

June 7, 1949.

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VAPOR RECOVERY SYSTEM FOR AIRPLANE FUEL TANKS

Filed Dec. 9, 1944

3 Sheets-Sheet 1

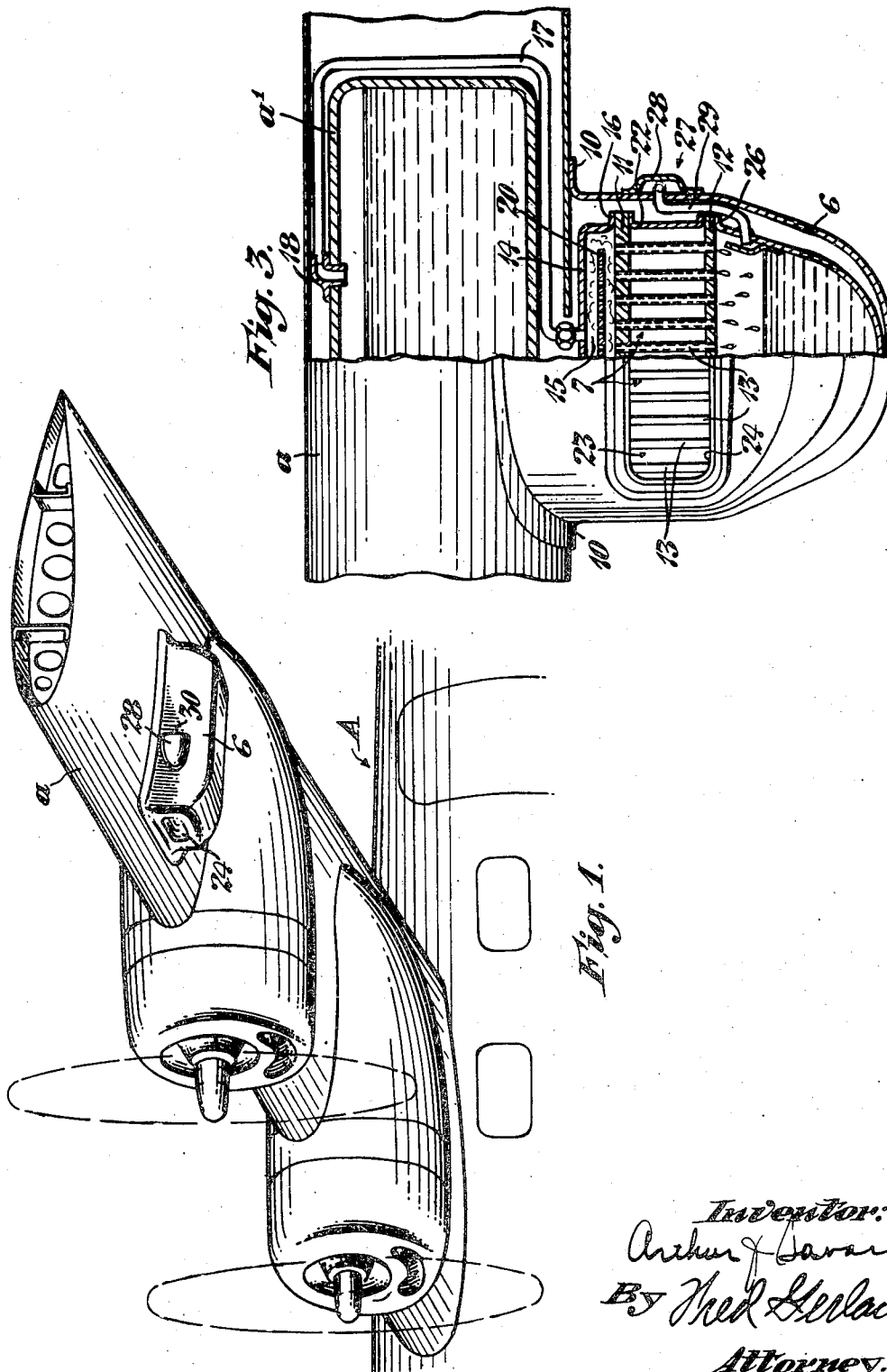


Fig. 1.

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3 Sheets-Sheet 2

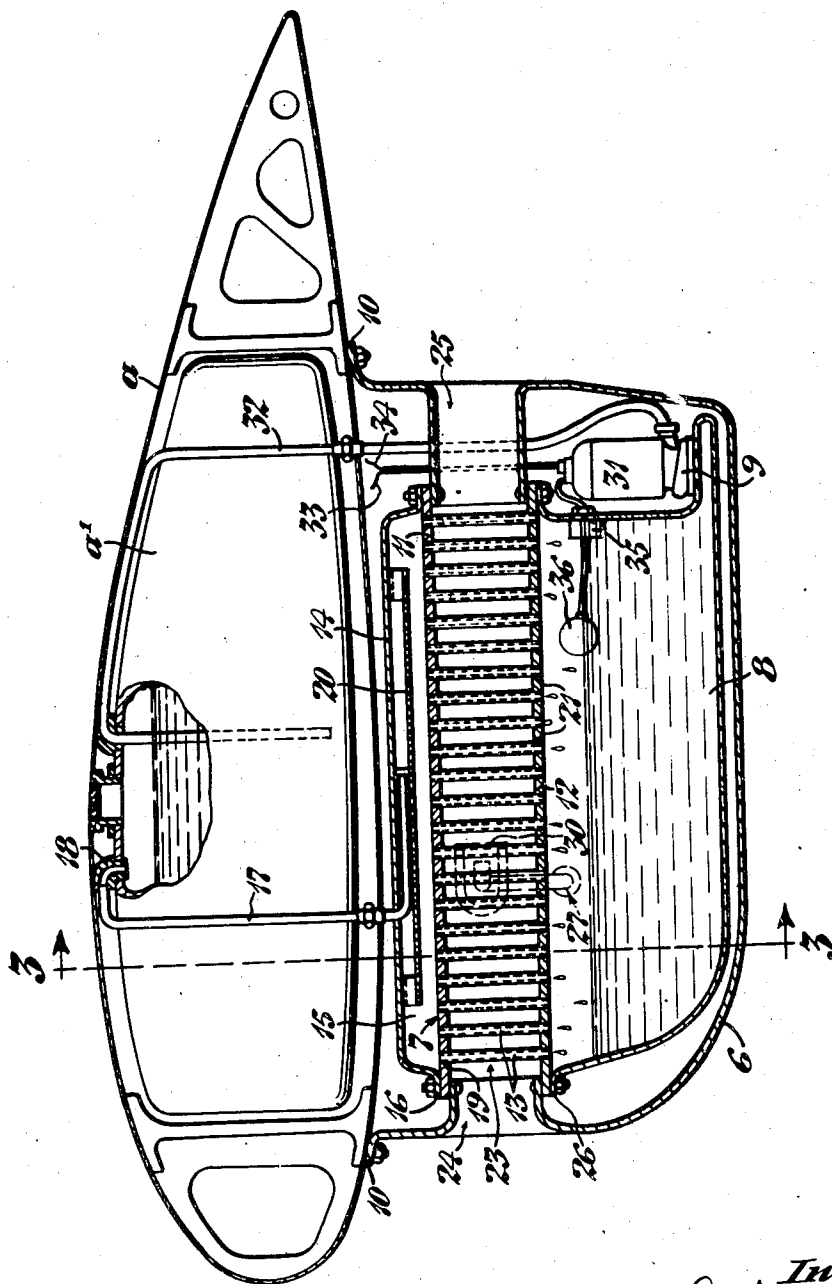


Fig. 2

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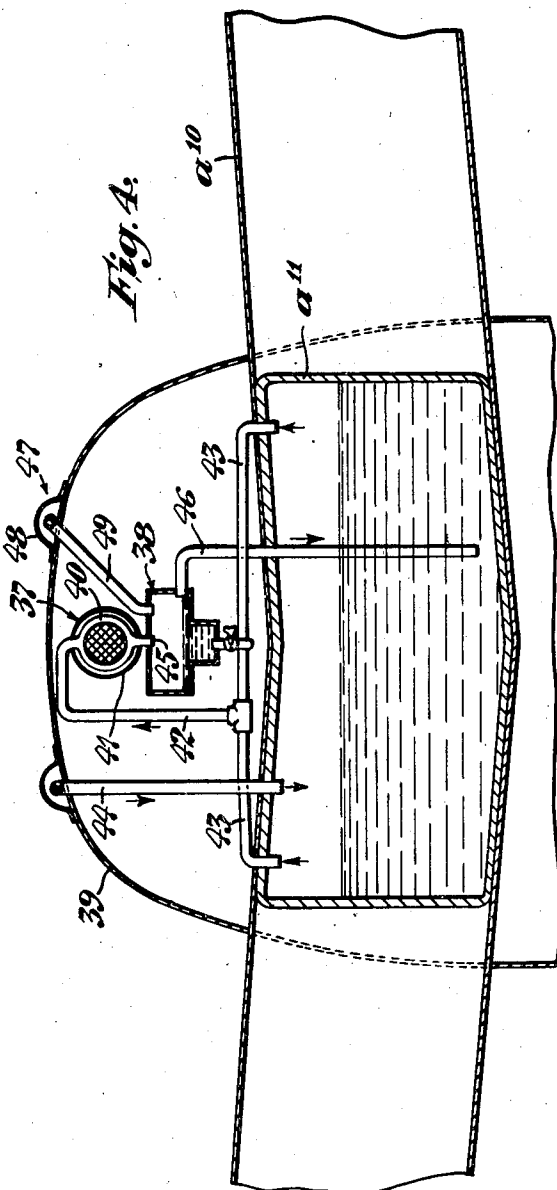
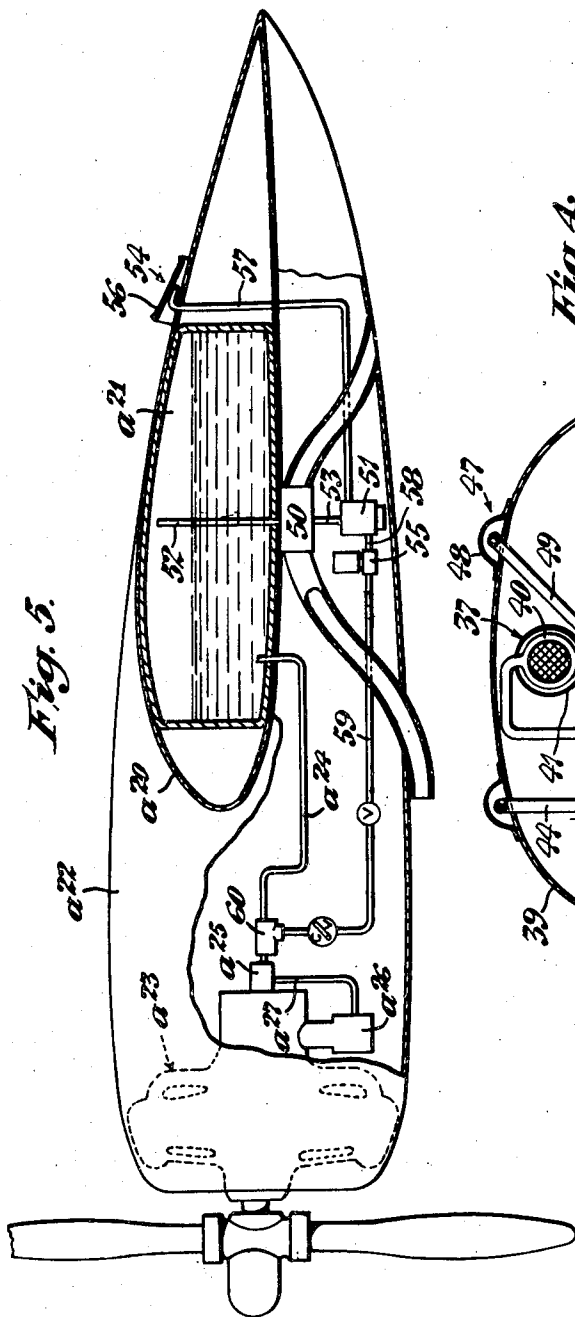
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VAPOR RECOVERY SYSTEM FOR AIRPLANE FUEL TANKS

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3 Sheets-Sheet 3



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## UNITED STATES PATENT OFFICE

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VAPOR RECOVERY SYSTEM FOR AIRPLANE  
FUEL TANKSArthur J. Savard, San Diego, Calif., assignor to  
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14 Claims. (Cl. 244—1)

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The present invention relates generally to systems for recovering fuel vapor. More particularly the invention relates to that type of system which is designed primarily for use in connection with an airplane fuel tank and serves as a medium or instrumentality for condensing and thereby recovering the vapor resulting from vaporization or evaporation of the fuel within the tank.

In the operation of an airplane it has been found that the loss of fuel by vaporization is an extremely important factor and results in pronounced diminution or curtailment of flying range, especially at high altitude. The rate of vaporization of fuel is principally dependent upon the temperature of the fuel when the airplane is on the ground, the rate of climb of the airplane, and the pressure of the vapor in the fuel tank at the flying altitude of the airplane. In practice it has been found that the loss of fuel by vaporization per thousand feet of altitude is from approximately .40 to .47% by weight, and that at a high altitude such for example as 30,000 feet, the loss of fuel due to vaporization or boiling may be as high as 9% of the total fuel load.

One object of the present invention is to provide a vapor recovery system for an airplane fuel tank, which is highly efficient and reduces to a minimum the amount of fuel which is normally lost by vaporization or evaporation.

Another object of the invention is to provide a vapor recovery system which comprises as its principal components: (1) a heat exchanger which is adapted to have the fuel vapor pass therethrough and serves to condense the vapor; (2) an accumulator which is connected to the heat exchanger so as to receive the condensate therefrom and has associated therewith means for developing a negative pressure within it in order to cause the fuel vapor to flow through the heat exchanger; and (3) means for returning the condensate or condensed fuel vapor to a desired point of use.

A further object of the invention is to provide a fuel vapor recovery system of the last mentioned type and character in which the means for developing a negative pressure within the accumulator is in the form of a Venturi variety device which is located in the slip stream of the airplane with which the system is associated, and the means for returning the condensate is in the form of an automatically controlled motor driven pump.

A still further object of the invention is to provide a fuel vapor recovery system which effectively and efficiently fulfills its intended purpose

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and is characterized by the fact that it is simple in design and embodies but a comparatively small number of parts.

Other objects of the invention and the various advantages and characteristics of the present fuel vapor recovery system will be apparent from a consideration of the following detailed description.

The invention consists in the several novel features which are hereinafter set forth and are more particularly defined by claims at the conclusion hereof.

In the drawings which accompany and form a part of this specification or disclosure and in which like letters and numerals of reference denote corresponding parts throughout the several views:

Figure 1 is a fragmentary perspective of an airplane having applied thereto a fuel vapor recovery system embodying one form of the invention;

Figure 2 is a vertical, longitudinal section of the system of Figure 1, illustrating the arrangement of the heat exchanger, the accumulator and the motor driven pump for returning the condensate from the accumulator;

Figure 3 is a vertical transverse section taken on the line 3—3 of Figure 2;

Figure 4 is a diagrammatic section of a second or modified form of fuel recovery system wherein the condensate within the accumulator is returned to the fuel tank by gravity; and

Figure 5 is a diagrammatic section of a third form of fuel recovery system wherein the condensate within the accumulator is fed or pumped into the fuel line leading to the airplane engine instead of back to the main fuel tank.

The fuel vapor recovery system which is shown in Figures 1 to 3, inclusive, of the drawings constitutes one form or embodiment of the invention and is illustrated in connection with, and as forming a part of, an airplane A. The latter is of conventional or standard design and embodies a wing *a* having a fuel tank *a*<sup>1</sup> therein. The tank is disposed between the front and rear spars of the wing and is suitably connected to deliver fuel to the fuel induction system for the engines of the airplane A. The recovery system serves as a medium for condensing the fuel vapor which is formed within the tank and as its main or principal parts comprises a cup-shaped shell 6, a heat exchanger 7, an accumulator 8, and a pump 9.

The shell 6 is disposed on the under side of the wing *a* directly beneath the fuel tank *a*<sup>1</sup>. It

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houses the heat exchanger 7, the accumulator 8, and the pump 9, and is preferably in the form of a sheet metal stamping. As shown in Figures 2 and 3, the shell 6 is elongated lengthwise of the airplane A and embodies at the upper margin of its side wall a continuous outwardly extending flange 10 which fits flatly against and is bolted or otherwise removably secured to the bottom portion of the wing a.

The heat exchanger 7 is located in the upper central portion of the shell 6 and comprises a normally horizontal upper plate 11, a normally horizontal lower plate 12, and a plurality of vertically extending tubes 13 between the two plates. In addition to the aforementioned parts the heat exchanger 7 comprises a sheet metal plate 14 which is spaced above the upper plate 11 and forms therewith a header 15. The margin of the plate 14 is bent downwards to form a continuous flange 16 which is shaped conformably to, and is fixedly secured against, the marginal portion of the upper plate 11. The header 15, which is formed between the plates 11 and 14, is connected to the upper portion of the fuel tank  $a^1$  by a pipe 17 in order that fuel vapor within the tank resulting from evaporation or boiling of the fuel is permitted to flow into the header. One end of the pipe 17 is connected to the top wall of the tank  $a^1$  by a fitting 18, and the other end of the pipe terminates in the central portion of the header. The upper ends of the tubes 13 fit within and extend through holes 19 in the upper plate 11 and communicate with the interior of the header 15. A foraminous preforated baffle 20 is disposed in the header midway between the plates 11 and 14 and serves to diffuse the vapor so the latter, after entering the header, flows downwards uniformly through the tubes 13. The lower ends of the tubes 13 extend through and fit snugly within holes 21 in the lower plate 12. A pair of laterally spaced longitudinally extending imperforate side walls 22 extend between and are suitably secured to the side margins of the upper and lower plates 11 and 12 and define with said plates a horizontal longitudinally extending duct 23. The front end of this duct communicates with the exterior of the shell 6 by way of an air inlet 24 in the front portion of the side wall of the shell, and the rear end of the duct communicates with the exterior of the shell by way of an air outlet 25 in the rear portion of the shell side wall. When the airplane A is in flight, air enters the duct 23 via the air inlet 24 then flows rearwards through the duct and past the tubes 13, and finally is discharged to atmosphere by way of the air outlet 25. As the air travels through the duct 23 it absorbs heat from the tubes 13 and causes condensation of the fuel vapor flowing downwards through the tubes. The heat exchanger 7 functions as a condenser for the fuel vapor which is created within the fuel tank  $a^1$ .

The accumulator 8 is located in the lower portion of the shell 6 and is cup-shaped. It is preferably in the form of a sheet metal stamping and has at the upper margin of its side wall an outwardly extending flange 26 which fits against and is bolted, riveted or otherwise fixedly secured to the margin of the lower plate 12 of the heat exchanger 7. The lower ends of the heat exchanger tubes 13 are in communication with the interior of the accumulator 8 which serves to store the condensate, that is, the condensed fuel vapor. Associated with the accumu-

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lator 8 is a Venturi device 27 for developing a negative pressure within the accumulator. This device consists of a hood 28 and a tube 29. The hood is disposed exteriorly of the shell 6 and is fixed to one of the side portions of the side wall of the shell at a point above the accumulator 8. It is preferably in the form of a sheet metal stamping and has a rearwardly facing opening 30. When the airplane A is in flight the air flowing past the hood 28 creates suction in the hood interior. One end of the tube 29 leads to the upper portion of the interior of the accumulator and the other end of the tube is disposed within the interior of the hood 28 and is arranged so that it projects rearwards. When suction is created in the hood 28 as a result of propulsion of the airplane A the tube 29 educts air from within the accumulator and results in a negative pressure being built up within the accumulator. Such negative pressure in turn results in the fuel vapor within the tank  $a^1$  being drawn into the header 15 via the pipe 17 then flowing downwards through the tubes 13 where, as a result of heat dissipation, condensation takes place. The tube 29 serves as a vent for the fuel tank in addition to forming with the hood 28 the Venturi device 27 for developing a negative pressure within the accumulator 8.

The pump 9 is located in the rear portion of the shell 6 directly behind the accumulator 8. It is driven by an electric motor 31 and has the inlet of the casing thereof connected to the bottom portion of the accumulator. The outlet of the pump casing is connected by a return pipe 32 to the fuel tank  $a^1$ . The discharge end of the return pipe 32 is positioned directly above the bottom of the fuel tank in order that the condensate which is returned to the tank by the pump 9 is introduced directly into the body or column of fuel in the tank. By having the discharge end of the return pipe 32 positioned directly above the bottom of the tank, the condensate or condensed vapor which is returned to the tank and is at a temperature lower than that of the fuel in the tank tends to cool the fuel in the tank and thus reduces vaporization or evaporation thereof. Another advantage in having the discharge end of the pipe 32 terminate directly above the bottom of the fuel tank is that the condensate or returned liquid fuel is not discharged into the vapor in the upper portion of the tank where it would tend quickly to vaporize or evaporate. The electric motor 31 for driving the pump 9 is positioned above the pump. It is supplied with current by way of a pair of conductors 33 and 34 and is controlled by a switch 35. The latter is mounted on the rear portion of the side wall of the accumulator 8 and has associated with it a float 36 which floats on the condensate within the accumulator 8 and operates when the level of the condensate rises beyond a certain point to close the switch and when the level of the condensate drops beneath the predetermined point to open the switch. By employing the float controlled switch 35 in the circuit for the electric motor 31 the motor is only energized when there is a predetermined quantity of condensate in the accumulator 8.

The operation of the fuel vapor recovery system which is shown in Figures 1 to 3, inclusive, is as follows: When the airplane A is in flight, the Venturi type device 27 operates to create or develop a negative pressure within the accumu-

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lator 8. Such pressure operates to draw fuel vapor within the tank  $a^1$  into the header 15 by way of the pipe 17 as heretofore pointed out. After flowing into the header 15 the fuel vapor flows downwards through the heat exchanger tubes 13 and is condensed as a result of the cooling effect which is produced by the flow of air through the duct 23 between the upper and lower plates 11 and 12 and the side walls 22. After flowing through the tubes the condensate or condensed vapor flows into the accumulator 8 where it is stored until such time as the float 36 is elevated to a predetermined height. Upon elevation of the float 36 to such predetermined height the switch 35 for controlling the electric motor 31 is automatically closed with the result that the motor 31 is energized and serves to drive the vane type pump 9. In connection with drive of the pump the condensate is pumped from the bottom of the accumulator back into the bottom of the fuel tank  $a^1$  through the return pipe 32.

The fuel vapor recovery system which is shown in Figures 1 to 3, inclusive, effectively and efficiently fulfills its intended purpose and results in a pronounced and substantially complete saving or recovery of the fuel which would normally be lost as a result of vaporization or evaporation within the tank  $a^1$ . It consists of but a comparatively small number of parts and hence may be produced at a low cost. As a result of the design and arrangement of the various component parts the system occupies but a comparatively small space and hence produces no appreciable drag so far as the airplane with which it is associated is concerned.

The fuel vapor recovery system which is shown in Figure 4 of the drawings constitutes or exemplifies another form or embodiment of the invention. It is illustrated in connection with, and as forming a part of, an airplane wing  $a^{10}$  having a fuel tank  $a^{11}$  therein. As its main parts the system of Figure 4 comprises a heat exchanger 37 and an accumulator 38. The heat exchanger and accumulator are positioned one above the other and are located above the upper surface of the wing  $a^{10}$  within the fuselage 39. The heat exchanger serves as a medium for condensing the fuel vapor and embodies a conventional type core 40 disposed within a duct 41. The duct extends lengthwise of the airplane and has its front and rear ends open in order that air circulates through the core 40 during flight of the airplane with which the system is associated. The upper portion of the core is connected to the upper portion of the fuel tank  $a^{11}$  by way of a pipe 42 having branches 43 at its inlet end. The branches as shown in Figure 4 lead downwards into the upper portion of the tank  $a^{11}$ . The fuel vapor within the tank is forced through the branches 43 of the pipe 42 into the heat exchanger core 40 as the result of the introduction of air under pressure into the upper portion of the tank  $a^{11}$  through the medium of a ram pressure tube 44. The inlet end of the tube 44 is disposed exteriorly of the fuselage 39 and faces forwards in order to receive air under pressure from the slip stream of the airplane. The other or discharge end of the tube 44 leads into the upper portion of the fuel tank  $a^{11}$ . When the airplane is subject to forward propulsion air under pressure enters the upper portion of the fuel tank  $a^{11}$  via the ram pressure tube 44 and causes the fuel vapor within the tank to flow to the heat exchanger core 40 as hereinbefore pointed out. The accumulator 38 is connected to the heat exchanger core by

way of a depending header pipe 45 the upper end of which is connected to the lower ends of the core 40 and the lower end of which leads into the upper portion of the accumulator. When the system is in operation the condensate resulting from the cooling effect of the air in transit through the heat exchanger 37 flows downwards into the accumulator 38 via the header pipe 45. A pipe 46 serves to connect the lower portion of the accumulator 38 to the upper portion of the fuel tank  $a^{11}$  and results in the condensate flowing by gravity from the accumulator back into the lower portion of the fuel tank by an extension of pipe 46. Associated with the accumulator is a Venturi type device 47 which is like the device 27 of the system of Figures 1 to 3, inclusive, and consists of a hood 48 and a suction tube 49. The hood 48 is fixedly secured to the outer surface of the fuselage 39 and has a rearwardly facing opening. One end of the suction tube 49 is disposed within the interior of the hood 48 and the other end leads to the top portion of the accumulator 38. The suction which is produced within the accumulator as a result of the operation of the Venturi type device 47 augments the ram pressure tube 44 in causing the fuel vapor to flow from the tank  $a^{11}$  into the heat exchanger 37.

The fuel vapor recovery system of Figure 4 functions like that of Figures 1 to 3, inclusive, and differs therefrom only in that it includes the ram pressure tube 44 and has the accumulator 38 arranged so that the condensate accumulating therein returns to the tank  $a^{11}$  by way of gravity.

The fuel vapor recovery system which is shown in Figure 5 of the drawings constitutes a third embodiment of the invention and is illustrated in connection with an airplane having a wing  $a^{20}$ . The wing contains a fuel tank or cell  $a^{21}$  and has attached to it a nacelle  $a^{22}$ . The latter serves as a housing for an engine  $a^{23}$ . The engine is supplied with fuel from the tank  $a^{21}$  by way of an induction system including a feed pipe  $a^{24}$ , a fuel pump  $a^{25}$  and a carburetor  $a^{26}$ . The feed pipe  $a^{24}$  leads from the bottom of the fuel tank  $a^{21}$  to the inlet of the fuel pump  $a^{25}$ . The fuel pump outlet is connected to the carburetor  $a^{26}$  by a pipe  $a^{27}$ .

The system of Figure 5 comprises a heat exchanger 50 and an accumulator 51. The heat exchanger is located within the nacelle  $a^{22}$  directly beneath the fuel tank  $a^{21}$  and is connected to receive vapor from the upper portion of the tank by an inlet pipe 52. It may be of any conventional or desired design and serves as a medium for condensing the fuel vapor as it passes or flows therethrough. The accumulator 51 is located within the nacelle  $a^{22}$  directly beneath the heat exchanger 50 and receives condensate from the heat exchanger by way of a pipe 53. It functions in the same manner as the accumulator 8 of the fuel vapor recovery system of Figures 1 to 3, inclusive, and the accumulator 38 of the system of Figure 4, and has associated with it a Venturi type device 54 and a motor driven pump 55. The device 54 serves to develop a negative pressure within the accumulator and consists of a Venturi tube 56 and a suction tube 57. The Venturi tube 56 is disposed exteriorly of the nacelle  $a^{22}$  and is arranged so that air from the airplane's slip stream flows therethrough. One end of the suction tube 57 is connected to the throat of the Venturi tube and the other end of the suction tube is connected to the upper portion of the accumulator 51. The inlet of the casing of the pump 55 is connected to the bottom

portion of the accumulator 51 by a pipe 58 and the outlet of the pump casing is connected to the feed pipe  $a^{24}$  of the fuel induction system for the engine  $a^{23}$  by a pipe 59. The discharge end of the pipe 59 is connected to the feed pipe  $a^{24}$  by a metering device 60 which serves to maintain the proportion of condensed fuel to straight fuel from the tank substantially constant at all times and regardless of the rate of flow of fuel to the fuel pump  $a^{25}$ .

The fuel vapor recovery system of Figure 5 is like that of Figures 1 to 3, inclusive, except that the condensate which accumulates in the accumulator 51 in connection with use of the system is fed to the feed pipe of the fuel induction system for the engine instead of being returned to the fuel tank.

The invention is not to be understood as restricted to the details set forth since these may be modified within the scope of the appended claims without departing from the spirit and scope of the invention.

Having thus described the invention what I claim as new and desire to secure by Letters Patent is:

1. In combination with an aircraft having a tank for liquid fuel, a fuel vapor recovery system comprising an air cooled heat exchanger arranged to be cooled by air from the slip stream of the aircraft, connected to receive fuel vapor from the tank, and designed to condense the vapor as it flows therethrough, an accumulator connected to the heat exchanger to receive the condensate therefrom, means operative during flight of the aircraft to force the fuel vapor from the fuel tank into the heat exchanger and the condensate to flow into the accumulator, and means for delivering the condensate from the accumulator to a point of use.

2. In combination with an aircraft having a tank for liquid fuel, a fuel vapor recovery system comprising an air cooled heat exchanger positioned in, and adapted to be cooled by, the slip stream of the aircraft, connected to receive fuel vapor from the tank, and designed to condense the vapor as it flows therethrough, an accumulator connected to the heat exchanger so as to receive the condensate therefrom, means operative during flight of the aircraft to create such pressure as to cause the fuel vapor to flow from the tank into the heat exchanger and the condensate to flow into the accumulator, and means for delivering the condensate from the accumulator to the fuel tank.

3. In combination with an aircraft having a tank for liquid fuel, a fuel vapor recovery system comprising an air cooled heat exchanger arranged to be cooled by air from the slip stream of the aircraft, connected to the tank so as to receive fuel vapor therefrom and designed to condense the vapor as it flows therethrough, an accumulator connected to the heat exchanger so as to receive the condensate therefrom, means operative during flight of the aircraft to create a negative pressure within the accumulator in order to draw the fuel vapor from the fuel tank into the heat exchanger and cause the condensate to flow into the accumulator, and means for delivering the condensate from the accumulator to a point of use.

4. In combination with an aircraft having a tank for liquid fuel, a fuel vapor recovery system comprising a heat exchanger connected to the tank so as to receive fuel vapor from the top portion of the latter and designed to condense the

vapor as it flows therethrough, an accumulator connected to the heat exchanger so as to receive the condensate therefrom, a Venturi type device disposed within the slip stream of the aircraft and connected and arranged to create suction within the accumulator in order to draw the fuel vapor from the fuel tank into the heat exchanger and cause the condensate to flow into said accumulator, and means for delivering the accumulated condensate from the accumulator to a point of use.

5. In combination with an aircraft having a tank for liquid fuel, a fuel vapor recovery system comprising an air cooled heat exchanger positioned to be cooled by the slip stream of the aircraft, connected to the tank so as to receive fuel vapor from the top of the latter, and designed to condense the vapor as it flows therethrough, an accumulator connected to the heat exchanger so as to receive the condensate therefrom, a Venturi type device positioned within said slip stream of the aircraft and connected and arranged so as to create suction within the accumulator in order to draw the fuel vapor from the fuel tank into the heat exchanger and cause the condensate to flow into said accumulator, and means for delivering the accumulated condensate from the accumulator to a point of use.

6. In combination with an aircraft having a tank for liquid fuel, a fuel vapor recovery system comprising a shell connected to, and positioned exteriorly of, the aircraft and having an air inlet and an air outlet whereby air from the slip stream of the aircraft is permitted to flow therethrough, an air cooled heat exchanger positioned within the shell between the air inlet and the air outlet, connected to the tank so as to receive fuel vapor from the latter and designed to condense the vapor as it flows therethrough, an accumulator disposed in the shell and connected to the heat exchanger so as to receive the condensate therefrom, means operative during flight of the aircraft to force the fuel vapor from the fuel tank into the heat exchanger and the condensate to flow into the accumulator, and means for delivering the condensate from the accumulator to a point of use.

7. In combination with an aircraft having a tank for liquid fuel, a fuel vapor recovery system comprising a shell connected to, and positioned exteriorly of, the aircraft and having an air inlet and an air outlet whereby air from the slip stream of the aircraft is permitted to flow therethrough, an air cooled heat exchanger positioned within the shell between the air inlet and the air outlet, connected to the tank so as to receive fuel vapor from the latter and designed to condense the vapor as it flows therethrough, an accumulator disposed in the shell beneath the heat exchanger and connected to said heat exchanger so as to receive the condensate by gravity therefrom, and means for delivering the condensate from the accumulator to the fuel tank including a motor driven pump disposed in the shell adjacent said accumulator.

8. In combination with an airplane having within the wing thereof a tank for liquid fuel, a fuel vapor recovery system comprising a shell connected to and depending from the airplane wing and provided with an air inlet in its leading portion and an air outlet in its trailing portion whereby air from the slip stream of the airplane is permitted to flow therethrough, an air cooled heat exchanger positioned in the shell between the air inlet and the air outlet, connected to the

tank so as to receive fuel vapor from the latter and designed to condense the vapor as it flows therethrough, an accumulator disposed within the shell and connected to the heat exchanger so as to receive the condensate, a Venturi type device disposed exteriorly of the shell and in the slip stream of the airplane and connected and arranged so as to create suction within the accumulator in order to draw the fuel vapor from the fuel tank into the heat exchanger and cause the condensate to flow into the accumulator, and means for delivering the condensate from the accumulator to a point of use.

9. In combination with an airplane having within the wing thereof a tank for liquid fuel, a fuel vapor recovery system comprising a shell connected to and depending from the airplane wing and provided with an air inlet in its leading portion and an air outlet in its trailing portion whereby air from the slip stream of the airplane is permitted to flow therethrough, an air cooled heat exchanger positioned in the shell between the air inlet and the air outlet, connected to the tank so as to receive fuel vapor from the latter and designed to condense the vapor as it flows therethrough, an accumulator disposed within the shell and beneath the exchanger and connected to the latter so as to receive the condensate by gravity therefrom, a Venturi type device disposed exteriorly of the shell and in said slip stream of the airplane and connected and arranged so as to create suction within the accumulator in order to draw the fuel vapor from the fuel tank into the heat exchanger and cause the condensate to flow into the accumulator, and means for delivering the condensate from the accumulator to the fuel tank including a motor driven pump disposed within the shell adjacent said accumulator.

10. In combination with an aircraft having a tank for liquid fuel, a fuel vapor recovery system comprising an air cooled heat exchanger arranged to be cooled by air from the slip stream of the aircraft, positioned above the fuel tank, connected to said tank so as to receive fuel vapor therefrom, and designed to condense the vapor as it flows therethrough, an accumulator positioned beneath the heat exchanger but above the fuel tank, connected to said heat exchanger so as to receive the condensate therefrom, means operative during flight of the aircraft to create such pressure as to cause the fuel vapor to flow from the tank into the heat exchanger and the condensate to flow into the accumulator, and connected to said fuel tank so as to deliver the accumulated condensate thereto by gravity.

11. In combination with an aircraft having a tank for liquid fuel, a fuel vapor recovery system comprising a heat exchanger positioned above the fuel tank, connected to said tank so as to receive fuel vapor from the latter, and designed to condense the vapor as it flows therethrough, an accumulator positioned beneath the heat exchanger but above the fuel tank, connected to the bottom of the heat exchanger so as to receive the condensate by gravity therefrom, and connected to said fuel tank so as to deliver the accumulated condensate thereto by gravity, and means operative during flight of the aircraft to create a negative pressure within the accumulator in order to draw the fuel vapor from the fuel tank into the heat exchanger and facilitate the flow of the condensate from the heat exchanger into the accumulator.

12. In combination with an aircraft having a tank for liquid fuel, a fuel vapor recovery system comprising a heat exchanger connected to the tank so as to receive fuel vapor from the top of the latter and designed to condense the vapor as it flows therethrough, an accumulator connected to the heat exchanger so as to receive the condensate therefrom, a ram pressure tube having one end thereof disposed exteriorly of and facing forwards with respect to the aircraft and its other end leading to the top of the fuel tank, and adapted during forward flight of the aircraft to introduce air under pressure into the top of the fuel tank in order to cause the fuel vapor to flow from said fuel tank into the heat exchanger and cause the condensate to flow into the accumulator, and means for delivering the condensate from the accumulator to a point of use.

13. In combination with an aircraft having a tank for liquid fuel, a fuel vapor recovery system comprising a heat exchanger connected to the tank so as to receive fuel vapor from the top of the latter, and designed to condense the vapor as it flows therethrough, an accumulator connected to the heat exchanger so as to receive the condensate therefrom, a ram pressure tube having one end thereof disposed exteriorly of and facing forwards with respect to the aircraft and its other end leading to the top of the fuel tank, and adapted during forward flight of the aircraft to introduce air under pressure into the top of the fuel tank in order to cause the fuel vapor to flow from said fuel tank into the heat exchanger and cause the condensate to flow into the accumulator, means for creating a negative pressure within the accumulator in order to augment the ram pressure tube in causing the fuel vapor to flow from the fuel tank into the heat exchanger and the condensate to flow from the heat exchanger into the accumulator, and means for delivering the condensate from the accumulator to a point of use.

14. In combination with an engine driven aircraft having a tank for supplying liquid fuel to the engine via a fuel induction system, a fuel vapor recovery system comprising a heat exchanger connected to the tank so as to receive fuel vapor therefrom and adapted to condense the vapor as it flows therethrough, an accumulator connected to the heat exchanger so as to receive the condensate from the latter, and means including a motor driven pump for delivering the condensate from the accumulator directly into the fuel induction system.

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