A FEW EXPERIMENTS WITH SHOCK-ABSORBING HULLS FOR FLYING BOATS.

Paper read by Lieut. N. A. Olechnovitch (Member), before the Institution, at the Engineers' Club, Coventry Street, W.1, on Friday, 23rd January, 1925. Mr. W. O. Manning in the Chair.

INTRODUCTION.

LIEUT. OLECHNOVITCH said :

It was early in 1916. I was about 15 miles out at sea watching German submarines. We expected the Black Sea Fleet to enter Sebastopol harbour that morning, and narrow passages between minefields were the usual place of attack of submarines.

The weather was extremely rough. My machine was a three-seater flying boat, built in Russia, and engined by a 130 h.p. Salmson, heavy construction with very little of power, and low speed (110 kilometres p.h.).

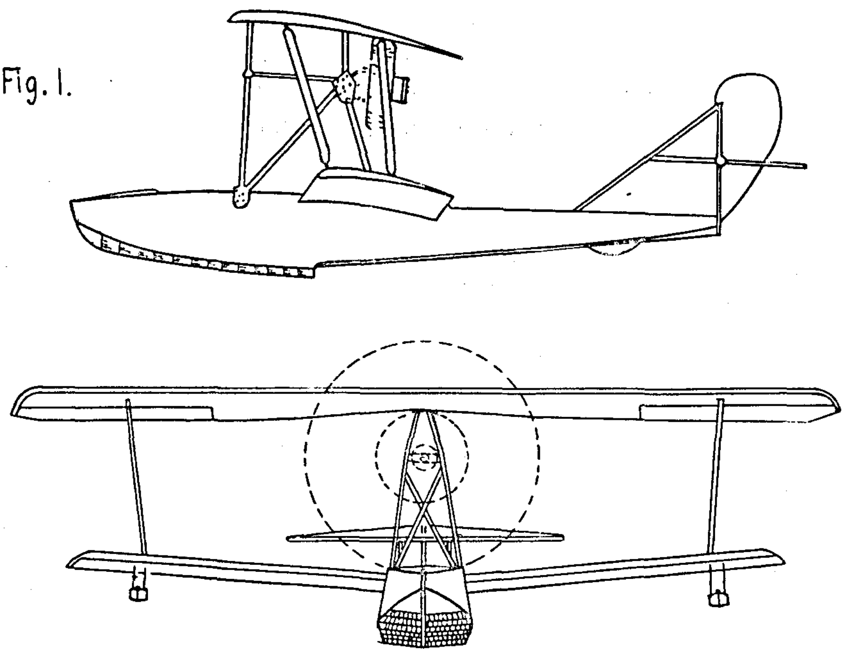
One particular squall, accompanied by rain, shortened the magneto circuit, and the engine stopped. My altitude of 500 metres was not sufficient to allow enough time to dry it up, and, therefore, I prepared to take the water. The task was a difficult one, but I succeeded in it, taking a small portion of a huge breaker inside the hull. When we made the engine run again, and I turned against the wind, I realised that it would be impossible to get off in the ordinary way. Then I remembered a very interesting fact, which came to my knowledge from yachting experience, particularly of old-days' yachting, when heavy and slow boats were extremely obstinate to change their course, turning against the wind.

Even a most rough sea, with strong wind blowing, opens sometimes waste "fields," as we call them, of comparatively smooth surface, without breakers or any sort of waves. Usually such a field lasts one minute, or may be a little less, and then drops down, transforming itself into the most dreadful breaker. But those fields are sufficiently large to allow a boat to be turned at least 20 points, and, therefore, I expected to have enough time to lift the machine from the water.

To find the field, I used the following manœuvre :—Increasing speed to such an extent that my machine was running on her redan (step), I mounted the top of a large wave, and started to cross it diagonally, with the wind partly behind. The necessity to cross it diagonally was due to the difference in the speed of the machine and the waves. By combination of both speeds it was possible to keep the machine all the time on the top of the wave.

When I noticed the "field," I made a circle, bringing the machine against the wind, and made usual lift. When we were a few feet high the field

Fig. 1.



disappeared, and a huge breaker ran towards us and struck the bottom of the hull with such a force that the whole machine, weighing more than a ton, jumped high up in the air, and nearly lost her speed. The three-ply bottom was completely smashed by this impact, and torrents of water, which we had in the hull, fell down from it. We made ourselves ready to swim, and turned home. I made a "parachute" descent so close to our station landing-place that the machine was dragged up on it before the water filled it up. Close examination of the bottom showed the following :—

(1) Most of the damage was located very close under the centre gravity of the machine.
(2) The nature of the breakage showed fairly even distribution of the pressure all round the place of contact.

This accident was the cause of my further experiments with shock-absorbing devices in relation to a flying boat's hull.

FIRST EXPERIMENT.

For those experiments I have used a little two-seater flying boat, built up at our station from different parts available, and " assembling " design of which I made accordingly. A 100 h.p. Le Rhône engine was used, and the general behaviour of the machine was satisfactory. The construction can be understood from Fig. (1).

The first shock-absorbing device consisted of the double-bottom; each half was an exact replica of the other, and they were coupled together by means of hinges in front and helical springs at the rear. Fig. (2) shows the arrange-

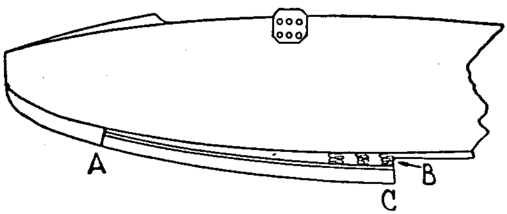
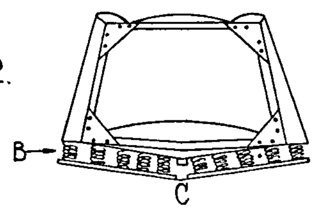


Fig. 2.



ment of parts. " A " represents the place where two bottoms were coupled by hinges. This point was considered answering to the requirements, after the following experiment :—

We took one of the old two-seaters, with Monosupape Gnôme engine, stripped off part of the inside flooring of the hull, and made a few runs on the step (redan) at varying conditions of the sea. During the run a mechanic was inside the hull pressing his fingers against different parts of the bottom in order to find the point where shocks of incoming waves did not cause the three-ply to vibrate.

I considered that this point would be the right place to joint the two separate parts of the bottom, and, therefore, point A was chosen.

Between the two bottoms three rows of steel springs were inserted (B) with such a calculation that the full weight of the machine, applied to the point C Fig. (2), should compress them approximately half-way. It was considered advisable to make each row of springs, starting from point C, gradually weaker in strength, but as we were obliged to use only material available, it was not carried out, and all springs were made of the same wire.

https://doi.org/10.1017/S2976690700000516 Published online by Cambridge University Press

Running experiments had shown the following results :—

(1) Small and short waves (1) produced by the strong wind in the harbour were absorbed perfectly. The usual unpleasant hammering into the bottom was reduced to a great extent.

(2) The effect of absorbtion at open sea with long waves, (2) was not so pronounced as in the first case.

(3) Two unpleasant results were found out after several runs—
 (a) Notwithstanding that the angle of the redan (step) remained approximately the same as in the case of the rigid bottom, the time for the boat to lift its tail and start to glide was longer, and could not be helped by " flapping " elevators.
 (b) When running on the step, or " gliding," irregular waves produced an unpleasant, see-saw movement of the longitudinal axis of the boat, due probably to the rebound action of the springs.

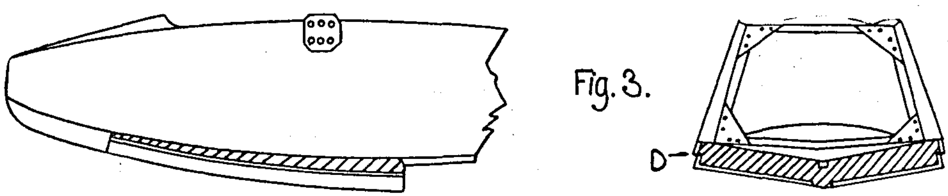
SECOND EXPERIMENT.

To improve the above-described shock-absorbing device, it was necessary to solve the two problems.

(1) Retain the step at its designed angle of inclination more rigidly.

(2) Eliminate, as far as possible, the rebounding effect of the springs.

For this purpose I made an air-cushion, consisting of a canvas envelope with rubber lining inside (simply car-tyres), which filled up the space between



two bottoms, and then the side members—D, Fig. (3)—of the bottom were made to move with slight friction.

The results of running were not too satisfactory.

(1) Increased rigidity of the construction, and its inertia, permitted shocks to be transferred to the hull, at full speed, to a very noticeable extent.

(2) Longitudinal rocking decreased, but was not eliminated. Therefore I considered that the cause was not exactly rebounding of the spring itself, but a similar rocking movement of the whole long bottom due to the rebounding.

(1) About 6 inches high. (2) About 2 feet high.

https://doi.org/10.1017/S2976690700000516 Published online by Cambridge University Press

After the second experiment the idea of a shock absorber was clear; it should be—

(1) of little inertia, (2) of good flexibility, and (3) it should not be solid along the whole bottom. Or otherwise the shock absorber should be differentiated into many small, flexible, and separate shock absorbers.

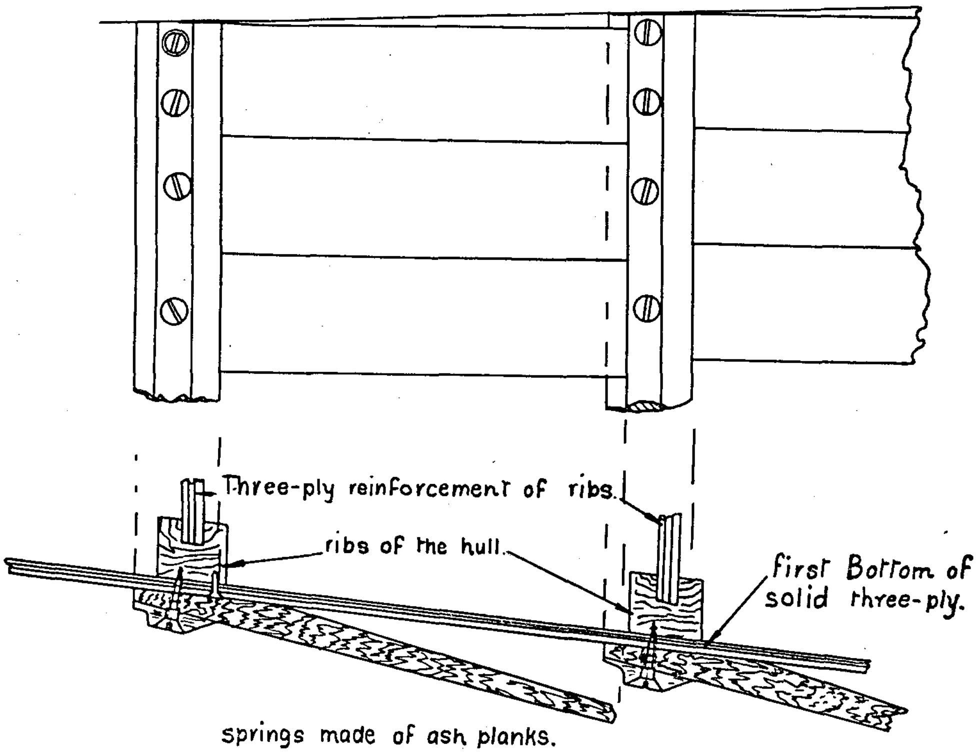


Fig.4.

THIRD EXPERIMENT.

Taking into consideration the three last paragraphs, I designed a shock absorber of the type shown in Fig (4).

It consisted of several rows of wooden planks fixed to the bottom of the hull by one end only—leaving the other free to vibrate. As every next

https://doi.org/10.1017/S2976690700000516 Published online by Cambridge University Press

row was slightly overlapping the previous one, it represented the aspect of fish-scales made of square pieces. Every separate wood spring resembled, in action, a quarter-elliptic spring of the car.

The part of the bottom covered with springs was exactly the same as at two previous experiments. An altogether new hull was made, as it required specially-made ribs, at special intervals, to fix the springs.

As it was the first hull built on this principle, it was slightly over-strengthened, and consequently over-weighted. As I received an offer to go to England, I hurried up construction, and when it was ready, I had very little time to test it. Notwithstanding that only six " take-offs " were made, the idea of the device seemed to be a right one.

All sharp knocks of the short waves were absorbed perfectly. Longitudinal rocking stopped, and here was no difference in performance, in comparison with the rigid construction, regarding the time for lifting the tail.

An especially interesting effect of the absorbers, was taking water at good speed, and " taxi-ing " on the redan. Usually I avoided fast taxi-ing, due to the undesirable overstraining of all parts of the boat, but with shock absorbers, it seemed to be quite an easy matter.

I had no chance to try it in rough weather, and therefore I consider this device to be in an experimental stage, and for this purpose it is now in the hands of Mr. Mitchell, of the Supermarine Aviation Co.

I hope, however, that I shall be excused for bringing it to your notice, because my only intention was to share my experience with those who are working for the development of Aeronautics, and who look at every experience, however small, as a benefit to our common endeavour.

Discussion.

Dr. Thurston : I think these experiments are most interesting, and feel that the lecturer is on the right lines. It is very well known that in landing a flying boat the pressure that develops is quite localised. I have made many experiments in landing on the river on account of the localised area. If, therefore, you can devise some means of absorbing this pressure at points where it is developed, you could get an easier-running boat than if you relied on the flexibility of the whole hull. The Linton-Hope hull is a wonderful construction and has a remarkable strength, but although it is flexible at all parts you do not want it to be so in the parts where pressure is developed. Therefore it seems to me that this idea of the Lieutenant's of having a part separate from the main hull specially devised for the purpose of absorbing the main portion of the pressure, is very valuable.

https://doi.org/10.1017/S2976690700000516 Published online by Cambridge University Press