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2,767,851 10/1956 Muller..... 116/70X
3,163,045 12/1964 Kaveckas et al. 73/368.2

FOREIGN PATENTS

238,827 11/1945 Switzerland..... 116/103

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[54] SOUND GENERATOR 2 Claims, 2 Drawing Figs.

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73/368.2

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[56] References Cited

UNITED STATES PATENTS

1,969,784 8/1934 Ebright..... 116/118X

ABSTRACT: Sound is generated directly from a heat source by providing an enclosure which includes a container of vaporizable liquid and a pair of mated members one of which is resilient and is alternately moved from a position corresponding to minimum volume to a position corresponding to maximum volume for the enclosure in response to the buildup of and decay of pressure within the enclosure produced respectively by the continuous application of heat to the liquid and the performance of work by the vapor within the enclosure on the resilient member.

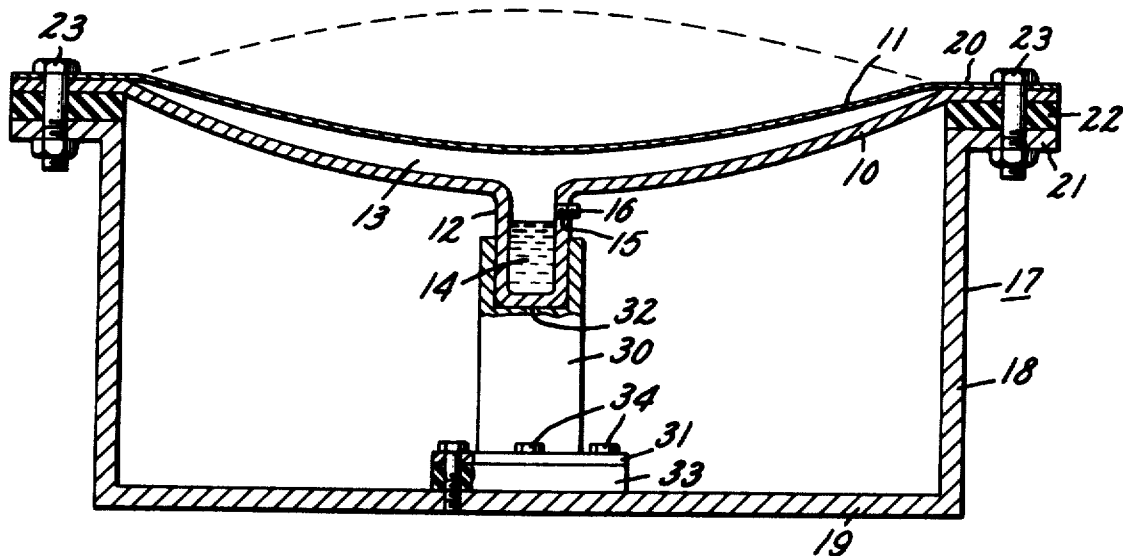


Fig. 1.

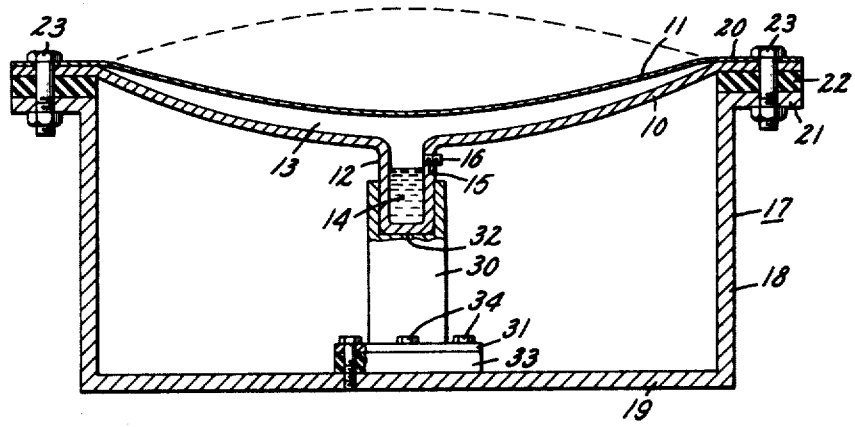
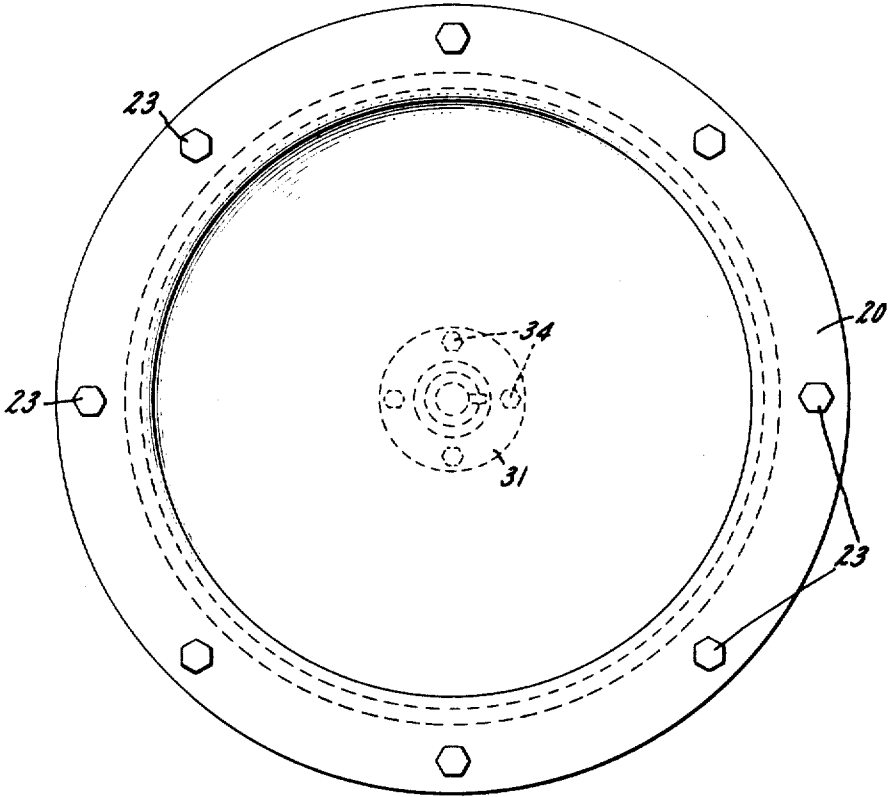


Fig. 2.



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SOUND GENERATOR

This invention relates to sound sources in which heat energy is directly converted to sound energy and in particular to such sound generators as would be suitable for use as oceanic signal beacons for surface and subsurface guidance of water vehicles.

It is an object of the present invention to provide a sound generator which converts heat energy directly into sound energy.

It is another object of the present invention to provide a sound generator which is simple in structure and has no moving parts other than the vibrating sound producing element.

It is another object of the present invention to provide a sound generator which is highly reliable, rugged and uses low cost heat sources.

In its broadest aspects my invention utilizes the changes in pressure within a sealed enclosure produced by the application of heat to a vaporizable liquid contained within the sealed enclosure and by the sudden expansion of the volume of the enclosure by the change in contour of a resilient wall thereof set to respond to a certain threshold pressure. When the volume is expanded the pressure drops below the threshold value and the resilient wall returns to its initial contour and the cycle is repeated.

In accordance with an illustrative embodiment of my invention I have provided a pair of concave members, one of resilient structure and one of rigid structure mated and joined to form a sealed enclosure. The resilient member is movable from a position in which the direction of the concavity thereof is the same as the direction of concavity of the rigid member and the volume of the enclosure has a minimum value to a position in response to pressure applied within said enclosure in which the concavity of the resilient member is in a direction opposite to the direction of concavity of the rigid member and the volume of said enclosure has a maximum value.

The resilient member is proportioned to respond to move into the distended position when the pressure within the enclosure exceeds a predetermined value. The pressure is produced by a heat source which may apply heat at a constant rate to the liquid within the enclosure to build the pressure of the vapor within the enclosure beyond the predetermined value. As a result, the resilient member is alternately moved from the undistended position to the distended position in response to the build up of pressure as the vapor in the enclosure is heated and to the decay of pressure as the vapor in said enclosure does work on the resilient member.

The features of my invention which I desire to protect are pointed out with particularity in the appended claims. The invention itself, however, both as to its organization and method of operation together with further objects and advantages thereof may best be understood by reference to the following description taken in connection with the accompanying drawings wherein:

FIG. 1 shows a side view in section of an illustrative embodiment of my invention.

FIG. 2 shows a plan view of the apparatus of FIG. 1.

The apparatus illustrated in FIG. 1 includes a generally concave or dishlike metallic member 10 of good structural rigidity and another generally concave or dishlike metallic member 11 of resilient structure, the concavity of which mates with concavity of the rigid member 10. The members 10 and 11 are joined along the periphery thereof to form a sealed enclosure. Centrally disposed on the rigid concave member is a container 12 in which is provided a liquid readily vaporizable in response to heat applied thereto. The container 12 and the concave members 10 and 11 form a sealed enclosure 13. The vaporizable liquid 14 may be applied through opening 15 in the container which in the operation of the apparatus is sealed by the plug 16. The enclosure 13 formed by the rigid and resilient members 10 and 11 is mounted along the periphery or rim thereof to the housing 17. The housing 17 is formed of a cylindrical member 18 which is mounted on a base portion 19. The rim 20 of the enclosure 13 is secured to a flange 21 on the

cylinder 8 by bolts 23. As the housing is shown as made of a metallic material, an insulating gasket 22 is provided between the rim 20 and flange 21 to impede the flow of heat from the metallic enclosure 13 to the housing 17.

Within the housing 17 is situated a heat source sealed in a metallic container 30. Inside the container may be situated a radioactive material which evolves heat which is conducted to the liquid container 12. The container 12 is shown as cylindrical in form and having a flat base portion 31 and a recessed upper portion 32. Flange base portion 31 is mounted on an insulator 33 and is secured to the base 19 of the housing by bolts 34. The upper recessed surface of the container 30 is in intimate contact with the bottom and sides of the metallic container 12.

In operation, heat from the heat source in container 30 vaporizes the liquid 14 in container 12 and builds pressure up in the space within the enclosure 13. The structure of the resilient member 11 is designed with respect to materials used and geometric proportioning thereof to retain generally its concave upward contour as shown in the drawing until a predetermined pressure is reached, at which time the resilient member springs from its concave upward position to a concave downward position with resultant enlargement of the volume of enclosure 13. Preferably the volume of the enclosure 13 in its distended position is made large in relation to the volume of the enclosure when the resilient member 11 is undistended. The expansion of volume in the enclosure represents work done by the vapor on the resilient member 11. Such work causes the pressure within the enclosure to drop and the vapor to condense on the inside walls of the enclosure. When the pressure drops below the threshold value, the resilient member 11 again moves back into its original undistended position and remains in such position until sufficient heat has been transferred to the vapor to build the pressure up again to the threshold value of pressure to distend the resilient member 11.

The physical properties of the material of the resilient member 11 and the geometry of the resilient member 11 determine its threshold pressure response. The heat energy output of the heat source in container 30 is arranged to provide pressure build up beyond the threshold pressure. Accordingly, by selection of desired parameters of the resilient member and the heat input to the liquid 14 the resilient member 11 can be made to oscillate over a wide range of frequencies. The efficiency of the conversion of heat energy into acoustical energy depends largely on the efficiency of the thermodynamic cycle for converting heat energy into work. Most of the work done on the resilient member 11 appears as sound energy although some losses would appear as frictional and thermal losses in the enclosure.

Although the heat source is shown as conductively connected in heat exchange relationship to the container for the vaporizable liquid, convection and radiation may be used as well individually or in conjunction with the conduction means used to supply heat from the heat source to the vaporizable liquid. While the resilient member has been shown as a concave member, any thin wall which responds in toggle switchlike action to pressures a vapor contained therein with resultant rapid increase in volume, may be used. It will be appreciated that the frequency of response can be changed by changing the heat input or the physical constants of the vibrating system. Also, should large powers be desired large systems would be provided. Suitable fluids for use in the system are fluorinated hydrocarbons normally used in commercial refrigeration and readily available. In temperate climate applications Refrigerant-11, well-known to those skilled in the art, would be suitable. Suitable materials for the resilient member are the stainless steels and the phosphor bronzes.

While the enclosure for the vapor is shown as consisting of a pair of mated concave members it will be appreciated that only one of the members need be generally concave. Both of the members may be made resilient and of oppositely directed concavity with the vaporizable container located at the peripheral support for such a structure.

While I have shown particular embodiments of my invention it will, of course, be understood that I do not wish to be limited thereto since many modifications may be made in the structural arrangement shown in the instrumentalities employed. I contemplate by the appended claims to cover any such modifications as fall within the true spirit and scope of my invention.

I claim:

1. A generator for converting heat energy directly into sound energy comprising:
 - an enclosure including a generally concave member of resilient metallic structure sealed along the periphery thereof to the remainder of the enclosure;
 - said resilient member movable from a position corresponding to minimum volume within said enclosure to another position corresponding to maximum volume within said enclosure in response to vapor pressure applied within said enclosure;
 - said resilient member being proportioned to respond to move into said other position when the pressure within said enclosure exceeds a predetermined threshold value;
 - a container having a vaporizable liquid therein sealed to said enclosure to provide vapor within said enclosure; and
 - a heat source of relatively constant heat output in heat exchange relationship with said liquid to provide sufficient heat to said liquid to cause the pressure of the vapor within said enclosure to build up beyond said predetermined threshold value to alternately move said resilient member from said one position to said other position in response to the buildup of said pressure as the vapor in said enclosure is heated and to the decay of pressure as

the vapor in said enclosure does work on said resilient member.

2. A generator for converting heat energy directly into sound energy comprising:

- a first generally concave member of rigid structure;
- a second generally concave member of resilient metallic structure;
- said members mated and sealed along the periphery thereof;
- said resilient member movable from a position in which the direction of concavity thereof is the same as the direction of concavity of said first member and the volume of said enclosure is minimal to another position in response to vapor pressure applied within said enclosure in which the concavity of said second member is in a direction opposite to the direction of concavity of said first member and the volume of said enclosure is a maximum, said second member being proportioned to respond to move into said other position when the pressure within said enclosure exceeds a predetermined threshold value;
- a container having a vaporizable liquid therein sealed to said first concave member to provide vapor within said enclosure; and
- a heat source of relatively constant heat output in heat exchange relationship with said liquid to provide sufficient heat to said liquid to cause the pressure of the vapor within said enclosure to build up beyond said predetermined threshold value to alternately move said resilient member from said one position to said other position in response to the buildup of said pressure as the vapor in said enclosure is heated and to the decay of pressure as the vapor in said enclosure does work on said resilient member.

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