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DYNAMIC TEST OF GRUSS SHOCK ABSORBER
MODEL X-58

(AIRPLANE BRANCH REPORT)

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DYNAMIC TEST OF CUSHION SHOCK ABSORBER

MODEL X-58

(AIRPLANE RESEARCH REPORT)
DYNAMIC TEST OF GRUSS SHOCK ABSORBER, MODEL X-58

(Prepared by R. E. Middleton and Theo. dePort, Matériel Division, Air Corps, Wright Field, Dayton, Ohio, June 26, 1931)

PURPOSE

The purpose of this test was to determine the shock-absorption capacity of the strut, and to make a comparison between it and the Gruss strut, model C-68-1, which is used on the Fokker Y1C-14 airplane.

CONCLUSIONS

The test shows that the Gruss model X-58 has performance characteristics much superior to model C-68-1, and that it is better suited for use on the Fokker Y1C-14 airplane.

TEST RESULTS

The following table summarizes the results obtained in the test:

<table>
<thead>
<tr>
<th>Strut model</th>
<th>C-68-1</th>
<th>X-58</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum dynamic load</td>
<td>pounds</td>
<td>21,100</td>
</tr>
<tr>
<td>Maximum tire deflection</td>
<td>inches</td>
<td>6.2</td>
</tr>
<tr>
<td>Maximum mass deflection</td>
<td>do...</td>
<td>12.6</td>
</tr>
<tr>
<td>Strut efficiency</td>
<td>per cent</td>
<td>20.8</td>
</tr>
<tr>
<td>Merit factor</td>
<td></td>
<td>0.069</td>
</tr>
</tbody>
</table>

TABLE 2

Table 2 shows comparative results obtained with strut model C-68-1. Conditions of test were the same in both cases.

DESCRIPTION OF STRUT

Several important changes from the usual Gruss design have been incorporated in model X-58. For a description of the general design of previous models, see A.D.M. Report No. 1130, Serial No. 3272 (reference 2).

In model X-58 a hollow plunger with a piston and orifice has been substituted for the solid rod and slapper valve which operated through a hole in the top of the air piston, and which was designed to check the recoil of the compressed air.

Reference is made to Figure 1 for a view of the working parts of the strut.

The air plunger and piston unit, shown on the left, which carries the packing gland, works in the air cylinder, shown in the right rear. The interior of this plunger is filled with oil, so that the oil level is always above the top of the air piston. Air under pressure is carried in the air cylinder, above the oil.

The oil plunger and piston unit, shown in the right foreground, work inside the air plunger, through a hole in the top of the piston. The upper end of this plunger is screwed into the top of the air cylinder. The piston contains a fixed orifice, so that as the strut is deflected, the inner plunger works as a conventional oleo while at the same time air is being compressed in the upper chamber.

The oil plunger is vented at the skirt of the piston so that oil flows into the space between the walls of the oil plunger and the air plunger. Then, on the return stroke of the piston, oil is forced back through the orifice, and also through four holes of \( \frac{3}{4} \)-inch diameter in the top of the air piston, thus snubbing the return stroke by dissipating the energy stored in the air.

Free communication between the air and oil chambers is provided by means of vents in the piston mentioned above and a vent of \( \frac{3}{4} \)-inch diameter in the upper end of the oil plunger.

Packing in this strut has been changed from the complicated system used in previous models to a simple gland consisting of four V-shaped rings of rubberized fabric, which tend to squeeze against cylinder walls and plunger and which are pressed in place between a collar bearing against a fifth ring of packing that fits into the V of the other rings, and a shoulder on the piston grooved to form a seat for the end ring.

The external appearance of this strut is unchanged from that of model C-68, as shown by photographs appearing in A. D. M. Report No. 1214.

DESCRIPTION OF TEST

The method used in testing this strut was the same as for model C-68-1. Tests were conducted in accordance with procedure outlined in A. D. M. Report No. 1091, Serial No. 3139. The conditions of test are explained in A. D. M. Report No. 1214.

The test weight used was 4,300 pounds. The wheel used was a 44 by 10 at 65 pounds per square inch. Drops were made at 3-inch intervals up to a maximum
FIGURE 1

of 15 inches. Maximum tire and strut deflections were recorded for each drop. These are plotted in Figure 2. A record was made on the time-deflection recorder of a drop from 15 inches, the analysis of which is shown in Figure 4. A cross plot of the load deflection curve of the strut is shown in Figure 3.

DISCUSSION

The strut as designed can be considered as a conventional oleo with an air spring in place of the usual steel spring. It is evident from the test results that this combination is much more satisfactory than the previous struts which used an air spring alone as a means of energy absorption. It is possible that the characteristics of the strut could be further improved by experiment, without reducing the desirable features inherent in an air spring. A strut efficiency as high as 73 per cent is possible by proper design of a conventional type oleo.

There is some question as to the serviceability of the strut in the field, particularly with respect to leakage. These questions should be settled by service test.

References:
1. A. D. M. Report No. 1091, Serial No. 3139.
2. A. D. M. Report No. 1130, Serial No. 3272.
Figure 3

Load-deflection curve for Gruss Air-Oil strut model X-58

Test weight = 4,300 Lbs.
Height of drop = 15 inches.
Tire = 4.6 X 10 at 65/# psi.
Max. Tire defl. = 4.9 inches.
Max. defl. of mass = 11.9 inches.
Input energy = (15 + 11.9) 4,300 = 113,800 In.-Lbs.
Dissipated energy = 14.3 X 4,000 = 57,200 In.-Lbs.
Strut efficiency = {113,800 / 57,200} ^ 100 = 43.2 %

Merit factor = \( \frac{(4,300)^2 \times 15}{25,000} \times 16.5 = 0.668 \)
Performance Curves for Grass Air-Oil Strut Model X-50
Wt. = 4500 #  Drop = 15"
Tire 44 X 10 At 65 °/a

Figure 4