H. C. HARRISON.

METHOD OF AND APPARATUS FOR MANUFACTURING TELEPHONE DIAPHRAGMS.

APPLICATION FILED NOV. 9, 1916.

1,275,022. Patented Aug. 6, 1918.

Fig. 1.

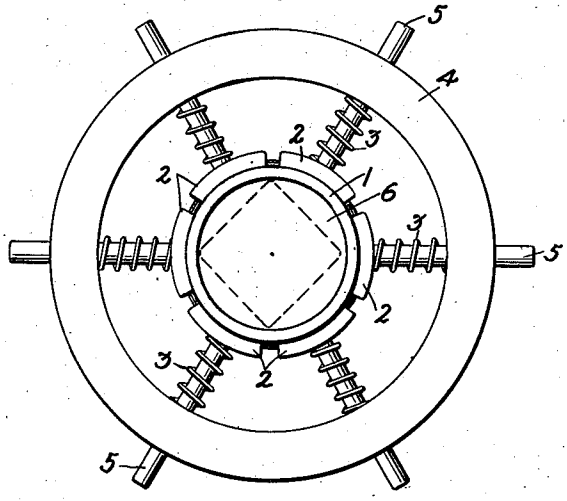


Fig. 3.

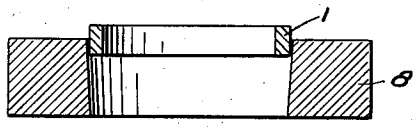


Fig. 4.

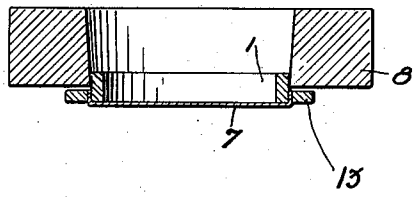


Fig. 2.

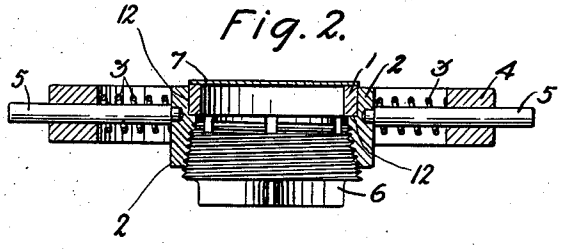


Fig. 7.

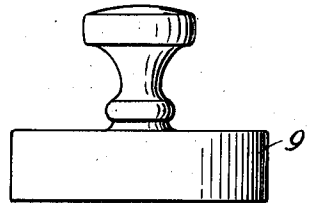


Fig. 5.

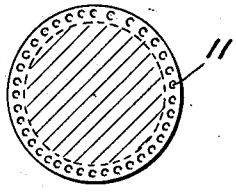


Fig. 8.

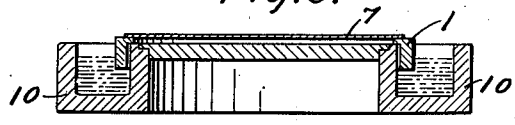


Fig. 6.

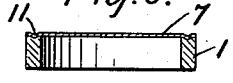


Fig. 10.

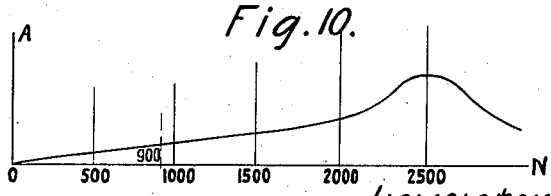
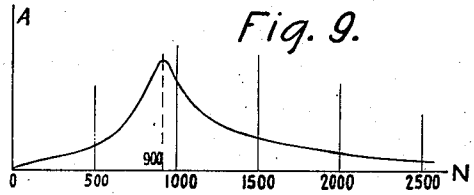


Fig. 9.



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UNITED STATES PATENT OFFICE.

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METHOD OF AND APPARATUS FOR MANUFACTURING TELEPHONE-DIAPHRAGMS.

1,275,022. Specification of Letters Patent. Patented Aug. 6, 1918.

Application filed November 9, 1916. Serial No. 130,498.

To all whom it may concern:

Be it known that I, HENRY C. HARRISON, a citizen of the United States, residing at New York, in the county of New York and State of New York, have invented certain new and useful Improvements in Methods of and Apparatus for Manufacturing Telephone-Diaphragms, of which the following is a full, clear, concise, and exact description.

This invention relates to certain improvements in the art of manufacturing stretched sheet material and its object is to provide an efficient method for obtaining diaphragms that are held under tension.

Diaphragms, such as are used in telephones, phonographs and other acoustic apparatus, have a more or less marked natural periodicity, and if acted upon by impulses of this periodicity, will respond much more than for materially different periodicities. The natural periodicity depends in general on the mass and the elasticity of the diaphragm, decreasing with increase of mass and increasing with increase of elasticity. In the usual telephone diaphragms, this natural periodicity or point of resonance is in the neighborhood of 900 cycles per second, which is well within the range of those frequencies used in speech. Because of this natural periodicity and the resulting inequality of response to impulses of different frequencies, a telephone diaphragm will distort the speech waves which are impressed upon it when the resonance point falls within that range which is of importance to speech. If, however, the diaphragm is so made that this resonance point is removed outside this range, there will be practically equal response to all important frequencies of the same intensity and consequently no distortion of the impulses impressed on the diaphragm. One method of so displacing the resonance point is to increase the elasticity of the diaphragm by placing it under tension, and this invention accordingly relates to a method and apparatus for accomplishing this result.

Specifically, the invention consists of a method of and apparatus for manufacturing an article consisting of some suitable stretched material and a tension frame, the method comprising the steps of changing the dimensions of one of the members by some suitable force, securing the two members together, and removing said force.

This invention will be more readily understood by reference to the drawings, in which Figure 1 illustrates a means for the compressing of the above mentioned tension frame; Fig. 2 is a cross-sectional view of Fig. 1; Figs. 3 and 4 illustrate another means for compressing the reinforcing frame; Figs. 7 and 8 illustrate a third method for obtaining the proper tension between the stretched material and the tension frame; Fig. 5 shows the completed stretched diaphragm, of which Fig. 6 is a cross-sectional view; Fig. 9 shows the relation between the incident frequencies N and the amplitude of the resultant oscillations A, set up by an unstretched diaphragm; and Fig. 10 is a similar characteristic for a stretched diaphragm.

Figs. 1, 2, 5 and 6 illustrate the preferred method and apparatus for the manufacture of stretched diaphragms having the peculiar properties noted above.

The apparatus illustrated in Figs. 1 and 2 consists of a chuck having clamping jaws 2, attached to supporting rods 5, which are in turn supported by a suitable frame 4. Around each rod is a coiled spring 3, used for compressing the jaws inwardly. 6 is a tapered screw plug, which screws into the lower portion of the chuck jaws, and 7 is a diaphragm, and 1 a tension ring to which the diaphragm is to be attached.

The chuck jaws and the tapered screw plug used in the above apparatus are preferably made as follows: A hollow metallic cylinder is selected of the proper size, a recess or pocket 12 is machined in its upper portion, in which a tension ring may rest during compression, and the lower portion threaded so as to form a tapered collar or nut. The tapered screw plug 6 is then threaded to correspond to the threads of the lower portion of the cylinder. The cylinder is then cut up into segments, forming the chuck jaws 2 as illustrated in Fig. 2.

The method of operation, in brief, comprises the steps of radially compressing the reinforcing frame shown here in the form of a tension ring 1, permanently attaching the diaphragm 7 thereto, and removing the compressing force. The radial compression is due to some uniform external force supplied

by coiled springs, hydraulic pistons or other source of force, and shown in Fig. 1 as due to chuck jaws 2 worked by coiled springs 3. In order to insert the tension ring, the chuck jaws are spread apart by turning the tapered screw plug 6 in the proper direction. When the jaws are spread sufficiently, the tension ring is inserted and the screw plug 6 is turned in the opposite direction until the coiled springs 3 exert on the tension ring any desired pressure. After the diaphragm 7 is attached by welding, soldering or some other suitable method, the pressure on the ring is released, so that the tension ring will tend to expand back to its former dimensions, thereby stretching the diaphragm attached to it. The amount the tension ring is compressed is regulated by the amount the screw plug is turned. It is evident that still other schemes may be satisfactorily used for the spreading of the chuck jaws and the regulating of the amount of compression other than the one just described.

Fig. 5 shows the stretched diaphragm attached to the tension ring by means of electric spot welding, the welded places being designated by 11.

Fig. 6 is a cross-sectional view of Fig. 5.

Fig. 3 shows another method in which the tension ring 1 is compressed by being forced in a taper collar 8, the upper internal diameter of which is approximately equal to the normal external diameter of the tension ring, but whose lower internal diameter is less than the diameter of the ring.

Fig. 4 shows the tension ring after it has been forced into the collar, thereby putting it under the proper compression for the permanent attachment of the diaphragm 7. The method of attachment may be by any suitable means as that described above or by means of a banding ring 13. If a banding ring is to be used, the diaphragm should be made somewhat larger than the tension ring, so that while the ring 1 is under compression, the edges of the diaphragm 7 can be crimped over the outside of the tension ring, and then the banding ring 13 thrust down over the crimped edges of the diaphragm, thereby firmly attaching it to the tension ring. After the diaphragm is attached, the tension ring is removed from the collar.

Figs. 7 and 8 show another method in which the diaphragm 7 is kept expanded under the action of a heated iron 9, placed nearby while it is being soldered or welded to the tension ring. The iron 9 may be heated by any suitable means such as a hot flame or by means of an electric current passing through a high resistance coil located inside the iron. If the method of attachment is to be by soldering, it is evident that either the heating iron 9 may be used as the soldering iron or another heated iron may be used independently of iron 9. The tension ring is kept cool by means of water in the vessel 10. On removing the heated iron, it is evident that the diaphragm will contract, thereby placing itself under tension.

Fig. 9 is a curve furnishing an example of how the intensity A of a train of waves transmitted by means of an unstretched diaphragm depends upon their frequency N. There is a maximum in the neighborhood of N=900 cycles per second. For a higher or lower frequency the intensity is considerably weaker. Fig. 10 shows a similar curve for a stretched diaphragm, which curve shows that by putting the diaphragm under tension, the maximum point has been pulled over to a frequency of about 2500 cycles per second the amount of displacement depending upon the tension exerted. In the case of this stretched diaphragm, the maximum peak is outside the usual range of frequencies used in acoustic apparatus, so that incident waves are transmitted with fairly uniform intensity unless, of course, the frequency of a portion of the train of waves corresponds to some point in the maximum region.

It is apparent that still other methods of obtaining stretched diaphragms may be used without departing from the spirit of this invention, which consists in changing the dimensions of either the reinforcing frame or the sheet material, attaching the frame and the sheet material together, and removing the means for changing the dimensions. The resulting tension may be due to either a compression of the reinforcing frame or an expansion of the sheet material before the two members are attached. It is also true that while in general it may be preferable to have the diaphragm symmetrically stretched, such is not necessary, as an unsymmetrically stretched diaphragm also has many advantages over the unstretched type. One of such advantages lies in the fact that an unsymmetrically stretched diaphragm has numerous natural frequencies so distributed as to result in an approximately uniform response of considerable intensity over a wide range. It will be noticed that both the apparatus of Fig. 1 and of Figs. 7 and 8 may be used to produce either symmetrically or unsymmetrically stretched diaphragms. In Fig. 1 the coiled springs 3 may exert equal or unequal stresses upon the tension ring. If the diaphragm in Fig. 8 is uniformly heated a symmetrically stretched diaphragm will result; but unequal heating will cause dissymmetry. Unequal tension may be obtained by many other methods, such as attaching the diaphragm to a tension ring of non-uniform thickness or by spacing the welding spots unevenly. The sheet material may be of any suitable material and size, although for phonographs and

telephones, it is preferable to have it of sheet steel. The reinforcing frame may be of any suitable size and material, and of any suitable open form. The method of attachment may be either by welding, soldering, a banding ring or other means of preserving the tension, although electric welding is preferable.

What is claimed is:

1. The process wherein a supporting frame and a sheet of some suitable elastic material are employed, which process comprises the steps of applying a force to change the radial dimensions of one of the members, attaching the two together, and then removing the said force.

2. A method of producing stretched diaphragms, comprising a reinforcing frame and a sheet of suitable material, which method consists in compressing said reinforcing frame by means of a uniform external force, attaching said sheet to the reinforcing frame, and removing the external force.

3. A method of producing stretched diaphragms comprising a tension ring and a sheet of expansible material, which method consists in radially compressing the ring by means of a uniform external force, welding the sheet to the tension ring, and removing the external force.

4. In the manufacture of stretched diaphragms comprising a reinforcing frame and a piece of sheet material, means for placing one of said members under strain and for preserving said strain while the two are being permanently secured together.

5. In the manufacture of stretched diaphragms comprising a reinforcing frame and a piece of sheet material, means for placing one of the members under strain for preserving said strain while the two are being permanently secured together and for releasing the stress on said member.

6. In the manufacture of stretched diaphragms comprising a reinforcing frame and a piece of sheet material, means for placing the reinforcing frame under tension for preserving said tension while the two members are being permanently secured together and for releasing the compression on said frame after the attachment has been made.

7. In the manufacture of stretched diaphragms comprising a reinforcing frame and a piece of sheet material, a chuck for holding said reinforcing frame under compression, said chuck comprising clamping arms and a supporting frame therefor, and a means for supplying said clamping arms with a compressing force acting on said reinforcing frame when placed between the clamping arms.

8. In the manufacture of stretched diaphragms comprising a reinforcing frame and a piece of sheet material, a chuck for holding said reinforcing frame under compression, said chuck comprising clamping members and a supporting frame therefor, and coiled springs compressed between said supporting frame and the clamping members, whereby the clamping members exert a pressure directed inwardly.

9. In the manufacture of stretched diaphragms comprising a reinforcing frame and a piece of sheet material, a chuck for holding said reinforcing frame under compression, said chuck comprising clamping members and a supporting frame therefor, coiled springs compressed between said supporting frame and the clamping members, whereby the clamping members exert a pressure directed inwardly, and means for controlling the amount of said pressure.

In witness whereof, I hereunto subscribe my name this 6th day of November A. D., 1916.

HENRY C. HARRISON.