L. S. LACHMAN.

ART OF STRETCHING SHEET MATERIAL.

APPLICATION FILED JUNE 9, 1910.

1,106,516.

Patented Aug. 11, 1914.

Fig. 1.

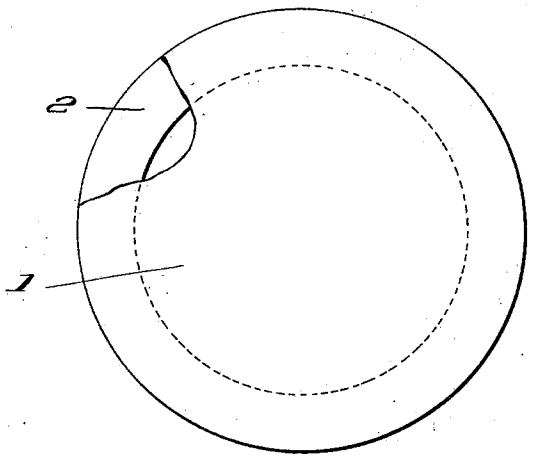



Fig. 3.

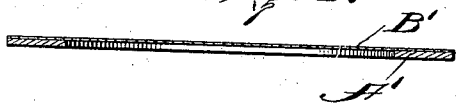



Fig. 2.

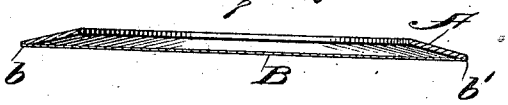



Fig. 4.




Fig. 5.

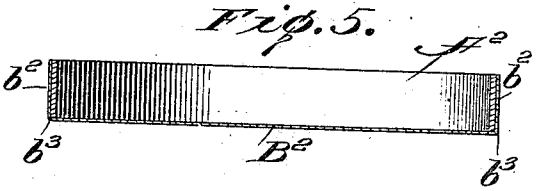
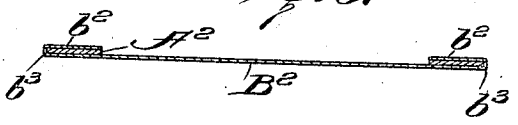



Fig. 6.




Witnesses:
L. Richards
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By his Attorney, Wm. A. Mynatt

# UNITED STATES PATENT OFFICE.

LAURENCE S. LACHMAN, OF NEW YORK, N. Y.

## ART OF STRETCHING SHEET MATERIAL.

1,106,516. Specification of Letters Patent. Patented Aug. 11, 1914.

Application filed June 9, 1910. Serial No. 566,052.

*To all whom it may concern:*

Be it known that I, LAURENCE S. LACHMAN, a citizen of the United States, and a resident of the city, county, and State of New York, have invented certain new and useful Improvements in the Art of Stretching Sheet Material, of which the following is a specification.

This invention relates broadly to certain improvements in the art of stretching sheet materials, forming the body of a reinforced object.

It more specifically relates to certain improvements in diaphragms, adaptable for use in phonographs, telephones, etc., and to the art of producing the same, and for this reason it is particularly illustrated, and will be particularly herein described, with reference to diaphragms. It is to be understood, however, that in its broader aspects it is not to be construed as restricted to such diaphragms, and that the latter is selected for illustrative purposes and because of peculiar advantages which the process and product possesses in their relation to said particular class of devices.

The invention consists broadly of a process of producing an article having a body of stretched material and a reinforcing frame, comprising the steps of securing the body and frame together and subjecting the frame to pressure which stretches the body; and to the product thereof.

The invention also consists in producing articles having reinforced peripheral portions and a body of sheet material comprising the steps of securing to each other, in a proper relation, a frame forming such reinforcement, and a body of suitable sheet material, and then stretching the latter by means of pressure adapted to change the form of the frame and to cause it while undergoing such change to transmit to the body a pulling force tending to disrupt the same.

The invention further consists in the product of such process.

The invention also consists in a diaphragm for phonographs, telephones or analogous apparatus or devices, consisting of a body of stretched sheet material, as metal, celluloid, etc., having a reinforced edge; and further in a process of producing the same by subjecting the body to stretching strain imposed thereon by alteration of the shape of the frame element.

These, and other ends, of the invention are well accomplished by the embodiments of my invention, illustrated in the accompanying drawings, in which:—

Figure 1 is a plan view of a completed diaphragm produced in accordance with my invention, with a part of the material of the body broken away. Fig. 2 is a vertical sectional view illustrating an initial position of the body and frame. Fig. 3 is a similar sectional view illustrating an initial position of the parts when the frame is of one different form from that of Fig. 2. Fig. 4 is a sectional view through a diaphragm produced from the parts illustrated in Fig. 3. Fig. 5 is a similar view illustrating an initial position of the parts when the frame has still another form; and Fig. 6 is a similar view illustrating the completed diaphragm when the frame of Fig. 5 is employed.

The body element, marked 1 in Fig. 1, may be of any suitable sheet material, shape and size, and the frame, marked 2 in the same figure, similarly may be of any suitable material and size, and of any suitable open form. For diaphragms for phonographs or telephones, it is preferred that the body of sheet steel, though other sheet metal and even materials, such as celluloid, which are capable of being stretched or expanded by the process hereinafter set forth and are properly responsive when stretched to the vibrations of a sound recording or reproducing tool of a phonograph, or to the sound waves or electrical impulses of a telephone receiver or transmitter, may be employed if desired. Preferably, the body is of circular form and the frame of annular form.

In the practice of the process, the frame is first mounted on the body in a suitable relation therewith and, after they have been rigidly secured together so that outward movement of the frame at its place or places of contact with the body will tend to disrupt the latter, pressure adapted to change the form of the frame is applied, said frame during said change obviously stretching said body tightly within the frame.

Referring now to the several forms ex-

emplifying various embodiments of my invention:—Fig. 2 illustrates a form in which the frame marked A is primarily a dish-shaped annulus having its outer peripheral edge superimposed on the body, marked B, contiguous to the peripheral edge of the latter, and secured thereto at *b*. In the practice of this particular embodiment of the process, the frame is pressed down until its under surface is in contact with the upper surface of the body, the latter retaining its flat shape. In its described movement, it obviously exerts outward pressure on the body, pulling the latter uniformly at all points around its periphery, thereby stretching it to a substantially uniform extent throughout.

In the embodiment shown in Figs. 3 and 4, the primary shape of the frame, marked A′, is that of a flat ring, and the primary shape of the body, marked B′, is that of a flat disk. When these parts are superimposed, with the contiguous surfaces in contact and suitably secured together, pressure is applied which changes the shape of the frame to that of a dish-shaped annulus, the shape of the outer portion of the body being similarly changed and thereby becoming stretched within the limits defined by the inner peripheral edge of the frame.

In the form shown in Figs. 5 and 6, the primary shape of the frame, marked $A^2$, is that of a vertically disposed ring superimposed edgewise on the surface of the body, marked $B^2$, and said body has a peripheral flange $b^2$ which encircles the outer surface of the ring and is suitably secured thereto. In the practice of the process this ring is flattened down toward the body, stretching the latter by exerting outward pressure upon the angle $b^3$.

The contacting portions of the body and frame, particularly the forms shown in Figs. 2, 3 and 4 are preferably integrally secured together, as by welding, electrically or otherwise, by brazing, or by soldering, electric welding being preferred. This is also true of the contacting portions of the body and frame of Figs. 5 and 6, but is not so important with respect to the latter form as the engagement of the flange of the body forms a securing means which is more or less effective in holding the parts together both during the formation of the articles and after the latter have been formed.

It is believed that my invention will be fully comprehended from the foregoing, and that it will be seen that it produces important advantages in the art of stretching metal and particularly in the art of producing diaphragms, as well as in the diaphragms themselves.

While I have shown the elements A, A′ and $A^2$ separte from the elements B, B′ and $B^2$, respectively, it is to be understood that said elements may be an integral part thereof, the thickened part to be formed in any desirable way as an integral part of said diaphragm or element B, B′ or $B^2$.

While the device as illustrated is in the form of a disk, it is to be understood that it may also be in any other desirable shape.

Having now described the invention what I believe to be new and desire to secure by Letters Patent, is:

1. The process herein described, which comprises the steps of rigidly and permanently securing an open frame and a sheet of expansible material together and subjecting the frame to pressure to change its shape and stretch the sheet.

2. The process herein described, which comprises the steps of securing an open frame and a sheet of expansible material together, and subjecting the frame to pressure which changes its form and causes it while assuming the new form to stretch the sheet.

3. The process herein described, which comprises the steps of permanently securing together a sheet of suitable material and a reinforcing frame therefor, and subjecting the frame to pressure which changes its form and causes it while assuming the new form to stretch the sheet.

4. A process of making diaphragms, consisting of a body of sheet material and a reinforcing frame therefor, comprising the steps of permanently securing the sheet at its edges to the frame and first subjecting the frame to pressure to stretch the sheet.

5. A process of making diaphragms consisting of a stretched body of sheet material and a reinforcing frame therefor, comprising the steps of permanently securing the body and frame together and subjecting the frame to pressure which changes its form and stretches the sheet

6. A process of making diaphragms consisting of a stretched body of sheet material and a reinforcing frame, comprising the steps of securing a dish-shaped reinforcing annulus to a body of sheet material, and subjecting the annulus to pressure which forces it toward the plane of the body and stretches the latter.

7. A process of making diaphragms, consisting of a stretched body of sheet material and a reinforcing frame, comprising the steps of securing a dish-shaped reinforcing annulus to a body of sheet material, subjecting the annulus to pressure which forces it toward the plane of the body into flatwise engagement therewith, and then subjecting the parts to further pressure which changes the form of their secured portions.

8. A process of making diaphragms consisting of a stretched body of sheet metal

and a reinforcing ring therefor, comprising the steps of permanently securing the body and ring together and subjecting the ring to pressure which changes its form and stretches the sheet.

9. A process of making diaphragms which comprises the steps of welding together contacting portions of a body of sheet metal and a frame and then subjecting the frame to pressure which stretches the body and puts it into a reinforcing relation with the latter.

In witness whereof I have hereunto set my hand at New York, county of New York and State of New York, this seventh day of June, 1910.

LAURENCE S. LACHMAN.

In presence of—
ISABEL R. RICHARDS,
JOHN J. RANAGAN.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."