TECHNICAL MEMORANDUMS

NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS.

No. 266

DEVICE FOR MEASURING SOUND IN AIRPLANE ENGINES.

By T. Robrovsky.

From "L'Ala d'Italia," March, 1924.

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By T. Robrovsky.

Nearly all airplane and engine constructors have experimented with devices for diminishing the noise of engines. Various types of silencers (Schneebeli, Ad Astra, Skribechk, etc.) have been tried with fairly satisfactory results.

Since, however, this problem has not yet been perfectly solved and endeavors to invent good silencers are being continued, I will here call attention to a device, constructed according to the system of Gati, with which it is possible to measure the sound of an engine and test the effect of a silencer.

Fig. 1 gives the sound diagram for an automobile engine. It shows large oscillations, because the engine had been much used.

Fig. 2 gives the diagram for an airplane engine. It may be seen that the sound of the latter is rather musical, its frequency being about 1800. In this figure, the upper curve is the sinusoidal curve corresponding to an alternating current with a frequency of 42 per second. The diagram was obtained as follows:

A microphone was placed on an elastic mass near the engine. The primary current was transformed with an ordinary telephone induction coil. The secondary current was conducted through an oscillograph which rendered it possible to photograph the record shown in Fig. 2.

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* From "L'Ala d'Italia," March, 1924, p.70.

If a measuring device ("barrettermetro") is substituted for the oscillograph, we can make direct measurements of the current and of the sound, the latter requiring the addition of a galvanometer.

Within certain limits, we can distinguish the sound variations by ear. This is the case with airplane engines. We can not distinguish any variation in an engine below 5% and, when we change the position of the engine, we can not tell whether the sound is increased or diminished. When we wish to obtain resonance by means of the microphone, we must give the secondary current a variable intensity and auto-induction (without employing iron) which does not scatter. If the sound intensity increases, it will be registered in the galvanometer of the measuring device. The intensity of the resonant current will have a value corresponding to the intensity of the sound. When the pointer of the measuring device is placed at zero, we can measure the slightest variations in sound (Fig. 3).

A,A are two similar storage batteries; B,B, resistance coils; G, continuous-current galvanometer; c, condenser; P,S, primary and secondary coils; M, microphone.

First, connect the microphone and then the measuring device with the circuit. If the strength of the current is great, care must be taken in order not to break the measuring device. When we have regulated the measuring device by the introduction of resistance coils, the galvanometer will have no current and we can therefore apply a micro-ammeter, even if there is a current of 15 to 20 milliamperes in the measuring device.

If the sound increases in front of the microphone, currents will flow through both the primary and the secondary circuit. The secondary current flows through the measuring device and heats the platinum wire, which has a diameter of 0.003 mm (0.00012 in.). This increases the resistance in the measuring device and disturbs the equilibrium of the bridge, thereby causing a displacement of the galvanometer needle proportional to the increase in the resistance and in the current representing the intensity of the sound.

Since the silencer problem is being very gradually solved, it is important to be able to measure differences of even 1% between one device and another. When the differences are small, the galvanometer needle moves away from zero. For example, when the intensity of the sound is great enough to require the application of a regulator sensitive to 0.1°, the resistance increases in the measuring device. Let us assume that this increase is six ohms. If we introduce a resistance of six ohms into another part of the Wheatstone bridge, the galvanometer needle returns to zero and the above-mentioned regulator is no longer required.

The same thing happens (Fig. 3) when we take three ohms from one part of the bridge and introduce them into another part. So long as the sound does not vary, the galvanometer needle remains at zero, but the least variation in the sound will cause the needle to oscillate. When the airplane engine vibrates, the needle will indicate these vibrations and we can measure them.

Since, on an airship during flight, it is impossible for the forward and the rear engine to make the same sound at the same time, when, e.g., the difference between the two engines is from 1 to 100 vibrations per second, it is possible for the crest of a wave from the forward engine to reach the ear at the same instant as the trough of a wave from the rear engine, in which case no sound is heard, since one wave obliterates the other. When the interference distance between the two waves varies, however, as in the case of an airship describing a curve, the sound is perceived.

Since the same phenomenon occurs in an airplane engine, it can aid us in solving the important problem of the silencer.

Translation by Dwight M. Miner,
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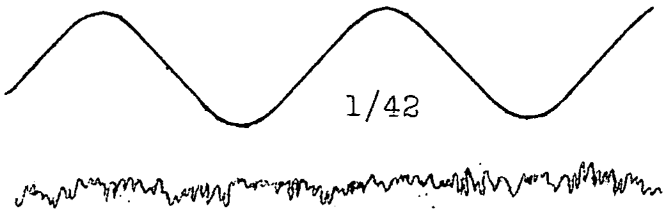

Fig.1

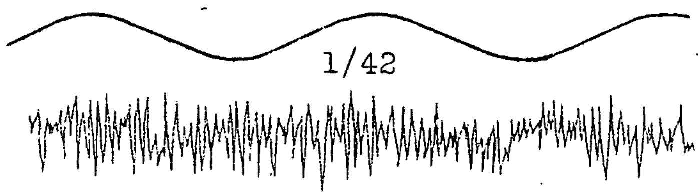

Fig.2

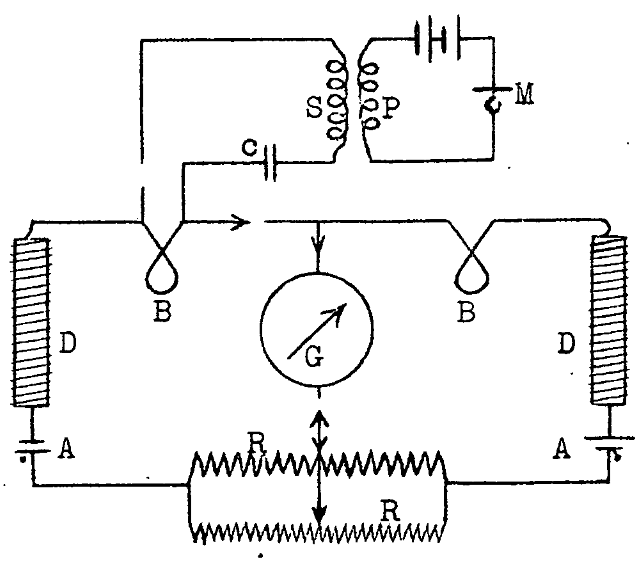

Fig.3