

CHAPTER 5

Flights with Diesel-Engined Aircraft

Practically all of the flights made with Diesel-engined aircraft in recent years have been accomplished with aircraft of German origin. In the case of civil airplanes, Deutsche Lufthansa has done the pioneering with several types of landplanes and flying boats equipped with Junkers Jumo 204 (4) and Jumo 205 Diesels. In the military field, the German Air Force has taken delivery of thousands of Jumo 205 Diesels and has used them in numerous squadrons of twin-engined bombing planes. Deutsche Zeppelin Reederei has pioneered the way for lighter-than-air craft by using Mercedes-Benz DB 602 Diesels in the Zeppelins LZ-129, the *Hindenburg*, and LZ-130, the Graf Zeppelin.

FLIGHTS IN 1931

Regular flights with Diesel-engined civil airplanes commenced in 1931 when Deutsche Lufthansa installed a 700 h.p. Junkers Jumo 4 Diesel in one of its Junkers F-24 six-passenger monoplanes. Subsequently, more small single-engined airliners of this type and of the Focke-Wulf A-17 type were equipped with these engines. In 1935, Junkers Jumo 204 Diesels were used to replace the gasoline engines in four-engined Junkers G-38 forty-passenger airliners. The 550 h.p. Junkers Jumo 205 Diesel first appeared about that time in three-engined Junkers Ju 52 and two-engined Ju 86 airliners, and in two-engined Dornier Do 18 flying boats (Fig. 47).



Fig. 47.—Dornier Do 18 flying boat powered with two 600 h.p. Diesels.

MODERN FLIGHTS

Regular air mail service across the South Atlantic with Diesel-engined Dornier Do 18 flying boats commenced in 1936. These planes, together with four-engined Blohm & Voss Ha 139 seaplanes powered with 600 h.p. Junkers Jumo 205 Diesels, were used for Deutsche Lufthansa's transatlantic survey flights across the North Atlantic in 1936, 1937 and 1938. Early in 1939, four-engined Dornier Do 26 flying boats equipped with similar engines were used for mail and passenger service across the South Atlantic.

With regard to military airplanes, the German Air Force did a good deal of flying with Diesel-engined warplanes in 1937 and 1938. Thousands of Junkers Jumo 205 Diesels were built to meet their needs and were installed in two-engined Junkers Ju 86-K fighter-bombers. These engines are also used in military versions of the Dornier Do 18 and a number of Blohm & Voss Bv 138 flying boats for patrol purposes.

In the case of lighter-than-air craft, regular scheduled flights with the Diesel have been confined

to the zeppelin, LZ-129, the *Hindenburg*. Deutsche Zeppelin Reederei made a number of transatlantic flights between Germany and the United States with this hydrogen-filled airship in 1936. Its loss in 1937 put an end to transatlantic airship service as the Germans could not obtain helium for the next airship of the series, the LZ-130 or "Graf Zeppelin" (Fig. 48).

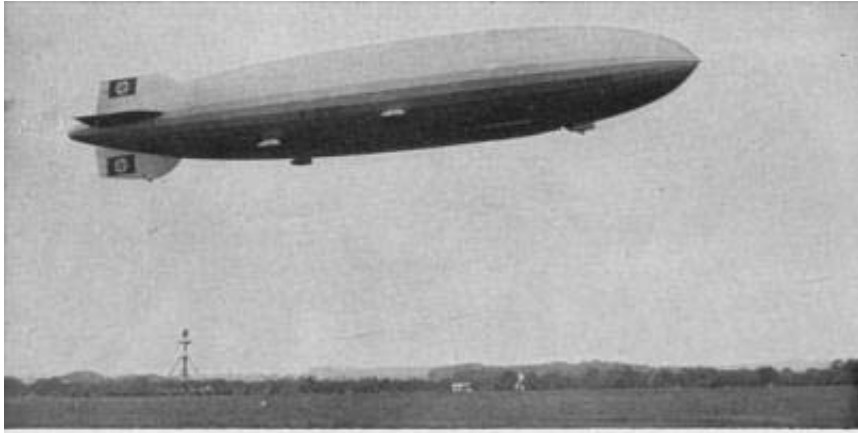


Fig. 48.—The airship LZ-130, "Graf Zeppelin," powered with four 1,320 h.p. Diesels.

DIESEL-ENGINED CIVIL AIRPLANES

The best-known Diesel-engined landplane used for civil purposes is the two-engined Junkers Ju 86. This up-to-date ten-passenger airliner has been used extensively in Europe and is somewhat similar in appearance to the Lockheed Electra built in the United States. Another recent Diesel-engined flying boat is the four-engined Dornier Do 26 which can carry both passengers and mail with a water take-off and also can be catapulted as a mail plane. Deutsche Lufthansa has had considerable success with these landplanes in Europe and these flying boats on its route between Germany and South America.

THE JUNKERS Ju 86

The Junkers Ju 86 airliner conforms to present-day conceptions of a high-speed landplane in that it is an all-metal, low-wing monoplane with monocoque fuselage, cantilever wings and retractable landing gear. The fuselage is of oval section with four longitudinal members and a number of bulkheads with a smooth outer skin of aluminum sheets attached with flush rivets. The center section of the wing is secured rigidly to the fuselage and contains the two engine nacelles. The outer sections are attached to the center section by ball-and-socket joints. A small auxiliary wing or flap extends along the trailing edge of the wing to prevent stall and improve the take-off and landing performance. The tail group is of cantilever construction with two rudders and fins at the extremities of the stabilizer. The landing gear retracts sideways into the lower surfaces of the wings (Fig. 49).

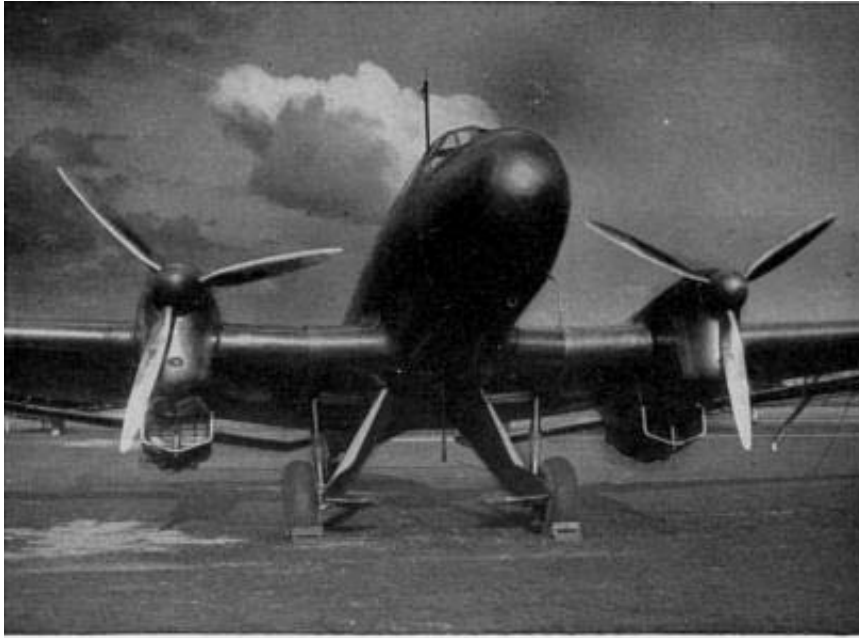


Fig. 49.—Junkers Ju 86 airliner powered with two 600 h.p. Diesels.

Power is provided by two 600 h.p. Junkers Jumo 205-C Diesels mounted in the leading edge of the wing. These engines develop 510 h.p. when cruising and have a good performance at altitude due to the inherent characteristics of the Diesel. The radiators for the cooling water are underneath the engines and have automatically-controlled shutters. The three-bladed controllable-pitch propellers are manufactured by Junkers under Hamilton Standard license. The frontal area of one of these engines is only 7.5 sq. ft. which is considerably less than that of a radial engine of equal power output. The fuel tanks in the center section of the wing adjacent to the engines contain 170 gallons of fuel oil which is of ordinary commercial quality. Electric inertia starters are used on the engines.

The passengers' cabin contains ten adjustable armchair seats. The walls are sound-proofed and the lights are concealed behind an overhead lighting strip. Hot air drawn from a muffler around an engine exhaust manifold is used for heating and the ventilating system is under the individual control of the passengers. The pilot's cabin contains the usual blind flying instruments and there is a two-way radio for the radio operator. Mail and air express are carried in compartments in the nose and behind the passengers' cabin (Fig. 50).

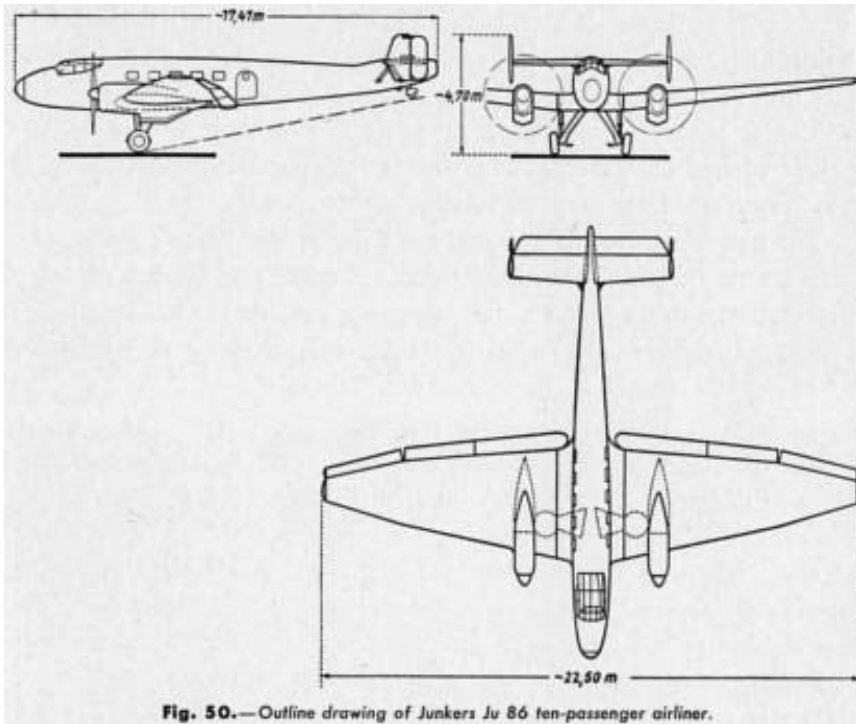


Fig. 50.—Outline drawing of Junkers Ju 86 ten-passenger airliner.

The performance of the Junkers Ju 86 is quite good and compares favorably with that of similar gasoline-engined airliners. Its maximum speed is 193 m.p.h. and it cruises at 174 m.p.h. at an altitude of 8,000 ft. Its landing speed is 61 m.p.h. It weighs 12,500 lb. empty, carries a useful load of 4,800 lb. and has a flying weight of 17,300 lb. It climbs at the rate of 730 ft. a minute and has a ceiling of 22,000 ft. Its normal flight range is 870 miles.

THE DORNIER Do 26

The Dornier Do 26 flying boat is an up-to-date example of the application of the Diesel to a long-range airplane. The Do 26 is an all-metal monoplane with four Diesels arranged in tandem pairs in slender nacelles so that its aerodynamic design is very clean. The two-stepped hull is divided by watertight bulkheads into eight compartments with a passageway running through them which can be closed by watertight doors. The cantilever wing is constructed in three sections with a pronounced dihedral angle in the center section supporting the engine nacelles. The tail surfaces are of semi-cantilever construction with a single rudder and fin. The wing tip floats are of narrow rectangular shape and retract sideways into the lower surfaces of the wings.

The bow compartment in the nose of the hull contains the usual marine equipment including anchors. Adjacent to this is a compartment for mail and express. The pilot's compartment behind the mail room contains comfortable armchair seats for the pilot and the co-pilot and an instrument panel with the latest flying instruments (Fig. 51). The engine controls and instruments with the exception of the main throttle controls are on a separate panel under the supervision of a flight engineer. There is also a navigation station with a two-way radio under the supervision of a radio operator. The tank room which comes next is not large as most of the fuel oil is carried in the bottom of the hull. Then there is another mail and express compartment and adjacent to it is the passengers' compartment containing accommodations for four passengers. The passenger capacity can be increased by converting the aft mail compartment so that eight passengers can be carried. A small galley with an electric stove for preparing meals occupies the next compartment and there is a lavatory further aft in the hull.

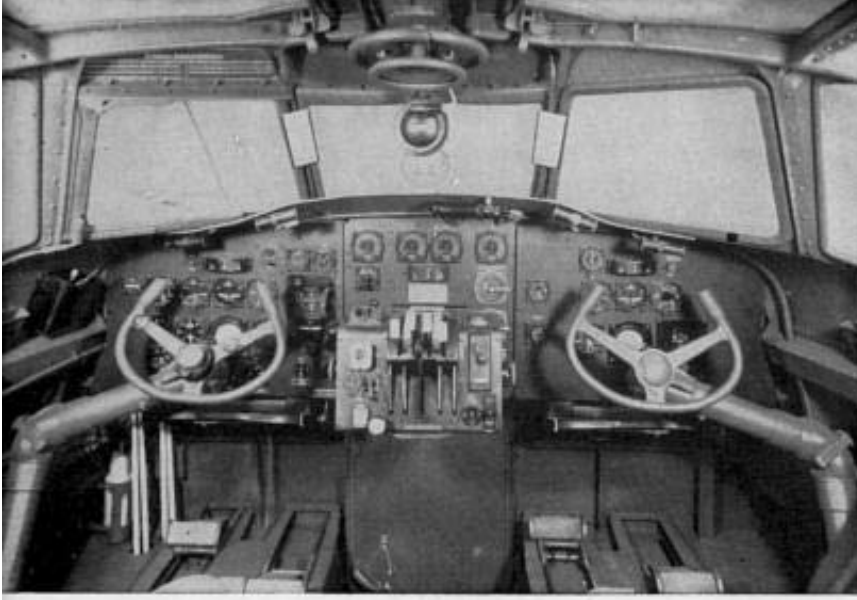


Fig. 51.—Interior of pilots' cabin in Dornier Do 26 flying boat.

The engines used on the Dornier Do 26 are 700 h.p. Junkers Jumo 205-E Diesels which cruise with an output of 560 h.p. each. The engines are mounted in tandem with the front engines well ahead of the main spar of the wing. The rear engines are located just behind the main spar with extension propeller shafts so that their propellers clear the trailing edge of the wing. This tandem arrangement has proved very successful on two-engined Dornier Do 18 flying boats and it is equally efficient on four-engined airplanes. On the Dornier Do 26 the rear engines and their propeller shafts can be tilted upward 10 degrees during take-off from the water so that the propellers are kept out of the spray. When the airplane is in the air the rear engines and their propeller shafts are lowered by electric motors to their normal position (Fig. 52).



Fig. 52.—Dornier Do 26 flying boat with rear engines raised for take-off.

The Dornier Do 26 has a maximum speed of 208 m.p.h. and cruises at 193 m.p.h. with full load. Its landing speed is 68 m.p.h. It weighs 22,400 lb. empty and can carry a useful load of 21,600 lb. which makes its gross weight 44,000 lb. Its rate of climb is 1,100 ft. a minute and its ceiling is 20,000 ft. Its range with water take-off is 2,000 miles carrying a crew of four and a payload of 3,000 lb. (Suitable for a 1,900-mile non-stop flight across the South Atlantic between the west

coast of Africa and Brazil). This payload can consist of eight passengers and 1,000 lb. of mail. When catapulted the range of the airplane is increased to 3,600 miles but the payload is reduced to 2,500 lb. (Suitable for a 3,400-mile non-stop flight across the North Atlantic between New York and Lisbon).

DIESEL-ENGINED MILITARY AIRPLANES

While Diesel-engined military airplanes are altogether unknown in the United States they have been built in large numbers in Germany. Most of these warplanes belonging to the German Air Force are two-engined Junkers Ju 86-K fighter-bombers. Numerous squadrons of them have been commissioned and they took part in mass air maneuvers as long ago as 1937. Other Diesel-powered warplanes in Germany are the two-engined Dornier Do 18-K and the three-engined Blohm & Voss By 138 flying boats both of which are used for patrol over the North Sea and the Baltic.

DIESEL-POWERED BOMBERS

The Junkers Ju 86-K fighter-bomber is similar in general construction to the Junkers Ju 86 airliner. Instead of accommodations for passengers there are racks for bombs and machine gun stations. One machine gun is in the nose in a rotatable turret and there are two more of them aft of the wing above and below the fuselage. Directional radio is standard equipment and the airplane is equipped for night flying (Fig. 53).

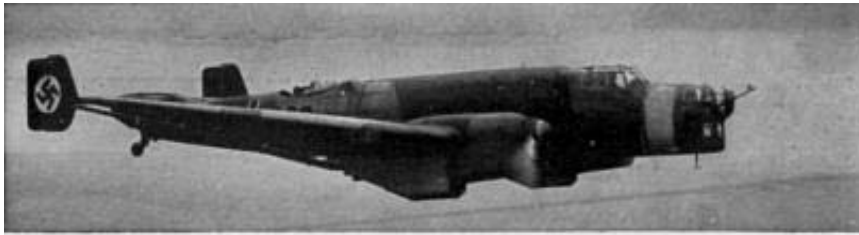


Fig. 53.—Junkers Ju 86-K two-engined fighter-bomber.

With two 600 h.p. Junkers Jumo 205-C Diesels, the Junkers Ju 86-K has a maximum speed of 183 m.p.h. and cruises at 165 m.p.h. When it is equipped with two of the military 880 h.p. Jumo 205-D Diesels its maximum speed is increased to 242 m.p.h. and its cruising speed to 217 m.p.h. Its landing speed is 62 m.p.h. and its ceiling is 26,000 ft. The weight of the airplane is approximately the same with either model of engine, namely, 12,600 lb. empty and it carries a useful load of 4,700 lb. which makes its gross weight 17,300 lb.

DIESEL-POWERED FLYING BOATS

The Blohm & Voss By 138 flying boat is of unique design with three engines mounted in the leading edge of its wing and its tail surfaces supported by two tail booms extending from the two outboard engine nacelles. This arrangement is excellent from a military viewpoint as there is a clear field of fire from the stern of the airplane which is its most vulnerable spot. The hull and the wing are of all-metal construction, the latter being constructed in three sections with the center section built around a large-diameter tubular steel spar. This spar constitutes the fuel tanks for the three 600 h.p. Junkers Jumo 205-C Diesels which are supported from it on flexible mounts. The two outer sections of the wing have tubular duralumin spars which are attached with flanges to the center section (Fig. 54).



The hull is divided by bulkheads into seven watertight compartments. In the bow there is the navigation equipment, then comes a retractable machine gun turret and behind that is the cabin for the two pilots and the radio operator. Next comes a combined bunk room and mess room for the crew. In the stern there are two defensive gun stations—an upper one on top of the turtle-back of the hull and another one at a lower level in a retractable turret in the extreme stern.

The Blohm & Voss Bv 138 has not been designed for high speed inasmuch as long range and economical operation are the desired characteristics. The weight of the airplane is 17,855 lb. empty and its normal useful load of 8,375 lb. makes its gross weight 26,230 lb. With this loading its range is 1,490 miles, but by increasing its useful load to 14,550 lb. its range can be increased to 3,100 miles. Its maximum speed is 171 m.p.h. and its cruising speed is 148 m.p.h. A crew of four or five men is carried and the airplane can be launched from a catapult if desired.

DIESEL-ENGINED AIRSHIPS

The use of Diesels for propulsive purposes in conjunction with helium as a lifting gas constitutes an ideal combination for a large rigid airship. In the United States we have built helium-filled airships but have had to power them with gasoline engines for want of suitable Diesels. In Germany they have built Diesel-engined airships but have had to use hydrogen as a lifting gas for want of helium. So far, the ideal combination of Diesels and helium has not been attained in a large rigid airship although it has great possibilities for long-range transportation. When an airship building program is renewed doubtless this combination will be employed.

THE ZEPPELIN LZ-130

The Zeppelin LZ-130, known as the *Graf Zeppelin*, is the latest airship to be equipped with Diesels in Germany. This huge airship is slightly more than 803 ft. in length and has a maximum diameter of 135 ft. Its framework is made of triangular aluminum alloy girders riveted together in the form of giant rings. These rings or sections are of different diameters and when joined together end-to-end constitute a framework of excellent streamline shape. The sixteen gas cells contained in these sections have a total capacity of 7,063,000 cu. ft. of lifting gas. Accommodations for the passengers and crew are provided in the bottom of the hull with the control car toward the nose. The four main engines are contained in streamlined cars or "power eggs" attached to the outside of the hull (Fig. 55).

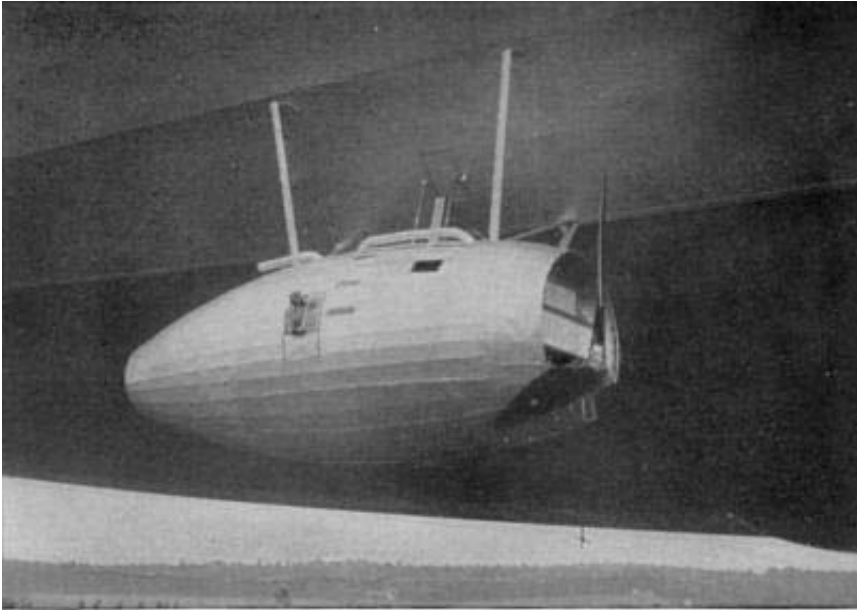


Fig. 55.—One of the four engine cars on the Zeppelin LZ-130.

The accommodations for the passengers are similar to those on an ocean liner. Most of the cabins are outside rooms with sloping windows in the hull through which one can view the scenery below. The lounge, smoking room and dining room are spacious and well appointed. Hot and cold running water are provided in the cabins and shower baths are another feature. More than fifty passengers can be carried on this airship which is normally manned by a crew of forty for a long voyage.

The four water-cooled Mercedes-Benz DB 602 Diesels which constitute the main engines have a maximum output of 1,320 h.p. each and a continuous cruising output of 800 h.p. Their fuel consumption is only 0.375 lb. per h.p. per hour, or 1,200 lb. of fuel oil per hour for all four engines. The water vapor contained in their exhaust gases is recovered and condensed for cooling purposes which helps to compensate for the weight of fuel consumed and eliminates much of the valving of lifting gas toward the end of a journey. Two 50 h.p. Mercedes-Benz Diesel-electric power plants on board supply the electricity for lighting, heating and cooking. All of the engines run on ordinary commercial fuel oil.

With regard to performance, the Zeppelin LZ-130 is a good deal slower than a 50-passenger airplane but it has much greater range and payload capacity. Its maximum speed is 84 m.p.h. and it cruises at 78 m.p.h. This type of airship can fly non-stop from Frankfort-on-Main in Germany to New York in 45 hours or to Rio de Janeiro in 85 hours. Its payload capacity of 20,000 lb. and flight range of 8,700 miles cannot be equaled by any transoceanic airplane now in existence. The only reason this Diesel-engined airship has not been used for passenger service is that the hydrogen with which it is now filled is too dangerous and non-explosive helium cannot be obtained in appreciable quantities in Europe.

FLIGHTS WITH THE DIESEL

Numerous long-range flights have been accomplished with Diesel-engined aircraft over land and sea. Over land the longest non-stop flights have been made with two-engined Junkers Ju 86 mail planes between Germany and Bathurst on the west coast of Africa. The distance of 3,600 miles has been flown non-stop in 20 hours with ample margin for 1,000 lb. of payload in addition to

fuel reserve. During another flight of a privately-owned Junkers Ju 86 airplane it was found that no regular fuel oil was available at Kabul in Afghanistan and so kerosene was used in the Diesels without ill effect for a 930-mile flight to Jask on the Persian Gulf.

TRANS-OCEANIC DIESEL FLIGHTS

Fine flights with Diesel-engined flying boats and seaplanes have been made across the North Atlantic and the South Atlantic oceans. Regular air mail service with two-engined Dornier Do 18 flying boats across the South Atlantic was inaugurated by Deutsche Lufthansa in 1937 and in the following year it was augmented with four-engined Blohm & Voss Ha 139 seaplanes. Four-engined Dornier Do 26 flying boats capable of carrying passengers as well as mail were put on this route in 1939. The distance of 1,890 miles between Bathurst and Natal in Brazil was flown on regular schedule in approximately 10 hours. One of the Dornier Do 18 flying boats made a remarkable flight in 1938 when it flew from the catapult ship Westfalen stationed off Plymouth in the English Channel to Caravellas in Brazil. This nonstop flight of 5,125 miles was completed in 45 hours and 10 minutes with a crew of four on board.

The survey flights made by Deutsche Lufthansa with Diesel-engined airplanes across the North Atlantic also deserve mention on account of the regularity with which they were carried out. In 1936 eight trips were made with Dornier Do 18 flying boats between New York and the Azores. In 1937 fourteen flights over the 2,400-mile route were made with Blohm & Voss Ha 139 seaplanes. The same airplanes were used for twenty-six more flights in 1938. Junkers Jumo 205 Diesels were installed in all of these airplanes and their fuel consumption at cruising speed was only 0.36 lb. per h.p. per hour. During these forty-eight survey flights across the North Atlantic a total distance of 116,490 miles was covered including shuttle service between the Azores and Lisbon (Fig. 56).



Fig. 56.—Blohm & Voss Ha 139 transatlantic mailplane, 1938.

MILEAGE FLOWN WITH DIESEL-ENGINED AIRCRAFT

The actual mileage flown with Diesel-engined aircraft is small compared with that flown with gasoline-engined aircraft. Nevertheless, it is sufficient to show what can be accomplished with this new type of power plant. During 1931 when there was one Junkers F-24 single-engined airliner flying with a Diesel the total mileage was only 1,634 miles. As Deutsche Lufthansa placed more Diesel-engined airplanes in service the yearly mileage increased so that for 1933 it had risen to 61,614 miles. Two years later it had increased to 608,233 miles and in 1938 the mileage flown was 1,247,428 miles. During the eight-year period from 1931 to 1938 Deutsche Lufthansa flew 4,243,895 miles with Diesel-engined civil airplanes (No figures are available for 1939 on account of the second World War).

In addition to these flights with civil airplanes there is also the mileage flown with military airplanes to be taken into account. Although actual figures are not available it is reasonable to assume that during 1937 and 1938 the numerous Diesel-engined squadrons of the German Air Force covered 50 per cent more miles than their relatively few civil counterparts. This being the case, a total of 6,365,842 miles was flown with Diesel-engined warplanes.

There is also the mileage flown with lighter-than-air craft powered with Diesels to be included. During the Summer and Fall of 1936, the Zeppelin LZ-129, the *Hindenburg*, made twenty non-stop flights between Germany and the United States. On these trips it flew 85,058 miles at an average speed of 80 m.p.h. carrying an average payload of 13,130 lb. of passengers, mail and freight per trip.

Totaling the mileage flown with Diesel-engined aircraft it is estimated that at least 10,694,795 miles were flown with them up to the end of 1938. This is a good indication of the confidence placed in the Diesel aircraft engine by one country and augurs well for its future in other countries.