M. R. HUTCHISON.
MECHANICALLY ACTUATED DIAPHRAGM.
APPLICATION FILED DEC. 3, 1908.

1,147,866. Patented July 27, 1915.

Fig. 1

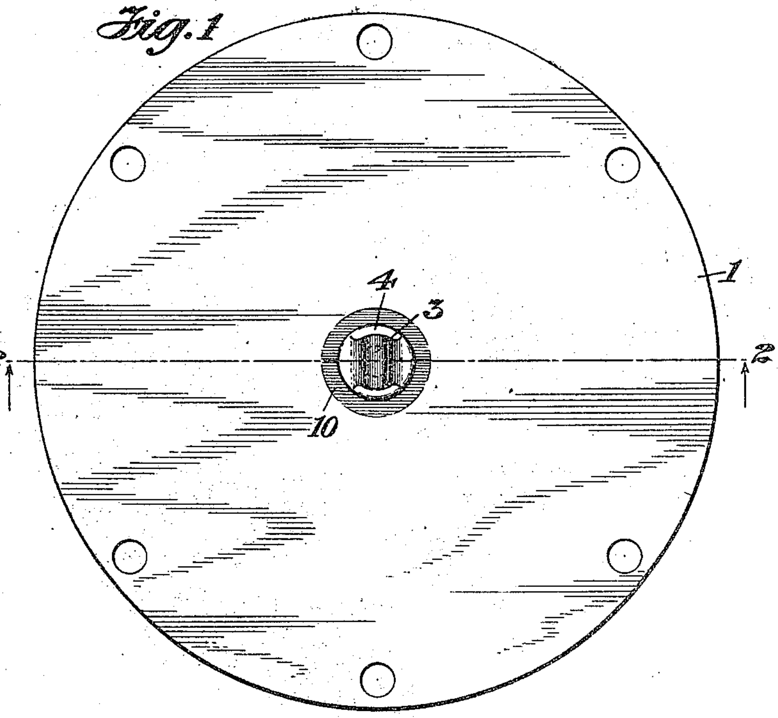

Fig. 2

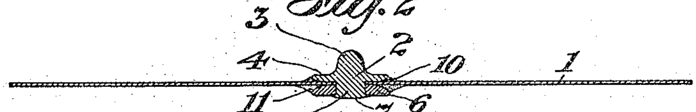

Fig. 3

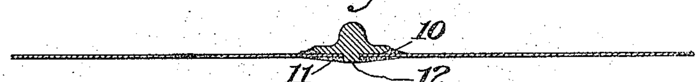

Fig. 4

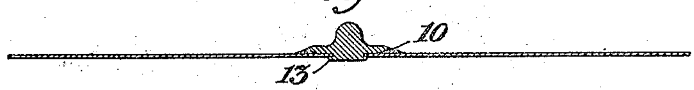

Fig. 5

Fig. 6

Witnesses
Chas J. Clagett
[illegible]

Inventor
Miller Reese Hutchison
By his Attorney
George C. Dean

UNITED STATES PATENT OFFICE.

MILLER REESE HUTCHISON, OF SUMMIT, NEW JERSEY, ASSIGNOR TO LOVELL-McCONNELL MANUFACTURING COMPANY, A CORPORATION OF DELAWARE.

MECHANICALLY-ACTUATED DIAPHRAGM.

1,147,866. Specification of Letters Patent. Patented July 27, 1915.

Application filed December 3, 1908. Serial No. 465,880.

To all whom it may concern:

Be it known that I, MILLER REESE HUTCHISON, a citizen of the United States, and a resident of Summit, in the county of Union and State of New Jersey, have invented certain new and useful Mechanically-Actuated Diaphragms, of which the following is a specification.

My present invention relates to diaphragms of the class wherein there is a wear piece on the diaphragm adapted to receive and transmit to the latter the force and movement of a rotary cam or other mechanical displacing member. Certain uses and requirement for such devices are set forth in my prior Patents Nos. 883,643, 923,048, 923,049 and 923,122. When a diaphragm is intended for such uses, I prefer to make the wear piece in the form of a projection of small altitude, low operative pitch, and preferably symmetrical in both directions, so as to present the same form of wear surface to the cam in whichever direction the latter may be rotated. The base of the wear piece should be of ample diameter, so as to apply the power over a sufficient area of the diaphragm. The ratio of altitude to base is preferably such as to cause lines of thrust of the cam to fall in or near the base of the projection. The form, arrangement, and pitch of the coöperating surfaces of cam and contact piece should be such as to give a large resultant perpendicular to the diaphragm, and, in general, the contact piece on the diaphragm may be of greater altitude with respect to the base according as the lines of thrust approach a perpendicular to the diaphragm. Where the wear piece is in the form of a projection, with its summit rounded or otherwise formed non-parallel with the diaphragm, the thrust or displacement of the diaphragm by the rotary member is a function of the shape and arrangement of both of the coöperating contact surface and these are capable of wide variation between the extreme where all the cam variation or displacement is developed on the rotary cam and the other extreme where all of the cam thrust or displacement is developed on the diaphragm projection.

My present invention may be usefully applied to diaphragms embodying any or all or none of the above special proportions and modes of operation, since it relates more particularly to characteristics of the diaphragm and modes of attachment of the wear piece thereto. The nearest prior art is indicated in my prior patent referred to above, in which I have described a tempered rolled steel diaphragm preferably formed of vanadium steel, nickel steel, vanadium nickel steel, or other similar tough elastic material. In said patent, the wear piece has a hardened wear surface for engagement by the driving cam. It is secured to the diaphragm preferably by riveting an integral soft metal shank which extends through the diaphragm and preferably through a washer on the back side thereof. When such device is formed with an integral wear surface, there is some times difficulty in getting the shank sufficiently annealed for tight riveting and at the same time maintaining the necessary hardness of the wear surface. Moreover, experience shows that there are difficulties in attaching soft metal, by a cold process, to a material of the hardness and elasticity of sheet steel in the condition in which it comes from the rolls. In my cam operated horn or alarm, the vibration and stress due to the considerable amounts of power applied may be so great that cold riveted shanks will occasionally become loosened even where the initial union of the parts by riveting has been made so intimate that a cross-section would fail to show any line of separation between the soft metal of the rivet and the hard metal of the diaphragm. Hence, though the cold riveted devices have proved very satisfactory and though the diaphragms produced thereby will stand up perfectly so long as the apparatus is used in the manner for which it was designed, there are nevertheless cases where users will abuse the device, as, for instance, by applying practically unlimited power to the rotary cam and then adjusting it up tight against the diaphragm. Hence, I have endeavored to improve the diaphragm and wear piece to a point where it will be capable of withstanding a wide range of abuse as well as of reasonable use.

Any one familiar with the practical side of the various operations involved would consider hot processes entirely prohibited in this connection, because the necessary heat will draw the temper of the wear surface of the projection and will also warp and anneal the diaphragm, thereby destroying the spring quality of the steel and distorting it in most irregular ways. I have discovered, however, that for my purposes the extreme stiffness and elasticity found in the sheet steel as it comes from the rolls, though desirable, is not indispensable, and that a diaphragm made according to my method herein set forth may have the wear piece attached by hot processes and yet have the diaphragm suitable for use, especially in connection with a resonator having an air column of sufficient cross-section so that it tends to control the movements of the diaphragm and force it to vibrate in the natural frequencies of the air column and resonator. According to my present invention, it is not necessary to prevent either the warping or annealing of the steel diaphragm. The wear piece is secured by a hot process and then instead of attempting to retemper the diaphragm by ordinary heat methods, I restore it to a plane by peening in accordance with the principles well understood in the art of making circular saws. This is a skillful operation, but it is well understood in that art and need not be further described than to say that by highly skilled manipulation, the irregularly expanded and warped metal is hammered back to shape. The hammering serves to restore a certain amount of temper to the metal, so that in the finished product the diaphragm proper has peculiar properties which are very desirable for my purposes, and its condition may be roughly and perhaps not inaccurately described as partly annealed by heat and partly tempered by hammering.

My present invention may be said to be based in part upon the discovery that the annealed and peened diaphragm is exceptionally durable and free from break down due to crystallization of the metal, and is sufficiently elastic for the purposes in view.

My present invention may be more fully understood from the following description thereof in connection with the accompanying drawings, in which—

Figure 1 is a plan view of the diaphragm [illegible]d attached wear piece; Fig. 2 is a section [illegible] the diaphragm and wear piece taken on the line 2—2, Fig. 1; The remaining Figs. 3, 4, 5 and 6 are sections corresponding to Fig. 2 but showing modifications.

Referring to Fig. 1, the sheet steel diaphragm 1 is provided with a wear piece 2 having a hardened wear surface 3, formed integral therewith. The [illegible]ase 4 is preferably slightly rounded off at the periphery and the integral shank 5 passes through a perforation in the diaphragm and preferably also through a washer 6 over which it is riveted as at 7. These parts may or may not be the same as those described in my prior Patent 883,643.

Various hot processes may be carried out in the assembling of these parts. For instance, the entire wear piece may be formed from air hardening steel, of which there are many varieties in the market and some of which are furnished to the trade in an initially soft condition, so that they may be easily milled and cut before heating. Whatever kind of air hardening steel is used, the wear piece is cut to shape, heated to the desired riveting temperature, assembled, and riveted. Upon cooling, the entire wear piece will become highly tempered. The diaphragm will have been heated and annealed at the center. If in the particular variety of sheet steel used, this impairs the quality of the diaphragm, the entire surface may be heat treated and annealed, the resulting distortion or warping being removed by peening. The diaphragm may be used in this condition, or, if desired, it may be subjected to the additional hot process hereinafter described. By this process, a less refractory metal may be fused between the contacting surfaces of the anvil and of the diaphragm, as will be hereinafter more fully described. This part of my invention involves using fused metal having a melting point below that of the steel. It is used either as a supplement to riveting or, if desired, as the sole means of securing the wear piece to the diaphragm. I have found that solder of such low melting point that it would not take the temper out of the diaphragm and anvil, is too soft for my purposes, and I prefer to use only those harder metals or compositions, commonly classed as brazing, hard solder, silver solder, etc. These harder metals are all of such high melting point that their application necessarily involves annealing and warping of the diaphragm and also annealing the wear surface of the wear piece, except, of course, where the latter is made of air hardening steel. For practice of this part of my process, I may form the wear piece of ordinary steel intended to be tempered by a chilling bath or by cyanid solution in the ordinary ways employed for tempering.

After the parts are formed, the contacting surfaces are heated and thoroughly cleansed by application of borax or similar material commonly employed for the purpose. The assembled parts are heated somewhat above the melting point of the brazing or other material to be used, preferably to a red heat.

This brazing is then applied in the usual way and if the cleansing has been sufficiently thorough, it will wet the adjacent surfaces of the diaphragm and anvil and will be drawn by surface tension and adhesion into the innermost portions of the joint. It will also tend to extend radially in an annulus which decreases in thickness toward the outer edge, as indicated at 10 and 11. While still in the heated condition, the wear surface 3 is tempered by chilling or application of cyanid solution. This may be done by applying the solution to the wear piece without moving the parts and before the brazing has solidified.

In practice, I find it very convenient to form some sort of an initial mechanical engagement of the wear piece with the diaphragm, which may be very slight, as indicated by the riveting in Figs. 4, 5, and 6, or may be it is quite substantial, as indicated in Fig. 2. When there is such attachment, the heated diaphragm and wear piece may be inverted over a bath and the tip of the wear surface 3 immersed therein, while the diaphragm and the rest of the wear piece is allowed to cool more slowly. This inverting and tempering of the wear piece attached as in Figs. 2, 4, 5, and 6, may be accomplished before the brazing solidifies, because the adhesion and surface tension will be sufficient to prevent the brazing from flowing out of the joint. Even where there is no riveting, the wear piece may be mechanically retained as in Fig. 3, by providing it with a small projection 12 tightly engaging the sides of the perforation in the diaphragm.

Referring to the various figures more particularly, it will be seen that Fig. 2 contemplates the application of brazing where the wear surface is already held by substantial securing means, the brazing being a supplemental bracing and securing means. In Figs. 3, 4, 5, and 6, the riveting attachment is inadequate for most practical purposes and the brazing is the principal attaching means. In Fig. 3, the brazing is practically the sole attaching means. In all cases, there seems to be special advantage in the tight union secured by brazing. There also seems to be considerable beneficial effect from the effective enlargement of area of the base by spreading the brazing out beyond the base, and also from the manner in which the brazing slopes off gradually toward the periphery. This seems to have the effect of making the outer edge of the base projection more indefinite so that there is practically no tendency to localized bending of the diaphragm at the periphery of the brazing.

For my purposes, I prefer that the inertia of the diaphragm shall be small and hence I prefer to decrease the weight of the wear piece and its attaching means. The brazing constitutes such a perfect union of the parts that the washer 6 and shank 7 may be dispensed with, the diaphragm projection may be of small altitude and the base of the wear piece may be very thin. These and other features will be evident from the various modifications indicated in Figs. 3, 4, 5, and 6.

In Fig. 3 the washer and rivet are omitted. In such case a small lug 12 passing through a perforation in the diaphragm, is convenient for centering the wear piece in place during the brazing, though this may be omitted and the diaphragm used imperforate where desired. Where the lug 12 is used, the brazing is preferably applied to both sides of the diaphragm after the manner shown at 10 and 11 respectively.

In Figs. 4 and 6 the end of the shank is slightly upset on the rear side of the diaphragm, as at 13. In Fig. 4, the brazing is applied only to the front side, as at 10, though, if desired, it may be used on the rear side also, as indicated in Fig. 5.

In Fig. 6 I have indicated how the brazing operation may serve to form a slight depression near the center of the diaphragm. When such depression is of relatively small diameter, it is not necessary to remove it by peening, since it seems to contribute to the durability of the diaphragm, possibly because the displacing effort is distributed more evenly.

In Fig. 5, the base 15 of the wear piece is very thin and light, and the diaphragm projection 16 is of less altitude than in any of the other figures. Moreover, it will be noted that the curves of the wear surface are of such small pitch even at the maximum that all lines of thrust thereon must fall within the base of the projection and even within the diameter of the shank 17, no matter what may be the shape of the rotary cam used to drive the same. Even with a radial faced rotary cam having only an edge engagement with the wear piece, no line of thrust or dynamic reaction could fall far from the center of the projection.

Figs. 4, 5, and 6 all illustrate the fact that the perforation may be decreased in diameter to any desired degree, because the brazing alone constitutes a sufficient and reliable securing means.

I claim:

1. As an article of manufacture, a diaphragm of rolled steel having an attached wear piece secured thereto by a hot process and having the tip or wear surface highly tempered, said diaphragm being flattened and partially retempered by peening.

2. As an article of manufacture, a diaphragm of rolled steel having an attached wear piece secured thereto by brazing at a temperature lower than the melting point but higher than the annealing temperature of said steel, said wear piece having the tip

or wear surface thereof tempered and said diaphragm being flattened and partially retempered by hammering.

3. As an article of manufacture, a rolled steel diaphragm having a hardened steel wear piece rigidly secured thereto by an intermediate body of metal melted into intimate contact with both said diaphragm and said wear piece, said diaphragm being flattened and partly retempered by peening after the attachment of the wear-piece and to partially restore the conditions existing before said attachment.

Signed at New York city, in the county of New York and State of New York, this seventeenth day of November, A. D. 1908.

MILLER REESE HUTCHISON.

Witnesses:

GEORGE C. DEAN,

IRVING M. OBRIEGHT.