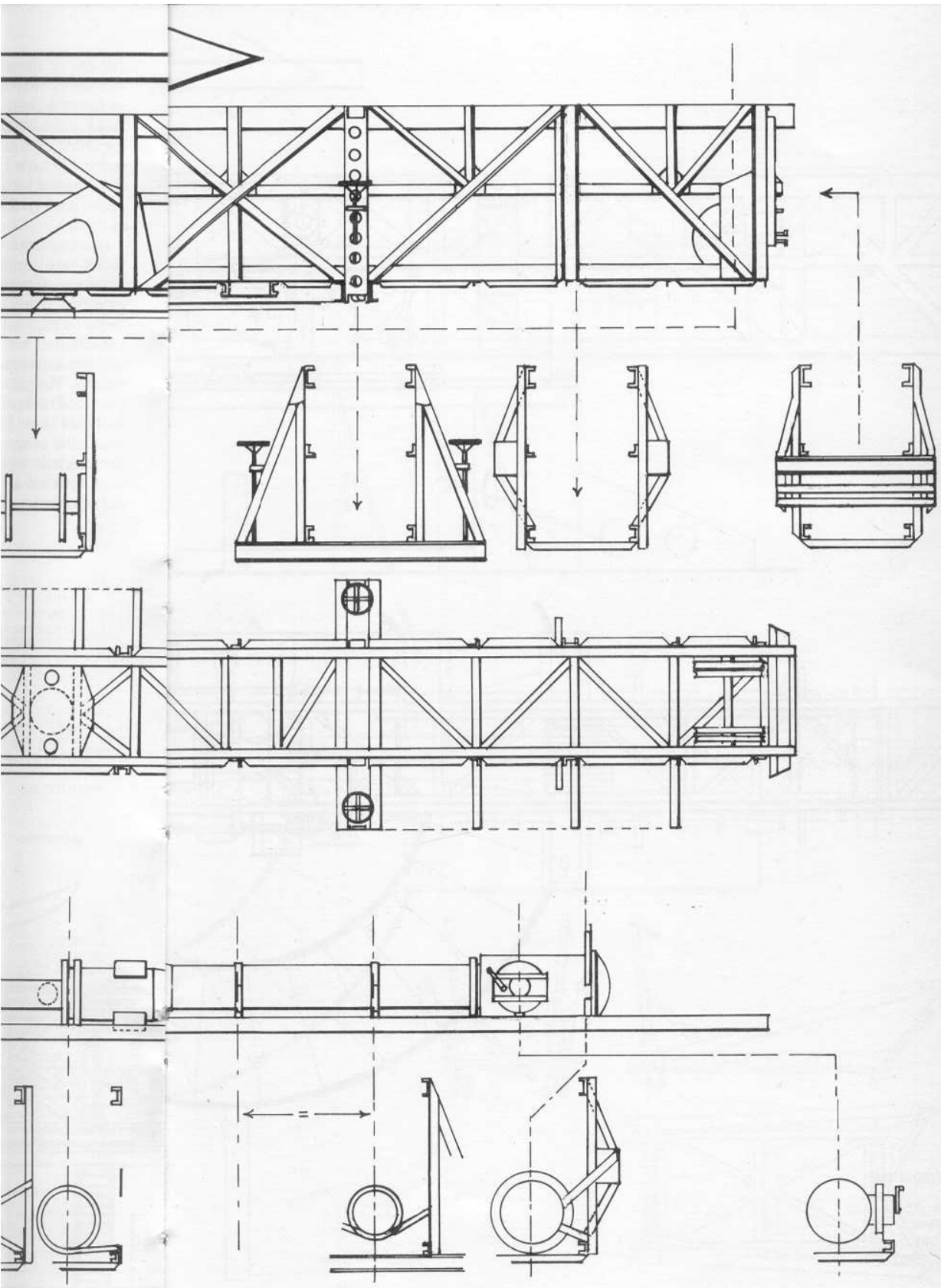
The original and the basic production Mactaggart Scott catapult was built to the following specifications:

	early	later
Length (stowed):	46ft	53ft
Length (extended):	75ft 9in	90ft
Total weight:	19 tons	
Accelerating travel of trolley:	50ft 6in	
Retarding travel of trolley:	13ft 6in	
Mean acceleration for 57mph launch:	2.16 gravities	
Max weight of aeroplane for 57mph launch:	8001b	

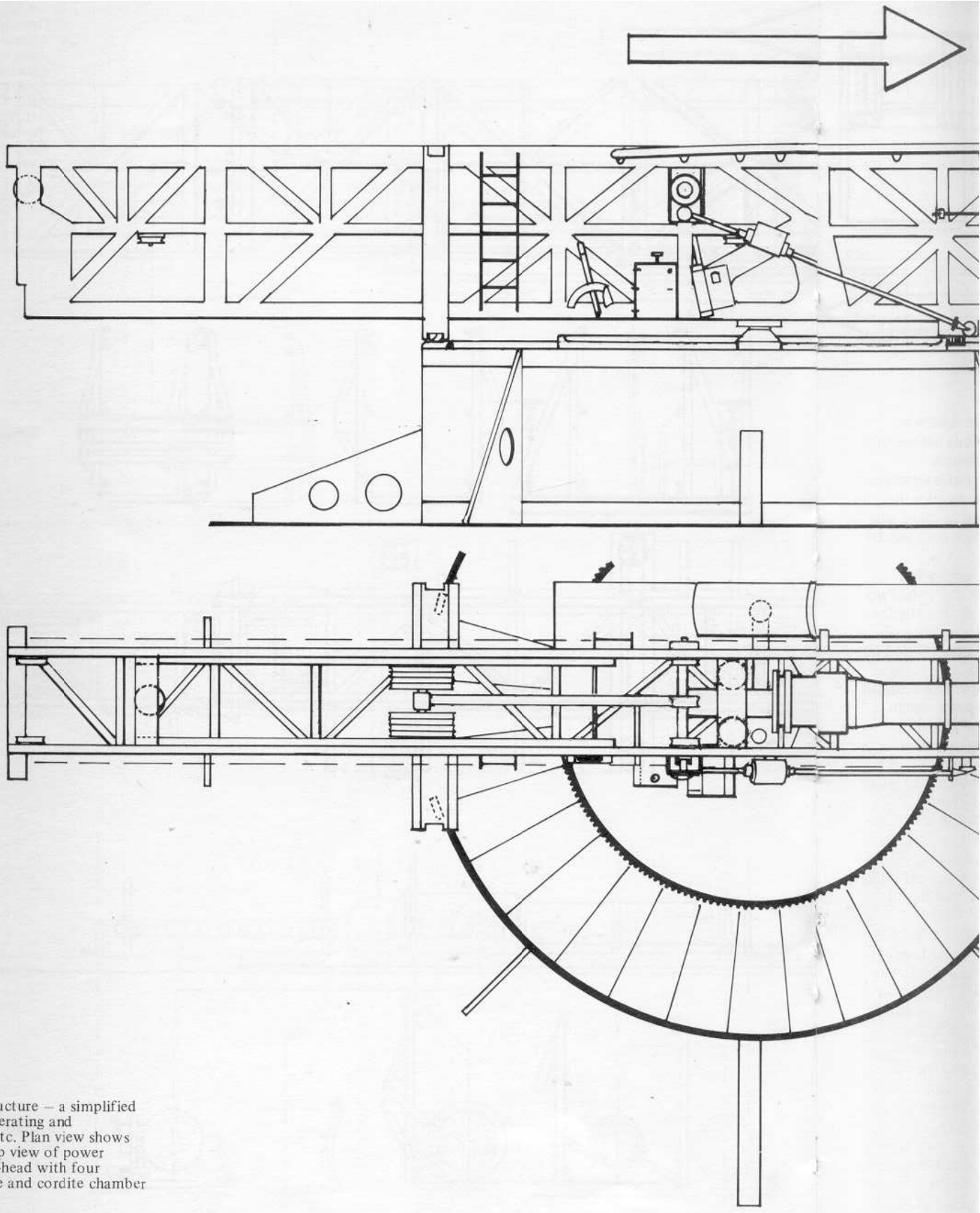
The original specification also mentioned that the firm could supply a fixed-type catapult in which the trolley rails were installed on the deck of a ship with the actuating mechanism housed below



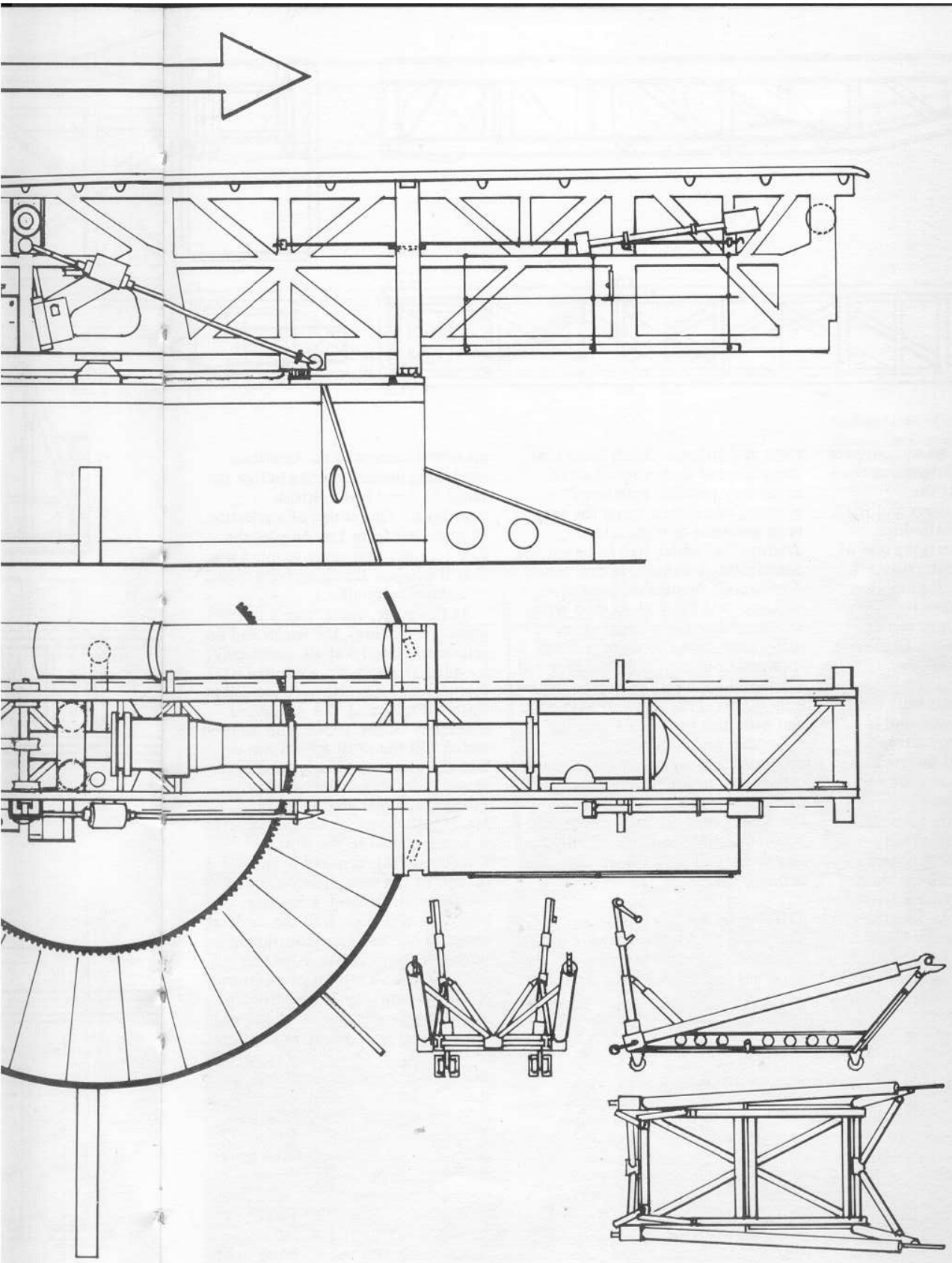


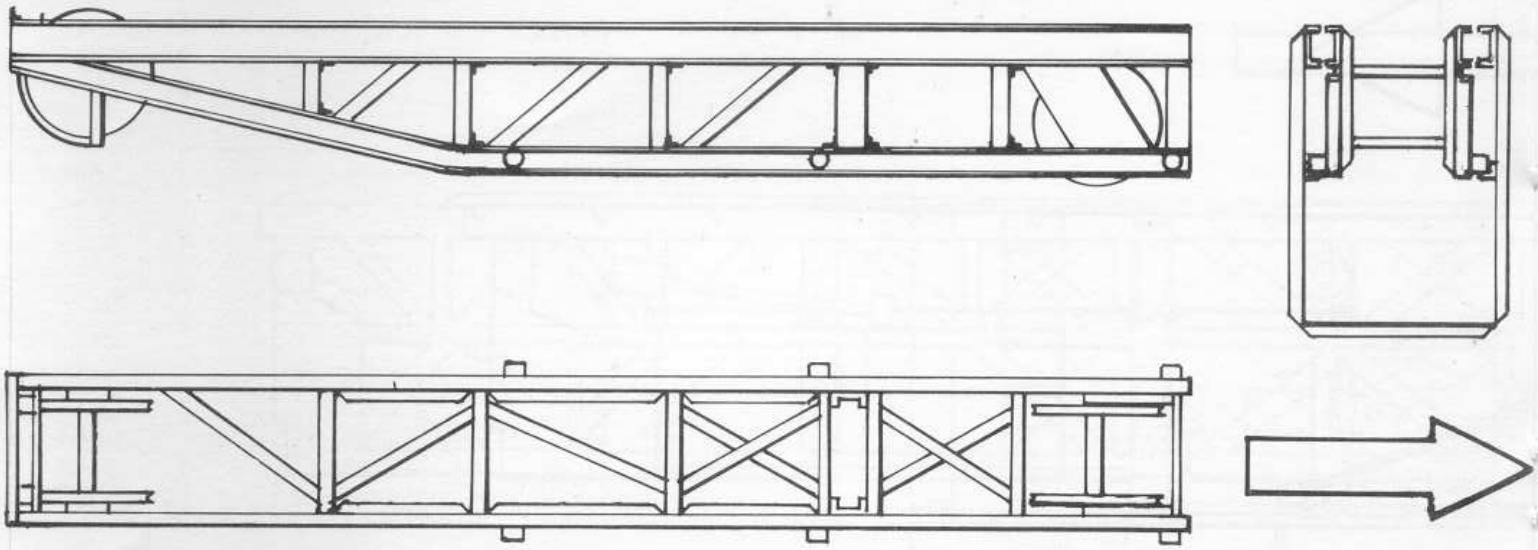


General arrangement of central structure showing cross sections. Lower drawing shows form and position of power cylinder with ram-head runway at left. The large arrow on this and other drawings indicates direction of launch.



View of central structure – a simplified view to indicate operating and manoeuvring gear etc. Plan view shows part of base and top view of power cylinder. Note ram-head with four pulleys on each side and cordite chamber at right.





deck. In fact, this design was adopted later for ships being designed or due for major refits such as the *Southampton* class cruisers and the *King George V* class battleships.

Ships identified as carrying one of the Mactaggart Scott catapults include the following: *Rodney* (on top of 'C' turret), *Valiant* (on quarterdeck), and *County* class, *Arethusa* class, *Dido* class, *Leander* class and *Hawkins* class cruisers. Some of these ships had the largest version fitted, which was 90ft fully extended and 53ft stowed and is depicted in the drawing. Aircraft carried on this catapult during the period 1930–43 were as shown in the accompanying table.

The catapults began to be phased out by 1942–43 and eventually removed, all catapult flights being disembarked in March 1944. New techniques including radar were becoming more efficient, and the advent of the escort carrier and later the helicopter removed the need for aircraft to be carried on board capital ships and cruisers. Apart from that, catapults and their aircraft were never very popular with ships' officers, one reason being the very large amounts of high-octane aviation fuel which had to be carried, constituting a dangerous fire hazard. The aircraft themselves were always exposed, and even when they were accommodated in a hangar they easily succumbed to damage from splinters or blast. To the naval purist, a catapult stuck in the middle of the holy quarterdeck with its ugly crane and offensive fuel tank could not have been too popular.

Catapults in another form of course came back, in the first instance with the CAM ships which hurled Hurricanes into the air from rocket-powered cradles and, later, with the steam catapult used on aircraft carriers.

THE MODEL

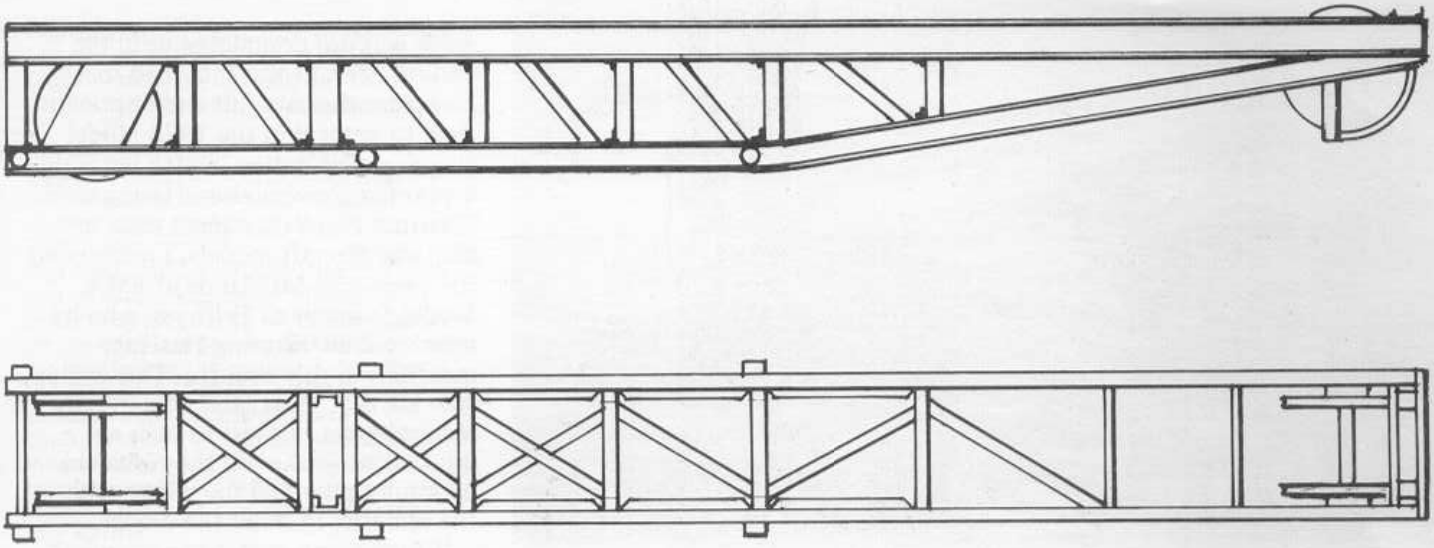
The writer first became aware of the remarkable modelling medium Plastruct in 1969 when he first saw an advertisement in an American modelling magazine, long before the range of items had a British distributor. On receipt of a selection of materials from Los Angeles the first thought that came to mind was that it was just the thing for a model of a ships' catapult.

At this stage, apart from a few magazine cuttings, the writer had no reference material at all. Eventually, by diligent searching, a number of features on catapults were located in various *Flight* and *The Aeroplane* magazines of the 1930s. The catapult which had the most appeal was in fact the most commonly used in Royal Navy vessels and was the Forbes type manufactured by Mactaggart Scott; an optimistic letter was despatched to the firm in Loanhead. This resulted in the receipt of the only drawing still in existence at the firm, a fading blueprint which showed the cardinal dimensions, shape and location of the main components. With this drawing came a reprint of a feature in the 25 February 1931 edition of *The Aeroplane* magazine which was more or less a technical description of the catapult apparently reprinted from the firm's own specification sheet.

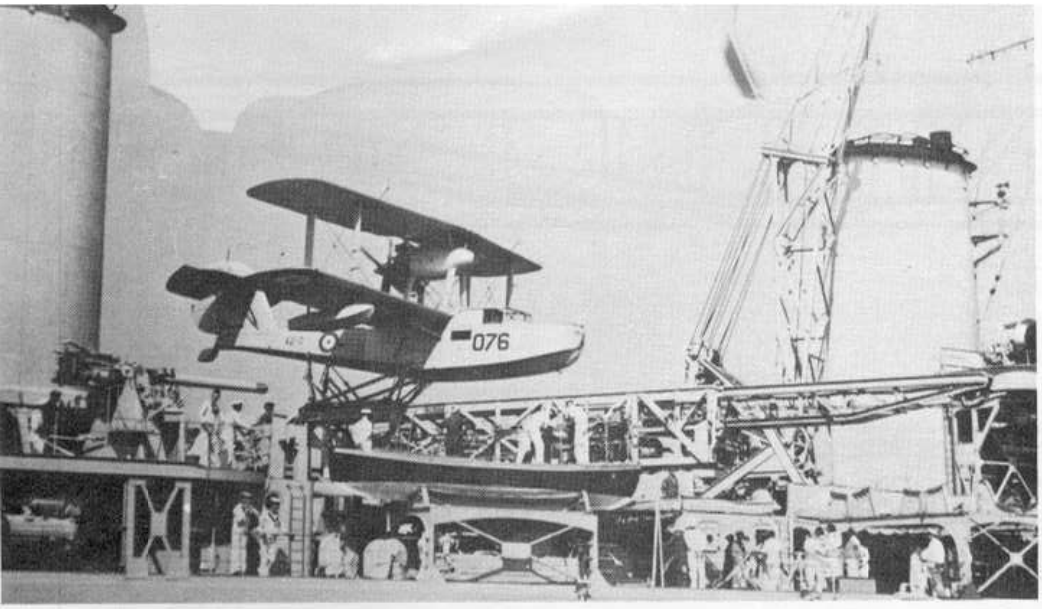
So far so good. However, it was intended to build a model of a catapult as an impressive base for a model of a Hawker Osprey, an attractive and commonly used fleet version of the RAF's Hart bomber. The scale was to be 1/48, so a considerable amount of detail had to

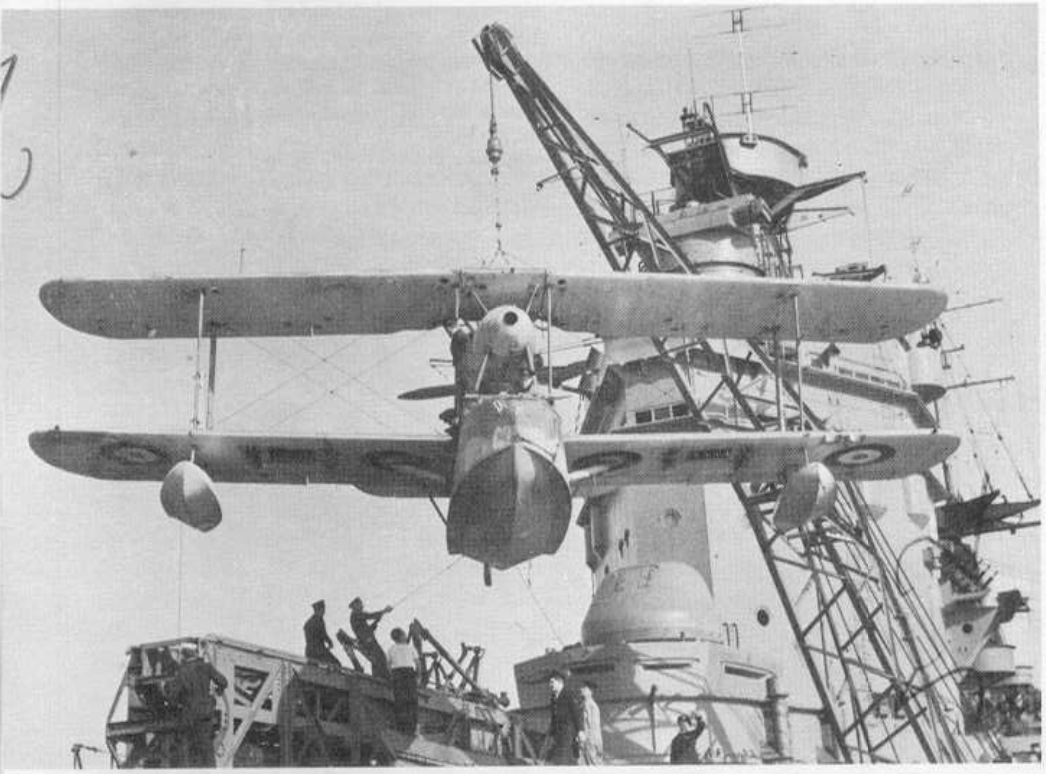
AIRCRAFT CARRIED ON MACTAGGART SCOTT CATAPULTS 1930–43

Approx period	Aircraft	On board
1930–34	Fairey IIIF floatplane	Battleships and cruisers
1932–38	Hawker Osprey floatplane	Cruisers
	De Havilland Queen Bee pilotless drone	
1938–41	Fairey Swordfish floatplane	Battleships
1937–40	Fairey Seafox floatplane	Light cruisers
1936–43	Supermarine Walrus amphibian	Battleships and cruisers



Above: views of extending sections.
Below: the Osprey photographed just as it is racing down the catapult during launch. Almost the full extended structure is seen here. The Forth Bridge is in the background.
Flight International 10870S





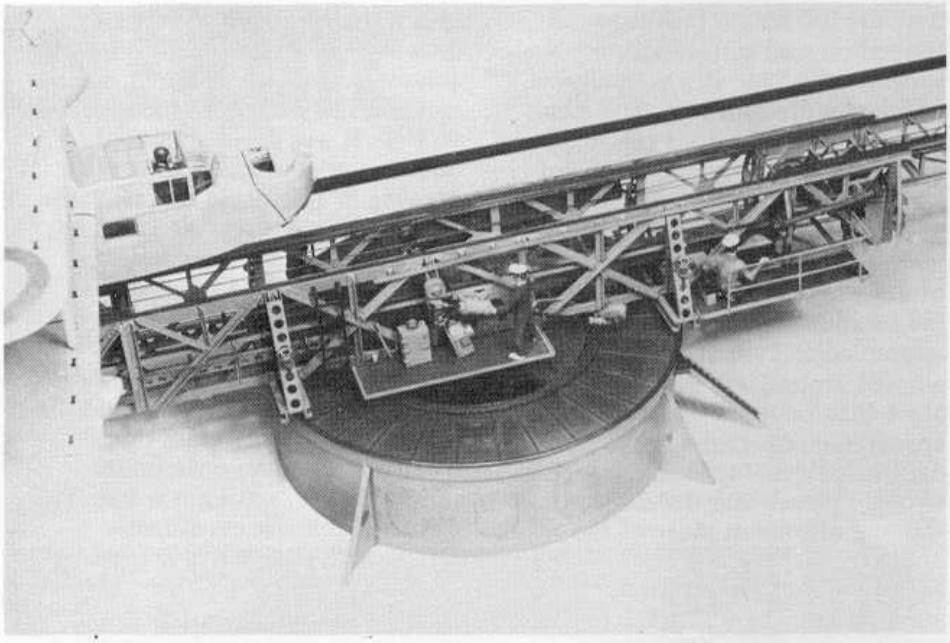
be incorporated in the model. Photographs were needed, and over a period of three years a search was made in the photo archives of *Flight International* and the Imperial War Museum. Other photos were obtained from the National Maritime Museum and some private sources, so that a collection of about 30 excellent prints was accumulated, together with a number of cuttings from magazines. Whilst a great deal of external detail was identified, the material did not offer enough information to produce a detailed drawing or a clear picture of the internal structure which would have to be reproduced in a model. The project was almost abandoned when, by a stroke of luck and some good advice from a correspondent, two maintenance and handling manuals for the catapult were obtained on loan from a donor who particularly wished to remain anonymous should such a feature as this appear in print. Now, with detailed descriptions and large scale fold-out drawings, more detail was available than was actually wanted for the scale to be used.

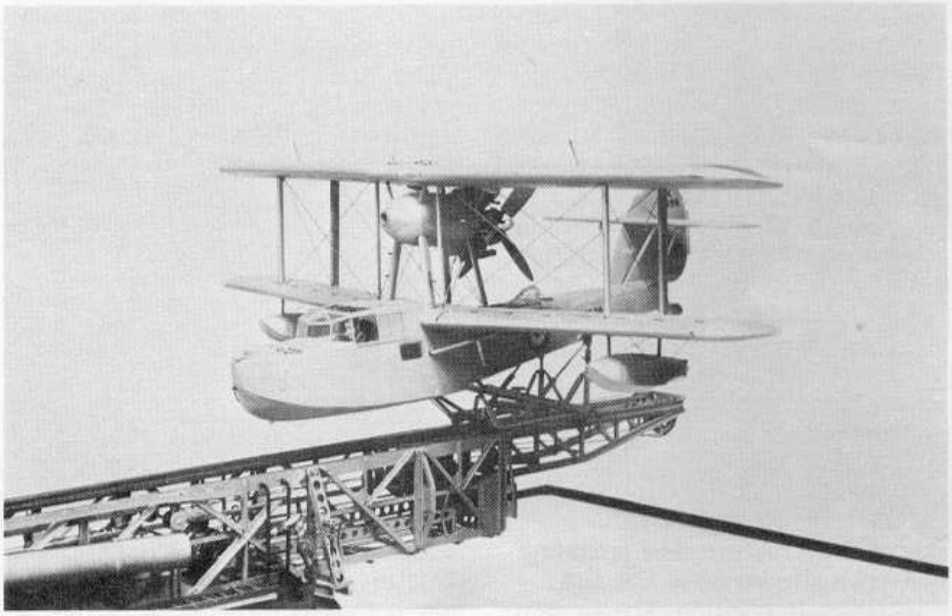
The drawing was started in 1976 but owing to interruptions and other work was not completed until the end of 1977. It was intended to complete the catapult and Osprey in time to enter it in the 1978 Model Engineer Exhibition, which left only a year for construction. Having used Plastruct items on a small scale in ship and aircraft models, I mentioned the project to Mr Hands of EMA Model Supplies of Feltham, who by now were distributing Plastruct materials in this country. This was at the MEE of 1977, and he naturally showed great interest in such an unusual project, with the result that he kindly provided the writer with the material to build the model.

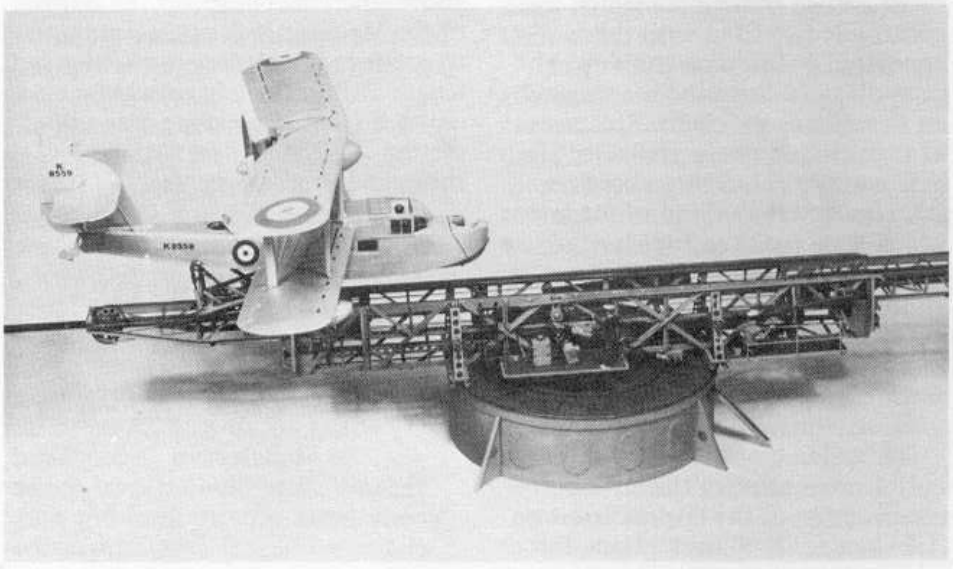
It took seven months to complete the catapult model, and there were some problems to overcome. One snag was that the grade of Plastruct channel strip suitable for the main longitudinal members of the tops of both central and extending structures was far too thick at the edge. This was overcome by joining two lengths of 'L' strip which made a channel with a far finer edge. Rivets, a distinctive characteristic of the structure, were formed by chopping pieces from a length of plastic rod, each one being fixed individually in place with a dab of cement. The 'rivet' was then smoothed out by applying a good drop of varnish which dried over the item giving it a rounded, domed appearance and the effect was completed by the paint overlay.

The original catapult was operated by a ram-head with a number of pulleys; pulleys were also present on the central structure and the sliding portions and four sheaves. The cable that connected all these items was in two parts in the original, each one starting at the front of the trolley, winding its way around all the pulleys, and eventually joining on to the rear of the trolley. In the model one long length was used – a length of rigging cord of over 18ft. To make it look like well-greased wire rope the cord was fixed to two points and the whole length smeared liberally with a mixture of silver, dark grey and a touch of yellow enamel. Whilst this was still wet, glossy varnish was also applied and the 'cable' allowed to dry. It still did not look greasy enough so, whilst it was still stretched, pencil carbon was applied

Opposite top: Supermarine Seagull V on catapult of HMRANS *Perth* in 1936. The Seagull eventually became the Walrus in the RN but retained its original name in the RAN.
Author's Collection
Opposite bottom: Walrus being lowered on to catapult fitted to 'C' turret of *Rodney* some time in 1940.
IWM A100
Top right: picture of operating platform side of author's model of Mactaggart Scott catapult in 1/48 scale. The seaman on the right is preparing the cordite charge for insertion in the explosion chamber at the extreme end of the cylinder. The seaman on the middle platform is confronted by the training, extending and manoeuvring gears. Note long shaft of training gear motor with worm gear engaging teeth on circular track below.
Ray Rimell
Centre: author's model Walrus almost at end of the extending part of catapult. In actuality, the engine would be running at this stage which is just prior to the launch. Note large receiver tank with seaman keeping an eye on pressure gauge.
Ray Rimell
Bottom: view of rear of catapult model. The black markings on the wings of the Walrus are areas which have been strengthened to allow men to walk over them, necessary when handling the amphibian in and out of the water. The black dots are actually shaped like footprints to emphasize the reinforced parts as the remainder of the wing was fabric covered. This model represents an early Supermarine built machine with metal hull; later models built by Saunders Roe had wooden hulls.
Ray Rimell







over the full length (a soft pencil rubbed on medium glasspaper provides this) and it was finally polished with a soft rag. The result was excellent: the cord still had some degree of flexibility and the paint was sealed off with the carbon. Threading this long cable through the model was the most tiring part of the whole building operation as the catapult had been fully assembled and the cable had to be worked around and in the structure. More than once the work had appeared completed when it was discovered that the lacing had been wrongly placed and the cable kept slipping off one or more of the pulleys. Finally it was completed; each time that the cable passed over a pulley a dab of matt (and hence invisible) varnish was applied to keep it in place. Of course, this meant that it was necessary to wait each time for the varnish to dry and hold the cable before passing to the next. It took a whole day and the language was truly nautical! There were 24 pulley wheels and 4 sheaves to accommodate before the cable at last was joined to the rear of the trolley.

Although this pattern catapult retained the same shape and structure there were many variations between ships, most of a minor nature. For example, on some of the earlier catapults the pulley wheels were unperforated, and sometimes odd items such as spare float racks for the seaplane were fixed to the side of the structure. The operating platforms also varied in size and, sometimes, in position. The greatest variation was in the base which was constructed to fit in with the appointed position on the ship. The catapult modelled used the original on *Leander* as the clearest pictures of that catapult were available. The base was typical of those used on this class of cruiser, and of those which were fitted to the quarterdecks of the battleships, although not so high. It was also noted whilst studying photographs that the crane which always accompanied the catapult appeared to be a standard model.

The building of the catapult left only five months for the construction of the Osprey to sit on it. In view of the limited time, this idea was abandoned as a set of drawings would have had to be completed for this machine, which would also have had to be built from scratch. It was decided instead to build a model of the Walrus as a drawing in 1/48 scale was available, an old plastic kit was also in hand, and the writer had a great deal of detailed information on this amphibian.

The decision proved to be a mistake, for on examination the plans revealed many errors, and the kit, an old Merit product since reissued more than once under various names, was even worse. The Walrus which was eventually completed had a new tail assembly, revised and remodelled wings, new engine and cockpit enclosure and a completely reworked hull shape. In the end it probably would have been quicker to build the Osprey!

The catapult, complete with Walrus, was completed about one month before the MEE started, involving far too much rush – never to be repeated. It was eventually awarded the Championship Cup for its class.

THE DRAWINGS

The original drawings were in pencil only for working purposes, in 1/48 scale and rather more extensive than those shown here. The main structural drawings have been traced for reproduction in a scale suitable for this journal so as to give the ship modeller an idea of the basic structure, how it was built up and how it appeared. As mentioned above, the drawing shows the largest of the Mactaggart Scott catapults; to produce the smaller one (extended length 75ft 9in) a bay should be omitted from the leading extending section and the central structure shortened accordingly.

Another voy

by Peter

Early in 1973, inspired by Björn Landström's wonderful drawings and painting in his *Ships of the Pharaohs* (Allen & Unwin, 1970), I started to make a 1/48 scale model of one of the ocean-going traders sent from Egypt to Punt by Queen Hatshepsut in about 1480 BC. At a fairly late stage in the construction of the hull, I found that it was going wrong (can I be the only modeller who *never* gets things correct at the first attempt?), so I put the job aside for the time being while I went ahead with another project.

Then at the 1973 ME Exhibition I saw Fenton F Robb's cool and nicely built version of the same ship, which not only won the H V Evans Trophy but has also found a home in the Science Museum. I decided that I had been 'gazumped' by a richer talent than my own, and forgot the whole thing.

However, in 1979 I thought I would have another stab at it. I had no desire to rival or to imitate the Robb model. Instead of building in the classical style, I decided to adopt the more romantic pictorial approach and to try to portray the ship as she might actually have looked as she set sail home from Punt with her exotic cargo.

Fenton Robb wrote a very useful and informative article (*Model Shipwright* No 10) on his ship in which he reproduced the Landström plans and I found his rigging and detail sketches particularly useful. My only justification for writing about mine is that it may be of interest to readers to show how

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