TEST OF SUPERCHARGER
AIR COOLERS

(Power Plant Section Report)

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CERTIFICATE: By direction of the Secretary of War the matter contained herein is published as administrative information and is required for the proper transaction of the public business.
TEST OF SUPERCHARGER AIR COOLERS.

OBJECT OF TEST.
The object of this test is to compare relative cooling effect of the three types of air coolers which have been tested with the Form "D" supercharger.

CONCLUSIONS.
The small honeycomb air cooler (Drawing No. X-34098) offers no advantage over the General Electric tubular type and has a somewhat greater pressure drop. The large honeycomb air cooler (Drawing No. X-38520) increases the cooling approximately 40 per cent with a proportional increase in area. While this air cooler is somewhat larger than necessary for flights up to 20,000 feet, it is recommended for use for all high altitude work or in special cases where increased cooling is necessary.

DESCRIPTION OF SUPERCHARGER AIR COOLERS.
The small honeycomb air cooler consists of a radiator core 4 inches by 15 inches by 9 inches made up of extruded copper tubes 0.268 inch in diameter and 0.313 inch across the hex, fitted in a sheet brass shell which conducts the air to the carburetor intakes. The weight of this air cooler averages about 36 pounds.

In the large honeycomb air cooler, which is similar in construction to the small one, the core is 15½ inches by 5½ inches by 9 inches and the radiator tubes of which it is composed has the hex head increased from 0.313 inch to 0.323 inch, giving more area between the tubes and decreasing the pressure drop through the core. This air cooler is shown in figures 3, 4, and 5, and weighs 37 pounds. The increased size of this air cooler, without the increased weight, was obtained by elimination of several soldered seams and a general refinement in design.
The tubular or General Electric air cooler, figure 6 (General Electric Drawing No. W-124315) consists of forty-two 3/4 inch O. D. steel tubes welded into two steel plates 3/8 inch thick. The weight of this air cooler is approximately 30 pounds, but an air header must be used to connect the two carburetor intakes. This brings the total weight of the air cooler up to approximately 37 pounds.

METHOD OF TEST.
Distance type thermometers were installed in the supercharger air outlet and the carburetor air intake, the difference between these two readings giving the temperature drop through the air cooler. The pressure drop through the air cooler was measured on a mercury manometer.
The curves shown in figure 1 were plotted from the average of a number of flights to 20,000 feet under varying conditions and indicate the increased cooling effect of the large honeycomb air cooler of the other types.

RELATIVE COOLING EFFECT.
The curve in figure 2 shows the temperature drop per square foot of radiating surface. In this respect the large and small honeycomb radiators are almost identical; the increase in temperature drop in the larger being directly proportional to the increase in radiating area. The tubular type air cooler gives from 80 to 90 per cent greater radiation per square foot of surface than the honeycomb types. This is undoubtedly due to the better air flow around the tubes, the radiator cores on the honeycomb types being blanketed to a certain extent by their proximity to other parts of the engine.
The effective cooling area to the different types are as follows:

<table>
<thead>
<tr>
<th>Type</th>
<th>Cooling Area</th>
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<tbody>
<tr>
<td>Small honeycomb</td>
<td>37.5 sq. ft.</td>
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<tr>
<td>Large honeycomb</td>
<td>55.5 sq. ft.</td>
</tr>
<tr>
<td>Tubular</td>
<td>21.5 sq. ft.</td>
</tr>
</tbody>
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That is, from the point of view of cooling effect. The honeycomb air cooler permits better vision, and offers slightly less head resistance.
FIG. 1.

TEST OF SUPERCHARGER AIR COOLERS

LARGE HONEYCOMB
TUBULAR
HONEYCOMB

TEMPERATURE DROP - DEGREES CENTIGRADE
10 20 30 40 50

PRESSURE DROP "/3QIN

0.2 0.4 0.6 0.8

20,000 FEET
15,000
10,000
5,000
Fig. 2.

Temperature drop per square foot surface in degrees centigrade.
Fig. 3.—Large honeycomb air cooler—side view.

Fig. 4.—Large honeycomb air cooler—three-fourths bottom view.
Fig. 5.—Large honeycomb air cooler—front view.

Fig. 6.—General Electric tubular air cooler.