Journal of Air Law and Commerce

Volume 5 | Issue 2 Article 4

1934

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RECENT DEVELOPMENTS IN AIR TRANSPORTATION*

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The watchwords of air transportation are speed, safety, reliability, economy, and comfort.

Speed is essential. The principal reason for the existence of air transport is that it furnishes the fastest means of transportation. To go back for a minute and think of the speeds we have had at various times in the history of transportation, we can go back, let us say, to 1830 when it took six months to cross the continent in a prairie schooner drawn by oxen. Shortly thereafter, the stage coach came in and cut that down to something over a month. Then followed the pony express, and, in 1869, the first transcontinental train. The railroad cut the time for a trip across the continent to seven days. From 1869 almost to date there has been, if we exclude air transport, very little increase in transcontinental speed. When we consider the last few years and realize that in 1930 it took two days by air and rail, flying by day and entraining at night, that in 1932 it took 31 hours to cross the continent by air, and in 1933 airlines instituted a high speed transcontinental service and made it in just over 19 hours, and this year planes are already built and will be in general operation within the next month or so that will cut the transcontinental time down to 15 or 16 hours, we must appreciate what we have seen in the last three or four years in the development of transportation. In sixty years the railroads managed to cut their time from seven days to five—from their first transcontinental train to the most modern train of today. The first airplane service more than halved this time and in the last four years of development the airplane has doubled its own original speed and is still improving.

It was only a few years ago that Colonel Lindbergh made a transcontinental record of 14 hours, 45 minutes, and 32 seconds, if I remember correctly. Now, in a matter of a few months with our most modern transport airplanes, that will be just an ordinary

*Part of an address before the Chicago Bar Association at a luncheon sponsored by the AIR LAW INSTITUTE of Northwestern University, January 25, 1934.

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every-day flight that all of you can make. Truly the record flights of today are the commonplace flights of tomorrow.

There are over 600 planes in operation in the United States —one plane to every nine Pullman cars. Not half of the Pullman cars in the United States are in operation; some are obsolescent and some are laid up. The actual operating figures show about one airplane in operation to every four Pullman cars. This gives a rough idea of how common air travel is becoming.

Three days ago a mechanic was working on my airplane in St. Louis. He called up in the afternoon and said he had found a worn valve and wanted a replacement. I wired to the engine manufacturer in Hartford, Connecticut, and the following morning the part arrived. That is the latest thing that aviation has done: it has inaugurated an air express service that really gives service. The truck will come to the place of business of the consignor, deliver the consignment to the airport; it is then loaded on the airplane, and at the other end the article is delivered to the consignee by another truck.

As an illustration of the time that can be saved by air express, I was in Mexico City a short time ago and found that one cylinder on the airplane (this was, incidentally, a racing plane and quite temperamental—I mention the fact because engine difficulty on conventional airplanes is now practically unknown) developed a little trouble and I had to have another immediately. At one o'clock in the afternoon I telephoned the Pratt & Whitney plant at Hartford, Connecticut, and two days later, at 11:30 in the morning, 46½ hours later—not even two days—the cylinder arrived. It just gives an idea of what air express means—when you think that it would have required at least a week by regular express.

We can group *safety* and *reliability;* they go together. Safety has been greatly increased by improved airplane design and more reliable engines. Public confidence has been gained and the people are becoming airminded. They are learning something about aviation, the potentialities of it, what it can do, and what it means to them. The days when people were ignorant of aviation are over. Ask any boy a question on aviation and then marvel at his clear-sighted knowledge. You recall the story of the elderly lady taking her first trip. She complained that it was too cold. The co-pilot came back and explained that that was the normal temperature, that they had heaters on the plane but he didn't think they needed to have it any warmer, and she said the least they could

do would be to turn off the three great fans out in front of the airplane. We know our aviation now!

Another important thing for safety and reliability is the large number of emergency landing fields built all over the country by our Department of Commerce.

The radio is a great factor. At present, there are in the United States some sixty-four weather broadcasting stations. Each transport plane carrying passengers has two-way radio. The pilot is advised every twenty minutes of the weather along his route and at the same time checks in with his ground station. He knows at all times exactly what the weather ahead of him is. If he is going into bad weather, he knows it and can change his course. He calls up and asks where the weather is most favorable, and he is advised the route he should take in order to get through.

There are approximately ninety-five radio beacons in operation. They constitute the roads of the air. If a plane leaves here and goes East or West, it goes on a radio beacon. For instance, let us say the route is from Chicago to Cleveland. The pilot puts on his earphones and adjusts his radio. The radio beacon beam goes toward Cleveland. If he is on the Chicago beam, he hears a certain signal, a constant hum broken periodically by the station's characteristic signal. If he is to the right of the beam he hears an "N," a "da-dit," or if he is to the left of the beam he hears an "A," a "dit-da." As he flies along he follows the beam and is directed exactly where he wants to go—regardless of the weather conditions.

Night flying has come in. Last year, 1933, 40 per cent of the flying done on air transport and air mail lines was done at night. There are almost 2,000 beacons spaced about ten miles apart along the important airways. On clear nights, as many as six of these beacons can be seen stretching out in front of a pilot and directing him to his objective. Their pleasant glow on bad nights is very friendly indeed.

Another great advancement that has been made recently is the development of the landing beacon so that a pilot can land at his objective regardless of weather conditions. There is one installed now on the West coast and another on the East coast. Blind-landing tests are being carried on with them.

When one realizes that the airplane carries instruments and equipment that acquaint the pilot with the exact attitude of his plane, his altitude and location, one can appreciate how simple and safe flying is. Mounted on the instrument board is an instru-

ment about four inches square; it has a picture of a little airplane painted on the face. There is a movable line that remains at all times parallel to the horizon. The small picture of the airplane takes the attitude of the plane and, by looking at the instrument, the pilot knows exactly whether his wings are level, whether he is diving or climbing; in fact, the exact attitude of his plane. By the use of the directional gyroscope—which is not really a gyroscopic compass because it is not North seeking—the pilot can set his course and keep steadily on it. By means of the radio, he is directed to his objective and the last step is the landing beacon down which he glides directly onto the field.

When you realize what this all means, you can appreciate that air transportation will soon be the only means of transportation, if we exclude mule-back, that will be able to carry on regardless of weather conditions. You often hear of boats being held up in New York Harbor because the fog is so thick that they cannot get in. You have driven a car when you have had to pull off to the side of the road in the fog because you were afraid to carry on for fear of running off the road or running into someone else. Those conditions can be overcome by the special equipment worked out by air transport operators, and will be, probably, this coming year. At first, only mail and express will be carried in extremely inclement weather but, after a period of test and proof, passengers will also be carried.

The two great hazards of air transportation are ice and fog. The preliminary work has been done on fog and that hazard is practically eliminated. The formation of ice on the wings of a plane has three definite effects: (1) the weight of the ice bears the plane down; (2) the shape of the wing is changed by the ice, and the efficiency of the wing is reduced and the plane will not lift as much as it would normally; and (3) the drag or resistance at the wing in passing through the air is greatly increased. Ice also forms on the propeller. But that has also been checked. This past year one of the airlines has installed rubber de-icers on the propeller and pneumatic de-icers on the wings. A hollow rubber covering goes over the leading edge of the wing and, through a distributing means, is inflated and deflated. As the cover is inflated and deflated it breaks the ice off. This method of ice removal has proved so successful that the manager of this airline stated that the de-icers paid for themselves in the first week of operation by permitting him to adhere to schedules he could not

have attempted, had he not had the de-icers. This, of course, was for mail operations only.

Altogether, the de-icing problem has been a very interesting one. There were several schemes devised and tried. One was putting some gelatinous substance on the wings, hoping the ice would slide off. Although several substances were tried, it was not found satisfactory because sometimes it seemed to retard the formation of ice and then again it seemed to accelerate it. Putting the exhaust heat through the wings was considered. This was only applicable to metal and the idea was abandoned due to the fire hazard. It was thought that it would be possible to remove ice by electrical means, but the weight of the electric heating element in the wings and the generating equipment to furnish the power was excessive and, as this would decrease the pay load, the scheme was impractical.

Relative to *reliability,* it is interesting to note that last year 95 per cent of the air transport schedules were completed, and completed on time. That gives you a good idea of the tremendous advance in reliability. A few years ago, before taking off a pilot would go out and stick his finger up in the air; if the wind was blowing fast enough to evaporate the moisture and cool his finger, the airplane was pushed back in the hangar. Those days are over forever!

Economy of operation is of paramount importance. Increased efficiency has permitted the airline operator to decrease his operating cost from 15 to 20 cents per passenger mile in 1928 to 6 cents per passenger mile in 1933. This last figure is commensurate and almost equal to rail transportation—when you add in Pullman fare and meals on the train. And certainly if we consider our time as of any value to ourselves, to our family, or to our employers, we should travel by air to take advantage of the saving in time it is possible to effect.

The growth of air transport is indicated by the fact that, in 1926, there were 23 cities served; there are now 178 cities in the United States served by air transport. In 1929 the government paid $1.09 per mile for the airmail flown. That cost came down the following year to just under $1.00, and last year to $0.54, and this coming year, 1934, it will be $0.38, indicating that the subsidy that the air transport companies have had indirectly from the government through payment for carrying the mail is about a third now of what it was four years ago. So the financial end of air transport is also working itself out.

In the past, the air transport operator thought first of safety, second of speed, and third of economy of operation. Little thought was given to the passenger. Last year the designers of aircraft began to think of the passenger's comfort. They realized that many people didn't ride because of the noise and discomfort incident to flight in airplanes. So the 1933 airplanes and the planes that are coming out this year are very comfortable. There is plenty of leg room, you can loll in your seat, and the noise level is lower than in a Pullman car. You can sit in one corner and talk to the person in the diagonally opposite corner seat without raising your voice.

From a military standpoint it was desirable to have quiet. The army started working on mufflers to reduce the engine noise. Experiment showed that by far the greater part of the noise came from the propeller. By gearing the propellers and turning them slower, so that the tip speed of the propeller was well below the speed of propagation of sound, the propeller noise was greatly reduced. This reduced the noise somewhat, but there was still an objectionable amount of it left. Then someone with an air transport company had an idea. "Let's insulate the passenger from the noise the plane makes." So the walls of the modern airplane now are made of felt, or other insulating material. Incidentally, spun glass is coming into use and is a very excellent material as an insulator. An instrument was developed which measured the sound level in an airplane, in flight, and located the sources of the noises. Furthermore, the ventilating air was found to be an important offender, so the incoming air was "denoised" before being admitted to the cabin.

All in all, air transport is becoming safer, faster, more reliable and more comfortable. The public is becoming airminded. The future of the airplane is assured both in commerce and as a military adjunct. I recommend it to you.