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No. 113

REPORT ON THE GENERAL DESIGN OF COMMERCIAL AIRCRAFT.

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It has too often been the practice of those responsible for the selection of airplanes for use on the European air transport lines to choose them with regard primarily, if not solely, to their commercial efficiency, to the pay load carried per horsepower, with secondary attention to accessibility and ease of maintenance. The passenger's viewpoint has too often been neglected, apparently on the theory that the passenger requires nothing except to be shot through the air from one city to another at maximum speed. In general, however, travelers will not ride a second time on a line where they have been uncomfortable or where they have had a feeling of constant strain and of omnipresent danger during their flight.

Since the passenger's point of view has seemed to be the one which suffered by neglect, it is that point of view that I have endeavored to preserve during my recent travels on European air-lines, and it is as a passenger that I have undertaken to discuss the airplanes in which I rode.

My air travels covered a little under two thousand miles, in the course of which I made use of six distinct types of airplane, one of those types being fitted with different engines

on the two routes on which I used it. The airplanes and engines and the distance covered in each are tabulated below:

DH 34	Napier Lion	330 miles
Handley-Page W8B	2 Rolls-Royce Eagles	230
Farman Goliath	2 Salmsons	170
Potez IX	Lorraine	260
Spad 33 (Berline)	Lorraine	350
"	Salmson	290
Fokker F.III	Siddeley Puma	110

Seating Comfort.

If the features which affect the passenger's enjoyment of an airplane trip are to be listed in order of importance first place must be disputed between seating comfort and ventilation of the cabin. In respect of seating most of the designs are much alike, being fitted with wicker chairs having low backs and cushions about two inches thick. The conspicuous exception is the Fokker, which is fitted with leather-upholstered seats the cushions of which are some twelve inches deep and sprung more easily than any automobile seat cushions. The effect on the passenger is somewhat similar to that of making him the stationary element of a seismograph, the airplane rising and falling in bumps while the seat cushions give the passenger the impression that he is stationary in space while the airplane moves around him. Personally, I found this seating very comfort-

able, but the only case of air-sickness that I actually saw this summer was on the Fokker, although the ventilation of the cabin was perfect and the air was not at all rough. One of the De Havilland engineers told me that Capt. De Havilland had made an extended investigation of this question of seating arrangement and had become convinced that the wicker chair was preferable, quite apart from its lighter weight , and it is interesting to note that on the most recent Fokkers, those fitted with Rolls-Royce engines, the deeply-sprung leather seats have been replaced by the more conventional type.

Ventialtion.

There is no doubt that most cases of air-sickness are due to insufficient ventilation of the cabin. While the very important matter of ventilation seems simply to have been ignored in some instances, it is not easy to secure satisfactory results even after the most careful study. The awkward nature of the problem and the difficulty of treating it by the accepted methods and formulas of the heating and ventilating engineer have been fully pointed out by Col. Beatty in his recent paper to the Royal Aeronautical Society. The major difficulty was there shown to be the small size of the cabins and the small volume of air per passenger.

In no case is there any evidence, in the airplanes under discussion, of elaborate provision for forced ventilation. There

usually are small openings in the roof of the cabin (in the Handley-Page, for example) which serve for the outflow of air but the primary dependence is placed on the windows, which can be open or closed as the passengers desire. This works out very well in warm weather, but it would of course be almost impossible to keep the cabin heated to a comfortable temperature in winter if it has to be ventilated by opening windows directly beside the passengers. The windows are generally arranged to slide horizontally, only a small part of the glass on each side being movable. In the Handley-Page, for instance, only two panes on each side slide, the remainder being permanently set. The Fokker is an exception in the use of large windows, a single one on each side, which drop vertically much like the windows of a closed automobile. The ventilation arrangement on that airplane is almost ideal for summer flying, and the Handley-Page and DH 34 are also very satisfactory. On the Potez the windows are small, and the air at times is bad, but it seems difficult to do better with a biplane having so small a cabin. My chief complaint against the windows on the particular Potez on which I traveled falls under the head of view, the panes being of yellowish color and unsatisfactory transparency. A good grade of non-shatterable glass should be, and generally is, used. The Farman Goliath and the Spad are peculiar in that there is direct communication between the cabin and the cockpit. The opening between the two cannot be closed, and heating would therefore be very difficult, the heated air all tending to flow to the cockpit and

up and out around the pilot's head. There is a further disadvantage, particularly marked on the Spad, where the cockpit is behind the cabin, in that there is a slight depression inside the cockpit. As soon as a window is opened, therefore, the air tends to flow through with great violence, blowing in the face of the passenger who sits beside the open window. To reduce the disagreeable effects of this draft, openings are provided in the roof, and when these are opened for ventilation the air entering there rushes down the aisle between the passengers, passing out to the cockpit. Incidentally, the windows on the Spad differ from all others in that, circular in form, they swing instead of sliding. The swinging window appears to me distinctly inferior to the sliding type, as it has to be almost fully opened before it is possible to get a clear view through it, and the window and its frame project far into the cabin when open. The Farman has movable windows (sliding) in the rear cabin. In the front cabin, however, where the windows face almost exactly in the direction of motion, ventilation is provided by little metal panels below the windows. These panels can be slid back to uncover a dozen holes about 3/4" in diameter.

Noise.

The subject of noise in commercial airplanes is one which has been badly neglected. As a result of having talked with many passengers immediately after their first air trips, as well as with others of more experience, I am convinced that the ex-

cessive noise of present-day airplanes is one of the greatest handicaps that commercial aviation has to meet. Many passengers have told me that they were glad to have made a flight, for the experience, but that they never want to make another. Being pressed for reasons, they nearly always allude to "the infernal racket" and declare themselves almost deaf after a three-hour journey.

Speaking first of the way in which the airplanes compare, the DH 34 is much the quietest. It is possible to converse inside the cabin of that airplane, even when a window is open, without shouting to an uncomfortable extent. Another American and I talked almost continually during the flight from London to Paris. We did not have to approach closer than eighteen inches from each other, and we were not hoarse when we arrived in Paris. I dwell on the incident at some length because there are few airplanes in which it would be possible to duplicate it. Not even the DH 34 can be considered satisfactorily quiet, but it represents a long step ahead. I have heard other travelers make some complaint of gear noise on the DH 34 with the Lion engine, but I personally did not notice it. Next in order of merit I put the Goliath and the Handley-Page, bracketing them together. The first-named is, if anything, a little the better. In these airplanes it is possible to make oneself understood by shouting very close to the listener's ear, but conversation is an exhausting undertaking. Next comes the Fokker with windows open (it would undoubtedly be better with them closed), in which a shout can

sometimes be understood, but not with regularity. Finally, in the Potez and Spad, conversation is virtually impossible under any conditions. It might be possible to hear a few words in the middle part of the Spad cabin with the windows closed. I did not have a chance to try it. In the Potez, however, I rode for two hours in company with two other passengers, during which time none of us was able to make the others understand a single word, and we had to communicate by writing.

On most of the European air-lines it is the practice to give each passenger some cotton, advising them to put it in their ears. It seems to me that no airplane on which such measures are necessary is fit for serious commercial work, and the passing out of the cotton is in the nature of a confession that the airplanes used are far too noisy.

The noise comes, of course, chiefly from the engine exhaust, and this part of it can be much reduced by fitting a long exhaust pipe. That is done on the DH 34, and it is noticeable that the noise becomes greater as one approaches the rear of the cabin and the end of the pipe. Another factor which is sometimes important is the vibration of the airplane structure itself. This is notably the case in the Fokker, where the slapping of the fabric covering against the steel tubular structure of the fuselage appears to be a major element in the sound.

Seating Arrangements.

The seating arrangements on all the large airplanes are the

same, individual chairs being placed on each side of the cabin, with an aisle between them. On the Goliath there are two cabins connected by an aisle which runs alongside of the pilot's position. The mechanic is ordinarily seated in this aisle, and has to remove his stool and crawl in partially under the pilot's seat whenever passengers wish to walk to and fro.

In the smaller airplanes there is more diversity of arrangement. On the Spad five passengers are carried, three of them riding inside the cabin in chairs facing forwards, one in a similar chair facing backwards, and the fifth in the cockpit beside the pilot, behind a windshield so excellent as to render goggles unnecessary. The arrangement of seats so that some or all of the passengers face towards the rear is undesirable, as it is likely to cause air-sickness, and this feature of the Spad design can hardly be approved. Carrying passengers in the cockpit is also an expedient of doubtful wisdom. It seems safer to follow the practice adopted by the Daimler Company and always to use the second seat in the cockpit for a reserve pilot capable of operating the controls in case the regular pilot is injured or becomes ill.

The Fokker, which also carries five passengers, employs quite a different scheme. Three persons are seated side by side on a seat which runs across the back of the cabin, the other two occupying chairs a little farther forward and against the sides. This seems to me the best arrangement that has been produced for a five-passenger cabin.

The Potez has a four-passenger cabin, and the seats are in pairs. The cabin is not wide enough to leave an aisle between the seats, and one of the rear seats is directly against the door The airplane is therefore loaded by removing the chairs and allowing the passengers to get in and then sliding the chairs in behind them. There is a metal cross-tube running across between the front and rear rows a little higher than a man's waist, and it is necessary for the forward passengers to duck under this to reach their places. It is a little too crowded for comfort in getting in, but there is plenty of room for the passengers after they are once installed.

The leg-room is remarkably good in the cabins of all these airplanes. I am considerably above the average height, but I had no complaint to make against any of them in that respect.

The chairs are always fastened in place, of course. In a few instances, as in the rear seat of the Fokker and in one or two of the larger airplanes, they are permanently installed, but in most cases they are held by a piece of shock-absorber cord with a hook at each end, running from an eye-bolt in the floor to one in the chair.

Safety belts are provided only in the Spad. Their provision seems to me unwise. They are useless unless they are fastened all the time, and an ordinary passenger will not strap himself in except after a lecture on the dangers of accident which will make him want to abandon the trip altogether. The psychological effect of the belt is bad, and there should be no vital necessity

for it inside of a closed cabin. It is better to fasten the chairs down and to make their arms of such form that it is easy to hold on in case of a rough landing.

Cabin Doors.

Doors are provided in all the airplanes now in actual commercial use, on one side only. They are satisfactorily large in most cases, the Potez being the most cramped for entry and exit, which is natural, as it is the smallest airplane in every way. In several of the airplanes under consideration it is something of an acrobatic feat to alight without assistance from outside, but that assistance is always available except in case of a forced landing. None of the doors are high enough to enter without stooping, but it is not really necessary that they should be, and I think, on the whole, that the present situation in this respect does not require improvement.

One feature which has been given some attention is the possibility of a door's being opened or opening itself in flight and allowing a passenger to fall out. No such accident has ever happened, but it seems wise to make definite provision against it. On the Fokker a steel bar is lowered across the door and locked in place, so that the weight of a passenger leaning out of the window falls on the bar and not on the door itself. Parenthetically, I may remark that such precautions do little good unless they are used, and that on my flight from Brussels to Amsterdam the mechanic who closed the door forgot to lower the bar. Provision against the opening of the door is also made in the

cotlath, incidentally to the attainment of another end, by the running of a fuselage bracing wire across the door. The wire has a quick detachable fitting of the lever-and-toggle type at one end, and it can therefore be disconnected and removed while the passengers are getting in and out, being replaced before going into the air.

Baggage Accommodation.

The storage of baggage is a problem of considerable and growing importance, especially in view of the number of tourists who are crossing from England to the Continent by air and who want to take with them everything that they own. The amount of this business is much larger in Europe than it would be likely to be in America, as the rates for international express service in Europe are fantastically high. A voyager by air from Paris to London actually finds it cheaper to take his baggage with him in the airplane than to send it by express, to say nothing of the fact that the express service takes about a week for two hundred and thirty miles. When I last crossed to England by Handley-Page I took with me in the airplane more than two hundred pounds of books and documents obtained on the Continent, and paying excess baggage on them by air actually was the cheapest method of transporting them.

There are three general methods of handling baggage. It may be sent along in another airplane especially fitted for its reception, it may be stacked in the cabin, or it may be carried

in a baggage compartment not directly connected with the cabin. The first method has been little used as yet, although one of the London-Paris lines has recently put on a special baggage and express service by airplanes without seats, the whole cabin being filled with express matter, and an American tourist well-known in aeronautical affairs in this country recently hired two airplanes, one for his family and another for his trunks, to take him across the Channel.

The second method, that of carrying the baggage in the cabin, is generally used in the French airplanes. It would be very undesirable were it not that the French lines are running as a rule with a very low percentage of full load, thanks largely to the great generosity of their subsidy, and there is nearly always plenty of spare room for the baggage, which is simply stacked between chairs and in the aisle. Trunks, however, cannot be handled in this way. To give an indication of the condition existing on the French lines on the Continent and the amount of space available and unused inside the cabin I have tabulated my own experiences below:

Route	Airplane	No. seats	No. passengers	% load
London-Paris	DH 34	8	7	88
Paris-Brussels	Goliath	12	2	17
Brussels-Amsterdam	Fokker	5	3	60
Prague-Vienna	Potez	4	1	25
Vienna-Prague	"	4	3	75
Prague-Strasbourg	Spad	5	1	20
Strasbourg-Paris	"	5	1	20
Paris-London	Handley-Page	10	8	80

The French companies on the London-Paris route are doing better than those on the Continent, although not so well on the whole as the English undertakings.

The carrying of baggage in the cabin can only be considered a temporary makeshift, and the only real solution is the use of a special compartment, such as is provided on the DH 34 and on the Handley-Page. In the DH 34 the baggage compartment is behind the cabin, thus being far from the center of gravity of the airplane, and the changing weight of baggage is likely to interfere with balance in flight. When I flew in that airplane the weight of baggage was unusually large, and we had been off the ground only a few minutes when the pilot requested that the heaviest passengers should take seats as far forward as possible and that the one vacant seat should be the rearmost one. On the Handley the likelihood of such difficulty is reduced by the provision of two compartments, one behind the cabin and the other in front, below the pilot in the very deep fuselage. The weight in the rear compartment can then be kept substantially constant. These compartments and the doors leading to them are large enough to admit a good-sized trunk.

Interior Arrangement of Cabins.

The interior decoration schemes on the transport airplanes actually in use are much simpler than were those shown at the last two Paris salons, and the change is, on the whole, for the

better. Lace curtains and similar ornaments were not only unnecessary but positively dangerous, owing to their inflammability. The most elaborately finished of the airplanes now in actual use is the Fokker, closely followed by the English airplanes, all of these having carpeted floors and cloth-covered or cleanly-painted walls and ceiling, and an evident effort having been made to keep the interior as neat as possible without allowing it to become ornate. The interiors of the three French airplanes used are very plain, being finished simply in brown or yellow paint.

The subject of interior arrangement naturally includes any arrangements made for the information and diversion of the passengers. The French lines make no such arrangements. On all the airplanes except the French ones, there are notices posted in the cabin for the purpose of instructing and allaying the nervousness of those travelling for the first time. They carry prohibitions of smoking and of throwing anything out of the windows (on the Goliath there was no prohibition of smoking, and the mechanic passed cigarettes around to the passengers) and comforting information to the effect that the bumps that will be felt merely correspond to waves at sea and do not represent any danger, the airplane being inherently stable (there may be some question as to how many of the passengers know what "inherently stable" means). They further add, in the two larger airplanes, the information that passengers can move about freely and change seats while in the air, the slight redistribution of weight hav-

ing no effect on the control. This is very wise, as the novice in air travel often seems to fancy that he is in a vehicle more tricky than a canoe, and sits staring straight in front of him with every muscle strained throughout the journey. The notice in the Handley goes on to specifically urge the passengers to relax and take it easy, while the Fokker notice, printed in three languages, says: "The pilot of this airplane has been selected after long training. He knows his business. Trust him and don't worry."

The notices are very useful, but they are sometimes too small to be read by all the passengers, and it would be well if they were supplemented, in accordance with the plan adopted by the Deutsche Luftreederei, by little booklets of information and suggestions for air passengers, to be given out to each person when they purchase their ticket. I heard the other day (it is a frivolous story, but it made two enemies for air travel) of two American girls who traveled for three hours of a hot day in the rear seats of a DH in which there were no other passengers. They could not read all of the notice in the front of the cabin, but saw something about windows (the warning not to throw anything out) and thought that it said not to open them, so they nearly suffocated and had a most unpleasant trip.

Many of the passengers, particularly those who are regular patrons, feel an interest in the performance of the airplane, and I have seen one or two of them carry pocket altimeters. It seems obvious that it would be wise to provide instruments inside

the cabin, but I have seen this done only on the Handley, where an altimeter and an air-speed meter are located on the forward wall. There is no notice provided regarding them, however, and many of the passengers don't know what they are. I believe that these instruments should be installed in all cabins, with a few words of explanation below regarding the causes of changes in speed.

Pilot's Position and Communication with Pilot.

On the two English airplanes under discussion and on the Fokker the pilot sits forward of the cabin, the passengers being placed at least near the trailing edge of the wings, if not actually behind them. On the Potez and Spad, as on most of the early British commercial designs, the pilot is behind the cabin, while on the Goliath he is between the two parts of the cabin. Opinion among pilots as to the relative merits of the different positions is variable, but there can be no doubt that it is better, from the point of view of the passengers, to have the pilot in front. The only flaw in a forward position, so far as those who pay to ride are concerned, is that on a twin-engine airplane their forward view is obstructed by the pilot. Its obvious advantage is greater safety, and if the possibility of crashes must be taken into account the safety of the passengers must be the first consideration. The pilot is paid to take the risk; the passengers are not. There have been too many accidents on airplanes with the pilot in the rear, where one or several pas-

sengers have been killed or badly hurt while the pilot has escaped uninjured.

It is desirable that the pilot and passengers should be able to communicate in emergency, and this is possible in most cases. On the Spad and Goliath, as already noted, there is direct connection between cabin and cockpit. The Potez has an opening about four inches in diameter in the instrument board. It is ordinarily covered with a metal door, but can be opened by the pilot. On the Handley-Page there is a door, ordinarily closed, between the cabin and the quarters of the mechanic, who sits beside and below the pilot and who also serves as radio operator, radiophone being carried on all the large British commercial airplanes. The DH 34, like the Potez, has a little door between cabin and cockpit, the cockpit in this case being forward of the cabin. The door can be opened from either side, and a notice instructs the passengers, should they wish to communicate with the pilot, to open the door and push a note through. On the Fokker, pilot and passengers are in two different worlds from the instant the engine starts, so far as the possibility of communication is concerned.

Pilot's Accommodations.

I cannot say much about these, since I was of course unable actually to occupy the pilot's seat during flight. The field of view for commercial purposes appears satisfactory in all cases. The Fokker is of course extremely blind upward and to the rear, but the view in the direction of travel is exceptionally good.

None of the airplanes examined except the DH 34 make provision for two pilots. Even in that instance there is only one control, which can be operated by either pilot.

The pilot's equipment of instruments is usually simply the ordinary lot provided on military airplanes. On the DH 34 and Handley, however, a turn indicator and a lateral inclinometer are carried. The turn indicator is of the static head type on the Handley, gyroscopic on the DH.

View from Cabin.

By far the best airplane in this respect is the Goliath, where an uninterrupted outlook forward and to each side is obtained from the forward cabin. The Fokker is a close second, thanks to the large windows and the parasol monoplane wing. A good view for the passengers is of enough importance so that I believe that it should weigh very heavily in choosing between the wing locations characteristic of the Fokker and Junkers monoplanes.

The range of view from the biplanes depends largely on the seat occupied. It is reasonably satisfactory, on the whole, although the swinging circular windows in the Spad offer some interference.

Safety.

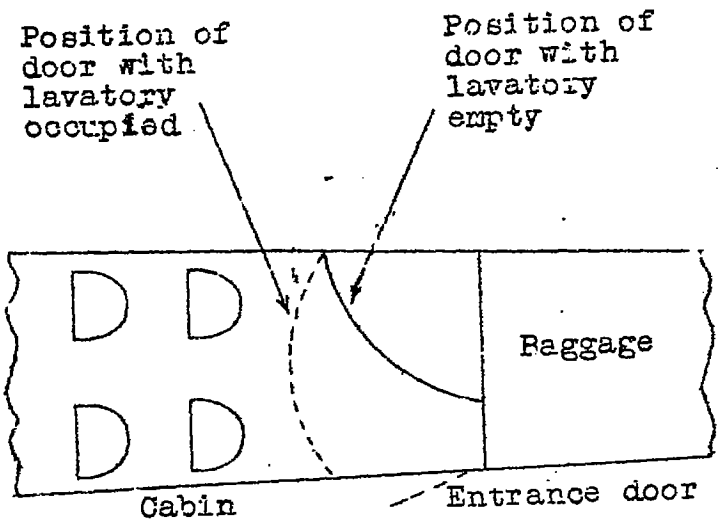
I have already emphasized the importance for safety of getting the passengers as far as possible from the nose of the fus-

elage. The only particular case that needs to be mentioned is that of the Goliath, an airplane which is extremely steady in flight and with a very slow landing speed, but which has a cabin projecting forward of the wings, wheels, and everything else, where it would take the full force of the impact in case the airplane nosed over. Despite the remarkably fine view obtained with this arrangement it seems to be undesirable on the score of safety.

The choice between the single-engined and the two-engined airplane is of course largely influenced by considerations of safety, either real or imaginary. Personally I am an advocate of the single engine, on the theory that an engine failure means a landing with either type and that there are twice as many chances of an engine stopping if there are two as if there is only one which can stop. The two-engined type has, however, an undeniable psychological advantage. Passengers, both novices and those with some experience, testify to an increased sense of security in seeing two engines in full operation.

Lavatory Accommodations.

These are provided on the Handley-Page, DH 34, and Goliath. They cannot be regarded as fully satisfactory in any instance, the arrangement on the Handley-Page being superior to the other two. The placing of the door there to secure a minimum sacrifice of space is very neat, and is illustrated in the sketch.


Position of door with lavatory occupied
Position of door with lavatory empty
Baggage
Cabin
Entrance door