

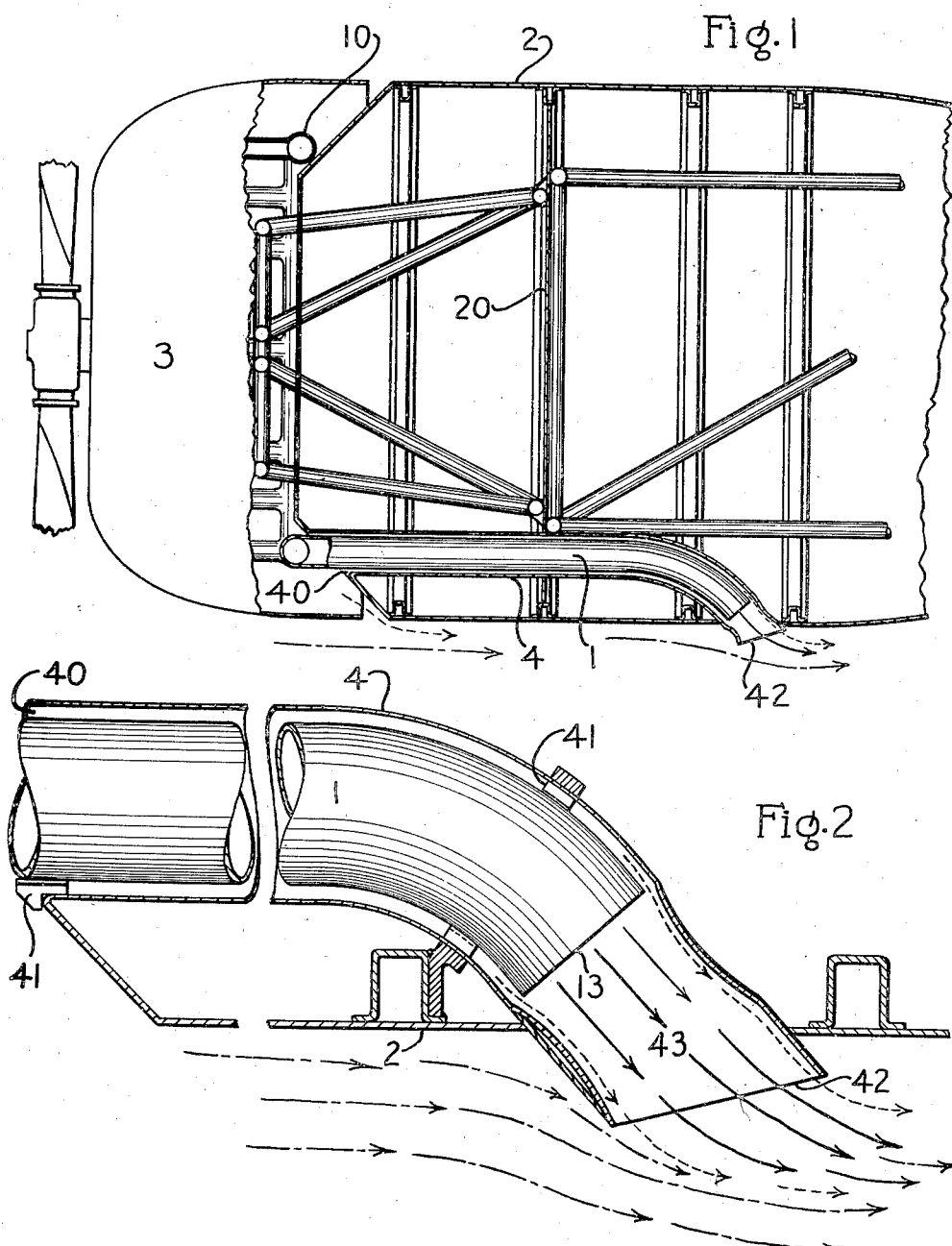
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COOLING MEANS FOR AIRCRAFT ENGINE EXHAUST STACKS

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COOLING MEANS FOR AIRCRAFT ENGINE
EXHAUST STACKS

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My invention relates to the cooling of the exhaust stack of airplane engines. The cooling of airplane exhausts has long been a problem to aircraft designers. Heretofore the exhaust stack has been carried out of the engine nacelle as soon as possible to get it out into the air stream. This was deemed necessary by designers owing to the intense heat of the exhaust stack. The streamlining of airplanes is of prime importance. Obviously, then, running an exhaust stack into the air stream for any distance reduces the effectiveness of the streamlining. To relieve this situation the exhaust stack was placed within the nacelle and was enclosed in a sleeve. This sleeve was, at its forward end, projected into the air stream in the form of a ram, or scoop, and thus the air was forced into this scoop, located in the air stream, thence carried up to the part of the sleeve surrounding the exhaust stack, and then along the stack until it was again projected into the air stream along with the exhaust gases. This system worked very well in theory but in actual practice a new difficulty was experienced, that of having ice forming in the intake scoop and restricting the amount of air passing around the exhaust stack, many times closing the air intake entirely. Thus, with this type of cooling and after the formation of ice in the intake, there was no longer any cooling, and the heat from the exhaust became a real source of danger.

Other ideas have been advanced which would provide sufficient cooling for the exhaust stack with little added wind resistance and still prevent the formation of ice that interferes with the cooling system. The main principle embodied in these ideas was the recessing of the exhaust stack in the engine nacelle, still keeping it outside to provide sufficient air for cooling. The recessing of the engine nacelle resulted in a weakening of that structure. To compensate for this general weakening additional structural members, or heavier and stronger members, would have to be added. Dead weight is another factor extremely important in airplane design and the addition of structural members, or the use of heavier members, would necessarily increase the dead load of the airplane.

The object of my invention is to provide a means of cooling the exhaust stacks of airplane motors which is free from all the difficulties heretofore described.

In the accompanying drawing my invention is shown embodied in a form which is at present preferred by me.

Figure 1 is in part an elevation and in part a section through the complete device, as assembled in the engine nacelle.

Figure 2 is an enlarged section of the device itself, showing the method of mounting the exhaust stack in the cooling sleeve.

The exhaust stack 1 extends rearwardly from the collector ring 10, as usual, but is enclosed within the nacelle skin or cowl 2, in such manner as will not interfere with the latter nor with the structural members of the usual engine mount or of the nacelle. It is also entirely within the cowl ring 3. If a fire wall is provided, as is customary, and as is illustrated at 20, the exhaust stack 1 extends through this fire wall, and terminates at or near the skin of the nacelle. Such an arrangement does not differ essentially from former arrangements wherein a rammed air supply cools the stack, but the present arrangement differs from the latter in providing means other than the force of the air at the entrance of a ram or scoop to move the cooling air lengthwise of the stack.

To concentrate the cooling air in the vicinity of the stack 1, it is surrounded by a sleeve 4, the entrance 40 of which is located within the cowl ring 3, but within a space wherein is available a continuous air supply, preferably under some pressure. Thus, the entrance 40 may be in or in advance of the fire wall 20, and in rear of the engine cylinders (not shown). In this region air which has entered the central nose opening of the cowl ring 3, and which has passed and cooled the engine cylinders, is available under some pressure, and while it has been warmed, it is far below the temperature of the exhaust gases, and can keep the stack 1 cool, particularly as large volumes of air are moved rapidly through the sleeve.

The sleeve 4 is spaced from the exhaust stack, throughout its length, by suitable spacers, as 41. Exclusive reliance is not placed upon the pressure at the entrance 40 to force the air through the sleeve, but auxiliary means are provided at the exit 42 of the sleeve to induce a flow of air through the sleeve, and hence over the stack 1. Various means to this end may be employed, but one of the most satisfactory means is to provide, in the sleeve, a venturi 43 so placed with respect to the outlet 13 of the stack, that the exhaust pressure from the stack will operate, by jet action, to induce a draft of air through the sleeve.

In addition, if the outlet 42 of the venturi and sleeve is projected through the nacelle skin 2

in a low pressure area, or is beveled in such manner, with respect to the relative airflow, as to produce a suction, a further or additive suction effect is produced, further assisting in drawing 5 air through the sleeve.

There is nothing projecting into the air stream, in this arrangement, except the terminus 42 of the sleeve, and this causes no material drag, and no material weakening of the nacelle. The air 10 which enters the sleeve at 40 is never subjected to icing conditions, and in fact has been preliminarily heated somewhat. It has been found that this arrangement will lower the temperature of the exhaust stack, in a typical installation, by 15 about 1000° F., and hence maintains ample cooling.

What I claim as my invention is:

1. In combination with the ring cowl of an aircraft engine, and with the exhaust stack, an 20 aircraft structure supporting the ring cowl, and wholly enclosing the exhaust stack, a sleeve within the aircraft structure, surrounding said stack, the rear end of said sleeve projecting a substantial distance out into the atmosphere, and 25 being rearwardly directed, its forward end opening within the ring cowl to a space filled with air under a pressure higher than that of the ambient atmosphere, whereby to induce a flow of air through said sleeve, and a Venturi throat 30 formed in the rear end of the sleeve, the rear end of the exhaust stack discharging into said Venturi throat, thereby to enhance the flow of air through the sleeve.

2. In combination with a ring cowl for a radial 35 air-cooled aircraft engine, an aircraft structure supporting the several parts and wholly enclosing an exhaust stack, a sleeve surrounding but spaced from the exhaust stack and open at its forward end within the ring cowl for the ad- 40 mission of air, a Venturi throat formed at the rear end of said sleeve and said sleeve projecting through and beyond an opening in the aircraft structure, and so disposed with relation to the end of the stack that the discharge of exhaust 45 gases from the latter will induce a flow of air through the sleeve.

3. In combination with an aircraft structure

such as an engine nacelle, and with the exhaust stack of an airplane engine, extending through such aircraft structure, said stack being circular in cross section, a cylindrical sleeve wholly en- 5 closed within the aircraft structure, and closely encompassing said stack along its length but spaced from it and closely conforming to the stack in shape from one end to the other end 10 thereof, an air inlet opening adjacent the engine for admission of air to said sleeve, a venturi surrounding the discharge end of said stack, open at one end to the atmosphere, and having its 15 axis disposed at an angle to the direction of motion of the relative air stream sweeping past such open end, and at its other end communi- 20 cating with said sleeve, and so arranged, relative to such discharge end of the stack, that the jet action of exhaust gases discharged from the stack induces air flow at a relatively high velocity through said member and over the stack, and a 25 diffuser leading from said venturi and projecting a substantial distance out into said stream.

4. Mechanism as in claim 3, and further characterized by said diffuser being beveled at its 30 outlet so that the leading edge of the outlet extends further into the stream than the trailing edge.

5. In combination with a ring cowl, surrounding an airplane engine, open to the front and 35 closed at the rear by a partition, an exhaust stack connected to the engine and extending through the partition to discharge to the atmosphere, and a sleeve surrounding and spaced from the exhaust stack, its intake end opening adja- 40 cent to the engine to air pressure in excess of atmospheric built up within the ring cowl forward of the partition, and the outlet end of said sleeve extending beyond the discharge end of said exhaust stack and projecting a substantial 45 distance out into the atmosphere beyond an opening in the aircraft structure, and being beveled so that the leading edge of the outlet end extends farther into the air stream than the trailing edge thereof, for operation as an air eductor accelerating discharge from said sleeve.

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