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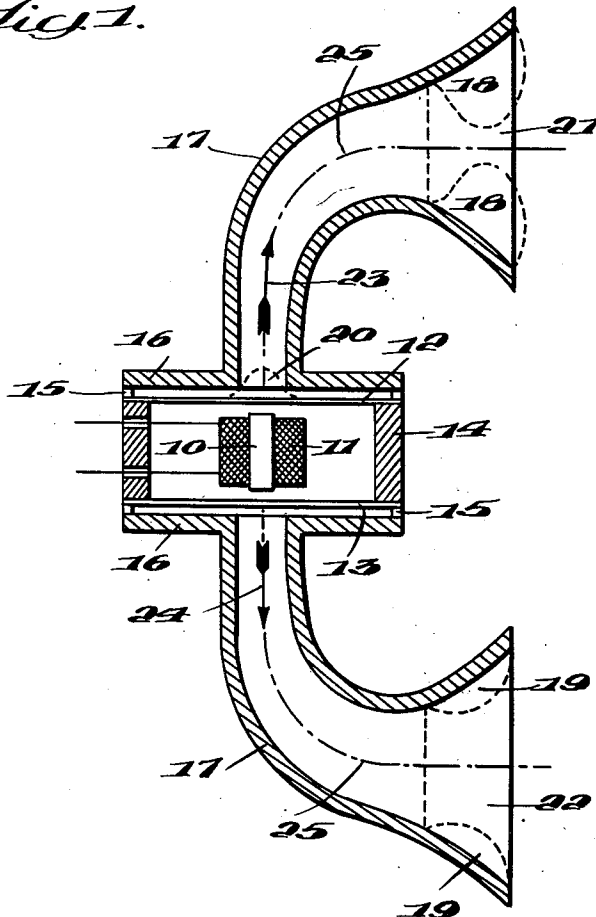
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SOUND SIGNAL TRANSMITTER DEVICE

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2 Sheets-Sheet 1

Fig. 1.



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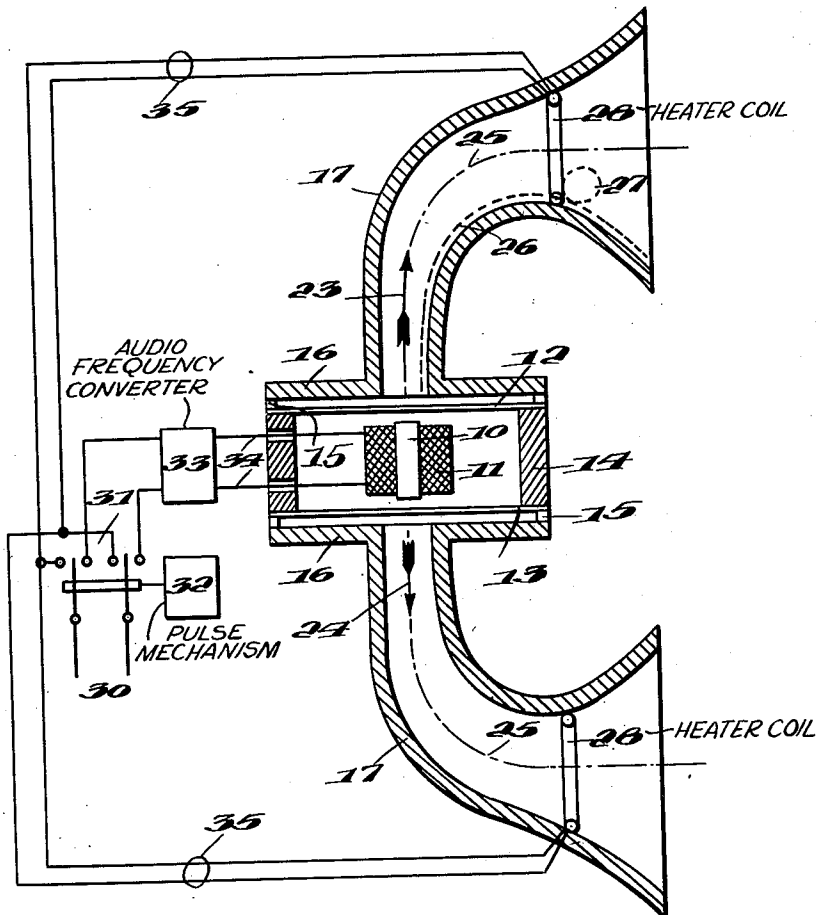
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Fig. 2.



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1

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SOUND SIGNAL TRANSMITTER DEVICE

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3 Claims. (Cl. 340—388)

As sound signal transmitters especially adapted for beacon and similar navigatory means of assistance are nowadays chiefly used electromagnetic sound signal transmitters according to the telephone principle. These usually contain a weak iron core provided with a winding, said winding influencing a diaphragm or eventually a diaphragm applied at each end of the rod formed core. The sound wave provided at the diaphragm or the diaphragms respectively, is thereafter conducted through a horn of exponential type. Sound transmitters of this kind are usually arranged in the open air, and consequently they may be made object of severe winter climate conditions, which may cause the formation of rigid deposits of snow or ice, so-called snow or ice "bark." The experience of ice bark or snow bark formation in such sound signal transmitters has proved that strange enough the ice bark or the snow bark, respectively, is formed in very specific places within the transmitter. It has been proposed to melt the said ice bark or snow bark away by means of electric heater coils, but the experiences hitherto made have had no success in this respect.

The present invention is based upon an investigation about the currents of air present in the exponential horn of a sound transmitter of the above mentioned kind, and of the climatic occurrences in the sound signal transmitter, respectively, determining the place of formation of the ice bark or the snow bark, and the invention refers to an arrangement based on these theoretical investigations, by which one can effectively prevent the formation of detrimental snow bark or ice bark.

The invention is further described in connection with the attached drawings, which show a sound signal transmitter of the present kind at two different occasions.

Fig. 1 shows a sound signal transmitter without the heater coil of the present invention.

Fig. 2 shows a sound signal transmitter utilizing the heater coil and corresponding electrical networks.

On the drawings the weak iron core is indicated 10, and the winding surrounding said weak iron core, which is fed by alternating current of audio frequency is indicated 11. The weak iron core is in this case assumed to be linear, and consequently one has applied an upper diaphragm 12 and a lower diaphragm 13 opposite to each end of the core 10. The magnetic circuit is completed through a casing 14, which is arranged between the diaphragms. The diaphragms are clamped in place by means of clamping rings 15, and outside these clamping rings lids 16 are provided, said lids being combined with the exponential horns 17.

As snow bark and ice bark have substantially the same influence in the respects here in question they will be indicated below as bark without any difference being made between them. The experience has now proved that bark appears in the opening of the two exponential horns, however usually to a greater extent in the upper exponential as indicated at 18, and to a less extent at the lower exponential horn, as indicated at 19. Furthermore, bark usually also forms on the upper diaphragm 12, as indi-

2

cated by 20. This formation of bark appears of course only under climatic conditions which make bark formation possible. These climatic conditions usually consist in a snow storm at very low temperature, and it is just on these occasions that it is of the uttermost importance, that the sound signal transmitter functions satisfactorily. It has proved, however, that this is usually not the case. The opening 21, which forms the sound transmission way from the upper sound transmitter will be very small, and the corresponding opening 22 in the lower sound transmitter is usually somewhat bigger, so small, however, that an essential decrease of the power of the sound transmitter occurs just on that occasion when the transmission from the sound transmitter is of the greatest importance.

The formation 20 of bark causes further an unequal load as far as the upper diaphragm 12 is closed in its position, and consequently the lower diaphragm 13 will have to take up a greater part of the magnetic power, which easily causes a breakage of this diaphragm. Hereby the sound transmitter is put out of function. It is therefore of the greatest importance to remove the bark from the sound transmitter in some suitable way.

As mentioned above different trials have been made to apply heating arrangements in the places where the bark is formed, but these trials have hitherto given no good results. The reason for this is assumed to be that one has not taken sufficient regard to the air circulation conditions emanating in an exponential horn of the kind here in question.

Investigations forming the basis of the present invention, as a matter of fact have proved the following relations.

The characteristic of compressibility of the air, that means the characteristic stating the compression pressure of the air as a function of for instance the movement of a diaphragm or other sound producing means, is bent. Consequently, there will not only exist a sound wave caused by the diaphragm but also a circulation of air of similar nature. These two circulations of air are superposed on each other, and they follow substantially the same laws, which also exist in radio technic rectification, in which a direct current is created by the rectification, but in which there is superposed on this direct current a rest component of the high frequency currency. The amplitude on the diaphragms 12 and 13 is the biggest in the middle part, and consequently you will obtain the greatest rectification effect and the strongest pressure for producing a rectified current of air in direction outwards in the centre of the diaphragms.

Independently thereof the vibrations of the diaphragms in a sound transmitter of the type here in question are usually so strong, that the air adjacent to the place, where the diaphragms have their greatest amplitude, that means adjacent to their centre, is made object to super-adiabatic changes, which easily cause a rather strong heating of the air. The provided directional potential thus cooperates at least in the upper exponential horn 17 with the produced heat potential for providing current of ventilation. This current of ventilation will for the reasons mentioned above take place in the direction of the arrow 23 when leaving the centre of the diaphragm 12.

It is true of course that the heat potential will in the downward directed exponential horn 17 counteract the rectification potential, but experience has proved, that there will be a created ventilation current also in the lower exponential horn 17, even if this current is weaker, as indicated by the shorter arrow 24. In both cases the ventilation current follows the laws, which are well-known as far as regards directional air currents superposed on sound waves. These laws mean that the current of air is to a very high degree of exactness directed perpendicularly to the isobars representing the sound wave.

The purpose of the exponential horns is now that the sound wave should be propagated as far as possible along isobars running perpendicularly to the centre line 25 of the exponential horn. The consequence thereof is also that the outward directed ventilation current will rather exactly follow the centre line, however, spreading itself out across the isonode planes, and consequently the inward directed ventilation current for replacing the outward directed current will be forced to accept a current way, which closely follows the wall of the exponential horn as a surface current.

The invention is now based on two different conditions, viz that one shall by causing a suitable resistance to the ventilation current decrease this current as far as possible, and further, that one shall by the provision of heater elements in the way of the ventilation current provide for the air, fed to the interior of the exponential horn, as far as possible being so hot, that formation of bark is avoided.

The provision of resistors in the way of the ventilation current will of course also mean that one provides a resistor in the way of the sound wave, and this is unfavourable for the function of the sound transmitter. However, practical tests have proved that the sound wave is due to the friction resistance against the wall of the sound horn propagating only to a very small extent through the surface layer, where the inward directed component of the ventilation current is passing, as is stated above. If the heating means are now placed very close to the wall of the sound horn, they will create unincreased resistance to the ventilation current without thereby appreciably damping the sound waves. Thus one will in this way obtain a resistance, eventually initiated by a whirl formation at the heater means and thereby essentially improved, as far as regards the ventilation current, without said resistance affecting the sound-carrying air current. It is thus evident from the above that the heater means should be placed close to the wall of the exponential horn, so that they heat and brake the inward directed replacement ventilation current eventually under formation of whirls. They partly decrease the ventilation current, and thereby also cause decreased cooling of the interior of the exponential horn, partly also heat the replacement air, which is slipping inwards along the walls of the exponential horn, and in this way one is forcing a rather high temperature of the air in the interior of the exponential horn.

Placing now the heater coil substantially vertically or in any case substantially perpendicularly to the direction line 25 rather close to the opening of the exponential horn, one will further gain that the outward directed radiation from the heat coil will be sufficient for melting down the bark 18, at the same time as transferring heat by convection to the air moving inwards, said heat being sufficient for melting down the bark part 20. In the cases, when the inward moving current of air is forced into a whirl formation by the heat coil, as indicated by the dotted line 26, this whirl 27 will of course have radial deepness from the surface of the wall of the exponential horn, which is essentially greater than the radial deepness

of the heater coil 28. Thereby the resistance against inwardly directed air current will be further increased as compared with the direct current resistance provided by the heater coil 28.

Practical tests have proved that one can with a rather low power on the heater coil 28 achieve a complete debarking of sound signal transmitters of the type here in question also during the most severe climatic conditions. The power, as a matter of fact, must not be greater than about the half of the power fed to the coil 11 for creating the sound wave. For decreasing the total maximal power in a system of the present kind one therefore advantageously provides the heater coil 28 and the winding 11 to operate alternatively. This will take place according to the invention in such a way, that power is fed from the network 30 to a coupling arrangement 31, controlled by a pulse mechanism 32. The pulse mechanism 32, in time with the sound pulse which should be transmitted from the sound transmitter, combines the network with conductors running to an audio-frequency converter 33, converting the input electrical power into audio frequency power, said power being fed through the conductors 34 to the winding 11 in the sound transmitter. During the periods, when the electrical power is not transferred to the frequency converter 33, it is instead over conductors 35 transferred to the heater coils 28. The heater coils 28 are thus intermittently heated, but they should suitably have so great heat capacity, that they are not fully cooled during the time, when the sound transmission is taking place. The heat present in the heater coil 28 will thus perhaps vary in temperature, but it will anyhow under all circumstances be sufficient for maintaining the abovementioned function regarding the ventilation current, by which formation of bark in the sound transmitter is effectively prevented.

The invention, of course, is not limited to the arrangement above described in detail, but different modifications may be made within the frame of the invention.

What is claimed is:

1. An outdoor sound transmitter comprising an exponentially formed horn open at one end, a diaphragm at the other end of said horn, means for vibrating the diaphragm, and an electrically heated toroidal heater coil disposed immediately inside the open end of said horn, said heater coil preventing the formation of ice and snow deposits within the horn by heating the cold input air.
2. An outdoor sound transmitter according to claim 1 wherein said vibrating means and the heater coil are connected to a single source of electric current and are intermittently energized from said single current source through an intermittently acting switching means.
3. An outdoor sound transmitter according to claim 1 wherein the heater coil is mounted in a plane perpendicular to the center line through said horn.

References Cited in the file of this patent

UNITED STATES PATENTS

1,614,858	Wenz	Jan. 18, 1927
2,386,513	Soderberg	Oct. 9, 1945