Feb. 18, 1930. V. A. SCHLENKER 1,747,847

METHOD OF MANUFACTURING ACOUSTIC RADIATORS

Filed May 22, 1923

FIG. 1

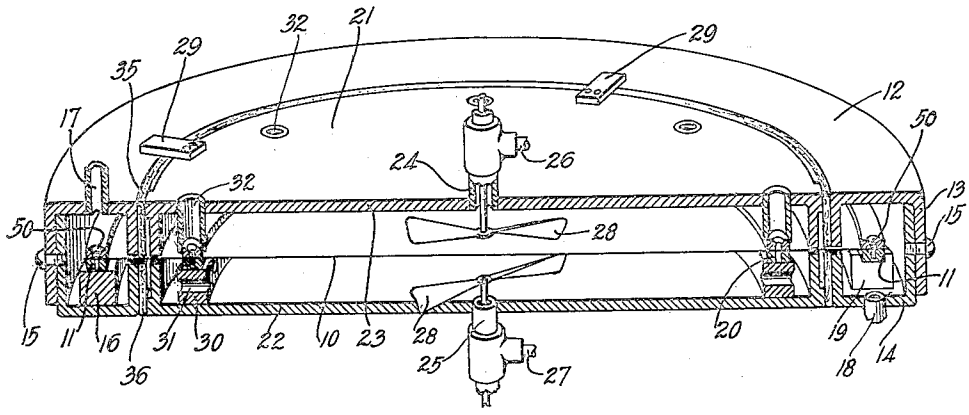
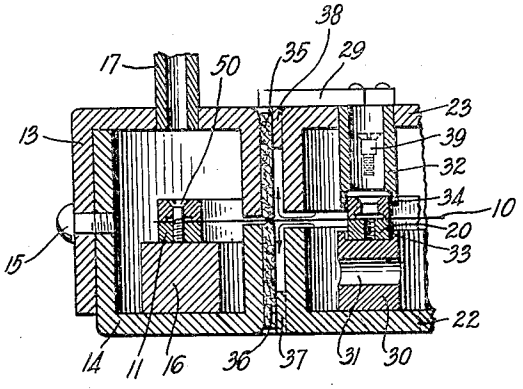


FIG. 2



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UNITED STATES PATENT OFFICE

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METHOD OF MANUFACTURING ACOUSTIC RADIATORS

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This invention relates to acoustic radiators and more particularly to the method of manufacturing them.

An object of the invention is to attain uniform high tension in a large metallic vibratory member which is adapted to efficiently radiate speech and music over a large portion of the frequency range.

In accordance with this invention the sound radiator comprises a large diaphragm of thin light material such as an aluminum alloy which is clamped to a master stretching frame. The master frame is enclosed in a jacket or chamber and heated to expand the frame and thereby cause the diaphragm surface to be stretched to a desired tension. During the heating of the frame the surface of the diaphragm may be enclosed in a chamber through which a cooling medium is circulated to maintain the diaphragm at a normal temperature, thereby preventing any change in the tension of the diaphragm after removal from the master stretching frame. When the desired tension is secured in the diaphragm surface a permanent clamping frame is positioned on the diaphragm, within the cooling chamber, and rigidly fastened thereto after which the enclosing chambers and the master stretching frame are removed. The sound radiator is then trimmed by cutting the projecting edge of the diaphragm surface extending from the outer edge of the permanent clamping frame.

The invention may be more readily understood by referring to the following detailed description in connection with the accompanying drawing, in which—

Fig. 1 is a perspective view in cross-section showing the detailed construction of one arrangement of apparatus for stretching a vibratory member in accordance with this invention.

Fig. 2 is an enlarged view of a section of the apparatus shown in Fig. 1 to more clearly show the detailed construction and relation of the parts of the apparatus.

Referring to the drawing the invention is particularly related to the stretching or tensioning of large vibratory members or diaphragms of the type which act directly in air without the aid of a horn or other directional wall. Such a diaphragm comprises a thin member of light metallic material, such as an alloy consisting chiefly of aluminum, and of large size. In a more specific form the metallic diaphragm or member consists of a circular sheet of aluminum-manganese alloy 0.002 inch thick and 29 inches in diameter. In accordance with this invention, the metallic vibratory member or diaphragm 10 is rigidly fastened by screws such as 50 to a master stretching frame 11 composed of a material, such as steel or a steel alloy having a high coefficient of expansion. The purpose of having a master frame with a high coefficient of expansion is to provide a frame which may be heated to a high temperature and which will expand uniformly in a radial direction to stretch or tension the diaphragm 10 which is rigidly fastened to the master stretching frame 11.

While the heating of the master stretching frame 11 may be accomplished in any suitable manner, it is desirable to provide some arrangement which will confine the heating substantially wholly to the master stretching frame. This may be accomplished as shown in Fig. 1 by enclosing the master stretching frame 11 in an annular heating jacket or chamber 12. This jacket is preferably of the separable type, for instance as shown in Fig. 1, in which the jacket or chamber 12 is formed in two sections 13 and 14. Each section is substantially U-shaped in cross-section, the section 13 forming the upper half of the jacket and the section 14 forming the lower half of the jacket. These sections may be fastened together by the screws 15. The master stretching frame 11 is supported on a metallic ring-shaped block 16 within the jacket which may be rigidly fastened to the section 14 of the jacket or formed integral therewith. The master stretching frame 11 may be heated to a high temperature by injecting live steam into the jacket through the inlet pipe 17, the steam being expelled from the jacket through the outlet pipe 18 which is arranged at an opposite position in the jacket. The ring supporting block 16 within the jacket is made discontinuous

adjacent the steam outlet pipe 18 as shown at 19. If desired, the steam jacket sections may be made wide enough to permit locating the outlet 18 inside or outside, the bottom side of ring 16 in which case the ring 16 may be made continuous. The free edges of the sectional halves of the steam jacket 12 are spaced from the upper and lower surfaces of the diaphragm 10, to allow free movement of the metallic diaphragm between the edges of the jacket. The close confining walls of the hollow jacket 12 provide an enclosure which may be filled with a heating medium, such as live steam, to raise the temperature of the master stretching frame 11 and thereby cause it to expand sufficiently to apply a uniform tension to the metallic member or diaphragm 10. While this method produces the required tension in the diaphragm 10, care should be taken that the useful portion of the diaphragm 10 which is encompassed by the permanent clamping ring 20 is not subjected to heating during the stretching process since any contraction of the diaphragm after the permanent ring 20 is fastened thereto will be detrimental. For this purpose it is desirable to maintain the portion of the diaphragm 10 extending from the annular jacket 12 at a normal temperature, for instance, by cooling the diaphragm surface during the heating process, to prevent any change in tension after the permanent ring 20 is attached thereto.

An efficient arrangement for accomplishing the cooling of the diaphragm surface 10 during the heating of the master frame 11 consists in covering the diaphragm with a two-part circular casing or chamber 21, one portion 22 being arranged below the diaphragm surface 10 and the other portion 23 being arranged above the diaphragm surface 10. Central air inlet tubes 24 and 25 are provided in the chamber portions to inject a cooling medium, such as air, through the inlet connections 26 and 27. A centrifugal fan 28 may be located in each chamber, to force the air injected through the tubes 24 and 25 toward the periphery of the chamber, to maintain the portion of the diaphragm adjacent the heating jacket at a normal temperature. The cooled air is emitted from the chamber by passing between the peripheral edges of the circular chamber portions 22 and 23 and the diaphragm surface as shown by the arrows in Fig. 2. The upper chamber 23 is spaced from the diaphragm surface by the bridging members 29 extending across the gap between the cooling chamber 21 and the heating jacket 12.

When the diaphragm surface is maintained at a normal temperature by employing the cooling chamber 21 as shown in Fig. 1, the permanent ring 20 should be placed in position on the diaphragm surface prior to enclosing the diaphragm in the cooling chamber. In such an arrangement, the lower portion of the ring 20 may be centered on a ring block 30 within the lower chamber 22, the ring block being provided with radial apertures 31 to permit the egress of air from the chamber. The upper half of the permanent ring 20 lies on the diaphragm surface 10 in alignment with the lower half of the permanent ring. A number of tubular guides 32 project downwardly from the upper wall of the chamber 23 and are arranged in alignment with the threaded openings in the permanent ring 20. The centering arrangement of the two portions of the permanent ring 20 is shown more clearly in Fig. 2, in which the lower portion of the permanent ring 20 is seated in a box-shaped groove 33 on the supporting ring block 30 and the upper half of the ring 20 is centered by the downwardly extending edges 34 on the tubular guides 32. A pair of heat insulating collars such as asbestos strips 35 and 36, may be placed between the adjacent surfaces of the heating chamber 12 and the cooling chamber portions 22 and 23, to prevent the transfer of heat from the jacket 12 to the cooling chamber and also to form a closure for the space between the opposing edges of the heating jacket 12 and the diaphragm surface. As shown in Fig. 2 the fibrous insulating strips 35 and 36 may be suitably attached to the surfaces of the heating jacket with one edge in contact with the diaphragm surface without exerting pressure thereon. The lower portion 22 of the cooling chamber may be spaced from the wall of the heating jacket 12 by the projections such as 37 on the peripheral surface of the chamber 22 while the upper portion 23 is spaced from the heating jacket by projections 38 on the peripheral surface of the portion 23.

The heating of the master frame 11 causes it to expand to a larger diameter, thereby stretching the diaphragm surface rigidly fastened to the frame. During this stretching process the permanent ring 20 will be maintained stationary due to the centering of the two halves of the ring in the cooling chambers. However, the diaphragm surface can easily stretch in a radial direction without being hindered by the permanent ring 20 located in the cooling chamber. When the desired tension is secured in the diaphragm surface, a suitable tool may be inserted through the tubular guides 32, in order to pierce the diaphragm surface in alignment with the threaded openings in the two halves of the permanent ring 20. The permanent ring is rigidly attached to the diaphragm 10 by the screw 39 inserted in each guide 32. The upper half of the cooling chamber may then be removed and the portion of the diaphragm exterior to the permanent ring 20 may be trimmed off to complete the operation. The uniformly stretched diaphragm surface

may then be removed from the casing to act as an acoustic sound radiator without any danger of, loss of tension, or fracture, due to difference in expansion and contraction between the diaphragm surface and the permanent ring 20.

What is claimed is:

1. The method of making a stretched diaphragm which comprises clamping said diaphragm in a frame, heating said frame to cause it to expand and to tension the diaphragm, and then clamping a second frame of smaller dimensions than said first frame around a portion of said diaphragm.

2. The method of making a stretched diaphragm which comprises, clamping said diaphragm in a frame, heating said frame to cause it to expand to tension the diaphragm, and clamping a second frame within said first frame around said diaphragm while cooling said second frame and the diaphragm surface inclosed therein.

3. The method of making a diaphragm which comprises placing a flat sheet between two frames, spaced one within the other, clamping the diaphragm between portions of the outer frame, heating the outer frame, cooling the inner frame and the diaphragm surface inclosed therein after the outer frame has been heated to the desired degree, clamping the diaphragm to the inner frame, and thereafter severing the diaphragm between the frames.

4. The method of stretching a diaphragm which comprises securing a flat sheet to a frame, and thereafter heating said frame to cause said frame to expand and thereby stretch the diaphragm.

5. The method of stretching an acoustic member which is held in a master stretching frame, which comprises heating said frame to tension said member, and cooling said member.

6. The method of stretching an acoustic member which is held in a master stretching frame, which comprises stretching said master frame by heating and stretching said member in a cold state simultaneously.

7. The method of stretching an acoustic member which is held in a master stretching frame, which comprises expanding said frame by heating to stretch said member without heating said member.

8. The method of stretching an acoustic diaphragm which is held in a master frame, which comprises heating said master frame, and cooling said diaphragm surface simultaneously.

9. The method of stretching an acoustic diaphragm which is held in a master frame, which comprises expanding said master frame by heating while maintaining said diaphragm surface at a normal temperature.

10. The method of stretching an acoustic diaphragm which is held in a master stretching frame which comprises heating said frame to tension said diaphragm, cooling said diaphragm surface, and applying a permanent frame to said diaphragm when the desired tension is secured.

11. The method of stretching an acoustic member which comprises attaching said member to a master stretching frame, enclosing said frame in a jacket, supplying a heating medium to said jacket to expand said master frame, and clamping a permanent ring to said member after stretching.

12. The method of stretching an acoustic member which comprises, attaching said member to a master stretching frame, enclosing said frame in a jacket, supplying a heating medium to said jacket to expand said master frame, enclosing said member in a chamber, and supplying a cooling medium to said chamber.

13. The method of stretching an acoustic diaphragm which is held in a master stretching frame which comprises, enclosing said frame in a jacket, supplying live steam to said jacket to cause the expansion of said frame, enclosing said diaphragm surface in a chamber, and forcing cold air into said chamber while heating said master frame.

In witness whereof, I hereunto subscribe my name, this 18th day of May, 1928.

VESPER A. SCHLENKER.