June 2, 1942. P. F. HACKETHAL 2,284,653

ENGINE HEATER

Filed Feb. 20, 1940 5 Sheets-Sheet 1

Fig. 1.

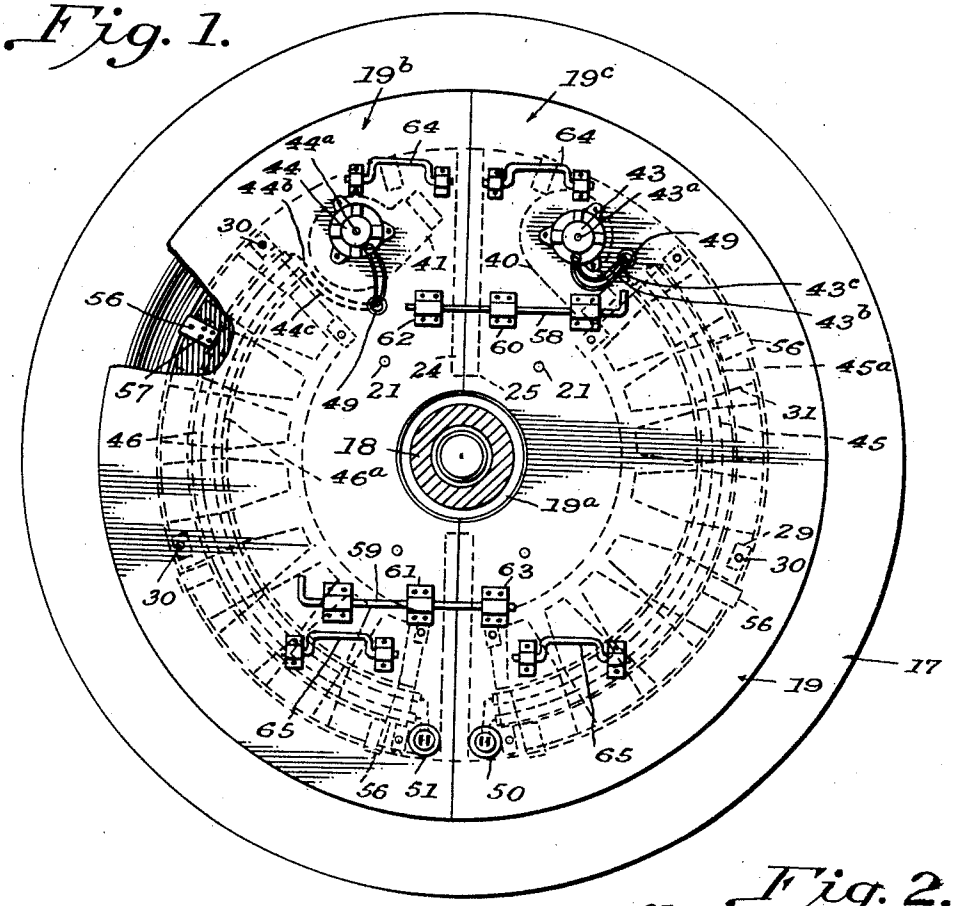


Fig. 2.

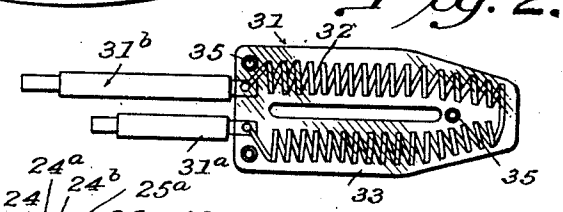
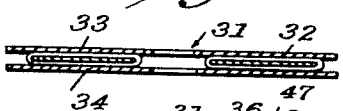


Fig. 3.



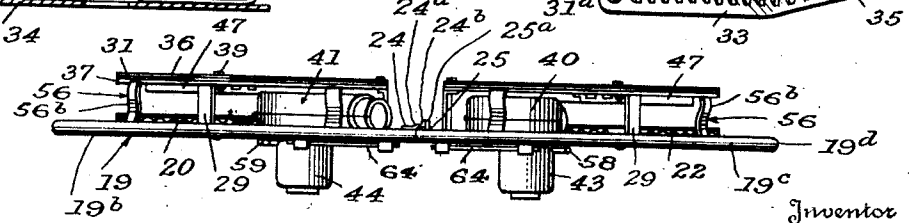


Fig. 4.

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ENGINE HEATER

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Fig. 5.

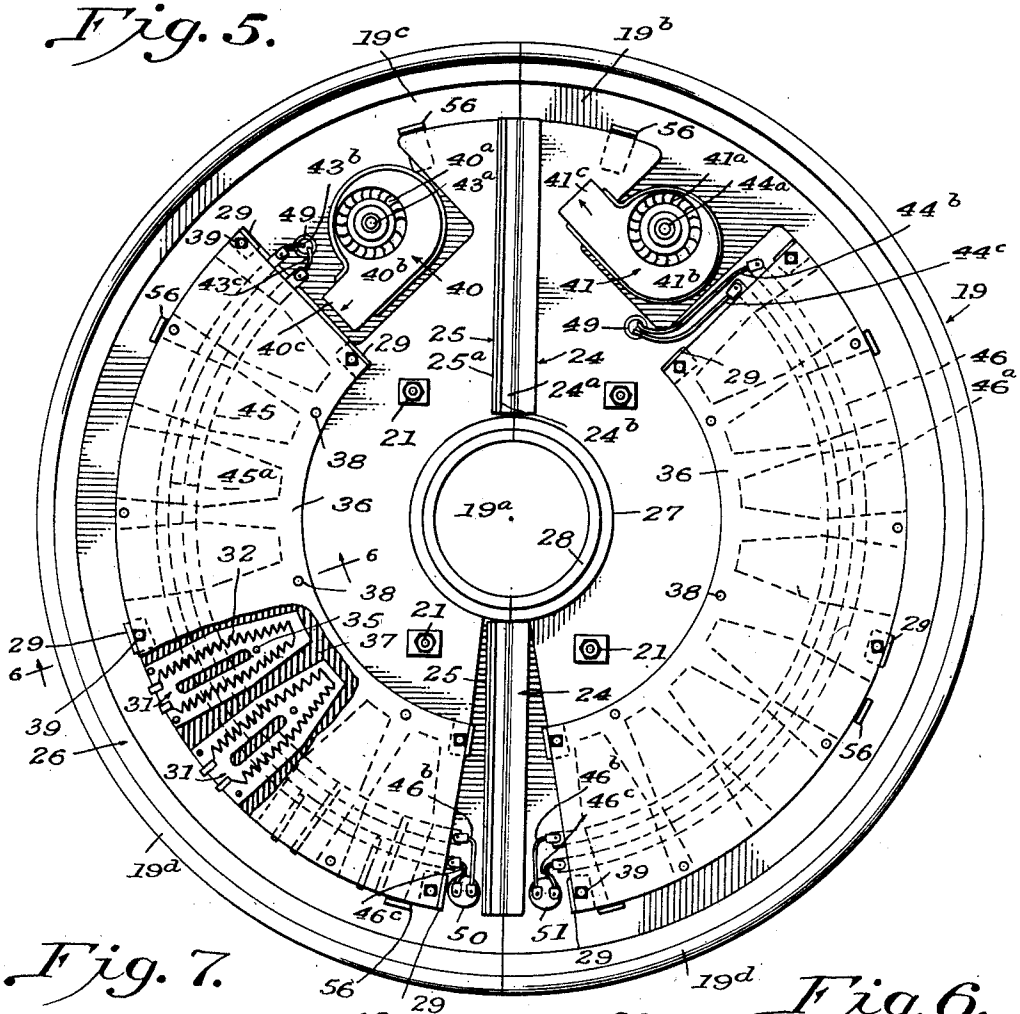


Fig. 7.

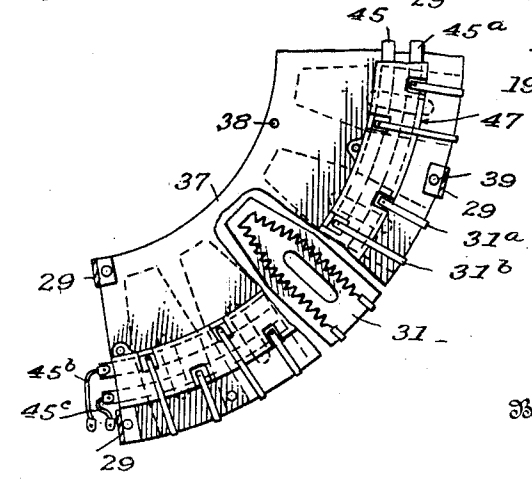
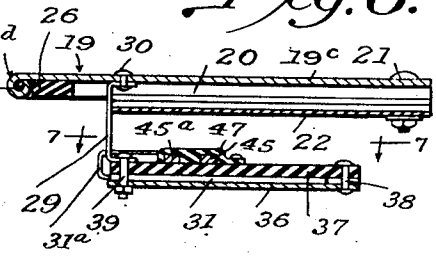


Fig. 6.



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ENGINE HEATER

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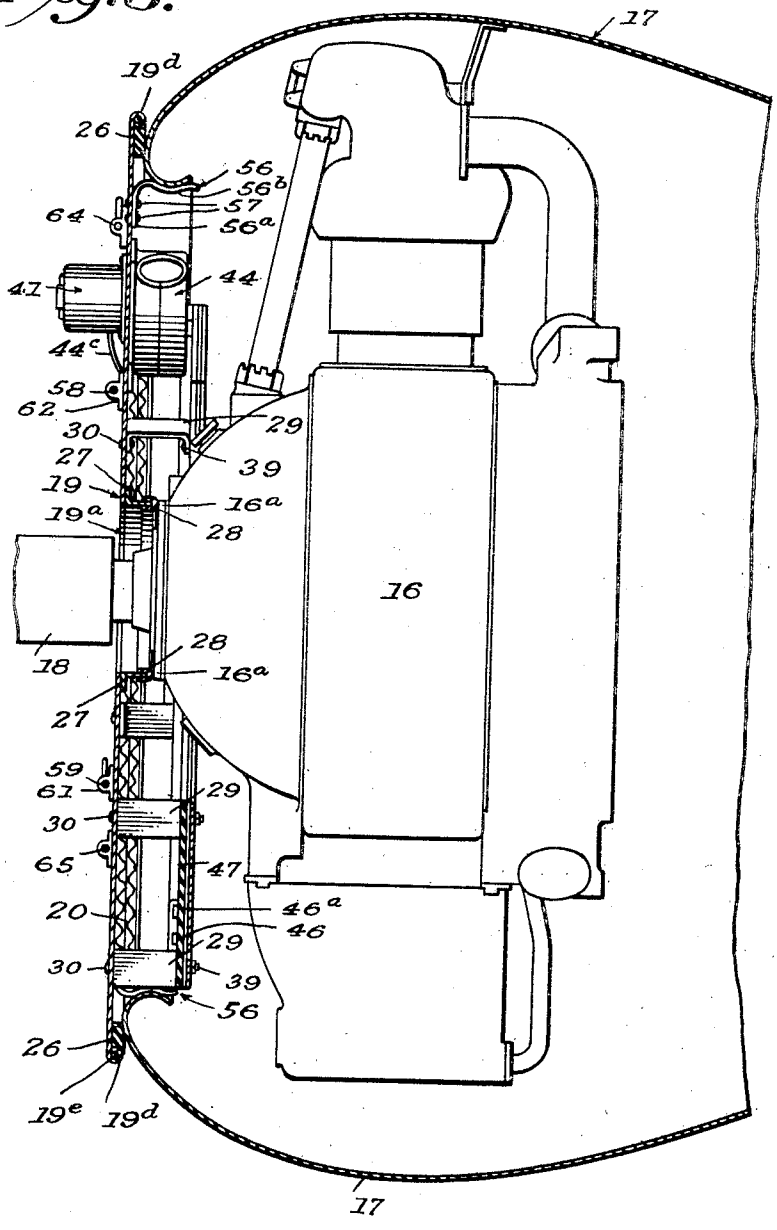
Fig. 8.



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ENGINE HEATER

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Fig. 9.

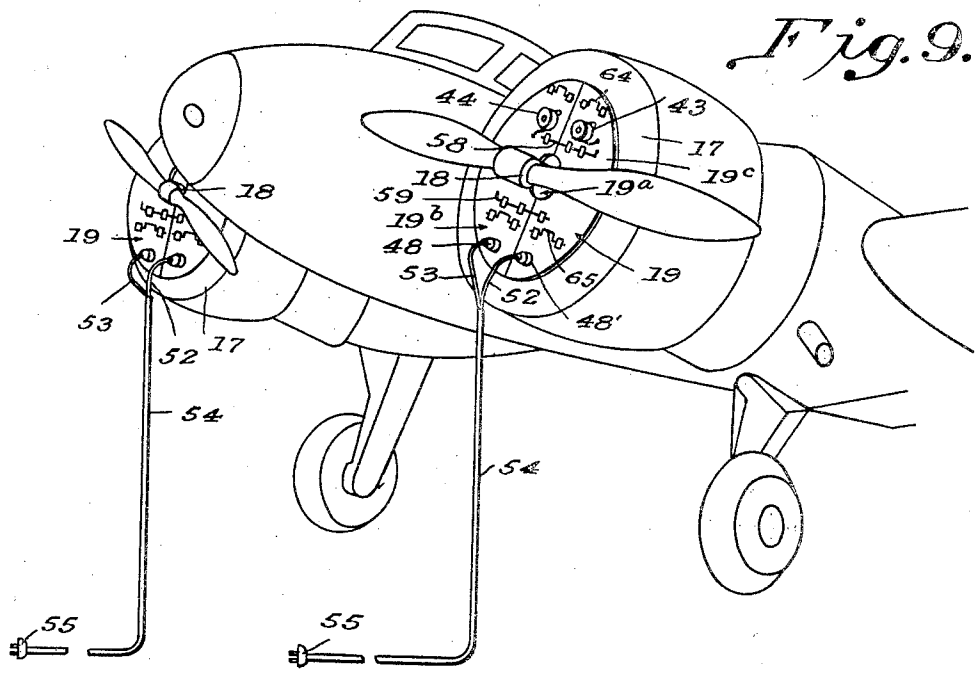
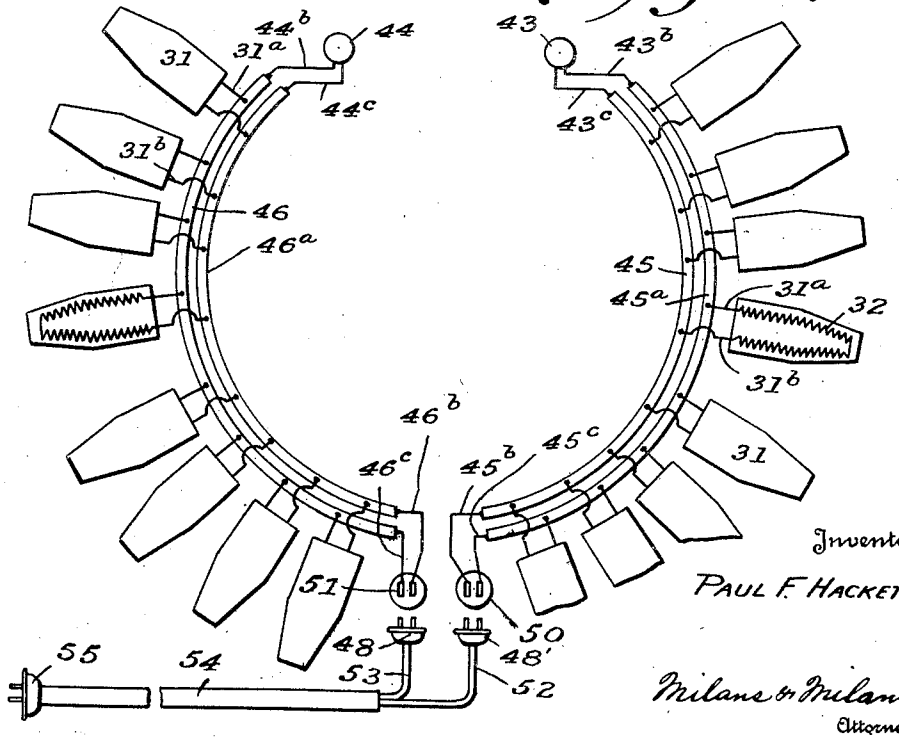


Fig. 10.



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ENGINE HEATER

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Fig. 11.

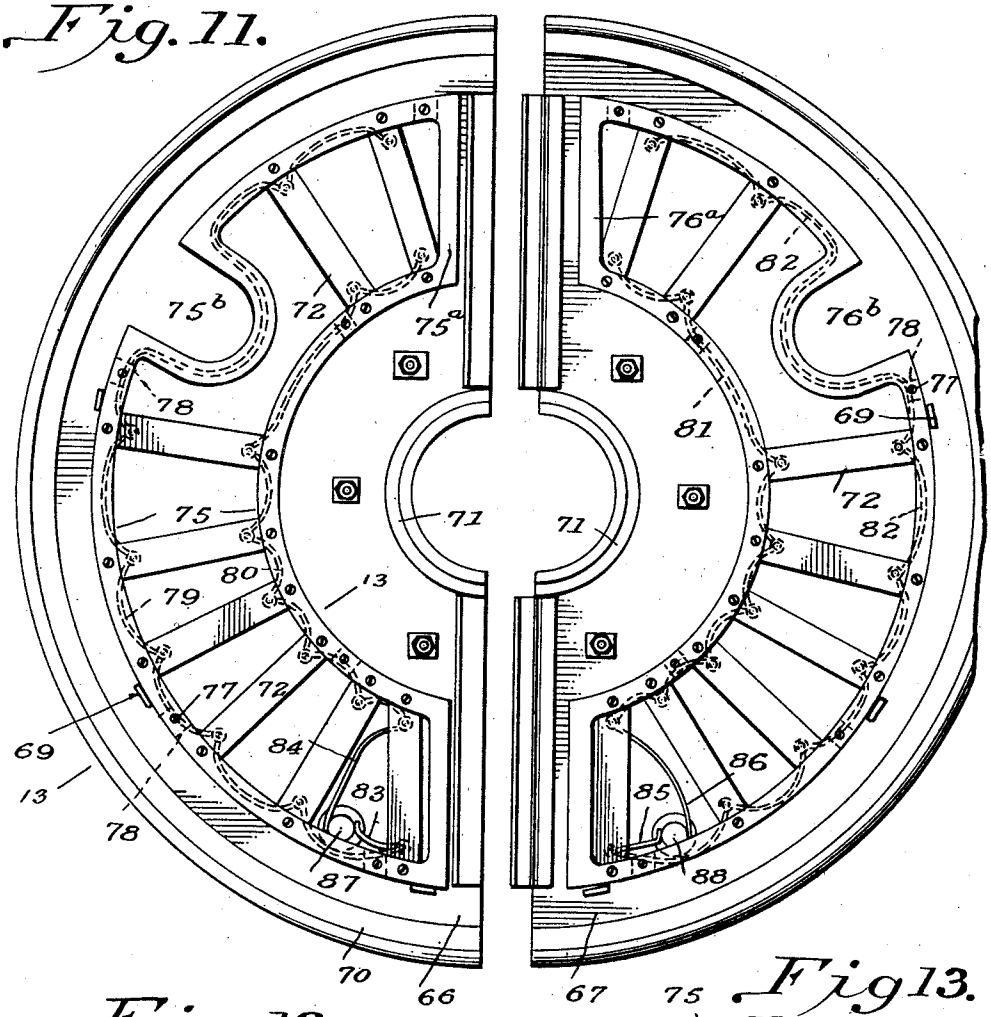


Fig. 12.

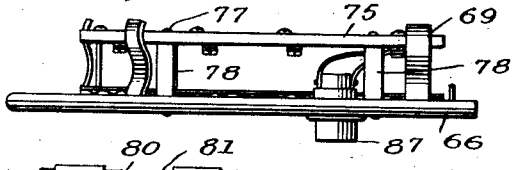
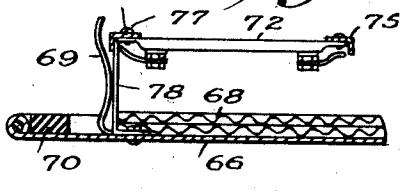


Fig. 13.



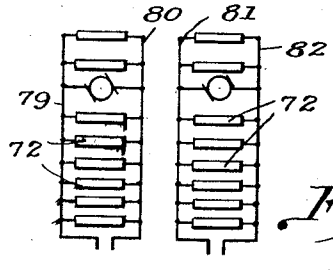


Fig. 15.

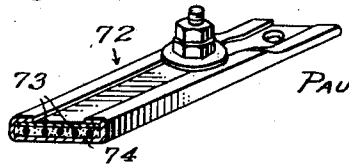


Fig. 14.

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Patented June 2, 1942 2,284,653

UNITED STATES PATENT OFFICE

2,284,653

ENGINE HEATER

Paul F. Hackethal, Baltimore, Md.

Application February 20, 1940, Serial No. 319,957

22 Claims. (Cl. 219—19)

This invention relates to improvements in heaters for aircraft engines for prewarming and keeping the engine at the desired temperature ready for take off.

The necessity for keeping aviation engines sufficiently warm to be started presents a great problem in cold climates. Heretofore, protective coverings have been used, the coverings being adapted to be slipped over the engine cowling and having tubular extensions leading to the ground where air is heated by various means and conducted through the extensions to the engine cowling. Covers equipped with charcoal or gasoline stoves have been employed but in the use of such apparatus among other drawbacks there is the great disadvantage in forming a fire hazzard due to the proximity of the flames of the heater to gasoline, oil or wing surfaces that have been treated with inflammable coatings. This is also true in the use of electric stoves and electric radiant heaters that have an exposed high temperature element which may easily ignite the fumes from dripping carburetors or other inflammable matter.

An object of the present invention is to provide an improved engine heater that will be safe and efficient in operation, and that can be easily and quickly attached to and removed from the engine cowling.

Another object of the invention is to provide an improved engine heater of light, compact construction that can be conveniently stowed on the airship.

Further more specific objects of the invention are the provision of heating means of such a character and so located relatively to the engine, together with provision for forced distribution of heated air within the engine compartment of the cowling so that heat from the heating means will be more advantageously utilized and radiated against the metal parts of the engine within the engine cowling to the ends that a quick heating of the engine can be safely and economically effected.

The invention, with other objects and advantages thereof, and the particular construction, combinations and arrangements of parts comprising the same, will be understood from the hereinafter contained detailed description, when considered in connection with the accompanying drawings forming part hereof and illustrating two embodiments of the invention.

In the drawings:

Figure 1 is a front elevation of an engine heater constructed in accordance with the present invention, the engine heater being shown attached to the front of the engine cowling.

Fig. 2 is a plan view of one of the heater units of the construction illustrated in Figure 1.

Fig. 3 is a transverse section of the heater unit shown in Figure 2.

Fig. 4 is a top plan view of the construction of engine heater illustrated in Figure 1, the closure sections being shown in mating relation.

Fig. 5 is a rear elevation.

Fig. 6 is a fragmentary section on the line 6—6 of Figure 5 looking in the direction of the arrow.

Fig. 7 is a horizontal section taken on the line 7—7 of Figure 6 and looking in the direction of the arrow.

Fig. 8 is a vertical section of the construction illustrated in Figures 1 to 8 and a fragmentary vertical section of the cowling of an aviation engine, showing the engine heater attached to the cowling, the engine being shown in side elevation.

Fig. 9 is a fragmentary perspective of an aeroplane with the engine heater attached to the engine cowling.

Fig. 10 is a diagram of the circuit connections for the heater units and the motors of the blowers in the construction illustrated in Figures 1 to 9.

Fig. 11 is a rear elevation of an engine heater of the same general character as that illustrated in Figures 1 to 9 but provided with a different construction of heating means, the closure sections being shown separated from each other.

Fig. 12 is a bottom plan of one of the closure sections of the construction illustrated in Figure 11.

Fig. 13 is a fragmentary section on the line 13—13 of Figure 11.

Fig. 14 is a fragmentary perspective of one of the heater units shown in Figure 11.

Fig. 15 is a diagrammatic showing of the circuit connections for the heater units and blower motors in the construction illustrated in Figures 11 to 14 of the drawings.

While two preferred embodiments of the invention are illustrated in the drawings, it will of course be understood that minor changes and modifications may be made in the particular constructions shown, and the invention may be embodied in other forms as will appeal to those skilled in the art and falling within the scope of the appended claims, without departing from the spirit of the invention.

In accordance with the invention, a closure is provided for the front opening of the engine

cowling, the closure being adapted to be detachably secured to the front of the cowling and carrying at the inner side thereof electrical heating means and also a blower, the heating means being advantageously located relatively to the engine, and the blower providing for distribution of the heated air from the heating means throughout the engine compartment of the cowling.

In Figure 8 of the drawings is illustrated a conventional form of aviation engine. In this view, 16 designates the engine, 17 the cowling, and 18 is the hub of the propeller.

Referring to a detailed description of the particular embodiment of the invention illustrated in Figures 1 to 10 of the drawings, 19 designates the closure for the front opening of the engine cowling. The closure is constructed of light sheet metal, preferably thin aluminum, and has a thick sheet of asbestos board 20 or other suitable heat insulating covering at its inner side, said insulating covering being secured to the closure by bolts 21 or equivalent fastening means. The insulating board 20 is provided on its outer face with a coating 22 of aluminum foil forming a heat reflecting surface. The closure, which is of circular form has a central opening 19^a to accommodate hub 18 of the propeller and is formed in two separate sections 19^b and 19^c. The metal sections are each shown provided with an outer marginal reinforcing bead 19^d having a wire core 19^e.

At their inner sides the metal plate sections are provided with metal strip members 24 and 25 extending along their straight mating marginal portions which serve as reinforcing means for the sections and are adapted to cooperate with each other to facilitate assembling and maintaining the closure sections in mating relation, the strip members 24 on the section 19^b each having an offset portion 24^a projecting beyond the mating edge of the section to be engaged by the strip members 25 on the other closure section 19^c in assembling the sections, and said strip members having inwardly projecting flanges 24^b and 25^a respectively. Said strip members are spot welded or otherwise suitably secured to the metal closure sections. The closure is adapted to fit against the front of the engine cowling as illustrated in Figure 8 of the drawings. The closure sections are provided at the inner sides thereof along their outer marginal portions with sealing strips 26 and at their inner curved marginal portions bordering the central opening for the propeller hub, they each have an inward extension 27, said inward extensions being provided with sealing strips 28. These latter strips and the sealing strips 26 are formed of rubber or any other suitable material. When the closure is applied to the cowling the sealing strips 26 fit against the cowling, and the inward extensions 27 extend within the cowling with their sealing strip portions 26 fitting against an end face 16^a of the engine casing, so that air tight joints are provided along the outer and inner marginal portions of the closure.

The electrical heating means is supported on U-shaped brackets 29 secured to the closure sections 19^b and 19^c by rivets 30, the brackets projecting rearwardly from the closure and the heating means being mounted at the outer ends thereof, said brackets extending within the engine cowling and the heating means being disposed close to the engine when the closure is attached to the cowling. The heating means comprises a plurality of units 31. These are shown in Figures 2 and 3 of the drawings as formed of resistance elements 32 of strip form looped back and forth in zigzag formation and inclosed between sheets 33 and 34 of mica or other suitable material that has good electric insulating properties and is also a good conductor of heat. The sheets 33 and 34 with the resistance element 32 interposed therebetween are secured together by rivets 35. The heating units 31 are disposed facewise in a common plane in radial arrangement spaced from each other, a group of the heating units being carried by each of the closure sections 19^b and 19^c. Each group of heating units is interposed between a metal sheet 36 and a sheet 37 of heat insulating board, said sheets, which are both arcuate shaped, and the insulating sheets 33 and 34 of the heating units being secured together in close contact by rivets 38, the assemblage in the form of a unit being secured by bolts 39 to the brackets 29 of one of the closure sections with the metal sheet 36 facing toward the rear.

In the particular exemplification of the invention illustrated in the drawings and referring especially to Figure 5, the air circulating means comprises a pair of small electrically operated blowers 40 and 41, one of said blowers being carried by each one of the closure sections at the inner side thereof. The construction of blower shown is one of the well known types, each blower comprising a multi-bladed fan wheel and a housing having an intake opening at one side and a tangential discharge outlets. 40^a and 41^a designate respectively the fan wheels of the blowers, 40^b and 41^b the housings thereof, and 40^c and 41^c the discharge outlets of the housings. 43 and 44 designate electric motors for the blowers suitably mounted on the closure sections at the front side thereof, the blower housings 40^b and 41^b being attached to the closure sections at the rear side thereof and the fan wheels 40^a, 41^a being secured respectively to the motor shafts 43^a and 44^a projecting rearwardly through openings in the closure sections. The blowers are arranged as shown at the upper part of the closure sections with their discharge outlets 40^c and 41^c directed outwardly tangentially of the closure and being adapted to withdraw the hot air accumulating at the upper part of the cowling and force the same to the lower part thereof, the special arrangement providing for circulating the air outwardly tangentially and downwardly around within the cowling and thus providing for a uniform distribution of the heat from the heating units 31 throughout the engine compartment of the cowling. As illustrated diagrammatically in Figure 10, the heating units 31 and the motors 43 and 44 of the blowers carried by each closure section, are connected up in parallel in the electric circuit, the terminals 31^a, 31^b of the heating units and the connections 43^b, 43^c and 44^b, 44^c, for the motors being connected with opposite lead conductors 45, 45^a and 46, 46^a.

As shown in Figures 6 and 7 of the drawings, the lead conductors 45, 45^a and 46, 46^a may conveniently be supported against the outer side of the sheets 37 of insulating material by insulating strips 47, which are suitably secured to the sheets 37, the insulated terminals 31^a, 31^b of the heating units 31 being folded back around the outer edges of said sheets and connected to the lead conductors. The conductor wires 43^b, 43^c and 44^b, 44^c that lead to the motors, pass through openings in the closure sections and are insulated

therefrom by insulating sleeves 49, which also serve to seal said openings. The conductor leads 45, 45a and 46, 46a on each of the closure sections have short extensions 45b, 45c and 46b, 46c that are connected with one of the terminal sockets 50, 51 secured to the closure sections and opening to the front thereof for reception of connector plugs 48, 48' at one end of power supply cables that are adapted to be connected with outlets from a source of electric power supply. As shown in Figures 9 and 10, the power supply cables 52, 53, are joined together in an insulating sheath 54 and the outer terminals of said cables are connected to a single connecting plug 55 to provide for convenient plugging in of both of the supply cables simultaneously with a service outlet.

The closure is equipped with means for detachably connecting the same to the engine cowling. On each of the closure sections at intervals thereabout are provided arms 56 projecting rearwardly from the inner side and near the periphery thereof, said arms being adapted to extend within and embrace the cowling ring as illustrated in Figure 8 of the drawings. The arms 56, which are constructed of spring metal, are shaped as shown, each having a flat inner end portion 56a secured by rivets 57 or equivalent fastening means to the closure section, and a rearwardly extending part 56b curved to conform to the general cross sectional curvature of the cowling ring, said arms being adapted to be sprung into engagement with the cowling ring.

Latch mechanism is provided for holding the closure sections in mating relation. This comprises a pair of lock rods 58 and 59 slidably mounted in plates 60 and 61 on the closure sections, and keeper plates 62 and 63 on the closure sections to cooperate with the lock rods, said lock rods being adapted to be adjusted to bridge the mating edges of the closure sections and engage the keeper plates when the sections of the closure have been assembled in mating relation on the cowling. Each of the closure sections is provided with a pair of handles 64 and 65.

When the engine heater is in operation, the metal plates 36 at the rear side of the groups of heating units 31 facing the engine and in close proximity thereto, will radiate the heat against the engine parts, the sheets 37 of insulating material at the front side of the heating units acting to concentrate the heat from the heating units onto the radiating plates 37. As will be understood, the layer 20 of insulating material at the inner side of the closure functions to prevent heat losses by radiation to the outside atmosphere, and the reflecting surface 22 contributes in accomplishing this result by throwing back the heat waves from the closure. The blowers withdraw the heat accumulating at the upper part of the engine compartment of the cowling and force the same outward tangentially and downwardly around within the cowling to effect a uniform distribution of the heat.

By the particular construction and arrangements of parts hereinbefore set forth, an engine heater is provided that will be safe, efficient, and economical in operation. It will be noted that the electric heating means is so constructed that the resistance elements thereof are not directly exposed, but while the resistance elements are protected, the construction and arrangement of the parts is such as to effect a quick warming up of the engine to takeoff temperature, the heating means being advantageously disposed within the engine cowling in close proximity to the engine when the closure is attached to the cowling. The heater can be easily and quickly attached to and removed from the cowling, and it is of compact construction that can be conveniently stowed on the airship. As will be appreciated, after the heater is attached it can be quickly connected to an electric power supply, and the heater has special advantages where airships are required to stand ready for takeoff during a comparatively long period, as for instance, a fleet of aeroplanes on the deck of an aeroplane carrier in winter weather. By the present invention, the necessity for providing a protective covering for the engine cowling with tubular extensions leading to heating means on the ground, and the disadvantages incident to the use of such equipment are entirely eliminated.

In Figures 11 to 14 of the drawings is illustrated another engine heater that is similar in general design and in principle of operation to the construction shown in Figures 1 to 10, except that the former is equipped with a different form of electrical heating means. In these views, 66 and 67 designate the metal plate sections of the closure, 68 the inner layer of insulating board, and 69 the spring arms on the closure sections for detachably connecting the closure to the engine cowling. 70 designates the sealing strips along the outer marginal portions of the closure sections, and 71 are the sealing strip portions of the inward extensions on the sections bordering the central opening for the propeller hub. In this modified construction, the heating means comprises heating units of strip form of the type comprising a metal sheath 72 enclosing resistance wire 73 insulated by material 74, such as magnesium oxid powder, that is a good conductor of heat. Different constructions of strip heating units of the general character referred to may be employed, the particular construction shown being a well known form of this type of heating unit. The heating units 72 carried by each closure section are radially arranged spaced from each other and spaced from the inner side of the closure sections. The heating units are shown more widely separated at the upper portions of the closure sections so that a greater amount of heat will be radiated at the lower part of the engine compartment of the cowling. The heating units are secured at opposite ends to spaced parallel arcuate shaped angle iron strips 75 and 76, said strips being suitably secured by screws 77 to the outer ends of brackets 78 which are secured to the closure sections at the inner side thereof. The pairs of arcuate shaped angle iron strips 75 and 76 are shown connected at their ends by short radial strip portions 75a and 76a.

As shown diagrammatically in Figure 15, the heating units 72 and the motors of the blowers carried by each closure section are connected together in parallel in the electric circuit, the pairs of lead conductors being designated respectively 79, 80 and 81, 82. As shown in Figure 11 of the drawings, the outermost of the pairs of arcuate shaped supporting strips 75b and 76b have inwardly curved portions 75c and 76c to accommodate the pair of blowers, the blowers, their motors and the circuit connections for the motors not being shown in this view. 83, 84 and 85, 86 are extensions of the pairs of lead conductors 79, 80 and 81, 82, said extensions being connected respectively with the connector sockets 87 and 88 on the closure sections.

The modified construction illustrated in Figures 11 to 15, functions similarly to the con-

struction illustrated in Figures 1 to 10, but with the strip type heating units having the separate outer metal heat radiating sheaths, heat will be radiated from both sides of the heating units, and the heating units are so spaced to leave sufficient openings therebetween through which heat from the front faces of the sheaths of the units will be thrown back toward the engine parts by the reflecting surface on the inner side of the closure.

If desired, a thermostatic control (not shown) may be associated with the engine heater to provide for maintaining the desired temperature within the engine compartment of the cowling. Such a temperature control would include a temperature sensitive element mounted on one of the closure sections at the inner side thereof, the temperature sensitive element being connected by an electric cord connection to an electric temperature indicator mounted on a panel together with an appropriate battery, voltage regulator and switch.

When the temperature within the cowling reaches the desired degree, the power supplied to the resistance elements may be reduced by a suitable regulator so that this temperature may be maintained. Thermostatic controls of the general character referred to are well known in the heating art.

What I claim is:

1. A heater for aviation engines including a closure for the front opening of the engine cowling, the closure having a central opening to accommodate the hub of the propeller and comprising separable sections adapted to be detachably secured to the cowling, the sections having a contour normally set to conform to the opening to be covered, and electrical heating means fixedly mounted on one of the closure sections at the inner side thereof to extend within the cowling when the closure is attached thereto.

2. A heater for aviation engines including a closure for the front opening of the engine cowling, the closure having a central opening to accommodate the hub of the propeller and comprising separable sections adapted to be detachably secured to the cowling, the sections having a contour normally set to conform to the opening to be covered, and the closure sections each having an inner annular rearwardly extending marginal portion adapted to extend within the cowling and fit against the face of a part of the engine casing at one end thereof, and electrical heating means carried by the closure at the inner side thereof to extend within the cowling when the closure is attached thereto.

3. A heater for aviation engines including a closure for the front opening of the engine cowling having a central opening to accommodate the hub of the propeller and adapted to be detachably secured to the cowling, electrical heating means on the closure arranged to exert its influence interiorly of the cowling when the closure is attached thereto, a blower supported on the closure at the inner side thereof for distributing heated air within the engine cowling, and an electric motor supported on the closure for operating the blower.

4. A heater for aviation engines including a closure for the front opening of the engine cowling having a central opening to accommodate the hub of the propeller and comprising separable sections adapted to be detachably secured to the cowling, the sections having a contour normally set to conform to the opening to be covered, electrical heating units fixedly supported on each of the closure sections at the inner side thereof in spaced relation therewith to be disposed within the cowling when the closure is attached thereto.

5. A heater for aviation engines including a closure for the front opening of the engine cowling having a central opening to accommodate the hub of the propeller and adapted to be detachably secured to the cowling, electrical heating means carried by the closure at the inner side thereof and spaced therefrom to extend within the cowling when the closure is attached thereto, said heating means including a resistance element laid between layers of non-electric conducting material, and a metal heat radiating cover sheet extending over the outer side of one of said layers and facing toward the rear.

6. A heater for aviation engines including a closure for the front opening of the engine cowling having a central opening to accommodate the hub of the propeller and adapted to be detachably secured to the cowling, electrical heating means carried by the closure at the inner side thereof and spaced therefrom to extend within the cowling when the closure is attached thereto, said heating means including a resistance element laid between layers of non-electric conducting material, a metal cover sheet extending over the outer side of one of said layers and facing toward the rear, and a sheet of heat insulating material covering the outer side of the other layer of non-electric conducting material and facing to the front toward the closure.

7. A heater for aviation engines including a closure for the front opening of the engine cowling having a central opening to accommodate the hub of the propeller and adapted to be detachably secured to the cowling, electrical heating means carried by the closure at the inner side thereof in spaced relation therewith to extend within the cowling when the closure is attached thereto, said heating means including a plurality of heater units, each comprising a resistance element disposed between sheets of non-electric conducting material, a metal sheet at one side of the heater units facing toward the rear, said heater units being radially arranged and secured flat against said metal sheet, and a sheet of heat insulating material covering the other side of said heating units and facing toward the closure.

8. A heater for aviation engines including a closure for the front opening of the engine cowling having a central opening to accommodate the hub of the propeller and adapted to be detachably secured to the cowling, a plurality of electrical heater units of elongated strip form carried by the closure at the inner side thereof to extend within the cowling when the closure is attached thereto, said heating units being supported at opposite ends upon brackets on the closure in spaced relation with the closure and radially arranged spaced from each other inwardly of the inner and outer marginal portions of the closure, each heating unit comprising a resistance element embedded in non-electric conductor material, and a metal sheath enclosing the same.

9. A heater for aviation engines including a closure for the front opening of the engine cowling having a central opening to accommodate the hub of the propeller and adapted to be detachably secured to the cowling, spaced parallel arcuate shaped supporting strips supported in

spaced relation with the closure at the innerside thereof inwardly of the inner and outer marginal portions of the closure, and a plurality of electrical heater units of elongated form radially arranged and supported at opposite ends in spaced relation with each other on said arcuate shaped strips.

10. A heater for aviation engines including a closure for the front opening of the engine cowling having a central opening to accommodate the hub of the propeller and adapted to be detachably secured to the cowling, electrical heating means on the closure arranged to exert its influence interiorly of the cowling when the closure is secured thereon, a pair of blowers supported on the closure at the inner side thereof and at its upper part to distribute heated air within the engine cowling, one of said blowers being arranged with its discharge outlet directed upwardly tangentially of the closure, and the other blower having its discharge outlet directed downwardly tangentially of the closure, and electric motors supported on the closure for operating said blowers.

11. A heater for aviation engines including a closure for the front opening of the engine cowling having a central opening to accommodate the hub of the propeller, and comprising separable sections, the sections having a contour normally set to conform to the opening to be covered, electrical heating means carried by the closure, and resilient means on the closure sections near the peripheral portions thereof adapted to extend within the front opening of the cowling and embrace the cowling to detachably secure the closure in place on the cowling.

12. A heater for aviation engines including a closure for the front opening of the engine cowling, the closure having a central opening to accommodate the hub of the propeller and comprising separable mating sections, the sections having a contour normally set to conform to the opening to be covered, and the sections being adapted to fit against the front of the cowling, a plurality of spring arms on the closure sections near the periphery thereof and projecting rearwardly therefrom, said arms being adapted to extend within the front opening of the cowling and embrace the ring of the cowling to detachably hold the closure sections in place on the cowling, and electrical heating means on the closure.

13. A heater for aviation engines including a closure for the front opening of the engine cowling, the closure having a central opening to accommodate the hub of the propeller and comprising two separable mating half sections, the sections having a contour normally set to conform to the opening to be covered, resilient members on each of the sections near the periphery thereof adapted to extend within the front opening of the cowling and embrace the cowling to detachably secure the sections in place on the cowling, means on said sections for locking the same together in mating relation, and electrical heating means on the closure.

14. A heater for aviation engines including a closure for the front opening of the engine cowling, the closure having a central opening to accommodate the hub of the propeller and comprising two separable mating half sections, the sections having a contour normally set to conform to the opening to be covered, means to detachably secure the sections in place on the cowling, one of said closure sections having offset strip portions projecting beyond its mating marginal edge and overlapping and fitting against the other closure section when the sections are assembled in mating relation, means on said sections for locking the same together in mating relation, and electrical heating means on the closure.

15. A heater for aviation engines including a closure for the front opening of the engine cowling, the closure having a central opening to accommodate the hub of the propeller and comprising two separable mating half sections, the sections having a contour normally set to conform to the opening to be covered, means to detachably secure the sections in place on the cowling, means on said sections for locking the same together in mating relation, said last mentioned means comprising a pair of rods slidably mounted on the sections to be adjusted to bridge the mating edges of the sections when the sections are assembled in mating relation, and eyes on the sections for engagement by the rods when the latter are adjusted to locking position, and electrical heating means on the closure.

16. A heater for aviation engines including a closure of disc-like form for the front opening of the engine cowling, means on the closure for detachably securing the same in place on the cowling, the closure having a central opening to accommodate the hub of the propeller and comprising separate sections, the sections having a contour normally set to conform to the opening to be covered, and electrical heating means on the closure at the inner side thereof.

17. A heater for aviation engines including a closure of disc-like form for the front opening of the engine cowling, means for detachably securing the same in place on the cowling, the closure having a central opening to accommodate the hub of the propeller and comprising separable sections, the sections having a contour normally set to conform to the opening to be covered, and electrical heating means on the closure.

18. A heater for aviation engines including a closure of disc-like form for the front opening of the engine cowling constructed of light sheet metal and having an inner layer of heat insulating material, the closure having a central opening to accommodate the hub of the propeller and comprising two separable half sections, electrical heating means carried by the closure at the inner side thereof, and means for detachably securing the closure sections in place on the cowling.

19. A heater for aviation engines including a closure for the front opening of the engine cowling having a central opening to accommodate the hub of the propeller, heat reflecting means on the inner side of the closure, electrical heating means carried by the closure at the inner side thereof in spaced relation therewith to be disposed within the cowling when the closure is attached thereto, said heat reflecting means being adapted to throw heat rays back from the closure into the cowling, and means for detachably securing the closure in place on the cowling.

20. A heater for aviation engines including a closure for the front opening of the engine cowling, the closure having a central opening to accommodate the hub of the propeller and comprising separable sections, the sections having a contour normally set to conform to the opening to be covered, electrical heating means on the closure arranged to exert its influence interiorly of the cowling when the closure is applied thereto, and means for detachably securing the closure in place on the cowling.

21. A heater for aviation engines including a closure for the front opening of the engine cowling, the closure having a central opening to accommodate the hub of the propeller and comprising separable sections, the sections having a contour normally set to conform to the opening to be covered, electrical heating means on the closure arranged to exert its influence interiorly of the cowling when the closure is applied thereto, handles on the closure sections at the front side thereof, and means for detachably securing the closure in place on the cowling.

22. A heater for aviation engines including a closure for the front opening of the engine cowling, the closure having a central opening to accommodate the hub of the propeller and comprising separable sections, the sections having a contour normally set to conform to the opening to be covered, electrical heating means on the closure arranged to exert its influence interiorly of the cowling when the closure is applied thereto, means on the sections for locking the same together in mating relation, and means for detachably securing the closure in place on the cowling.

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