Jan. 7, 1936. D. L. HIGGINS 2,027,315

HEAT EXCHANGE APPARATUS

Filed March 23, 1935 2 Sheets-Sheet 1

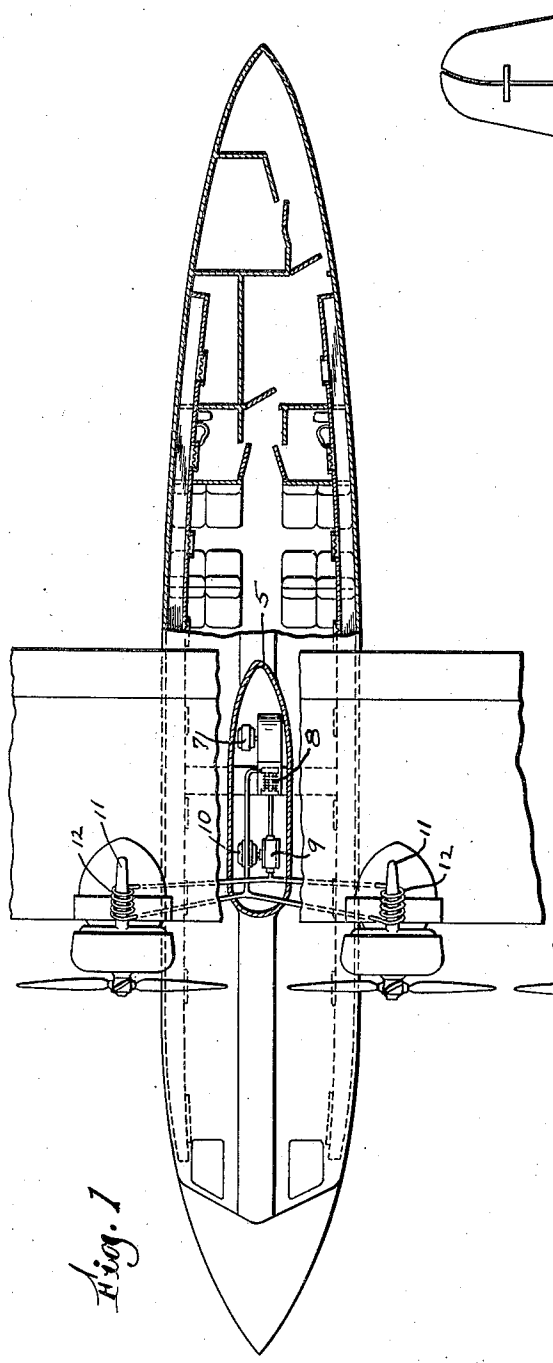


Fig. 1

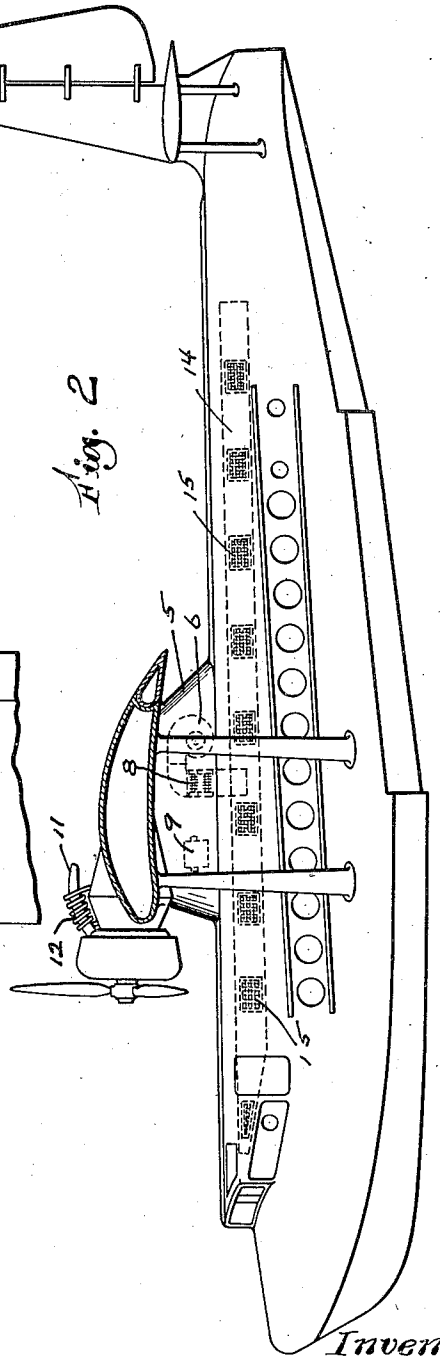


Fig. 2

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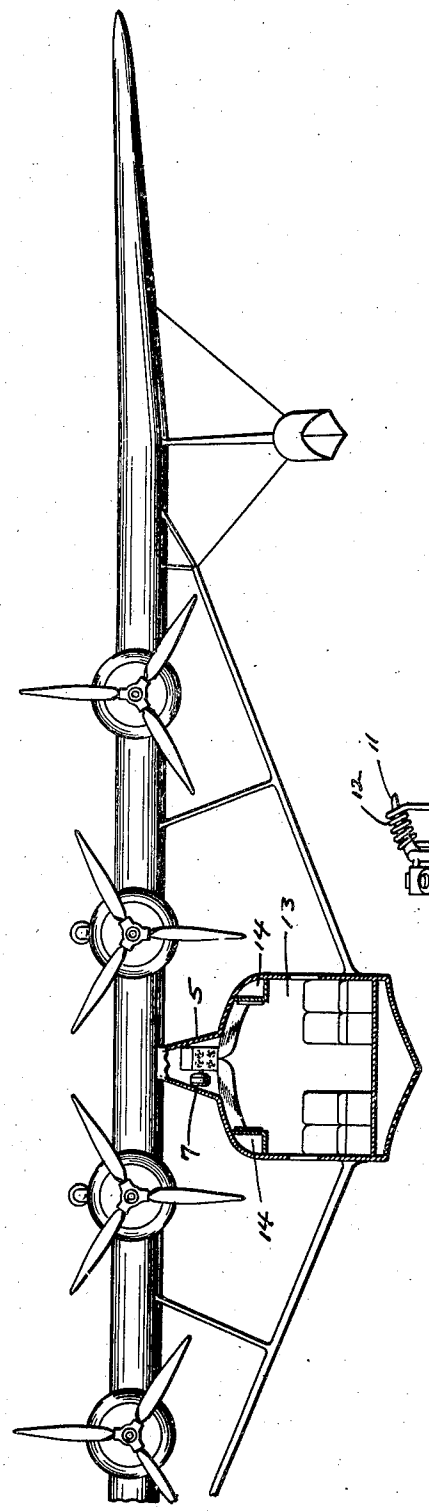


Fig. 3

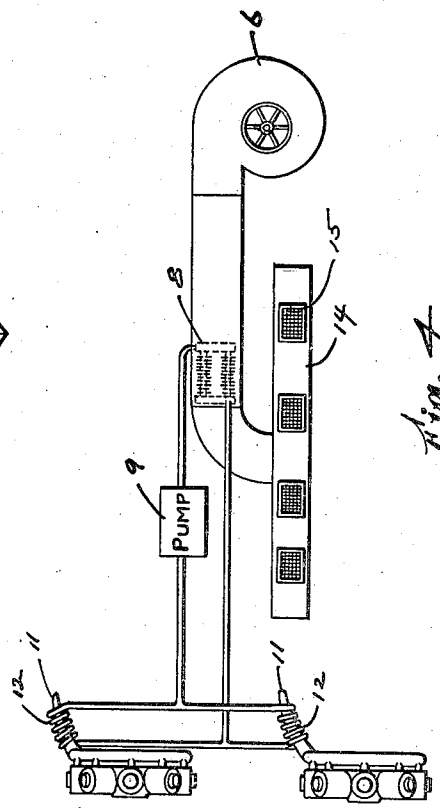


Fig. 4

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HEAT EXCHANGE APPARATUS

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5 Claims. (Cl. 237—12.3)

This invention relates to heat exchange apparatus and relates more particularly to apparatus for the heating and distribution of air in air liners of the flying boat type.

The most successful air liners of the flying boat type now in use are those having a single wing in the leading edge of which are mounted a plurality of internal combustion engines. The cabin of the aeroplane is suspended a substantial distance below the wing. Since planes of this type fly at high altitudes, it is necessary that the passenger space be heated. It has been obvious that the heat in the exhaust gases from one or more of the engines should be used for heating the passenger space, but prior attempts to so utilize the exhaust heat have not been successful. It has been proposed, heretofore, in aeroplanes of this type, to produce steam by the heat in the exhaust of the engines, and to pass this steam through coils mounted in the passenger space. The steam, however, condensed in the heating coils and it was not practical to return the condensate to the steam producing means because of the location of the engines and the exhaust manifolds at a considerable height above the passenger space. Hot water or other heating systems were not thought practical because of the difficulty of providing suitable expansion chambers for the heating liquid, which it was thought would be required, in view of the wide temperature ranges that would be experienced in flight, especially in view of the fact, that an aeroplane of this type might be called upon to fly from a tropical port in South America to a point which required the crossing of the Andes Mountains. Then, too, it was not desirable to place heating coils within the cabin as had been proposed in the past.

According to this invention, a liquid having a high vaporization temperature and a low freezing point such as "Prestone", is employed as a heat transfer medium. A plurality of extended surface heat exchange coils, and an electrically driven blower are arranged in a small stream lined housing, separating the cabin of the plane from the upper wing. The liquid is heated in coils, which are exposed to the heat from the exhaust from one or more of the motors and is circulated by a pump through the extended surface coils and back again through the coils exposed to the exhaust gases. The pump, fluid lines and coils are not completely filled with the liquid, so that sufficient space is left in these for the expansion of the liquid at high temperatures. One or more ducts are arranged longitudinally within the cabin and the air is passed by the blower over the extended surface heating coils and into the ducts, which are provided with a plurality of spaced outlets from which the heated air is discharged into the passenger space.

An object of the invention is to provide a heating system for supplying heated air to the passenger space of a high wing cabin aeroplane, utilizing heat from the exhaust gases of the aeroplane engines.

Another object of the invention is to provide heat exchange apparatus of the forced draft type for heating the passenger space of a high wing cabin aeroplane; the apparatus being arranged between the wing of the cabin and the aeroplane.

Other objects of the invention will be apparent from the following description taken together with the drawings.

The invention will now be described with reference to the drawings of which:

Fig. 1 is a plan view looking downwardly, with a portion in section, of an aeroplane equipped with heat exchange apparatus according to this invention;

Fig. 2 is a side view of the aeroplane of Fig. 1, with a portion in dotted outline;

Fig. 3 is a front view, with a portion in section, of the aeroplane of Figs. 1 and 2; and

Fig. 4 is a diagrammatic view of heat exchange apparatus installed in the aeroplane.

High wing aeroplanes, especially, of the flying boat type have the wing spaced above the cabin. The space between the wing and the cabin at the central point of the cabin is filled by the stream lined housing 5. It is understood that with this arrangement, the engines are supported further from the water spray produced when the aeroplane is in contact with water and the cabin is further removed from the engines with reduced noise therefrom. In designing the heat exchange system according to this invention, the space within the stream lined compartment 5, is utilized for the blower 6, the electric motor 7, which drives the blower, the extended surface heat exchange coils 8, the liquid pump 9, and the electric motor 10 for driving the pump.

The exhaust pipes 11 of two of the motors are wound with the coils 12, which in turn, are connected to the pump 9 and coils 8, so that liquid, heated in the coils 12, is, in operation, continuously circulated through coils 12, pump 9 and heating coils 8.

Arranged longitudinally within the cabin 13 of the aeroplane are the two longitudinal distribution ducts 14, which are connected to the

output side of the casing containing the heat exchange coils 8. The space within the compartment 5 communicates with the space within the cabin 13, and the blower 6 draws in air from the space within the compartment 5 and the space within cabin 13, the heated air being continuously recirculated. Due to the high speed of the aeroplane, there is sufficient infiltration of fresh air and exhaust of heated air, so that no provision for the heating of fresh air and positive exhaust of heated air need be provided. The ducts 14 are provided with the spaced discharge outlets 15 from which the heated air passes into the passenger space.

After many experiments, it was found that the above described arrangement was the only one suitable for heating the air within the cabins of the high wing type aeroplanes, due as previously explained to the fact that a liquid such as "Prestone" was used to partially fill the fluid lines, and to the selection and arrangement of the apparatus. The expansion of the heat exchange fluid is taken care of, and the characteristics of the fluid are such that it does not solidify at low temperatures, nor vaporize at high temperatures. Then, again, the heat exchange apparatus which enables a forced draft of heated air to be produced is provided without encroachment upon the limited passenger space and without the production of unpleasant noises.

Whereas, one embodiment of the invention has been described, for the purpose of illustration, it should be understood that the invention is not to be limited to the precise arrangement described as many departures will suggest themselves to those skilled in the art, after having had access to this disclosure.

What is claimed is:

1. Heat exchange apparatus for an airplane having a cabin and having an internal combustion engine mounted above said cabin, comprising a liquid circulating system, containing a liquid having a lower freezing point and a higher vaporization temperature than water, means in said system for heating said liquid with heat from the exhaust gases of said engine, air heating coils and a pump in said system mounted below said heating means and between said cabin and said engine, a blower for moving air over said coils, means for passing recirculated air from said cabin into said blower and means for passing the heated air leaving said coils into the passenger space within said cabin.

2. Heat exchange apparatus for an airplane having a cabin and having an internal combustion engine mounted above said cabin, comprising a liquid circulating system, partially filled with a liquid having a lower freezing point and a higher vaporization temperature than water, means in said system for heating said liquid with heat from the exhaust gases of said engine, air heating coils and a pump in said system mounted below said heating means and between said cabin and said engine, a blower for moving air over said coils, means for passing recirculated air from said cabin into said blower, and means for passing the heated air leaving said coils into the passenger space within said cabin.

3. Heat exchange apparatus for a high wing cabin airplane, having an engine mounted above the cabin and having a relatively small stream lined compartment between the wing and cabin, comprising a liquid circulating system containing a heat exchange liquid, means for heating the liquid in said system with heat from the exhaust gases of said engine at a point above said compartment, air heating coils in said system mounted in said compartment, a pump for circulating the liquid in said system, a blower for moving air over said coils, means for passing recirculated air from said cabin into said blower, a duct having spaced openings extending longitudinally above the passenger space in said cabin, and means for passing the heated air leaving said coils into said duct.

4. Heat exchange apparatus for a high wing cabin airplane, having an engine mounted above the cabin and having a relatively small stream lined compartment between the wing and cabin, comprising a liquid circulating system partially filled with a heat exchange liquid having a lower freezing point and a higher vaporization temperature than water, means for heating the liquid in said system with heat from the exhaust gases of said engine at a point above said compartment, air heating coils in said system mounted in said compartment, a pump for circulating the liquid in said system, a blower for moving air over said coils mounted in said compartment, means for passing recirculated air from said cabin into said blower, a duct having spaced openings extending longitudinally of said cabin above the passenger space therein, and means for passing the heated air leaving said coils into said duct at a point substantially midway thereof.

5. Heat exchange apparatus for a high wing cabin airplane, having an engine mounted above the cabin and having a relatively small stream lined compartment between the wing and cabin, comprising a liquid circulating system partially filled with a heat exchange liquid having a lower freezing point and a higher vaporization temperature than water, means for heating the liquid in said system with heat from the exhaust gases of said engine at a point above said compartment, air heating coils in said system mounted in said compartment, a pump for circulating the liquid in said system mounted in said compartment, a blower for moving air over said coils mounted in said compartment, means for passing recirculated air from said cabin into said blower, a duct having spaced openings extending longitudinally of said cabin above the passenger space therein, and means for passing the heated air leaving said coils into said duct at a point substantially midway thereof.

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