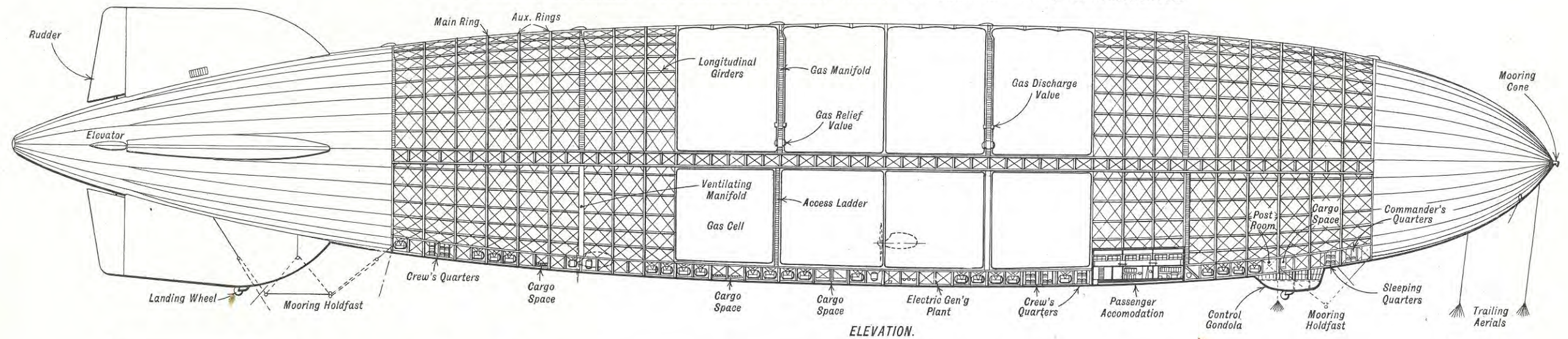
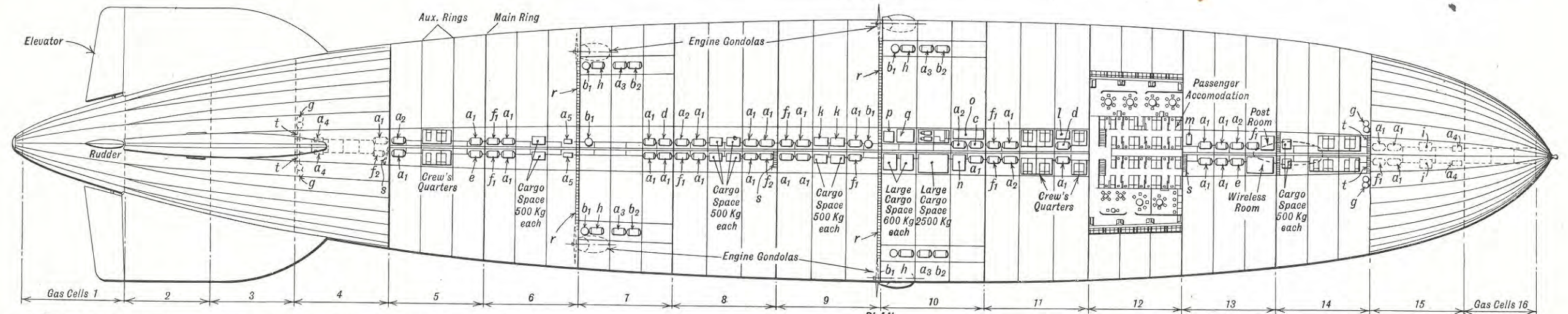


THE ZEPPELIN AIRSHIP "HINDENBURG"

DR. H. ECKENER, DESIGNER: LUFTSCHIFF ZEPPELIN G.M.B.H. FRIEDRICHSHAFEN, CONSTRUCTORS

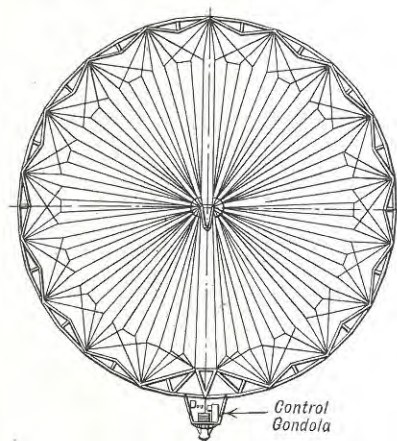


ELEVATION.

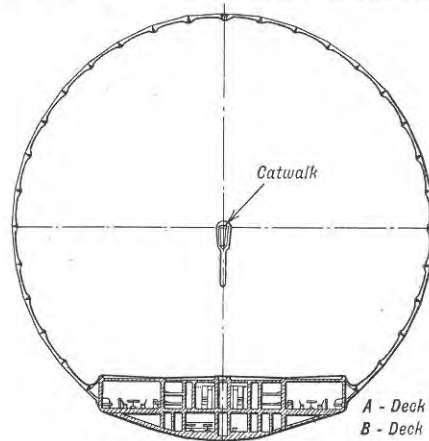


PLAN.

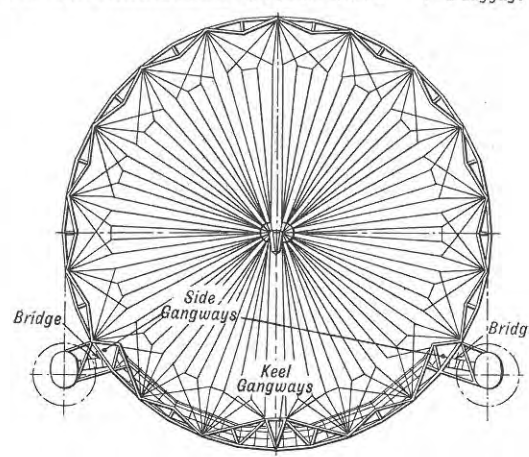
- a_1 -28 Fuel Oil Tanks, Each 2,500 L a_4 -4 Fuel Oil Tanks, Each 1,250 L b_2 -4 Lub. Oil Tanks, Each 380 L e -2 Dirty Water Tanks, Each 2,500 L g -4 Double Ballast Bags, 2 x 500 L k -2 Spare Part Rooms, Each 500 Kg n Engineer's Rm o - Ventilating Fan. r - Gangways to Engines.
 a_2 -4 Fuel Oil Valve Chests, Each 2,500 L a_5 -2 Fuel Oil Tanks, Each 850 L c -1 Drinking Water Tank, 2500 L f_1 -9 Tanks for Recovered Ballast Water, Each 2,500 L h -4 Cooling Water Tanks, Each 400 L l -1 Provision Store, 500 Kg p - Lavatories.
 a_3 -4 Fuel Oil Service Tanks, Each 800 L b_1 -6 Lub. Oil Tanks, Each 500 L d -2 Fresh Water Tanks, Each 2,500 L f_2 -2 Tanks for Recovered Ballast Water, Each 2,000 L i -2 Luggage Comp't, Each 500 Kg m -1 Provision Store, 250 Kg q - Workshop.
 s -3 Gangways to Access Ladders.
 t -4 Gangways to Ballast Bags.



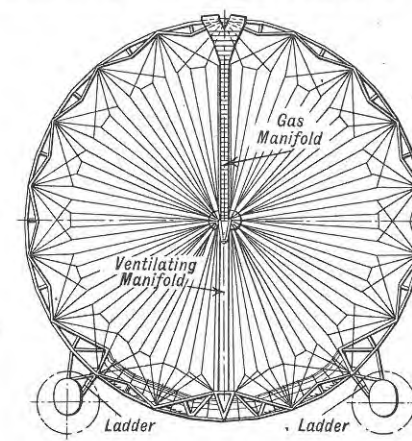
SECTION AT CONTROL GONDOLA.
"THE ENGINEER"



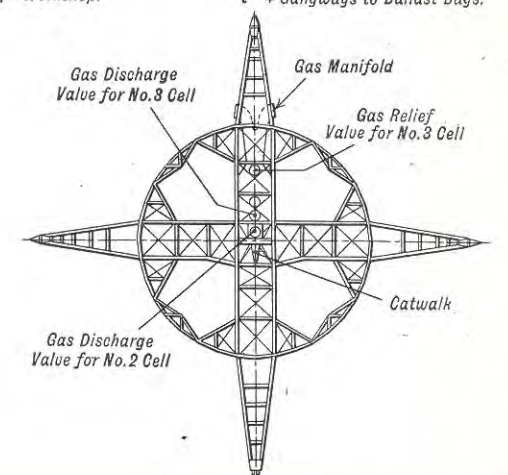
SECTION AT PASSENGER ACCOMMODATION.



SECTION AT THE FORWARD ENGINE GONDOLAS.



SECTION AT THE REAR ENGINE GONDOLAS.



SECTION AT RUDDER FINS.

The Zeppelin Airship "Hindenburg."

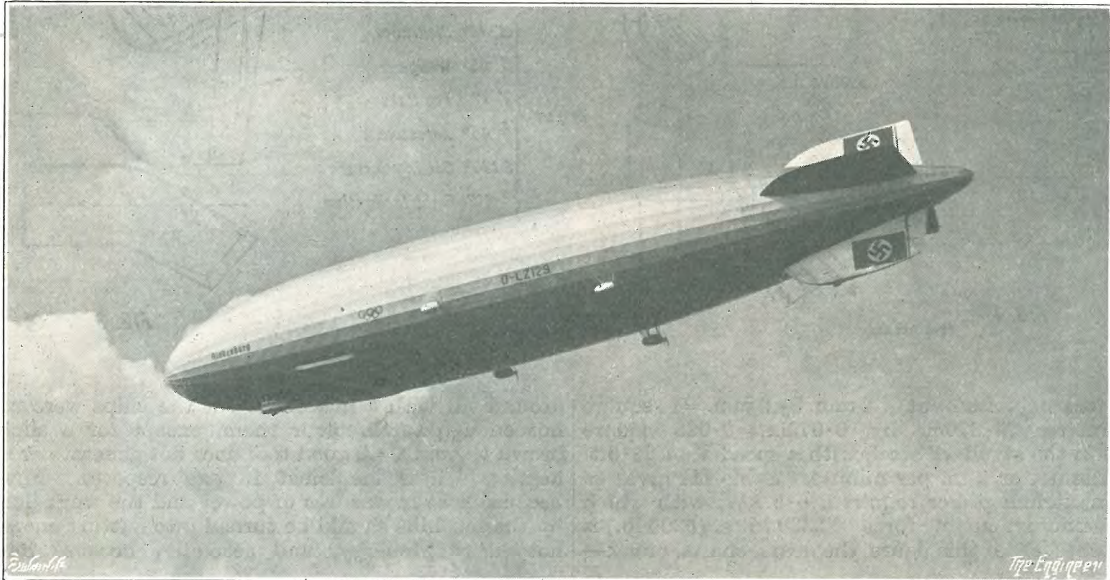
No. I.

IN our Seven-Day Journal we record with deep regret the loss by fire at Lakehurst, New Jersey, of the Zeppelin airship "Hindenburg," which occurred as the ship was about to moor on her arrival on Thursday evening, May 6th, after her first North Atlantic crossing of 1937. For the first time use was being made of her new cabins, which increased the number of passengers from about fifty to seventy persons. The loss of this fine example of lighter-than-air construction, at a time when British and American interest was again being aroused in the possibilities of a commercial North Atlantic airship

Fritz Sturm dealt with the engines. The particulars of the Atlantic services were prepared by the Zeppelin Reederei G.m.b.H.

DESIGN OF THE "HINDENBURG."

A few weeks ago, by permission of the German Air Ministry, we were afforded an opportunity of inspecting the "L 130" in her shed at Friedrichshafen, and also paid a visit to the "Hindenburg" at the Frankfurt-on-Main airport, just before she made her first trip this year to South America. We were greatly impressed by the thorough way in which the problems



THE "HINDENBURG" IN FLIGHT

service, and when the postal advantages of a two-day voyage between Frankfurt and New York were being recognised by all, will retard progress, but it will not stop the further perfecting of the design by Dr. Eckener and his trained staff of workers on the building and operation of airships. While the services of the sister ship the "Graf Zeppelin" have been temporarily cancelled, pending the German inquiry into the cause of the accident, it is officially announced that work is to be accelerated on the construction of the new ship, "L 130," similar in design to the "Hindenburg," which is now approaching completion at Friedrichshafen, and will, it is hoped, be ready for service in the early autumn of the present year.

The Zeppelin Company has suffered a particularly severe loss in the death of Captain Ernst August Lehmann, who, next to Dr. Eckener, did so much to

of design have been worked out and embodied in the construction of the new ships, and the way in which the arrangements for the operation and navigation of the ships have been perfected.

The "Hindenburg" was designed by Dr. H. Eckener, who decided on her requirements as regards passenger and cargo-carrying, and settled the question of her propelling machinery, for which for the first time in a Zeppelin Daimler-Benz heavy oil engines were adopted. The building and construction was carried out at the works of the Luftschiff Zeppelin G.m.b.H., at Friedrichshafen, on Lake Constance, under the supervision of Director Dr. L. Dürr and the late Captain E. A. Lehmann, who was her first commander when in the early part of 1936 she entered the service of the Zeppelin Reederei G.m.b.H.

The general particulars of the hull and propelling

Zeppelin construction which have been followed during the last thirty-five years of airship construction by the Zeppelin Company.

In an accompanying engraving we show a typical view of the "Hindenburg" as she appeared when in flight. The longitudinal plan and elevation on the opposite page, together with the accompanying

Hull and Machinery Particulars.

Length overall	245 m., or 804ft.
Largest diameter	41.2 m., or 135ft.
Length to breadth ratio	Approx. 6 to 1
Maximum height over landing wheels	44.7 m., or 146ft.
Maximum width over air screws	46.8 m., or 153ft.
Full gas capacity	200,000 cubic metres, or about 7,060,000 cubic feet
Propelling machinery	Four Daimler-Benz L.O.F.6 type oil engines
Maximum power each engine	1100 to 1200 B.H.P.
Cruising power each engine	800 to 900 B.H.P.
Fuel consumption normal service	0.167 gm., or about 0.373 lb. per B.H.P. hour of gas oil
Speed of engines, maximum	1500 r.p.m.
Speed of engines, service	1350 r.p.m.
Speed reduction to air screws	2 to 1
Diameter of air screws	6 m., or 19ft. 8½in.
Radius of action at 500 m., with fifty passengers at 110 kiloms. per hour	20,000 kiloms., or 12,000 miles
Normal service speed	121 kiloms., or 75 m.p.h.
Maximum speed	139 kiloms., or 86 m.p.h.
Total load carried at normal temperature and pressure	114.6 tons
Number of passengers for long voyages	50 to 70
Number of passengers for short cruises	60 to 70
Places for crew and training staff	56

Analysis of 1936 Services.

Total voyaging time	2810 h. 26 min.
Total length of voyages	308,323 kiloms.
Number of passengers carried	2656
Weight of mail carried in kilos.	8294 kilos.
Weight of cargo carried in kilos.	9047 kilos.
Number of flights to December 7th	56

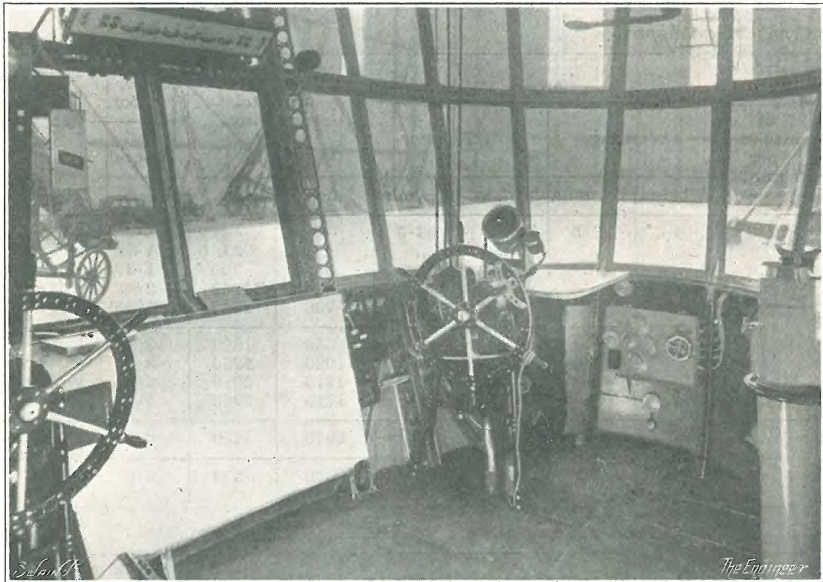
1936 North Atlantic Flights.

Number of round trips	10
Number of single trips	20
Number of passengers carried	1002
Weight of mails carried in kilos.	4458 kilos.
Weight of cargo carried in kilos.	4196 kilos.
Total distance travelled	136,949 kiloms.
Time taken on voyages	1163 h. 42 min.
Number of Atlantic crossings, 1936	20

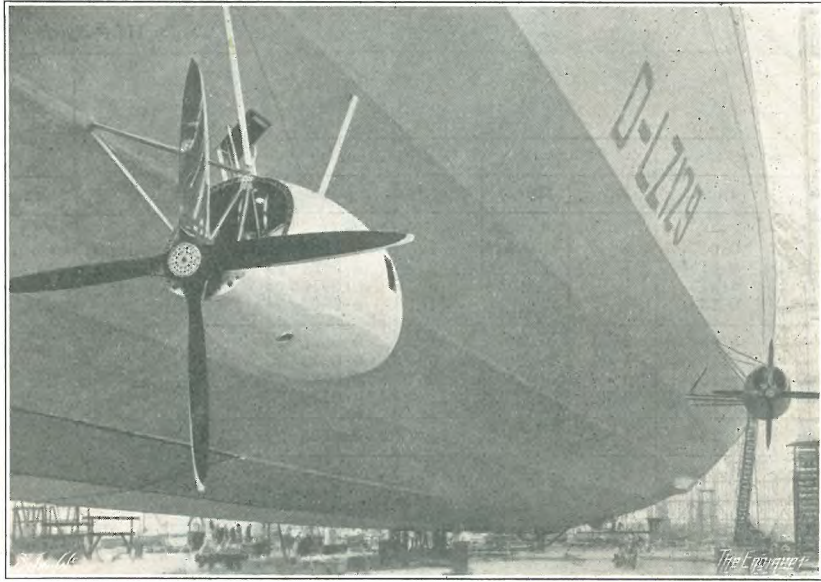
1936 South Atlantic Flights.

Number of round trips	7
Number of single trips	14
Number of passengers carried	559
Weight of mails carried	2906 kilos.
Weight of cargo carried	4851 kilos.
Total distance travelled	148,352 kiloms.
Time taken on voyages	1369 h. 53 min.
Number of Atlantic crossings, 1936	14

cross sections, illustrate clearly the general design of the ship and the method of construction adopted. The arrangement of the passengers' quarters is shown, along with the parts of the ship used by the officers and the crew and the lay-out of the various tanks for fuel and lubricating oil is also marked on the drawings. A view taken at the rear of the ship shows the position of the rear engine gondolas in relation to the skin of the ship, and another view within the navigating or control cabin is also reproduced.



INTERIOR OF CONTROL GONDOLA



ARRANGEMENT OF ENGINE AND GONDOLAS

bring about the very successful North and South American services of last year, an analysis of which accompanies this article.

More than usual technical interest will attach to the forthcoming American and German inquiries into the cause of the disaster, and the means which may ultimately be adopted to remove the remaining fire risks in airships, and we publish this article giving detailed particulars of the design of the ship and of her machinery, so that the findings of the inquiry may be more clearly followed by our readers. We would express our indebtedness to the special V.D.I. "Zeppelin" issue of March 28th, 1936, in which Dipl.-Ing. W. E. Dörr gave details of the hull design and the passenger accommodation, while Dipl.-Ing.

machinery are given in the accompanying table. The gas capacity of the ship, 200,000 cubic metres, is about double that of the earlier "Graf Zeppelin," and the diameter is 10 m. greater, with an increase in overall length of about the same amount. As our drawings on the opposite page clearly show, an outstanding feature of the new design was the separation of the control gondola, which was placed below in the front of the ship, from the passenger quarters, which were arranged on two decks inside the hull of the ship. By this means more space was made available for the use of the passengers, while a better view backwards under the ship was obtained.

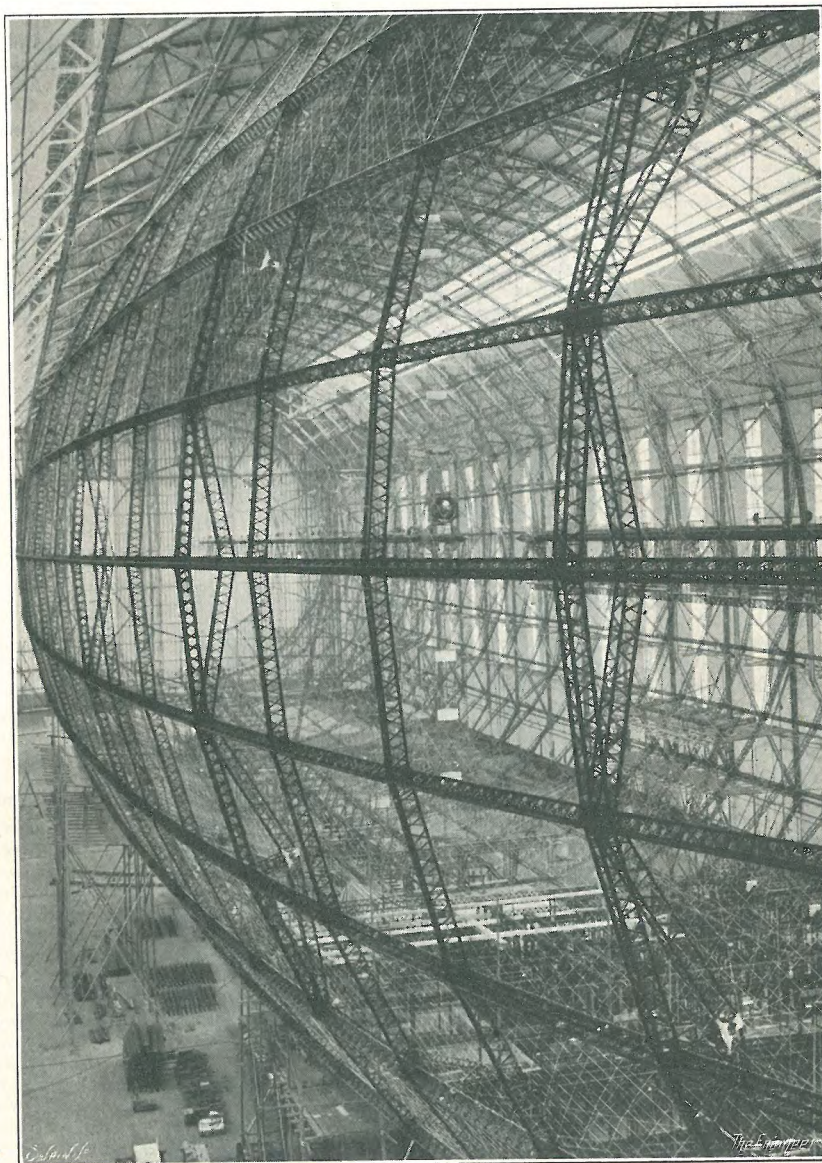
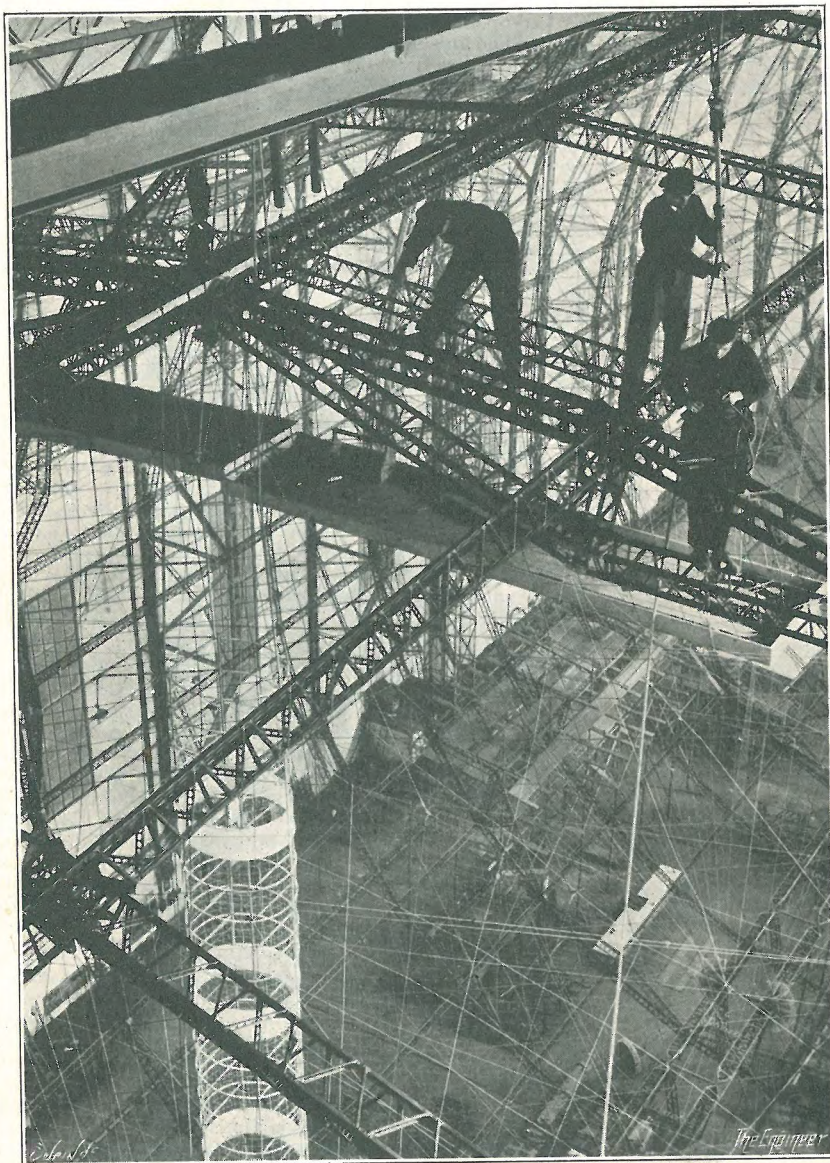
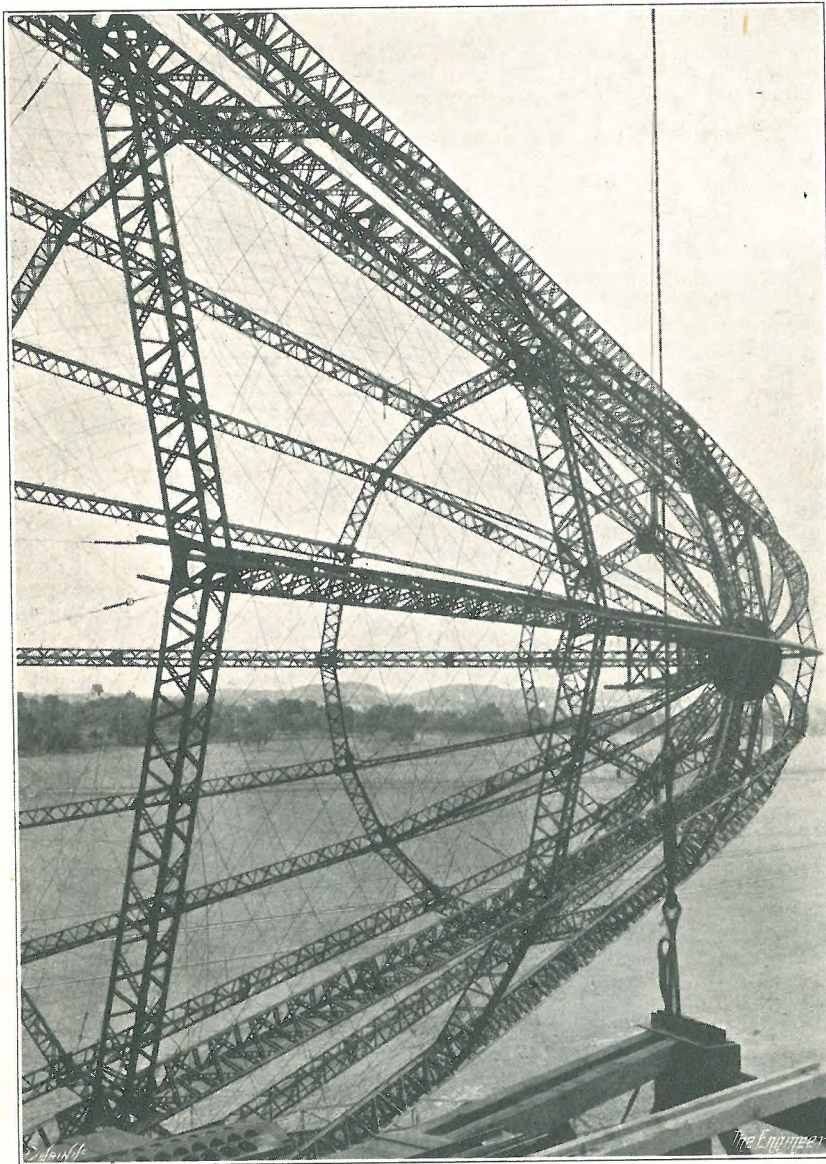
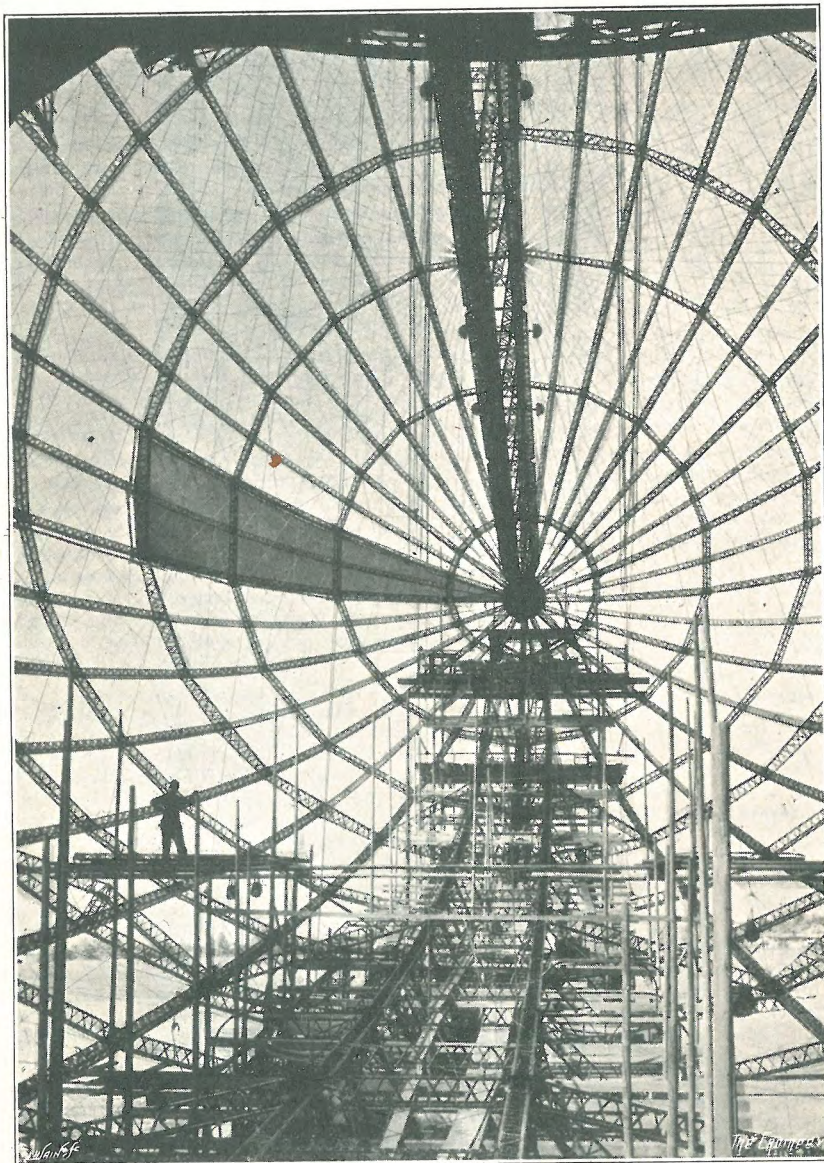
As regards the general construction, there was no essential difference made from the basic designs of

From the drawings it will be seen that there are fifteen main rings dividing the hull of the ship into sixteen parts, and between each main ring there are two secondary rings. The main rings are spaced at about 15 m. apart and they are made in the form of a thirty-six-sided figure, with the longitudinal members arranged at each of the corners. As the cross sections show, the main rings carry bracing wires, which are attached to the ring members and a centrally arranged girder member in such a way that only the corners of each two sides are braced. In our next article we propose to deal further with the constructional details of the ship and the arrangement of the gas bags and the valves for filling and discharging the gas.

(To be continued.)

CONSTRUCTION OF THE ZEPPELIN AIRSHIP "HINDENBURG"

DR. H. ECKENER, DESIGNER: LUFTSCHIFF ZEPPELIN G.M.B.H. FRIEDRICHSHAFEN, CONSTRUCTORS



BOW FRAMING
CONSTRUCTING GAS MANIFOLD

STERN FRAMING
MAIN HULL FRAMING

for which important advantages are claimed.

Never in the history of the firm have the shops been more busy, and apart from present and past extensions at Norwich considerable extensions have been necessary at Manchester, where the smaller industrial motors are made.

Mr. Scott, who is now seventy-five, is still active and his advice on technical matters is still sought. On Thursday, May 13th, over 400 people, composed of members of the staff, workpeople, pensioners, and visitors, attended a dinner in Norwich to celebrate his seventy-fifth birthday. Major S. E.

May he be on the bridge for many years to come."

Captain G. J. Scott, managing director of the company, replying to the toast, said that after the hurricane between 1930 and 1934, which nearly caused the ship to founder, it was now passing into calmer waters. The orders in 1932 at their three works—two at Norwich and one at Manchester—amounted in value to £192,000. In 1936 their value was £954,000, and in the first four months of 1937 £430,000. The output in 1932 amounted to £250,000; whilst in 1936 it was £600,000, and for the first four months of 1937 £250,000. In 1932 the number of employees

in orders and the fact that output had not kept pace with demand had made it necessary to increase floor space and tools considerably—by 60 per cent. at the Manchester works and 30 per cent. at Norwich—during the last eighteen months.

On the day following the dinner a party of visitors in which we had the privilege of being included, inspected the Norwich machine and switchgear works. On the marine side there was in the course of manufacture part of a large batch of motors for the White Star Line, submarine electrical equipments for the Navy, generators and motors for the Holt Line, and

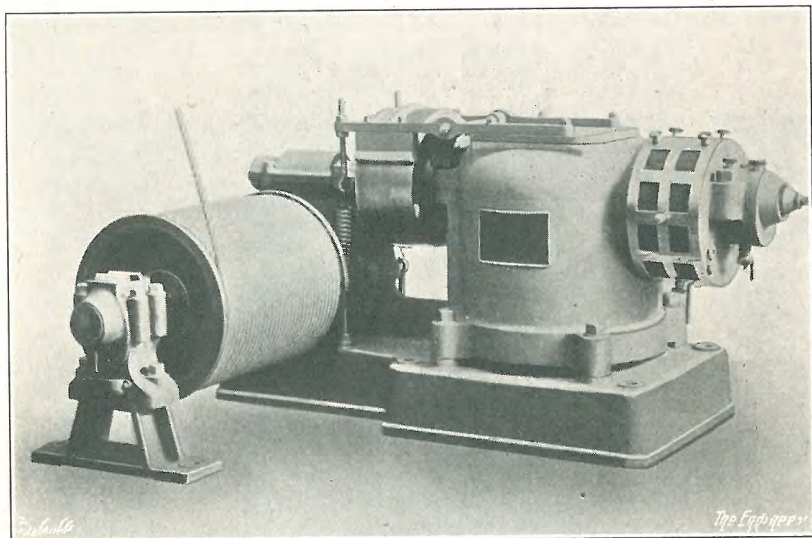


FIG. 5—EARLY ELECTRIC WINCH

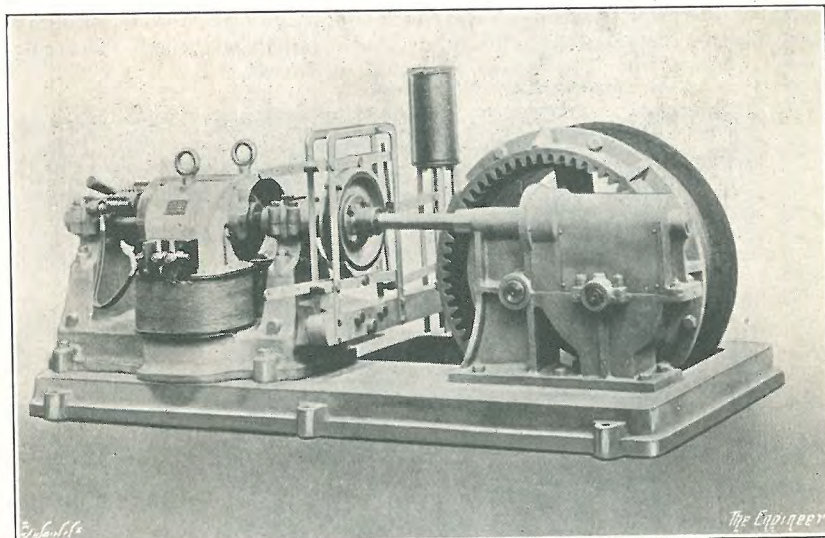


FIG. 6—EARLY ELECTRIC LIFT EQUIPMENT

Glendenning, of the company's technical staff, was in the chair, and proposed "The Guest of Honour," to which Mr. Scott replied. Other speakers included Captain G. J. Scott, managing director, and Mr. P. A. Mossay, technical director of the Company; while Mr. William Reavell and Mr. Thomas Glover replied to the toast of "The Visitors."

Referring to the early Norwich electricity undertaking, Major Glendenning explained that the small generating station was near the Free Library. Eventually the undertaking was turned into the Norwich Electricity Company, with a larger station in Duke-street, and with Mr. Scott's underground ducts with bare conductors under the pavements. In due course the concern was bought up by the Corporation and the big grid station at Thorpe was the direct descendant of the two small locally made sets of the first station. The first ten or fifteen years of the firm was the period during which the industry was being born and was a time of development relatively more rapid than anything since experienced. Among the few British pioneers who might almost be numbered on the hand, Mr. Scott held an important place. Besides the various advances in electrical work we have men-

tioned, Mr. Scott was responsible, Major Glendenning explained, for the development of mica insulation, which constituted the biggest step forward in the reliability of electrical machinery and control gear.

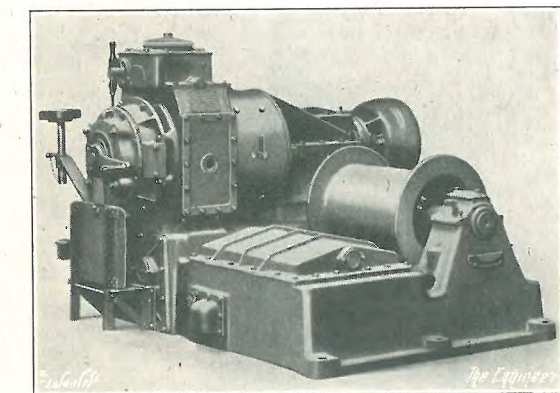


FIG. 7—MODERN ELECTRIC WINCH

tioned, Mr. Scott was responsible, Major Glendenning explained, for the development of mica insulation, which constituted the biggest step forward in the reliability of electrical machinery and control gear.

In responding, Mr. Scott recalled the early days when they did not quite know what they were making or what results they would obtain. Those were worrying times. Often he had gone home in the evening wishing he were a workman getting £2 a week and no worries. But those times had gone, and he was very much gratified by the congratulations from foreign friends and others for whom they did a lot of work.

In thanking the staff and workpeople for presents presented to them, Mrs. Scott read the inscription of the illuminated address: "To Mr. W. H. Scott on the occasion of his seventy-fifth birthday. This is the tribute by the crew of the good ship 'L.S.E.', which he launched into the troubled waters of the electrical industry in 1883, and which has safely weathered the storms of more than fifty years. The safety of the ship, its enviable reputation, and the happiness of the crew reflect the wisdom of the skipper.

was 1080, in 1936 2550, and to-day 2800. One of the firm's greatest difficulties was that when the slump began it had not properly developed the industrial business. It had confined itself mainly to electrical machinery for ships, but A.C. machines were mostly used for industrial purposes. In 1929 the orders for A.C. motors only represented £14,000. Since then, however, an enormous effort had been made to develop the industrial market, and in the first four months of 1937 the orders for this type of machinery alone represented £120,000. That great increase

auxiliary motors for the "Queen Mary's" sister ship, and for the Cunard "intermediate" boat. Many examples of the firm's patented steel-frame machines and "Emcol" motors were in evidence. Large machines of the latter and other types were in the course of construction, including 1600 H.P. vertical-spindle hypo-synchronous motors for the Rand Water Board, a 560 H.P. motor for power station work, and motors for the Handley Page wind tunnel. There was also evidence of brisk overseas business.

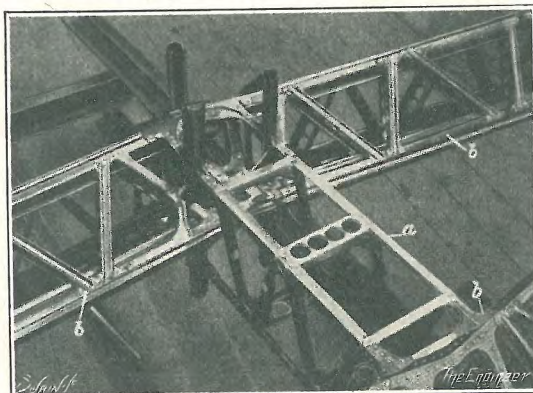
The Zeppelin Airship "Hindenburg."

No. II.

(Continued from page 563, May 14th.)

SOME CONSTRUCTIONAL DETAILS.

IN our last article we dealt with the design of the Zeppelin airship, and we now pass to some further details of the hull and its construction. The new design incorporated the long-established Zeppelin principles of construction, which include a braced light metal girder construction with the internal space divided by rings, forming compartments in which the cells or bags for the lifting gas are housed. There is a central bracing member and a lower or keel gangway or catwalk strong enough to take the loads, and which at the same time gives access to all parts of the ship. The four engravings reproduced on page 596 show various stages during the construction of the ship at

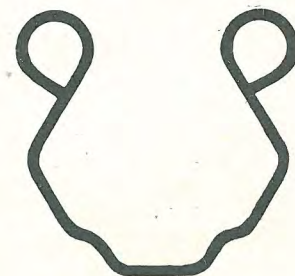


JUNCTION BETWEEN MAIN RING AND LONGITUDINAL GIRDER

Friedrichshafen. These and the other photographs reproduced in our articles were taken by the Zeppelin Company and are published with its permission.

The design of the girders forming the framing of the ship differs from the earlier ships only in the increasing demands on the strength of the structural members and the materials of which they are composed which the construction of larger ships has brought about. The special form of profile used for the rolled sections of light aluminium alloy which, with latticed bracing, form the principal members of

the girder construction is shown below. It may be noted that this special profile, which is in effect a six-cornered figure with an open side bounded with two beaded edges, gives five flat faces to which riveted parts can be attached, and it forms a strong section, which can be employed in various ways. Another engraving shows its use in the junction between a part of one of the main rings *a* and the triangular longitudinal girders *b*. As mentioned in our first article, there are fifteen of these main rings, which are placed at



"THE ENGINEER"

SWAIN SC.

PROFILE OF CONSTRUCTIONAL SECTIONS

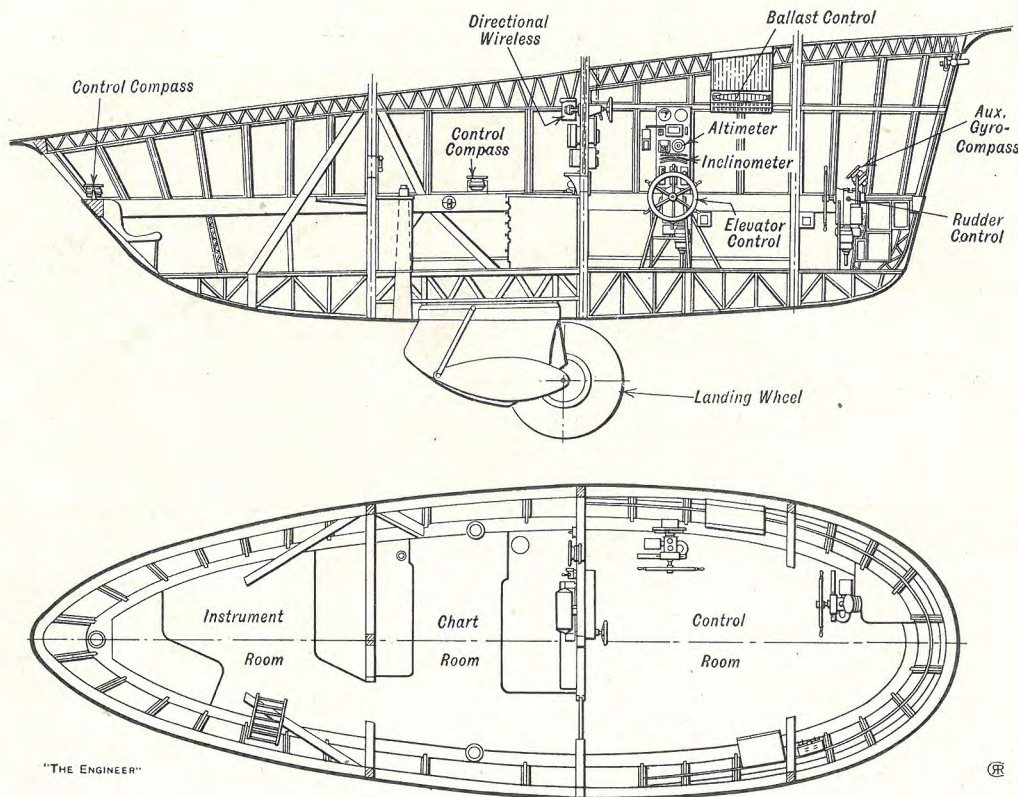
distances of 15 m. apart. They have sixteen corners, to which the longitudinal girders are attached. The sixteen compartments between the main rings are each designed to accommodate a gas bag. It will be understood that in the main rings the triangular girders are assembled with the apex pointing inward, while in the case of the longitudinal members the apex of the girder points outwards. The method of assembly of the main ring members is shown on page 601. In order to avoid deformation they were built up in a horizontal position on the floor of the shed, within an assembly ring, and then lifted into position in the manner shown in our illustration. This view also indicates the arrangement of the bracing, which runs out from the central fixed point at the middle of the hull to supplementary girder members on the main ring, the object of which is to transmit the tension to each pair of adjacent corners. The construction employed is clearly shown on the drawings reproduced on page 562 *ante*. The longitudinal girders are reduced in number and in size towards the bow and

the stern end of the ship, and at the bow there is a cap of metal with an anchor ring to facilitate the attaching of the ship to a mooring mast. Running from the bow cap to the stern there is a keel gangway, with side gangways to the four engine gondolas. This lower gangway is also connected to the central gangway by three access ladders.

At the stern the four fins form a part of the body of the ship, and to these fins the rudders are attached. The lower fin differs in shape from the three other fins, in that its lower edge is not parallel to the ground, but is sloped upwards towards the main body of the ship. The lowest point is at the forward end of the fin, and at this point the fin is fitted with a landing wheel, a similar wheel being placed under the control gondola, as shown in the drawing. The outer envelope, which gives the well-known Zeppelin contour to the ship and provides the desired smooth surface, is formed of cotton or linen material disposed so as to meet the different loadings imposed. It is of light weight and is rendered more weatherproof and is given a smoother surface by the application of a number of coats of cellulose paint. By mixing the paint with aluminium powder in a certain proportion a reflecting surface was obtained, which assisted to protect the ship from the heat of the sun's rays. In order to diminish the effect of ultra-violet radiation the top side of the envelope was treated with a special red paint. On the sides near to the air screws the covering was specially strengthened so that hard substances, such as ice thrown against the hull would not damage the gas bags. Each of the compartments had a cell or bag, which, when inflated with hydrogen, would completely fill it. At the bow and the stern the two end bags were joined together. There were thus fourteen automatic gas relief valves and fourteen hand-operated discharge valves for the purposes of manœuvring the ship, which were operated from the control gondola. The system of gas bags, each shaped so that the central gangway passed through them, could be filled from a centrally arranged filling hose, special connections being made to the end bags. The material used for the gas bags consisted of two layers of cloth with a gas-tight skin between them, which has replaced the goldbeaters' skin employed in earlier ships. This special material was tested over a long period in the "Graf Zeppelin" with satisfactory results. It was found that the amount of gas which would pass through under normal circumstances was not more than 1 litre per square metre during twenty-four hours. The original design provided for the use of small inner gas bags in addition to the larger main bags, so that, if necessary, two kinds of lifting gas could be employed, namely, helium and hydrogen. This plan would allow the main bags on the outside of the hull to be filled with helium, only using hydrogen gas for manœuvring purposes, which could be easily and cheaply replaced. As the supplies of helium could only be obtained outside Germany, it was necessary to dispense with its use for the time being, and in the "Hindenburg" only hydrogen was employed. Each pair of gas cells had arranged between them a gas

arranged, but also those lower parts of the ship to the keel gangway. To assist the ventilation the lower part of the envelope is made in such a way that air can pass through it. The control gondola, the arrangement of which is shown in Fig. F, has an overall length of nearly 9 m., or close upon 29ft. 6in., and a breadth of 2.5 m., or about 8ft. 2in., at its widest part. Forward is the steering platform, which is equipped with an altimeter, inclinometer, and the rudder and elevator controls. This part of the ship also contains the ballast and trimming control gear.

which is carried in bags hung in the bow and stern of the ship. Each of these bags holds 500 kilos., or about 1100 lb. of water. The position of the bags is clearly shown in the plan drawing reproduced on page 562 ante. Other ballast tanks are those arranged on either side of the lower gangway, which include thirteen ballast tanks for recovered ballast water, each of 2500 litres capacity, along with two further tanks of 2000 litres. As previously mentioned, the emptying of the tanks is worked from the control gondola. The hydrogen can also, when necessary,



ARRANGEMENT OF CONTROL GONDOLA

Behind the control platform is the chart room and also the directional wireless room, which also serve to house the control compasses. The landing wheel immediately below the gondola may be noted. On the after bulkhead of the control platform is the control board for the filling and emptying of the various gas bags. The rudders are operated by means of wire controls and winch gear, and they can also be worked by hand from a point near the after end of the lower gangway, where the auxiliary rudder controls are arranged. The power required to work the rudder controls is very small, and one man can turn the ship; an electrically operated rudder gear is, however, also provided. The ship can also be

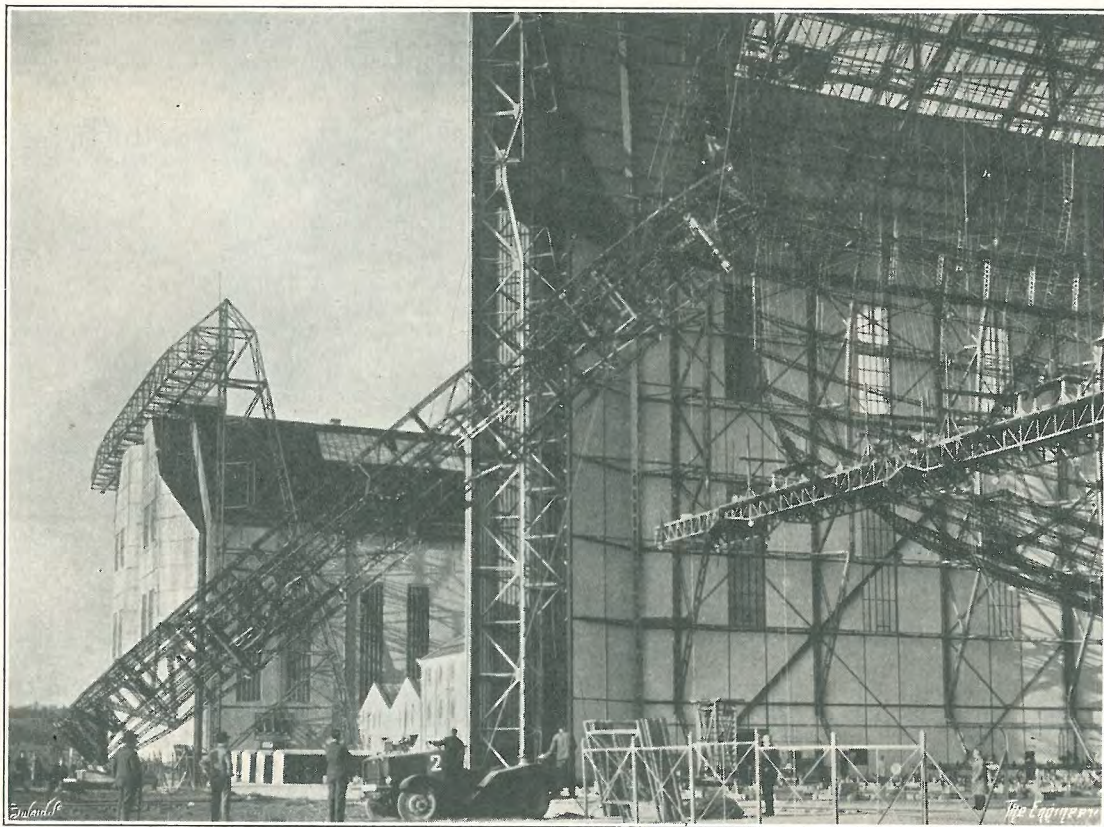
be discharged from the gas bags. Other instruments in the control gondola include magnetic and gyrostatic compasses and instruments for measuring the humidity of the air, the temperatures of air and gas, and indicating and recording gear for the speeds of the engines, and of the ship. Near to the control gondola and above it is the wireless cabin, which is equipped with long and short-wave transmitters, each of 200 W aerial capacity, also receivers for all wavelengths and directional wireless.

(To be continued.)

SIXTY YEARS AGO.

To Professor Osborne Reynolds the scientific side of engineering owes many a debt. One of the lesser-known discoveries which he made has an important bearing on the management of ships particularly during the critical moments preceding a threatened collision. In 1875 at the Bristol meeting of the British Association Reynolds made the statement that a screw ship when the engines were going astern while the ship was still forging ahead did not obey its helm in the ordinary way. A committee consisting of James R. Napier, Sir William Thomson, Froude and Reynolds was appointed to investigate the subject. The Admiralty and private owners were invited to assist the committee by making full-sized experiments. Various trials were carried out of which the most important, summarised in our issue of May 25th 1877, were made on the Donald Currie liner "Melrose" off Toward Point in the Clyde. While the steamer was travelling at about full speed, 10 knots or so, the order was given to reverse the engines to full speed astern. As soon as the engines began to move full speed astern the helm was put hard a-port. The ship's head swung 28 deg. to port before her headway was stopped. Again at the same speed a similar trial was carried out, the helm being put hard a-starboard as soon as the engines began to move in the reverse direction. In this case the ship's head swung 40 deg. to starboard before her headway was overcome and thereafter her head remained stationary. The experiments, we said, proved in the clearest possible way that the influence of the screw on the rudder when the engines were going astern was such that the ship would do just what she was intended not to do. It was difficult, we added, to persuade sailors that ships would under any circumstances go to port when they were intended to go to starboard. It was therefore highly desirable that every captain should take the trouble to convince himself of the only deductions which were to be drawn from the experiments we had described.

ELECTRICITY IN THE UNITED STATES.—According to the Federal Power Commission of the United States, 113,473 million kWh of electricity was generated for public supplies in that country during 1936. The increase over the previous year was 14 per cent., due mainly to a 22 per cent. increase in output from fuel, whereas from water power there was an increase of only 2 per cent. Preliminary statistics show the average fuel consumption in steam stations to be about 1.45 lb. per kWh.



RAISING ASSEMBLY OF RING MEMBERS INTO POSITION

manifold or shaft into which the gas release valves discharged, and the gas escaped through a special discharge fitting arranged on the skin of the ship. The gas manifolds also served to ventilate the interior of the ship, not only the parts that lie above the central gangway, above which all the gas valves are

steered electrically from the gyrostatic compass system.

The ballast arrangements include ballast that can be quickly dropped, and for slower movements ballast which can be discharged over a longer period. The ballast generally employed for quick action is water,

The Zeppelin Airship "Hindenburg."

No. III.

(Continued from page 601, May 21st.)

PASSENGER AND CREW ACCOMMODATION.

THE passenger accommodation of the "Hindenburg" was, compared with the earlier Zeppelins, much more roomy and extensive. As shown below, it was arranged within the hull of the ship, on two decks one above the other, the entrance being made from the lower or B deck by means of short ladders which could be lowered to the ground when the ship was moored. Sleeping accommodation was originally provided for fifty passengers, and just before the last voyage accommodation for twenty more persons was added. The new cabins were aft

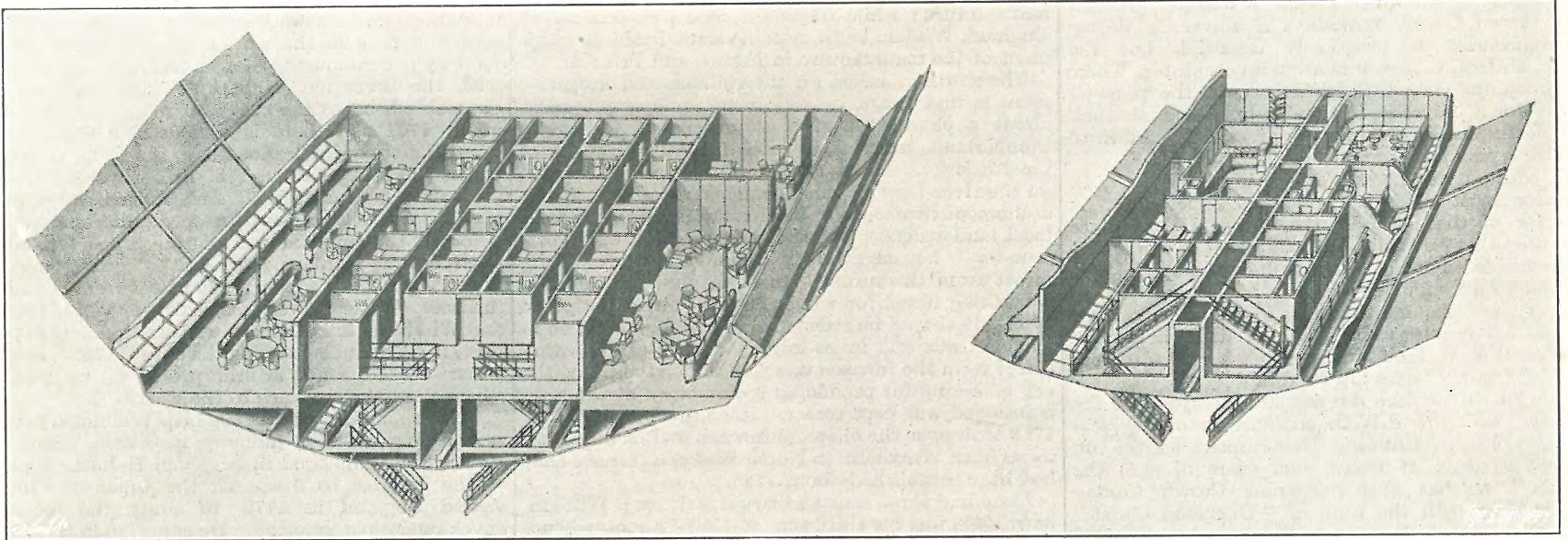
kitchen quarters, with the mess-rooms for the officers and the crew on either side of it. Below is a view in the crew's mess during its construction. The kitchen equipment included an electric galley stove, some 2 m. in length and 0.7 m. wide, with the necessary working tables and a cooling cupboard of about 700 litres capacity. The lower deck had also a shower bath for passengers' use, and the usual sanitary arrangements.

ACCOMMODATION FOR OFFICERS AND CREW.

The sleeping accommodation for the crew was arranged in three groups in different parts of the

from which it was pumped to the service tanks in the engine gondolas. It was also possible to trim the ship by pumping oil from one set of fuel tanks to other tanks. For this purpose a pump driven by a propeller working in the air stream of the ship was generally used. The fuel tanks included thirty-two tanks each of 2500 litres capacity, four each of 1250 litres capacity, two of 850 litres, and four of 800 litres capacity, making the total amount of fuel which could be carried 90,000 litres. The horizontal cylindrical tanks were made of aluminium alloy metal.

Each engine—see page 619—had a maximum designed output of 1100 to 1200 B.H.P., when running at 1500 r.p.m., and a continuous cruising rating of 800 to 900 B.H.P. at about 1350 r.p.m. As shown on page 619, the engine had a built-on 2 to 1 reduction gear of the Zeppelin-Farman pattern. The airscrew was attached to a countershaft through a toothed coupling. The airscrews were supplied by the firm of Heine, of Berlin, and they were of the four-bladed type with the leading edges of the blades pro-

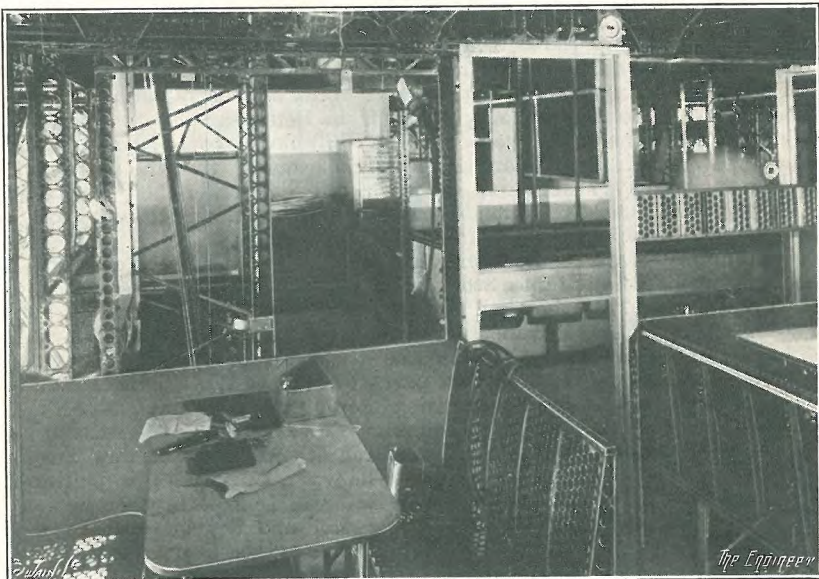


PASSENGERS' SLEEPING, DINING AND LIVING QUARTERS

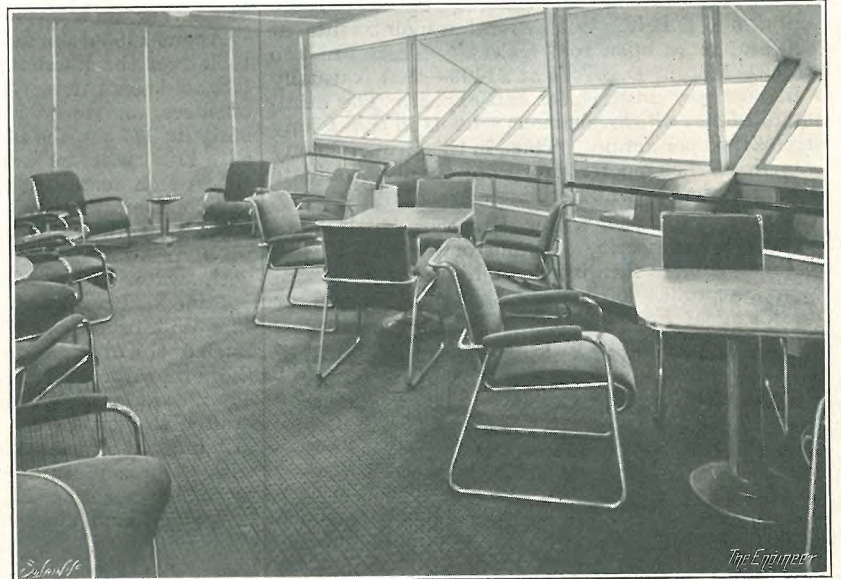
of the main passenger space, at the side of the ship, and were provided with portholes. It will be seen from the left-hand view above that in the upper A deck the sleeping cabins were in the centre, and were served by two corridors. In each cabin were two beds, the upper of which could be folded up during the day, the design adopted being similar in its general arrangement to the Pullman beds used in Continental sleeping cars. Hot and cold water was provided in each cabin, along with a wash basin, and provision for hanging clothes. Electric lighting was fitted, and there was a supply of conditioned air, which could be warmed by the heat of the engine

ship, and was reached from the keel gangway. Accommodation for the captain and his officers was provided in the ship forward of the control gondola, while there were other rooms in the central part of the ship, and also near the auxiliary electric lighting plant. The positions of these rooms was shown on the plan and elevation reproduced on page 562 ante. For the cargo, which might reach 10 tons or over, special space aft of the passenger quarters was reserved at the sides. Provision was made to fasten heavy cargo, such as motor cars, to the structure, and for loading and unloading there were removable panels in the envelope. The safety equipment

tected against the action of rain by brass sheathing. Coolers for the circulating water and the lubricating oil were built into the forward part of the engine gondola. By means of adjustable inlets, the temperature of the water and the oil could be varied as required. Each gondola was fitted with the necessary oil and cooler connections and the drawing given on page 619 shows the arrangement of the lubricating oil circuits. The engines could be supplied with warmed water for starting in cold weather, and each gondola had a starting air cylinder which had a capacity of about 60 litres, and was kept charged by an engine-driven two-stage air compressor, at a working pres-



CREW'S MESSROOM UNDER CONSTRUCTION



PASSENGERS' DINING SALOON

cooling water. Conditioned air was also supplied to the day rooms, which will be noted on the port and starboard sides of the ship. These rooms had a length of 14 m., with a breadth of 4 m. The room on the port side served as a dining saloon, and was connected with the kitchen below by a small food lift. One of the engravings shows this room, and it indicates the large space which was provided, and the long side windows. On the starboard side similar space was allotted to a social room and a writing room. On the lower or port side of the B deck—see right-hand view above—there was a smoking room under the special observation of a steward, which could only be entered or left through a lobby used as a bar. Adjacent to the bar was a stewards' room which also served as the ship's office. On the port side was the

included a number of devices, such as life-belts for use over the sea; several fire extinguishing equipments were also carried.

THE PROPELLING MACHINERY.

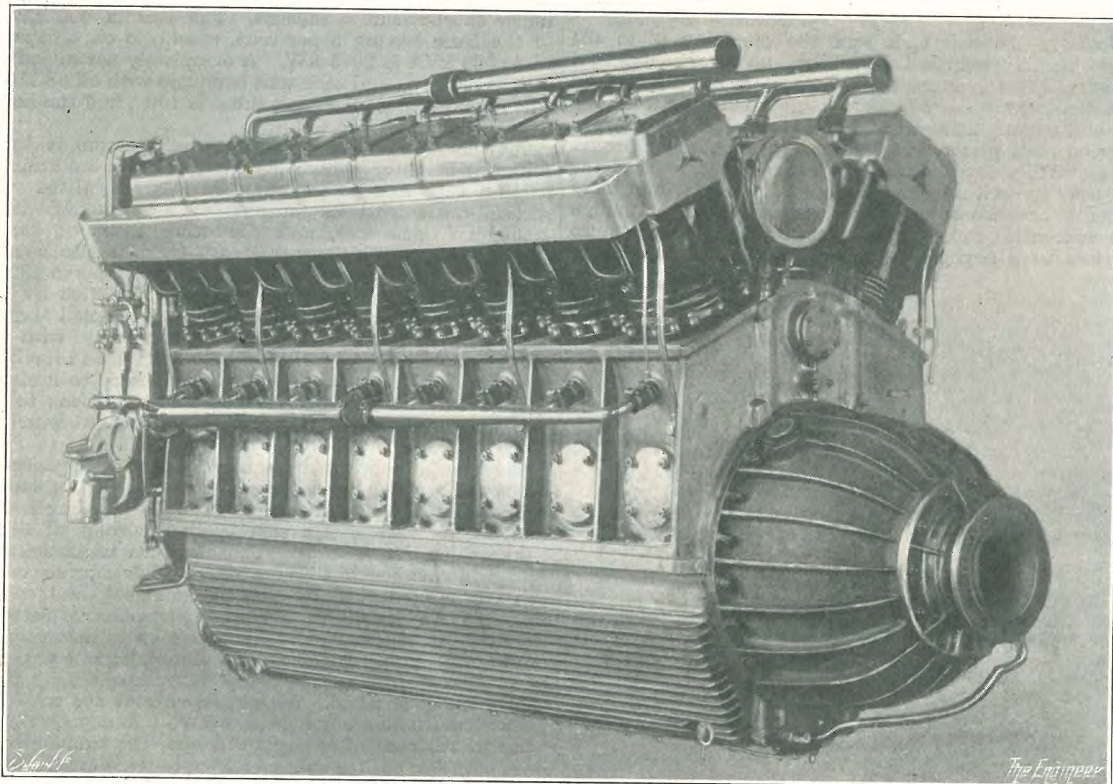
As already mentioned in our first article, the propelling machinery consisted of four sixteen-cylinder, V type, heavy-oil engines, designed and built by the Daimler-Benz A.G., of Stuttgart-Unterturkheim, which were housed in four motor gondolas placed outside the hull of the ship. In the stern view of the ship, reproduced on page 619, the wide distance between the engine gondolas and the skin of the ship may be noted. The fuel supply for the engines, which generally consisted of gas oil, was carried in a series of fuel tanks arranged alongside the keel gangway,

sure of 50 atmospheres. This compressor also supplied the necessary air for the springing arrangement on the landing wheels and the echo-sounding apparatus. The exhaust from the engine passed through a manifold with "S" formed cooling ribs. The discharged gases were directed downward away from the skin of the ship. The end of the inner pipe terminated in a nozzle, the suction effect of which was used to draw air through the gondola, and so provide the air necessary for cooling the manifolds and removing any traces of exhaust gas from the gondola. There was one engineer in each gondola, and the running of the engine was shown by the various instruments provided in each gondola and in the chief engineer's room.

Some details of engine construction may be noted.

The engine was mounted on a duralumin supporting base and the upper and lower parts of the crankcase were made of Alpax-Gamma modified aluminium silicon alloy. Cooling ribs on the underside of the

auxiliary motor and heating services was supplied by two oil engine driven generator sets, one of which was in general service, with the other as a stand-by. The engines were Daimler-Benz units of 45 to 50



ONE OF THE MAIN 1200 B.H.P. ENGINES

crank case were provided. All the working parts were enclosed, and the cylinders had two inlet and two exhaust valves, while the water-cooled liners were of steel. The connecting-rods were provided

B.H.P. capacity, coupled to 30-kW generators. Besides the generators, there was a switchboard with connections for an outside supply when the ship was in the shed. There were two circuits, one for the lighting and auxiliary motors, operating at 220 volts, and the other for a 24-volt instrument and emergency lighting service. The generator room and switchboard room were metal lined as a means of fire protection.

The Naval Review at Spithead.

On Thursday, May 20th, His Majesty the King reviewed his naval and mercantile fleets at Spithead. In a leading article last week we discussed some of the points of the new programme of naval construction, and showed how the ships which were assembled at Spithead foreshadowed the mighty strengthening of the Fleet within the next few years, when the ninety-nine fighting ships now in hand or authorised will reinforce the sea strength of this land. Among the visits to the Review in which we took part was that arranged by the Institution of Naval Architects. Starting from Waterloo at the comfortable hour of 9.45, Southampton was reached at 11.35, and at noon the Southern Railway Company's cross-Channel steamer "Dinard" left Southampton Docks for her anchorage at the south end of the Review lines off the coast near Lee-on-Solent. There were some 320 members and guests of the Institution on board, led by the Secretary of the Institution, Mr. G. V. Boys, who was supported by several members of Council. The party was fortunate in having with it Mr. H. E. Skinner, a member of the Royal Corps of Naval Constructors, who by his running commentary from the bridge, which was broadcast through the ship, added much to a day of unusual interest.

Proceeding down Southampton Water we noticed some of the Admiralty guest liners, and moored in the Solent was the German Admiralty yacht the "Grille," a pleasing vessel of some 2500 tons, propelled by geared turbines, which was recently added to the German Fleet. The anchorage was reached shortly before 1 p.m., and was just behind the minesweeper "Fleetwood" and the net-laying and Fleet photography ship the "Guardian," both of which were clearly visible, in spite of a slight haze. With a freshening breeze all were enabled to watch the approach of the Royal Yacht and to hear the Royal Salute of guns and the cheering from the fully dressed and manned ships, the "Victoria and Albert" steamed slowly down the lines, led by the Trinity House vessel "Patricia" and escorted by the Admiralty Yacht "Enchantress," with the attendant sloops and liners carrying the Admiralty guests. Later in the afternoon was the impressive fly past of the Fleet Air Arm squadrons, and it was regretted that the prevailing haze was such as to prevent the return flight and the ceremonial graceful dip in salute of the Royal Yacht.

Shortly after 6 p.m. the "Dinard" was allowed to leave her anchorage and to pass down the lines in the reverse direction to the course taken by the Royal Yacht and her attendant ships. During that very interesting and all too short voyage, Mr. Skinner was

able to indicate to those on board some of the progress which has recently been made in the design and construction of destroyers, submarines, aircraft carriers, and cruisers, a task often hampered by Treaty conditions. Particular interest was shown in the new 9000-ton cruisers "Southampton" and "Newcastle," with their length of 584ft. and high speed of about 32 knots. The provision for carrying aircraft was noted, with the accompanying cranes and hangars for the lifting and housing of the machines. Among the older battleships, great admiration was expressed for the fine lines and design of the "Hood" and the "Rodney" and "Nelson" of the Home Fleet, with their powerful 16in. gun armament and the peculiar tower-like construction of the foremast, sometimes called, we were told, the "Queen Anne's Mansions."

Rounding the Royal Yacht, the numerous ships and boats made manoeuvring none too easy for such crowded waters, so that anything might be expected, but the call of the look-out, "Girl Pat" on the star-board bow," was received with some amusement. This little ship, which quite recently was so much in the public eye, was, we noted, engaged in the peaceful carrying of Review trippers.

On the return through the lines an opportunity was given to see the foreign warships attending the Review. An outstanding vessel was the French battleship "Dunkerque," which has only recently completed her trials. Her main armament comprises eight 13in. guns, which are mounted in two quadruple turrets, both of which are arranged on the forecastle. Her gun arrangement and her tower-like foremast are reminiscent of the design adopted in our own battleships the "Nelson" and "Rodney." Germany was represented by one of her recently completed "pocket battleships," the "Admiral Graf Spee," remarkable for her powerful armament, and the fact that she is one of the few capital ships propelled by oil engines. Alongside her was the Russian battleship "Marat," with her bent-back fore funnel, a device adopted to keep the smoke away from the foretop. Another interesting ship was the Argentine battleship "Moreno," showing traces of her American origin in her lattice masts and widely spaced funnels, with posts carrying searchlights arranged between. The American flagship, the battleship "New York," calls for special mention as she is one of the very few large capital ships propelled by reciprocating steam engines. When she was laid down in 1911, the turbine builders in America would not accept the turbine specifications of the Navy Department, and reciprocating engines were therefore ordered to show that the Navy Department was determined to have turbines built to its own designs or not at all. A very powerful and well-manned ship was the Japanese battleship "Asigara," which in speed, armament, and protection is a revelation of what can be put into a 10,000-ton design. Her green aeroplanes added an almost Eastern colour and atmosphere to the ship. Space will not allow us to do more than mention that there were at the Review many other representative ships from the Home and Mediterranean Fleets and from the navies of the Netherlands and the Scandinavian countries, and some of the smaller Powers. A reminder of a very essential service was the presence of the Admiralty oiler "Brambleleaf," very smartly turned out.

The return voyage was made during the late evening, and Southampton was reached about nine o'clock and London at 11.20 p.m. It was not possible for the Naval Architects' party to wait for the Fleet illuminations, but while going round the ships the preparations were seen in progress, and sheaves of rockets were noted on the decks of the ships, while illuminated devices and lamp battens were being brought into position and tested. Before leaving the "Dinard," Professor C. E. Inglis thanked Mr. Skinner on behalf of all present for his informative and interesting talk. Mr. Boys and his staff were also thanked for all that was done to make the day a memorable one.

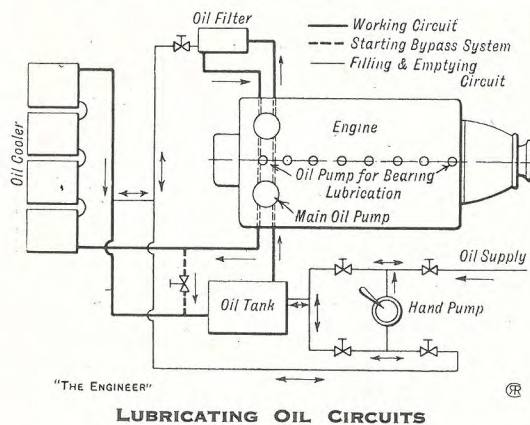
We cannot close this short appreciation without some reference to the excellent hospitality which was provided for the guests of the Admiralty and the Government on specially chartered liners, which included the "Strathmore," the "Vandyke," the "Rangitiki," the "Laurentic," the "Cameronia," and other ships. The transport by railway from London to Portsmouth and Southampton was excellently arranged by the Southern Railway Company, which handled an unprecedented amount of traffic from Waterloo and Victoria without any delay. The catering and accommodation on board the liners was of the best, and most of the guests were able not only to follow the Royal Yacht around the Fleet, but also had the pleasure of remaining on board for the night in order to see the Fleet illuminations and the display of fireworks which took place from ten o'clock until midnight. They were brought back to London by special trains in the morning.

NEW AERO-ENGINES.—The new De Havilland six-cylinder air-cooled, inverted in-line aero-engine is to be known as the "Gipsyking I." It is to be introduced into the Royal Air Force in the "Mentor I" machines. The other new twelve-cylinder air-cooled, inverted vee, supercharged engine of the same company is to be installed in the Royal Air Force "Don I" machines and named "Gipsyking II."



STERN VIEW OF AIRSHIP

with roller bearing bottom ends, and great care was taken to produce an engine free from torsional vibration. So successfully did the engines operate in service, that a similar design has been adopted for



LUBRICATING OIL CIRCUITS

the sister ship "L.Z. 130," which is under construction at Friedrichshafen.

AUXILIARY LIGHTING INSTALLATION.

The current for the lighting of the ship and for the