

Oct. 29, 1935.

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2,018,740

SOUND PROPAGATING APPARATUS

Filed June 22, 1934

2 Sheets-Sheet 1

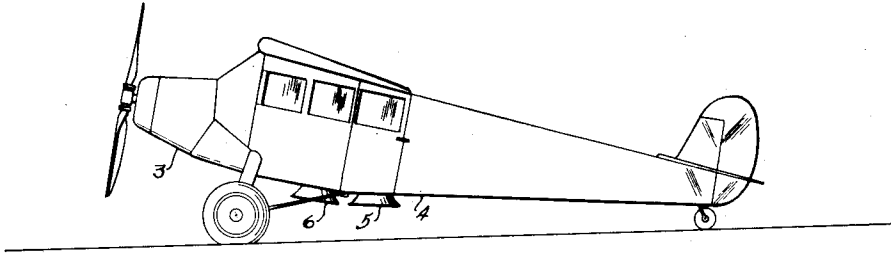


Fig. 1

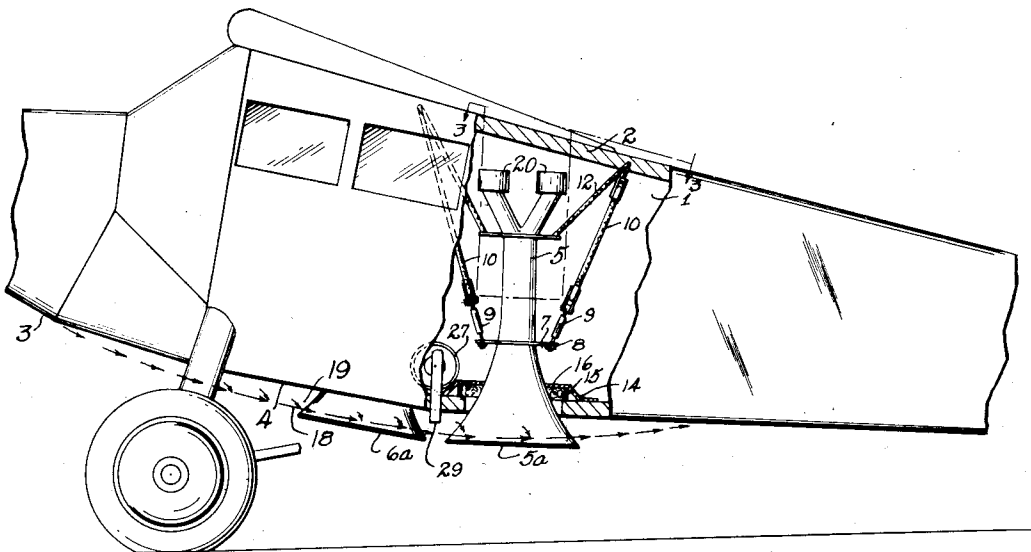


Fig. 2

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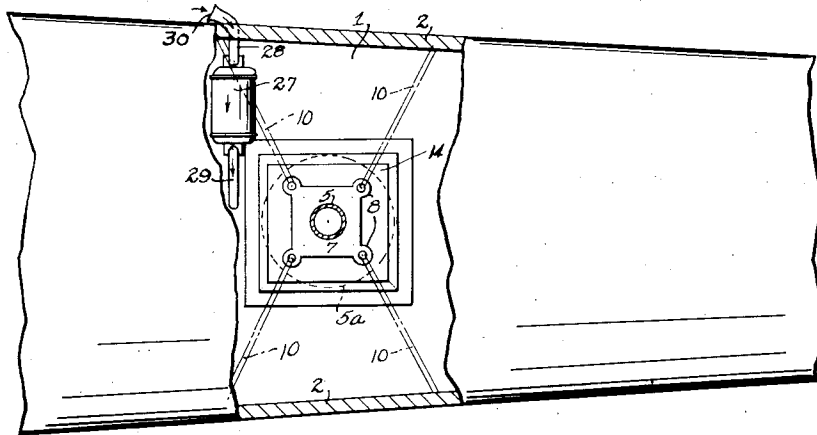
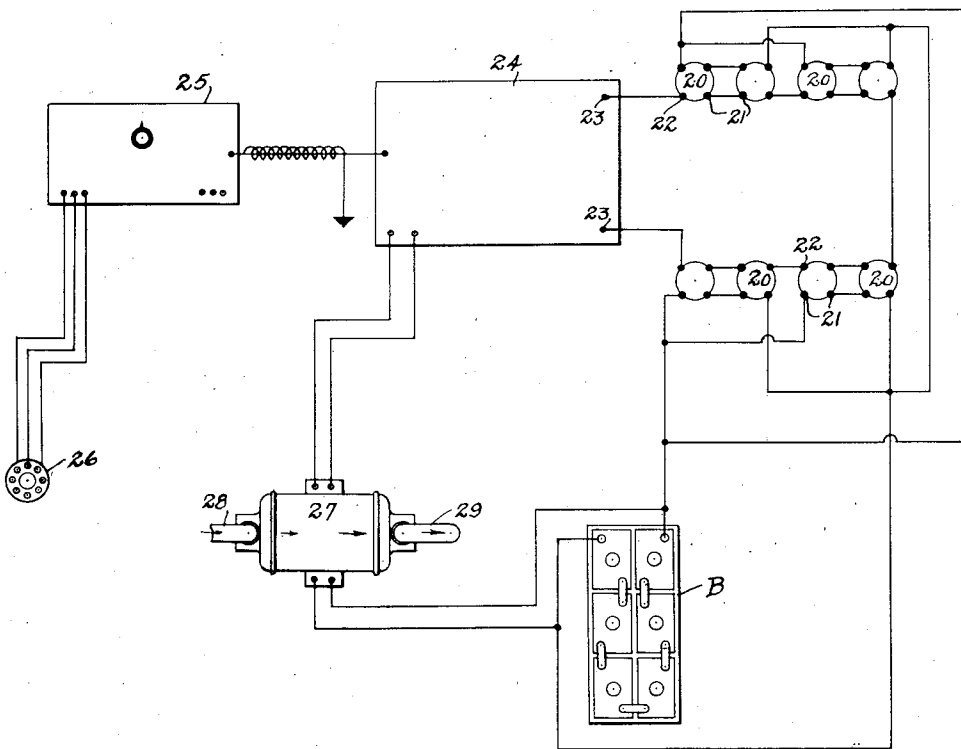
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SOUND PROPAGATING APPARATUS

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5 Claims. (Cl. 244—31)

This invention relates to the propagation of sound waves from airplanes, the principal object being to propagate sound waves more efficiently and with reduced power requirements.

Another object is to clarify the sound wave propagated from the airplane by reducing the effects on the propagating apparatus of vibration of the airplane structure itself, and by substantially eliminating the reverberation of audible waves by the diaphragmous fuselage of the airplane.

Another object is to provide a simple and effective mounting for the sound propagating mechanism by which the same is suspended floatingly within the body of the airplane in a manner to prevent transmission of vibrations from the body structure thereto and to dampen the mechanism to reduce any harmonics occasioned by extraneous noises.

A specific advantage of the present invention resides in the manner in which the high potential utilized in the operation of the sound propagating and amplifying mechanism is supplied.

Other objects and advantages will become apparent from the following specification wherein reference is made to the drawings in which,

Fig. 1 is a side elevation of an airplane showing the relative position of the sound propagating horns;

Fig. 2 is an enlarged fragmentary side elevation of the airplane, partly in section, illustrating the mounting of the horns;

Fig. 3 is a fragmentary top plan view of the airplane body showing the relative position of the horn and motor-generator set for supplying the high potential to the sound amplifying mechanism; and

Fig. 4 is a diagrammatic plan view illustrating the electrical circuit employed in the present invention.

For the purposes of illustration, the invention is shown installed in a monoplane of cabin type having a cabin 1, the fuselage forming the roof and side walls thereof being mounted at the top on the usual longerons 2 of the framework of the airplane. In the airplane shown and, in fact, in substantially all airplanes, the forward under surface 3 of the airplane body slopes downwardly rearwardly, meeting the more rearward under surface 4 of the body at a comparatively abrupt angle, a feature which is utilized effectively as will hereinafter be described.

In propagating sound from airplanes, the practice heretofore has been to provide a downwardly directed sound propagating horn formed as an

integral part of the airplane body and also to terminate the discharge end of the horn in the plane of the under surface of the airplane body. In one instance, the horns have projected below the under surface of the body, but the openings of the horns were faced forwardly and rearwardly thus completely changing the air currents passing the horn in a manner to defeat the operation herein described.

In all such prior instances, excessive power requirements have been necessary for effecting propagation of waves of sufficient intensity to be clearly audible on the ground when the plane was flying at a sufficiently safe altitude. Furthermore, heretofore such horns have had no carefully delineated relation to the airplane, with the result that efficiency was largely a matter of chance.

Experiments with the present invention have demonstrated that the use of one or more exponential horns mounted on the interior of the cabin of the airplane and discharging downwardly through the floor thereof, is preferred for such purposes, the exponential horn preferably being one of sufficient length so that the upper end thereof is disposed in closely spaced relation below the roof of the cabin when the discharge end protrudes into the atmosphere below the floor of the cabin a distance determined in accordance with the directions herein set forth. In the form illustrated, two such horns 5 and 6 are utilized, each being of the exponential type.

In order to mount the horns floatingly within the body, each horn is provided at its lower portion with a rigid peripheral mounting plate 7 having anchor lugs 8 to which are connected upwardly radially extending turn buckle connections 9. Secured by one end to each turn buckle is an upwardly and outwardly extending cable 10, the upper or opposite ends of the cables 10 being fixedly secured to the longerons 2 of the airplane. Four such cables are provided for each horn and two cables of each horn are secured to each longeron. If desired, additional cables 12, similarly connected to the longerons and to the horn near the upper end, are provided.

The lower end portions of the horns pass through the floor of the cabin and are in spaced relation to the edges of the floor defining the openings therethrough. In order to reduce the lateral sway of the horn while insuring that the horn is floating relative to the body structure, a box structure 14 is provided on the floor, the box structure having an internal peripheral channel 15 adjacent the horn which channel is

filled with a suitable felt or other packing 16. Neither the floor nor the box structure 14 touch the horn, the bracing effect resulting from the resilient packing 16. Thus the horn is entirely floating within the body so that very few vibrations of the body affect the same.

In order to dampen the body vibrations and reduce harmonic vibrations of any portion of the horn and sound propagating mechanism carried thereby, the cables 10 are preferably of heavy rubber covered with cloth and are sufficiently heavy so that, when stressed for holding the horn in place, they have a periodicity either below or sufficiently low in the audible speech range so that they dampen any tendency of harmonic vibrations of the horn and the transmittal of body vibrations thereto through them, at least to such a degree that the vibrations do not noticeably distort sound waves in the general range of periodicity of human speech propagated from the horn.

As above set forth, the horn protrudes below the under surface of the body, and also as previously explained, the forward portion 3 of the under surface of the body slopes downwardly rearwardly and meets the portion through which the horns protrude at a comparatively abrupt angle. As a result of this relative inclination of the surfaces 3 and 4, the relatively onrushing air impinging on the body portion 3 due to forward motion of the airplane is deflected downwardly by the portion 3 and into the strata of the adjacent air which is likewise flowing relatively rearwardly past the airplane. Due to the impingement of these air streams, a low pressure area is created along the under surface of the portion 4 of the airplane body, and extends a substantial distance rearwardly from the juncture of the surfaces 3 and 4. In the form illustrated, the deflected swift moving air stream is indicated by the arrows 18, the space between this air stream and the under surface 4 of the body of the airplane, which is the low pressure area, being indicated at 19. The discharge ends of the horns 5 and 6 protrude beneath the floor or under surface of the airplane a distance such that their outlet openings, designated 5a and 6a, are below the low pressure area and preferably just into the relatively rearwardly flowing air stream. Thus the sound waves propagated by the horn are discharged into the normal, or perhaps slightly compressed, atmosphere. If the horns extend an appreciable distance into the air stream the surface presented to this stream by them causes considerable drag and reduces the speed of the airplane, but considering the purpose for which the airplane is used, this reduction in speed without a reduction in safety is not undesirable, as the slower speed prevents traversing a large territory in the short interval during the propagation of a complete message.

It should be noted that if the horns were arranged to discharge into the low pressure area 19, as has been the practice heretofore, the low pressure area would considerably reduce the density of the transmitting medium and consequently act as an insulator, thus reducing the intensity of the waves passing through. If, however, the horns discharge in the normal transmitting medium or the more dense air stream, they are propagated much more efficiently.

Another decided advantage resulting from the fact that the horns protrude below the low pres-

sure area is that this low pressure area, which is a poor conductor of sound waves, prevents sound waves which pass out from the horn from reverberating against the under surface of the fuselage with such great intensity as would normally occur and from reentering or affecting the horn, and also forms an insulating pocket which prevents any material repropagation of said waves downwardly from the diaphragmous body.

A third advantage results solely from projecting the horns below the undersurface of the body in the case of exponential horns. The exponential horn is designed to transmit waves along their natural curve of expansion and consequently allow them to radiate freely into the atmosphere in all directions. With this particular type of horn, therefore, considerable sound passes upwardly or in a direction away from the outlet of the horn. Ordinarily this would be reverberated from the bottom of the airplane in a very pronounced manner and also reverberate against and reenter the horn, causing harmonics or waves out of phase with those being propagated. Such effects are considerably reduced in the case of an exponential horn merely by the protrusion of the horn beyond the body, separate and apart from the effect of the air currents, but the combined result of all of these features is especially desirable.

Referring next to the motor-generator and amplifying unit used in connection with the horns, it will be noted that, in the form illustrated, each horn is provided with four diaphragm speaker units 20. The field coils of the speaker units are connected to a storage battery B through their respective binding posts 21. The voice coils of the speakers are connected in series through their binding posts 22 with the binding posts 23 of the amplifying unit 24. A suitable volume control panel 25 is operatively connected with the amplifying unit 24 and is provided with a microphone 26 for delivery of the message to be propagated. The high potential for the amplifying unit is supplied by a motor-generator set 27 which is of the usual construction, having both the motor and generator built into a common housing and having at each end of the housing suitable inspection ports. The motor-generator is driven from the battery B in the usual manner. Such motor-generators normally can be used only for short intervals, due to heating. In order to utilize the same over longer periods, without the addition of elaborate cooling means, the usual inspection plates are removed at the ends of the casing of the motor-generator 27. In all of this type of motor-generators, the casing is entirely closed except for the inspection ports covered by these plates, and consequently, if air is introduced into one inspection port, and withdrawn from the other, an effective flow is maintained throughout the motor-generator housing for cooling the same. For accomplishing this purpose, an inlet conduit 28 communicating with one inspection port and a discharge conduit 29 communicating with the other port are provided. The inlet end of the inlet conduit 28 protrudes through the wall of the cabin with its inlet opening facing forwardly, as indicated at 30, so that air is forced thereinto consequent upon forward movement of the airplane. The discharge or exhaust conduit 29 is arranged with its outlet preferably discharging into the low pressure area heretofore described. Consequently a pressure above atmospheric is maintained on the inlet conduit and sub-atmospheric

pressure on the exhaust conduit with resultant maintenance of a voluminous stream of cooling air through the housing.

It is apparent from the foregoing description that not only is the invention of such nature that it may readily be incorporated in a small space within the cabin of a plane but also all extraneous sounds and vibrations are effectively dampened out so that the sound waves desired to be propagated are substantially the only audible sounds emanating from the horns.

Having thus described my invention, I claim:

1. In an airplane body having a downwardly rearwardly sloping forward bottom portion extending part way of its length, whereby a low atmospheric pressure area is formed along the bottom of and exteriorly of the body, rearwardly from said sloping portion by deflection of the on-rushing air stream occasioned by forward travel of the body, a sound projecting horn the major portion of the horn being mounted within the body and the discharge end of the horn extending directly downwardly and protruding through the bottom of the body rearwardly from said sloping portion, the discharge end of said horn projecting below the body and through the resultant low pressure area a short distance into the normal atmosphere, whereby the sound waves are discharged by the horn directly into atmosphere of normal pressure and baffling and reverberation of sound waves by the bottom of the body are reduced by the low pressure area.

2. In an airplane body having a floor, a sound broadcasting horn disposed in the interior of the body and discharging downwardly through a passage in the floor of the body and opening into the atmosphere beneath the floor, resilient tension means extending outwardly and upwardly from the horn and floatingly securing the horn to the airplane body in spaced relation to the body structure, a casing on the floor of said body surrounding a lower portion of said horn in spaced relation thereto, and a soft yieldable packing within the casing and engaging said horn and holding the lower portion of said horn in spaced relation to the casing and edge portions of the floor defining said passage.

3. In an airplane body, a sound projecting horn mounted within the body and spaced from the body structure, said horn opening at its

discharge end through the floor of the body, resilient tensioned braces secured to the horn and to the body structure for suspending said horn within and in spaced relation to the body structure and supporting the entire weight of the horn, said braces, when supporting the horn, being tensioned to provide a periodicity of the horn sufficiently different from the periodicity of the sound waves to be propagated from the horn to eliminate objectionable distortion of the propagated sound waves by extraneous vibrations and sound waves, and means to tension said braces.

4. In an airplane body, a sound projecting horn mounted within the body and opening at its discharge end through the floor of the body, a loud speaker mechanism operatively associated with the horn, whereby sound waves are projected from said horn, resilient cables secured to the horn at different positions longitudinally of the horn and to the body structure for suspending the horn in spaced relation to the body structure, said cables, when suspending the horn, being tensioned to impart a periodicity to the horn and speaker assemblage sufficiently removed from the major portion of the audible range of sound to eliminate vibration of the horn by the cables, said cables being sufficiently heavy to prevent swaying and movement of the horn relative to the plane structure, and means to tension said cables.

5. In an airplane having a body and means for driving the airplane through the air whereby upon forward motion of the airplane an intense turbulent air zone results along the under surface of the body, a downwardly directed sound propagating horn mounted within the body and protruding at its discharge end through the bottom of the body into the outside atmosphere beyond the intense turbulent air zone, the discharge opening of said horn being in spaced relation to and below the under surface of the body, an amplifying device on the inlet end of the horn and the portion of said horn intermediate the amplifying device and discharge end being imperforate, whereby the sound waves traveling through the horn are not interfered with by any extraneous waves and the sound waves discharged from the horn are discharged into substantially normal outside atmosphere.

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