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LARGE GERMAN AIRSHIP STATIONS.

By

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The strength of a country's air service does not depend simply on the number of its pilots and machines, but also on the character of its factories and its stationary plants (parks, airdromes, etc.). It may even be said that the latter elements are the most immediately necessary, for, though it is possible to improvise an air fleet quite quickly, as during the war, it is a much slower and more costly process to create the inner structure which alone can give the requisite stability.

For nothing, moreover, is there greater need of stations well equipped with tools than for airships. Thus, on going over the list of 73 airship hangars, which the Germans possessed at the time of the armistice, and the stations they have created, not only in Germany but also in Poland, Bulgaria, and Hungary, we can not help thinking that a country possessing such elements of aerial power remains redoubtable, even though it has temporarily lost the airships once contained in these stations. It also makes us realize that our own country should have stations comparable with those of its rivals.

In this connection, it is profitable to examine the organization and equipment of the German airship stations. The stations best adapted for serving as the basis of this study were chiefly

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constructed by the German Navy, during the war, for exclusively military purposes and do not therefore entirely satisfy the conditions of exploitation required for a civilian air service. The requisite modifications for satisfying the latter conditions may nevertheless be readily determined according to circumstances.

General Plan of an Airship Station.

This depends first on the number and kind of hangars it has. From this point of view, "L'Aeronautique" has already considered the advantages presented by orientable hangars (See "L'Aeronautique," for July, 1920). In spite of these advantages, the Germans employed during the war only one movable hangar, that at Nordholz. The dispositions made in various stations, notably at Schneidemuhl, indicate however that, if circumstances had permitted it, the employment of revolving hangars would have been much more common. It is, in fact, probable that the necessity of rapid and economical construction led our enemies to resort to the almost exclusive use of stationary structures with simple metal frames.

On glancing at the plan of a large German station, we are first struck by the large space occupied. At Nordholz, about 1200 hectares (3000 acres) are occupied by the maneuvering fields and their dependencies. The hangars themselves seem to have been dropped at random on this vast expanse, without any of the alinements or geometrical arrangements often found in other countries.

This disorder is however more apparent than real. The hangars are, in fact, generally constructed in pairs, each with perfectly free access at both ends. Besides, each pair is oriented differently from the others, so that, whatever the prevailing wind direction, one or the other of them is favorably situated for the entry or exit of its airships.

There are evident advantages in such a plan for the utilization of the airships, but unfortunately it leads to multiplying the hangars and distributing them over extensive fields. Besides, since the most accessible hangars vary according to the direction of the wind, it is necessary, in order to guarantee regular service, to have in each group one airship always ready to start, and a free place for any airship returning to port unexpectedly.

The most complete application of the above mentioned principle is at the Nordholz station which has, in addition to its rotary hangar, three groups of hangars oriented at 120° with reference to one another. The distance between each group and the others is from 500 to 1000 m., making the maneuvering fields entirely independent of one another. There is room in each group for four airships, corresponding normally to one on the point of departing, two in reserve or being repaired and, lastly, to one place available for the reception of any airship returning to port.

We also find similar dispositions at Ahlhorn. However, in order to save space (500 to 600 hectares, instead of 1000 to 1200), the groups are nearer together and their landing fields partially overlap.

Let us note, in passing, that the employment of revolving hangars would have given the same facilities for maneuvering and, other things being equal, with less space and fewer airships.

Construction Details. Hangar Accessories.

The existing large airships are about 225 m. long by 26 m. wide and 30 m. high. The newest German hangars are 260 x 75 x 40 m. and each can hold two airships side by side. A double hangar has great advantages. In the first place, it can be used as a single hangar in case a rapid increase in the size of airships should render it necessary. Furthermore, the maneuvers of entering and leaving the hangars would be facilitated by the greater width between the doorposts. On the other hand, the risk is greater in case of fire.

Each pair of hangars constitutes, in Germany, an autonomous whole, which is served by a standard-gauge railway and provided with storehouses and barracks.

This independence, which is still further accentuated by the considerable distance generally existing between the groups, is advantageous from the military point of view, since it limits the possible destructive effects of a fire or bombardment. It is more subject to criticism from the industrial point of view, because a more compact arrangement would make it possible to reduce the number of plants and facilitate their operation, besides economizing in the size of the field occupied.

The hangars, considered individually, should, above all, be designed with a view to facilitating the care of the airships contained in them. They should also be protected against fire.

In caring for an airship, it is necessary to go about without a light, not only around the balloon and its cars, but even inside the envelope, especially in the keel corridor. It is therefore essential that the daylight illumination of the hangar be well provided for. The light must also be well diffused, in order to avoid contrasts of light and shadow which greatly obstruct the view inside the envelope. In the German hangars, windows cover not only the side walls but also the roof and the end doors. They cover about one-third of the surface. The glass is colored yellow in order to reduce the chemical action of the sun on the fabrics.

By night, it is especially necessary to illuminate the floor and the roof of the hangar on account of the operations of propping and suspending the frame of the airship. Lamps must therefore be installed a few meters from the ground and also under the roof. The precautions prescribed for localities where combustible gases may accumulate apply also to lamps, to their wiring and to their accessories.

It is also essential for the good preservation of the balloon fabrics, and especially for goldbeater's fabrics, to avoid excessive dryness or humidity, frost or high temperatures.

Excessive dryness is prevented in summer by a systematic sprinkling of the hangar floor, combined with energetic ventilation. The cold and humidity are combated by means of a central radiator well spread out.

Lastly, the hangar walls are covered with heat-insulating materials (bitumenated cardboard and asbestos board), and the roof is provided with large ventilating chimneys. Each hangar has about thirty of these chimneys, which are about 0.6 m. in diameter, and can be closed by movable trap doors. The side windows have a movable part for creating air circulation about the balloons.

Said devices serve not only for the protection of the hangar against the heat, but also against fire, by the rapid elimination of the combustible gases escaping from the ballonets. This elimination is especially important during inflation and, above all, during deflation of the balloon.

The gas conduits (which are generally double and 0.5 to 0.6 m. in diameter) are buried under the floor of the hangar and are provided every 20 m. with strong branch valves. The connection between the stationary conduits and the ballonets is made by strong flexible sleeves from 6 to 7 cm. in diameter, terminating in dust filters. Precautions are taken to prevent the formation of dangerous sparks from the electrization due to the friction of the gas on the metal parts of the filters.

The gasoline is never handled in the open air. It is stored in subterranean reservoirs of 30 to 60 cu.m. capacity. The upper part of these cisterns is filled with some inert gas, generally carbon dioxide, which renders it possible to force the fuel into the portable distribution tanks mounted on wheels and provided with pumps and safety cocks. These tanks deliver the fuel to the various tanks on the airship.

Of course, the foregoing precautions against fire are supplemented by numerous fire extinguishers and a complete system of water pipes under pressure. There are, in general, on each side of the hangar, about every 50 meters, hydrants with two branches, provided with ordinary hose and nozzles.

Independently of the above dispositions, it is interesting to note the following accessories with which German hangars are generally provided. A tank of distilled water, capable of being heated, serves for filling the radiators. Piping for the distribution of ordinary water likewise serves for filling the ballast bags. One or two towers, of variable height, similar to the ones used in repairing telegraph lines, three or four portable ladders with adjustable inclination, numerous ordinary ladders and several connecting bridges enable access to the various parts of the envelope. Lastly, there are usually under the roof three longitudinal bridges along which run suspension rails, which serve as supports for the frames of airships held in reserve or being inflated.

Maneuvering Fields and Accessories.

The maneuvering fields occupy, as we have seen, extensive tracts of land. Each group has, as a rule, two fields at each end of the corresponding hangars. The ground is leveled and carefully drained. All telegraph and other wires are put under ground and no obstacle is left to interfere with the work of the landing gangs.

For removing the airships from the hangars or for returning them, use is uniformly made of two guiding rails in underground conduits. Heavy cars run on these rails which hold them equally well either horizontally or vertically. The rails pass through the whole length of the hangar and extend into the field about 250 m., or a little more than the length of the airship. When the hangars are double and contain normally two airships, there are three rails, one of which serves both ships in common.

The guiding cars are mounted on ball bearings and are easily controlled, in spite of their weight. They are provided with a very rapid slacking device. Generally two of these cars are employed on either side of the airship, or four in all, but this number may be increased to six in case of bad weather.

This device seems to have given complete satisfaction, since it is uniformly employed in all German stat ions and since it has not been considered advisable to resort to screens, outside ports and devices for mooring in the open air, which are favored in France and especially, in England.

On the landing fields and hangars there are, of course, night landing lights and meteorological and radio stations. In case of fog, recourse is frequently had to a captive observation balloon.

Hydrogen Works.

In concluding, we have a few words to add on the German hydrogen works. These plants have a capacity suspected by few persons in France. At Ahlhorn their capacity of production is 70,000 cu.m. per day. Let us recall, for the sake of comparison, that the large French works, based, it is true, on other processes, delivered during hostilities hardly 4000 cu.m. per day.

Most of the German works employ the so-called "iron" process, that is, the decomposition of steam by red-hot iron and the regeneration of the iron oxide by a current of water gas. Since this method requires highly heated furnaces, it is economical only when continuous. Since, however, its consumption is not regular, extensive facilities for storing the gas are necessary. Moreover, it is well to be able to transport and even to sell unrequired surplus. Developments in the use of this gas (for hardening oils, for various chemical processes, and, lastly, for autogenous welding) are favorable for the existence of such outlets.

It must be possible, at the stations, to inflate and replenish the balloons very rapidly, if they are to render the greatest efficiency. It is, moreover, the question of inflation which precedes, in determining the plants, the question of replenishing. In fact, for a large airship of 70,000 cu.m., with a total theoretical carrying capacity of 50%, the maximum unballasting (fuel, ballast, bombs, etc.) during a voyage, is 15 to 20 tons. On its return, therefore, it must receive a fresh supply of 15,000 to 20,000 cu.m. of hydrogen. Under these conditions, unless for a particularly intense service, it is sufficient to hold in reserve 10,000 to 15,000 cu.m. of gas for immediate replenishing.

It is not exactly the same for inflating. It is assumed, in fact, that it must be possible to fill a large airship in 10 to 15 hours (The L-72 was filled at Friedrichshafen in 12 hours). At this speed, there is the advantage of not requiring so large a personnel and, above all, of facilitating the process of balancing, which might needlessly strain the frame of the balloon. It is, in fact, just so much easier to avoid a wrong distribution of the weight and lifting forces, as the means are more powerful for producing a rapid flow of gas into the balloon. It was probably for this reason that most of the German stations have a gasometer of 30,000 cu.m. and a battery of cylinders containing 30,000 to 50,000 cu.m. of gas under pressure, making a total of 60,000 to 80,000 cu.m., a volume practically equal to that of the largest airship.

It is then easy, as soon as an inflation is anticipated, to provide for completing the inflation from reservoirs, without furnishing the balance of the gas required at the end of the operation directly from the hydrogen works to the balloon.

It is, moreover, surprising how large a proportion of the hydrogen in Germany is stored under pressure. At first thought, it would seem, in fact, more economical to resort to the exclusive use of gasometers and thus avoid the expense of compressing, which absorbs about 0.5 HP per cubic meter. Nevertheless, the compressed gasplants of the German stations are interesting to consider. The containers are enormous cylinders 15 to 20 m. long by 1 m. in diameter, each holding about 1000 cu.m. of gas at 100 kg. They are stationary, on beds of masonry, and separated from one another by strong partitions. The whole plant is generally placed in a deep cave, sheltered from bombs. Lastly, in order to avoid explosive mixtures during the first filling, vacuum pumps are provided for removing the air from the reservoirs.

Due to these precautions, the reserve supplies in cylinders are little visible and little vulnerable. Their installation is rapid and easily modified. Lastly, there are no losses, such as may be very troublesome in using gasometers at long distances. Since there is little chance for the introduction of air into the cylinders, the purity of the gas is excellent. (The lifting force of the gas used in the L-72 was about 1188.)

Lastly, there exist in addition to the above described stationary plants, stores of portable cylinders similar to the French cylinders, and many tank cars, designed for running on ordinary railways, each holding from 1500 to 3000 cu.m. of gas.

The capacity of the hydrogen compression plants naturally depends on the productive capacity and exploitatiom conditions of their hydrogen works. It is not so much the inflations (relatively less frequent) as the replenishing and the needs of the service away from the central station, which determine the output of the compressors.

Ordinarily the 30,000 cu.m. of the gasometer would seem sufficient for the daily replenishing and for serving as a balance between the continuous production of the works and the irregular consumption of the balloons. In short, it is the needs of the outside consumers who, depending entirely on the compressed gas, determine the importance of the battery of compressors. At Nordholz the hourly output (1200 cu.m.) of the compressors differs but little from that (1000 to 1500 cu.m.) of the hydrogen producing works. The situation is about the same at Tondern (500 cu.m.). On the contrary, at Ahlhorn, where the gas production exceeds 2500 cu.m., the hourly output of the compressors differs but little from that of Nordholz.

Conclusion.

We have reviewed the various organs required for the intensive exploitation of an airship station. They constitute altogether a veritable factory whose industrial character is clearly evident. As in every enterprise of this character, the cost of the first establishment is high. If, however, the plants are conceived on a large enough scale and methodically executed, the expenses incurred are rapidly amortized and the benefits of a favorable exploitation are assured. In this connection, it must be recognized that the Germans had a broad outlook in the organization of their airship stations. May France some day profit from the example thus given her by her rivals.

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