

It is necessary however to take the cables from the elevators through the plane of the hinge axis of the tail, as otherwise they become tight and slack when the tail adjustment is operated.

If the tail is pivoted on the rear spar a system of bell crank levers can be used instead of a worm, but is not irreversible, and if operated by a lever instead of a handwheel requires a toothed quadrant to locate the settings.

Operation by lever and bell cranks has the advantage over the worm system in that it is much quicker, and of course a worm, even with double or triple starts, requires several revolutions to effect the change of incidence required.

DISCUSSION.

MR. W. O. MANNING.—I have listened to this paper with very great interest, and have found the lecturer's problems somewhat different from those I usually have to deal with on controls. I have found it very convenient to consider such things as aileron controls on an energy basis, rather than on the more usual moment basis. The aileron that takes the least energy in producing a given effect on a machine is the best, measuring the energy from no angle to angle required.

I have a considerable objection to balance where it can be avoided. I have found it possible to use unbalanced ailerons in machines up to 12,000 lbs. I agree that rudder balance is advisable in any case, as it is easy to carry out, and has no disadvantages.

The lecturer's remarks on engine-bearers are very useful. He did not mention landing loads. It will usually be found that if the bearer is strong enough to stand a landing with the usual factor, it will be strong enough to stand the engine torque.

Tail jacks of the worm-gear type are, of course, common, but one does not feel quite sure that they will not turn under vibration if the wires are cut.

His remarks with regard to fairing are excellent, and much more attention should be paid to this subject than is the case to-day. It certainly pays to fair to a considerably greater extent than is usually done, and I am inclined to think that in this respect some modern designs compare unfavourably with machines built in 1913.

With regard to the diagram, the question of the protection of the gunner from the slipstream needs remark. I think aeroplane designers will be forced to some sort of turret for protection of the gunner.

In conclusion, I should like to thank Mr. Tinson for a most interesting paper.

MR. TINSON'S reply :

I thank Mr. Manning for his criticism.

I am interested in his remarks with regard to aileron controls and balance, and particularly to know that he has found it possible to use unbalanced ailerons on a machine weighing 12,000 lbs., which is quite a respectable size.

With regard to his remarks on seaplanes and the use of the water rudder, I shall deal with this in the next part of my paper.

I am rather pleased to find that he agreed with me regarding ball-bearings, because there seems to be some difference of opinion concerning the advantages of using ball-bearings for the controls.

The engine-bearer strength in landing is a point I had not thought of in writing this paper, but I mentioned the question of torque, owing to the fact that with the high powers now being developed at low propeller revolutions, the torque forces exceed in importance those due to dead load.

With reference to fairing in a proper manner, I quite agree with Mr. Manning that the additional trouble and expense of putting proper fairing on tubes is well worth it, and that is shown by various tests which have been made on tubes with the fairing behind only, and those in which the tube is not at the leading edge, and the additional work entailed in doing the job properly does not add appreciably to the cost.

With regard to protecting the gunner, this is a further matter which I thank Mr. Manning for pointing out, not having occurred to me. I should like to say once more, however, that these drawings merely represent a typical design so as to have something about which we might have a discussion. It is therefore impossible to deal with the subject more particularly in its relation to aeroplane-seating apparatus, etc.

After a hearty vote of thanks to Mr. Tinson for this second interesting paper, the Chairman asked Mr. Manning if he would give them a short description of what he had seen at Itford, and that gentleman kindly consented.

With the aid of a rough drawing Mr. Manning gave a very clear idea of the conditions at the gliding competitions at Itford, and made a few remarks on what he had seen. The following were some of the chief points :

The scene of operations was a hill of anything from 600 to 700 feet above sea level, at the foot of which was a valley. The hill was very steep in some parts, it being only just possible to walk up. The up-current was not measured, but might be one in six in the region where the soaring was done.

The great point was that at Itford it was by no means necessary for a machine to have a really fine gliding angle. The French and Fokker machines soared well, and probably neither had a very good gliding angle. From what the speaker heard of the German machines, they would probably have soared extremely well.

The competition was largely a question of controls. Raynham's controls were quite insufficient. His one-hour-fifty-minutes' flight was certainly the finest exhibition of piloting the speaker had ever seen. His machine had a small elevator lever at the right hand, and along the front of the cockpit was a turn-buckle which he moved horizontally to control the ailerons.

It was quite common with some English machines to see them turning to the left while the rudder was turned several degrees to the right. What one wanted for gliding was the best possible gliding angle, combined with ample control. The gliding angle, or curve, of the machine should have a flat top, so that the best angle extends over as large a speed range as possible. In Germany they went to great trouble to reduce resistance, even covering the cockpit up with an apron through which the pilot slipped his head.

The severe up-currents at Itford led people to think that a fine gliding angle was unnecessary.

The speaker again laid stress on the other necessary factor—very powerful controls capable of perfect operation in every direction.

One important result at Itford was this—to prove that duration tests for gliders were now ridiculous. A glider could only keep up so long as the wind blew or the pilot could stick it.

COL. BELAIEW asked whether the gliding competitions were likely to have any practical effect on aviation as a whole.

MR. MANNING was of opinion that it would certainly encourage us and help to remind us that it was exceedingly important to fair every part of an aircraft. He also thought the man-in-the-street would be encouraged: there were a good many of them at Itford, and those who saw anything were greatly interested. Although there were many crashes which were serious for the machines, hardly any personal damage was done.

A hearty vote of thanks to Mr. Manning then brought the meeting to a close.
