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. 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 mentioned, 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. 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 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 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 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 tunne . There was also evidence of brisk overseas business.

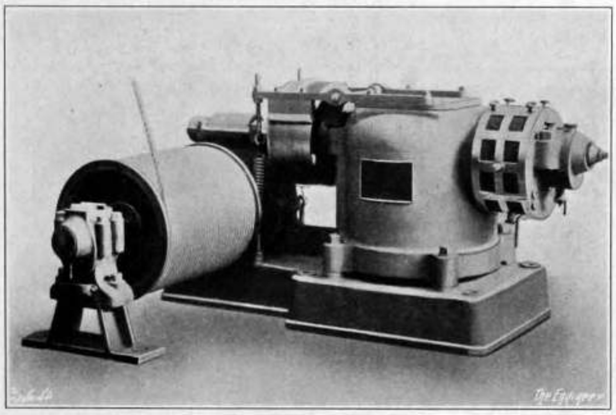


FIG. 5—EARLY ELECTRIC WINCH

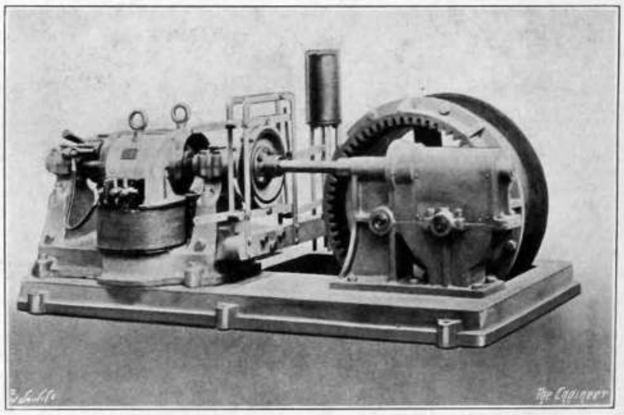


FIG. 6—EARLY ELECTRIC LIFT EQUIPMENT

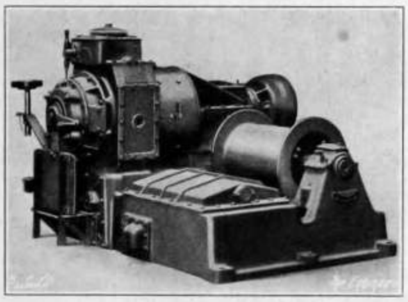


FIG. 7—MODERN ELECTRIC WINCH

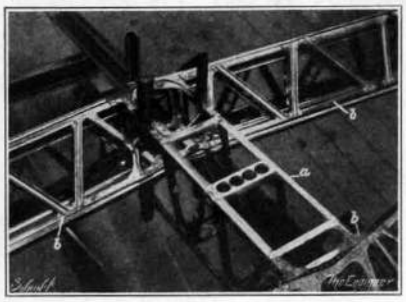
The Zeppelin Airship "Hindenburg."

No. II.

(Continued from page 563, May 14th.)

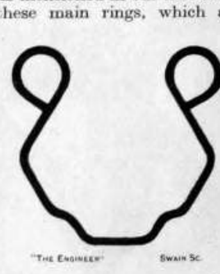
SOME CONSTRUCTIONAL DETAILS.

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



JUNCTION BETWEEN MAIN RING AND LONGITUDINAL GIRDER

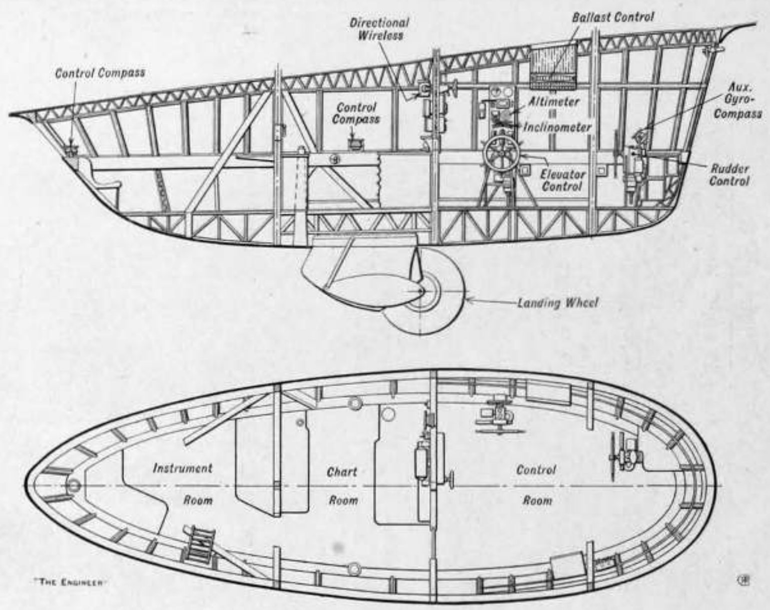
The design of the girders forming the framing of the ship differs from the earlier ships only in the increasing demands on the strength of the structural members and the materials of which they are composed which the construction of larger ships has brought about. The special form of profile used for 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 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



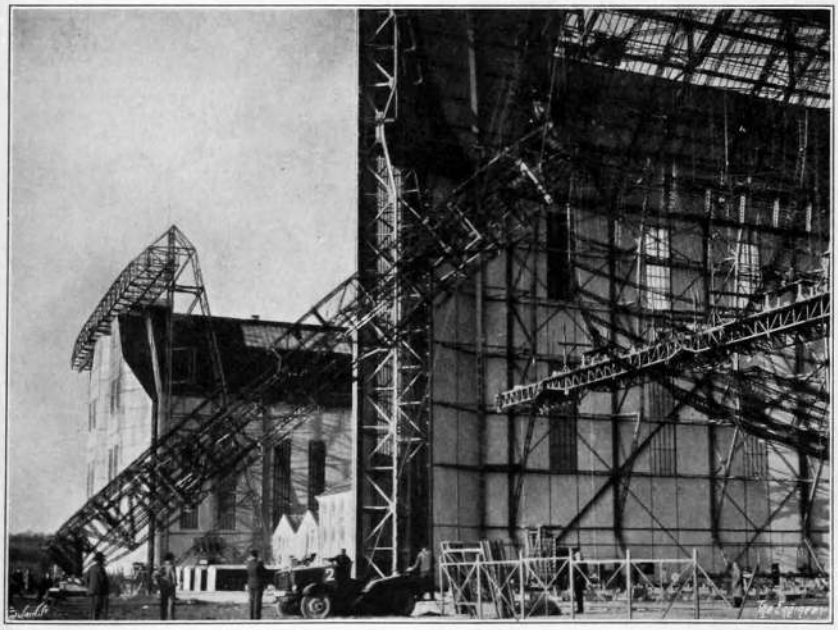
PROFILE OF CONSTRUCTIONAL SECTIONS

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 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 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.



ARRANGEMENT OF CONTROL GONDOLA



RAISING ASSEMBLY OF RING MEMBERS INTO POSITION

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 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, 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, 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.