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2,624,417

ACOUSTIC DIAPHRAGM WITH FLEXIBLE RIM PORTION AND RIGID BODY PORTION

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Fig. 1

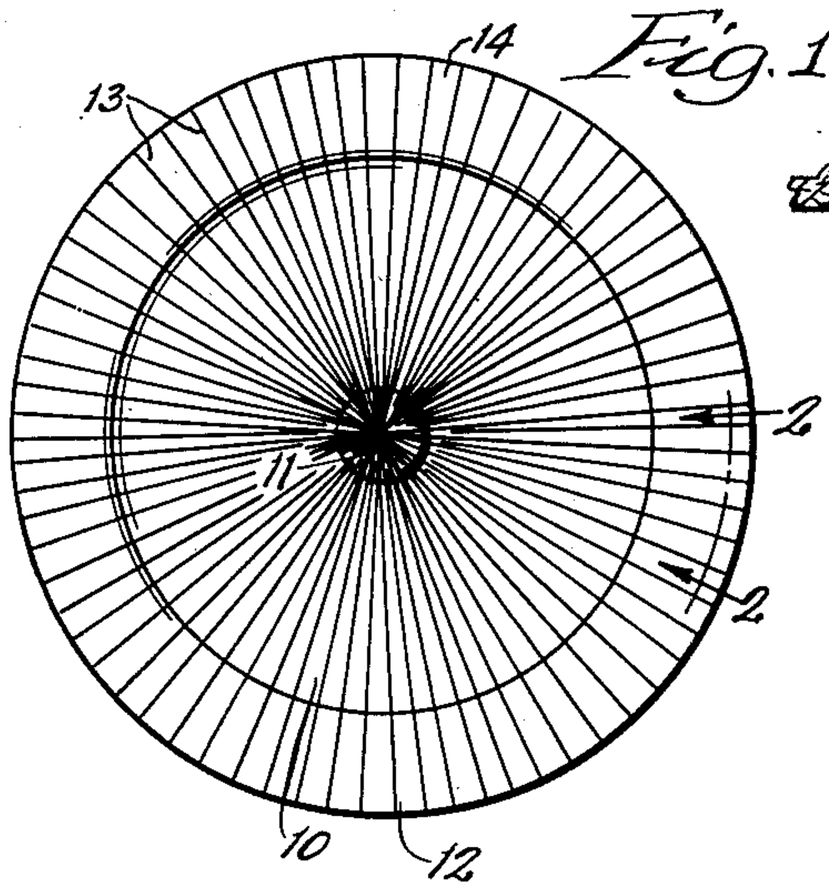


Fig. 2

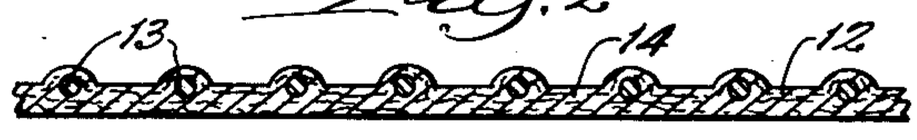


Fig. 3

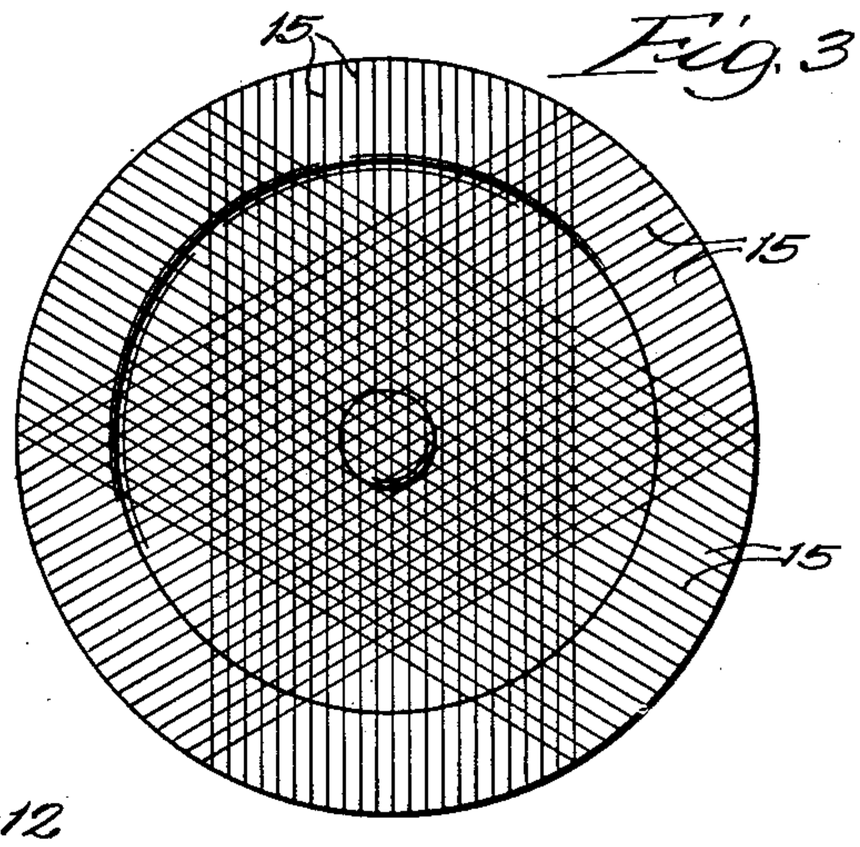


Fig. 4

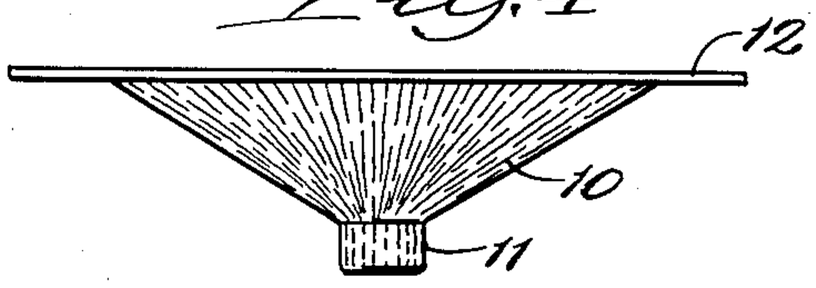


Fig. 7

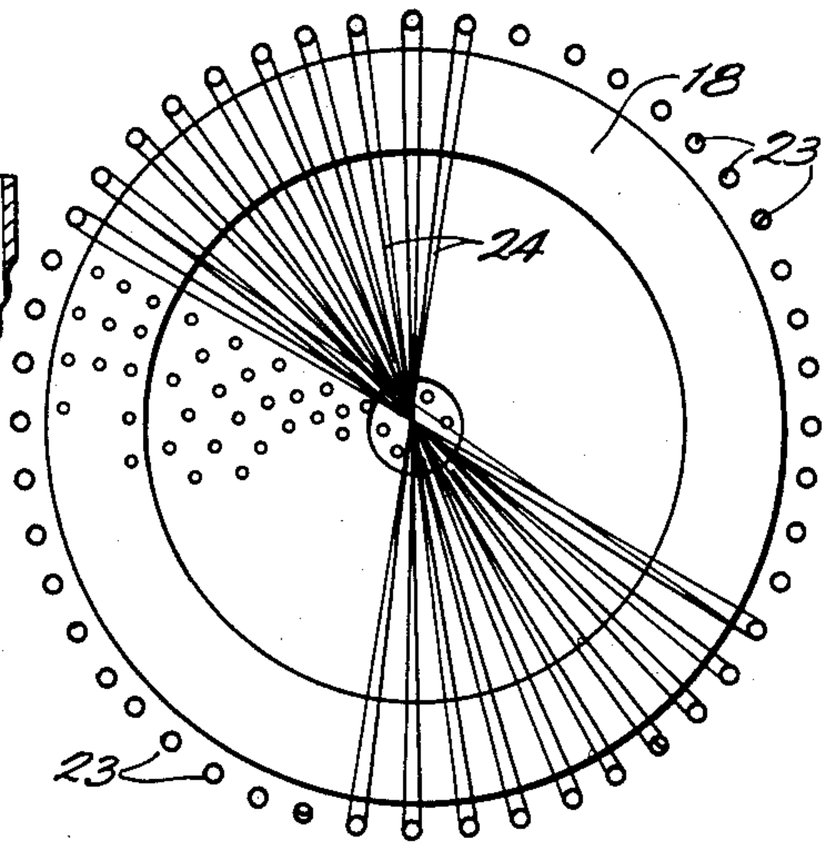


Fig. 5

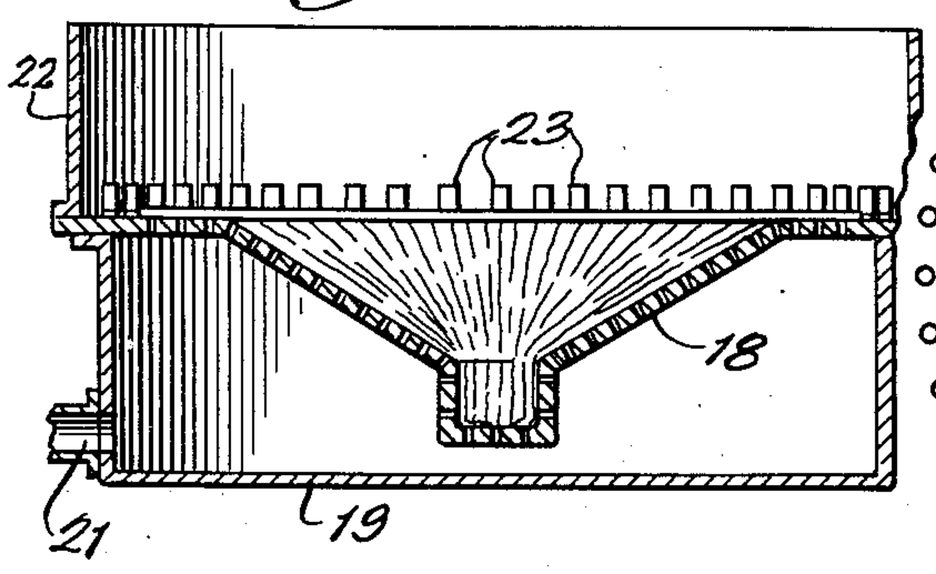


Fig. 6

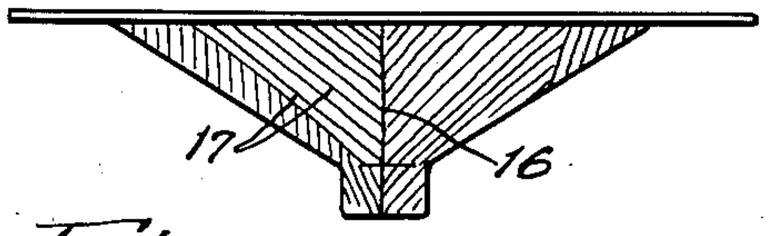
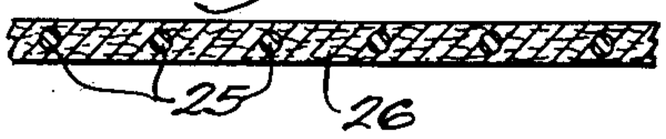


Fig. 8



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ACOUSTIC DIAPHRAGM WITH FLEXIBLE RIM PORTION AND RIGID BODY PORTION

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2 Claims. (Cl. 181—32)

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This invention relates to acoustic diaphragms and method of making the same and more particularly to the manufacture of flexible fibrous diaphragms of the type used in loudspeakers.

One of the objects of the invention is to provide an acoustic diaphragm and a method of making the same in which the diaphragm is formed by a plurality of spaced strands or cords extending radially across at least the rim portion of the diaphragm and connected by a layer or sheet of felted fabric. In this construction the strands contribute the major part of the supporting strength of the diaphragm so that an extremely high degree of flexibility can be obtained without the sacrifice of the necessary strength.

Another object is to provide a diaphragm in which strands or cords of fibrous material extend across the diaphragm in a generally radial direction from one edge portion to the other and are bonded together and bridged by a relatively thin layer or sheet of felted fibrous material.

Still another object is to provide a method of making diaphragms in which strands or cords of fibrous material are first placed over a form and fibrous material is then deposited on the strands and on the form to bond to the strands and to bridge the spaces between the strands. Preferably the strands are initially held in position over the form by looping them about pins adjacent the periphery of the form.

The above and other objects and advantages of the invention will be more readily apparent from the following description when read in connection with the accompanying drawing, in which—

Figure 1 is a face view of a diaphragm embodying the invention;

Figure 2 is an enlarged partial section on the line 2—2 of Figure 1;

Figure 3 is a view similar to Figure 1 of an alternative arrangement;

Figure 4 is a side view of the diaphragm of Figure 1;

Figure 5 is a diagrammatic view illustrating the method of forming the diaphragm of Figure 1;

Figure 6 is a view similar to Figure 4 illustrating an alternative arrangement of the strands;

Figure 7 is a top plan view of a form illustrating one manner of arranging the strands thereon; and

Figure 8 is a view similar to Figure 2 of an alternative construction.

According to the present invention diaphragms of the type generally used in loudspeakers are constructed with a supporting structure of cords or strands extending generally radially across the diaphragm and connected and bridged by a relatively thin layer or sheet of felted fibrous material. As shown, in Figures 1 and 4, the diaphragm may comprise a generally circular body having a conical body portion 10 terminating in a central flange portion 11 for connection to the driving coil of a speaker and having a peripheral flat rim portion 12 by which the diaphragm is mounted. The diaphragm is formed by a plurality of cords or strands 13 which are preferably of fibrous material such as pulp fibers, cotton fibers or similar vegetable fibers or mixtures thereof formed into elongated strands. The strands may if desired be loose cards or rovings or where greater strength is required without increasing the thickness, they may be twisted or woven into relatively hard cords. The strands extend diametrically across the diaphragm, each strand extending from one edge portion of the diaphragm diametrically to the opposite edge portion. The cords are spaced substantially uniformly and are connected and bridged by a relatively thin layer of felted fibrous material 14. This material may be of sufficient thickness and density to connect and bridge the fibers so that a complete diaphragm will be formed and are sufficiently thin to be extremely flexible.

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The completed diaphragm may be mounted in the usual manner by clamping the rim portion 12 to a support so that the main body portion 10 can vibrate in response to the driving coil. It will be noted that when the diaphragm is mounted the cords or strands 13 provide the major supporting strength so that the felted layer or sheet 14 can be relatively thin and weak. In this way a diaphragm having high strength and an extreme degree of flexibility is produced.

Instead of running the strands or cords diametrically across the diaphragm as shown in Figure 1, they may be arranged in parallel groups which cross each other as shown in Figure 3. This construction provides a diaphragm which is reinforced by crossing cords in its central portion to provide greater strength and rigidity of the central part of the conical body 10 while leaving the rim portion highly flexible. As shown in Figure 3, there are three groups of cords 15 of sufficient width so that each group of cords will occupy approximately one-sixth of the rim circumference at each end with the several groups arranged at 60° angles with respect to each other. The cords are bonded together and have the spaces between them bridged by felted fibrous material such as the material 14 of Figure 2 to complete the diaphragm.

Still another arrangement of cords is shown in

Figure 6 wherein there are a plurality of main cords 16 extending radially across the diaphragm and each of which has connected thereto at spaced points in its length secondary cords 17. In this construction the main cords 16 extend radially of the diaphragm and the secondary cords lie at angles to the main cords so that they extend generally radially across at least the rim portion of the diaphragm. This arrangement provides a diaphragm of substantially uniform thickness and strength throughout. It will be understood that cords 16 and 17 are connected together and are bridged by felted fibrous material such as shown at 14 in Figure 2.

In forming diaphragms according to the present invention the cords or strands are first laid over a porous form and fibrous material is deposited thereon by spraying or from a liquid suspension as desired. Figures 5 and 7 illustrate one apparatus for forming diaphragms including a porous form 18 having substantially the configuration of a desired finished diaphragm. The form 18 is supported on a suction box 19 which may be connected to a source of vacuum through a conduit 21 and may have an upstanding flange 22 around its periphery to receive a liquid suspension of fibrous material. A plurality of pins are arranged around the periphery of the form beyond the portion thereof which defines the edge of the diaphragm. In using this apparatus a continuous cord or strand 24 as best seen in Figure 7 may be looped over the pins so that the cord or strand will extend across and lie against the form. The cords may be arranged diametrically as shown in Figure 7 or could if desired follow the arrangement of Figure 3. As the cords are placed, the central parts thereof may be forced into the bottom cup portion of the form and may, if necessary, be held therein by tying or clamping. Since the bottom end of the cup will be cut out in the completed diaphragm, it will be seen that any desired holding means employed for the cords at this point will not affect the finished diaphragm.

With the cords in place the flange 22 may be filled with a liquid suspension of fibrous material which will be drawn on to the form and the cords by suction in the suction box 19. The suspended fibrous material will bond itself to the fibrous cords and will form a web or sheet between the adjacent cords, as shown in Figure 2. After the fibrous material has been deposited, the diaphragm may be removed from the form and may be pressed to produce the required density and the desired finished shape. After trimming the edge and cutting out the center of the cup shaped portion, the diaphragm is completed and ready for use.

In the completed diaphragm the section may be as shown in Figure 2 in which the diaphragm has a greater thickness as at points where the cords occur or may, if preferred, be of uniform thickness as shown in Figure 8. In this figure

the cords or strands as indicated at 25 are enclosed in a sheet or layer 26 of fibrous material which is of uniform thickness throughout. However, because the density of the fibrous material is substantially less than that of the cords, it will form a web or sheet of extremely high flexibility so that the cords must furnish the major portion of the supporting strength of the diaphragm. In forming a diaphragm as shown in Figure 8, the fibrous material will be deposited to a thickness greater than the thickness of the cords and may be pressed to form smooth surfaces thereon of the desired density.

While several embodiments of the invention have been shown and described in detail herein, it will be understood that they are illustrative only and are not to be taken as a definition of the scope of the invention, reference being had for this purpose to the appended claims.

What is claimed is:

1. An acoustic diaphragm having a concave body portion and a peripheral, mounting rim portion extending laterally of the body portion, said body and rim portions formed by a plurality of separate flexible elongated fibrous strands extending generally radially across the rim and body portions and circumferentially spaced from each other, and a relatively thin sheet of felted fiibrous material inclosing and bonded to the strands in the rim and body portions and bridging the spaces between them, the flexible strands reinforcing the body portion and imparting flexibility to the rim portion.

2. An acoustic diaphragm having a concave body portion and a peripheral, mounting rim portion extending laterally of the body portion, said body and rim portions formed by a plurality of separate flexible elongated fibrous strands extending generally radially from the central part of the body portion across the rim portion, and circumferentially spaced from each other, and a relatively thin sheet of felted fibrous material inclosing and bonded to the strands in the rim and body portions and bridging the spaces between them, the flexible strands reinforcing the body portion and imparting flexibility to the rim portion.

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