M. R. HUTCHISON.

DIAPHRAGM HORN.

APPLICATION FILED MAY 11, 1911.

1,172,712.

Patented Feb. 22, 1916.

4 SHEETS—SHEET 1.

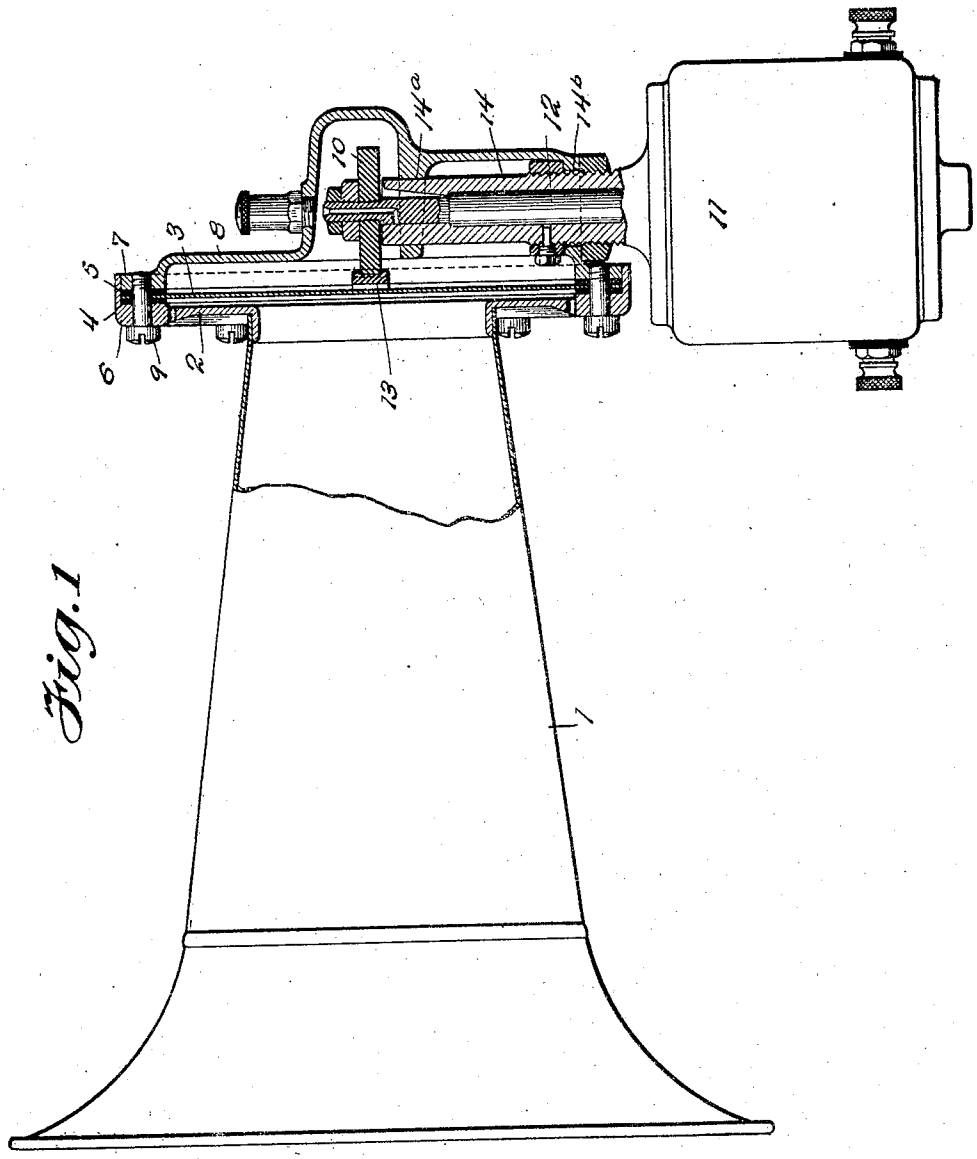



Fig. 1

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4 SHEETS—SHEET 2.

Fig. 2

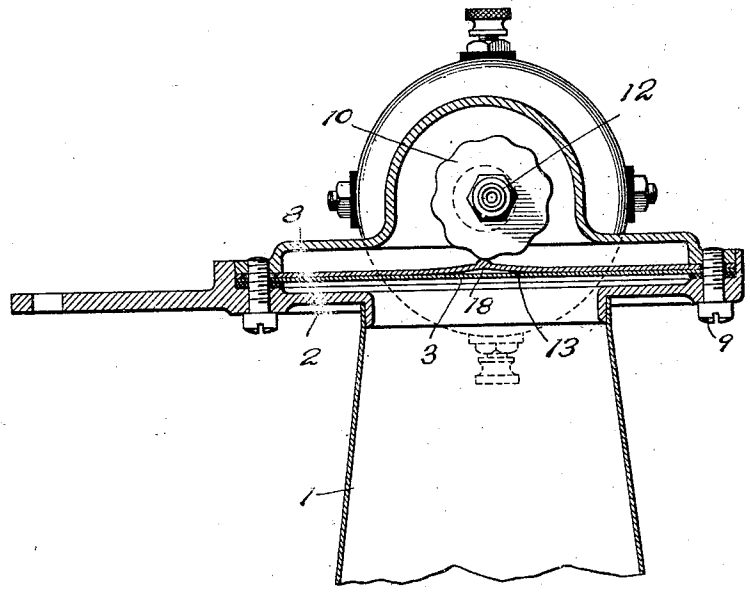
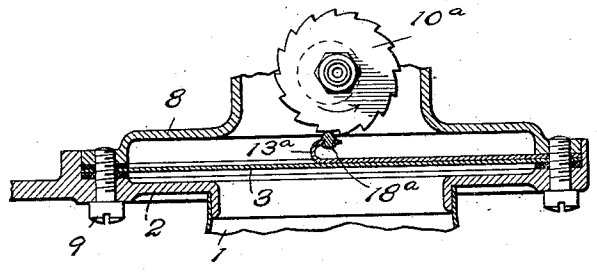



Fig. 3




Fig. 4




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4 SHEETS—SHEET 3.

Fig. 5

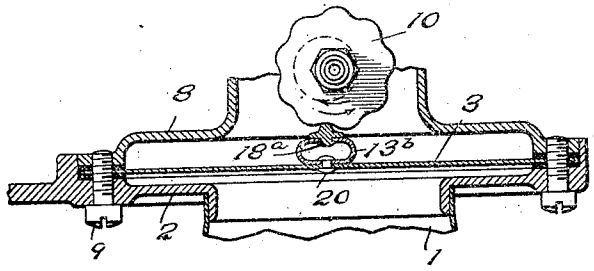



Fig. 7

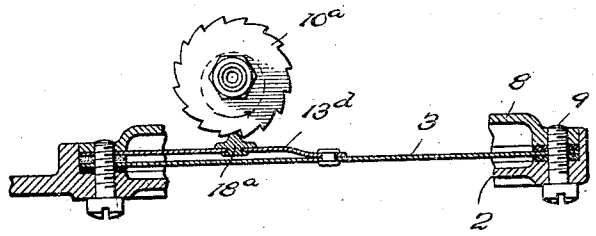
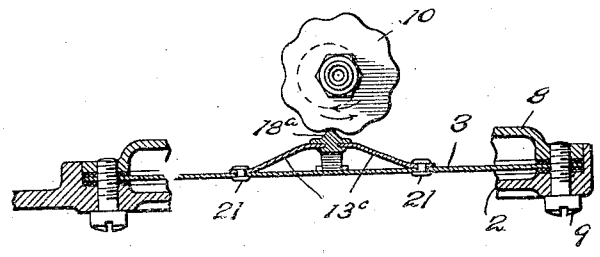



Fig. 6




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4 SHEETS—SHEET 4.

Fig. 8.

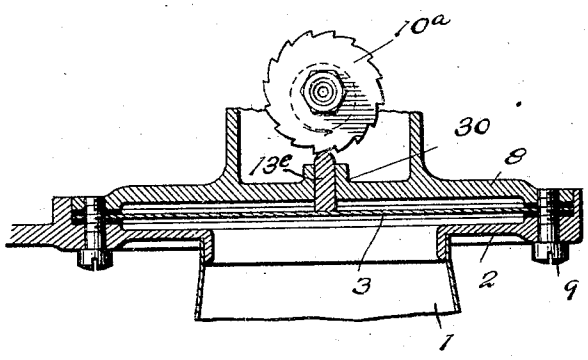



Fig. 9.

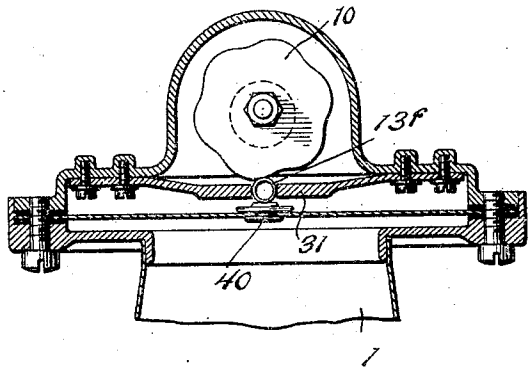
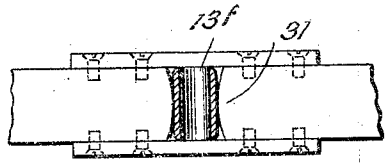



Fig. 10.




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# UNITED STATES PATENT OFFICE.

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

## DIAPHRAGM-HORN.

1,172,712. Specification of Letters Patent. Patented Feb. 22, 1916.

Application filed May 11, 1911. Serial No. 626,487.

*To all whom it may concern:*

Be it known that I, MILLER REESE HUTCHISON, a citizen of the United States, and resident of West Orange, in the county of Essex and State of New Jersey, have invented certain new and useful Improvements in Diaphragm-Horns, of which the following is a specification.

This invention relates to that kind of mechanically actuated diaphragm horns in which the diaphragm is vibrated bodily by high speed mechanism, such as a shaft or rotary member driven by an electric motor and provided with an eccentric portion or cam faces adapted to transform rotary into reciprocatory movement. In a highly successful embodiment of such a signaling device, suitable for use on vehicles, factories and elsewhere, the rapidly repeated blows have been delivered rigidly to the diaphragm; best results being obtained when there is synchronism between the rigid blows and a natural frequency of the diaphragm or of the diaphragm and resonator acting as a resonant unit. In certain cases the blows have been delivered directly to the diaphragm or to a wear piece fixed on the central portion thereof, as by a rotary cam, having a plurality of teeth or faces, of such number and of such altitude and pitch as to cause diaphragm vibrations of the desired frequency and with minimum interference. Such an assemblage has the merit of simplicity of construction and is especially adapted for the production of a powerful warning note of peculiarly imperative quality. In some cases, however, it is preferable to have a signal that will give forth a sound of less harshness, or even of considerable softness or purity; and it is also desirable to save wear and tear on the diaphragm, attendant particularly on those arrangements in which the blows are applied rigidly to the diaphragm or the central wear piece thereon. I find that these ends may be attained, without sacrificing too much of the warning value, by actuating the diaphragm by suitably softened or tempered blows.

In my prior application, Serial No. 494,688, filed May 7, 1909, (now Patent 1,148,231, issued July 27, 1915) for mechanical horns and diaphragms therefor, I have shown a signal having this characteristic and desirable property, by virtue of the employment of a hollow cylinder of spring steel as a thrust member between the diaphragm and the driver. Such hollow cylinder of spring steel is illustrated and claimed in my prior Patent 1,131,635, issued March 9th, 1915. This assemblage is illustrated and described herein as an embodiment of the broader phases of the present invention, in accordance with which the softened blows are attained by the use of a suitable cushioning connection or coupling between the driver and diaphragm, properly designed and arranged to receive the rigid thrust of the driver and to partially absorb and partially transmit directly to the diaphragm the energy thus supplied to it, in this way materially lessening the abruptness with which the diaphragm is set in motion or the direction of its motion changed, so that the quality of the sound produced is tempered according to the degree and nature of the yielding of which the connection is capable.

Preferably the cushioning connection is normally in contact with or coupled to the diaphragm, or is so constructed and arranged as to contact simultaneously with both the rotary cam and the diaphragm. When such a connection is constructed and arranged so that its range of yielding is small as compared with the effective altitude of the cam projections, and insufficient to destroy the positiveness of cam thrust or governing action of the diaphragm on the cam, the power loss may be minimum and the sound produced may be of adequate loudness and carrying quality, with a marked softening and purification of the tone, due partly to the less abrupt actuation of the diaphragm and partly to the suppression by the cushioning connection of the discordant vibrations produced by the scraping of metal on metal. The wear piece or anvil is preferably on the cushioning connection, or the cushioning connection constitutes the wear piece, so that the diaphragm is relieved of the direct pounding or wrenching occurring where the anvil is directly or rigidly secured to the diaphragm. Moreover, it is possible to construct and arrange the cushioning connection so that the stress is distributed and is elastically applied to the diaphragm at a plurality of points preferably symmetrically disposed around the center of the diaphragm, so that it is rendered easier to cause all parts of the diaphragm to move

simultaneously in the same direction. A further development in this regard is that neither the cushioning connection nor the wear piece need be anchored or permanently coupled to the diaphragm, either by brazing or by welding, or by riveting through a perforation in the diaphragm and certain forms of my invention contemplate the loose coupling or even a mere surface engagement of the cushioning connection to the diaphragm. With such an assemblage I am enabled to employ what I may term a plain diaphragm, without perforation or permanent attachment inside the peripheral clamps. This tends to improve its sounding qualities and to increase its durability.

In the preferred form I employ a spring tongue of comparatively light weight loosely or permanently coupled to the diaphragm and carrying a wear piece for contact with the driver.

Having thus briefly described the general characteristics of my invention, I shall proceed to a description of certain particular forms thereof, reference being had to the accompanying drawings, in which:

Figure 1 is a side elevation, partially in section, of a diaphragm horn embodying one form of the present invention; Fig. 2 is a horizontal section through the case, diaphragm and resonator, showing the same form as in the preceding view; Fig. 3 is a detail view of the loosely coupled spring tongue used in this form of the signal; Fig. 4 is a partial section corresponding to Fig. 2, showing another form of loosely coupled cushioning tongue; Figs. 5, 6 and 7 are similar views showing other forms of tongues; Fig. 8 is a corresponding view, illustrating a cushioning connection consisting of a guided member of fiber or the like; and Fig. 9 is a corresponding view, illustrating the spring cylinder form of connection. Fig. 10 is a detail view, partly in section.

The resonator or projector 1 is carried by the front section 2 of the diaphragm case. The diaphragm 3 is held between cord washers or the like 4, 5, by the marginal clamping portions 6, 7, of the front section 2 and the rear section 8 of the diaphragm case. The clamping is effected by screws 9, which pass through openings in the clamping portions of the case sections and in the gaskets and the marginal region of the diaphragm.

The rear section 8 of the case is formed to receive the rotary driver 10, which is shown as a disk provided with a plurality of peripheral cam projections. Preferably the axis of this rotary driver is parallel to the diaphragm, as shown. Suitable means for rotating the driver at high speed is illustrated in the form of an incased electric motor 11, the armature shaft 12 of which is prolonged into the rear section of the diaphragm case, there carrying the rotary driver. The driver is preferably solidly mounted so as to deliver rigid thrusts to the cushioning connection 13; and to this end the bearing 14 of the rigid shaft 12 rigidly holds the shaft and is rigidly secured to the rear section of the diaphragm case. The bearing sleeve 14 has exterior cylindrical bearing upon the case at $14^a$, $14^b$, the axis of the shaft being eccentric to said cylindrical bearing surfaces, so that rotary adjustment of the sleeve adjusts the cam to or from the diaphragm.

The cushioning connection 13, in Figs. 1 to 3, is in the nature of a flat spring tongue applied against the diaphragm and extending, preferably diametrically, all the way across the same. At its ends it is provided with openings 15 and 16, through which pass two of the clamping screws 9 to secure the tongue in position against the diaphragm. At its central portion this tongue is suitably formed for contact with the rotary driver. To this end the tongue, which for the most part lies flat against the diaphragm, is slightly raised away from it, and at the crest of the low broad ridge so formed the tongue may be thickened or otherwise equipped with a wear piece or portion 18 for sustaining the thrusts and frictional engagement of the driver.

One of the openings, as 16, in the tongue may be slotted, so as to permit of the slight endwise movement of the cushioning member in this form of signal. The tongue is normally in contact with both the diaphragm and the driver; its range of yielding is small, and by reason of its lightness and its close confinement between the driving and driven members it is unlikely to interfere with the harmonious coöperation thereof. By virtue of the loose coupling of the tongue to the diaphragm I am enabled to make the latter perfectly plain and imperforate in its working portion, that is, within the area inclosed by the marginal regions clamped between the gaskets. The thrust of the cam projections is distributed over comparatively remote points on the diaphragm, and may be regarded as applied particularly at the points at diametrically opposite sides of and materially spaced from the center, where the inclined central portions of the tongue merge with the portions thereof which lie in parellelism against the face of the diaphragm. Obviously, the region over which the thrust is applied will vary during the continuance of the thrust, as the central portion of the tongue is forced more into parallelism with the diaphragm. From this distribution of the stress at points around the center and comparatively remote from each other it follows that the bodily vibration of the diaphragm is promoted, since there is no tendency for one portion of the diaphragm,

receiving the entire thrust, to be forced unduly in advance of the remainder thereof. In operation, the amount of sound produced by this assemblage will approach that produced by a rigidly actuated diaphragm horn, according to the stiffness of the spring tongue and the extent to which its wear portion intercepts the path of travel of the cam projections. The less yielding the connection the more does it directly transmit the thrust of the cam member and the less should it engage between the cam projections, or the less should be the elastic stress with which it is held between them. As the thrust of each projection begins and continues, the power is in part transmitted by the connection to the diaphragm and in part spent in flexing the connection. For this reason the degree of interception of the path of travel of the projections by the wear portion of the connection should be greater than the interception in the case of a wear piece fixed directly on the diaphragm. In other words, the yielding connection has the effect of prolonging the time and reducing the intensity of each thrust. From this it naturally results that the diaphragm is displaced less abruptly and violently and that the sound is much smoother and softer than in the case of a rigidly actuated signal. Where the rotor has projections of double inclination as shown in Fig. 1 the gradual back slope of such cam projections may, in certain cases, have the effect of enabling the spring tongue 13 to give up some of the energy stored therein to the diaphragm after the crest has passed the wear portion 18, so that the outward force of the diaphragm may commence somewhat up the slope of the projection and continue slightly beyond the crest.

In my previously filed application Serial No. 494,120, filed May 5, 1909 and a division thereof (now Patents 1,160,900 and 1,160,899, issued Nov. 16, 1915) for mechanically actuated diaphragm horns, I have explained how any tendency of the rotary driver to speed up causes the projections thereon to intercept the diaphragm projection on the backward swing of the diaphragm, with the result that the power required to rotate the driver at such a speed is greater than the motor is capable of delivering and the driver is held substantially to synchronous speed. Substantially the same results are obtained in the present instance. The stiffer the spring tongue, the more the conditions will reproduce those in the rigidly actuated signals.

In Fig. 4, the spring tongue $13^a$ is of about half the length of the tongue $13^a$ of the preceding views, being secured at one end after the manner of the tongue 13, but without the provision for endwise movement. The inner end portion of the tongue is reversely bent and provided over the center of the diaphragm with a wear piece $18^a$, which may be riveted to the tongue, as shown, or otherwise secured thereto or formed thereon. The rotary driver $10^a$ in this instance has cam teeth with abrupt rear sides, so that the spring tongue, or rather the wear piece thereon, is free to snap back after the passage of the tooth. The narrow reverse bend gives the projecting portion of the tongue considerable stiffness, so that the transmission of thrust from the driver to the diaphragm may approach that of a rigid connection; but by making the spring tongue more flexible the actuation of the diaphragm may be lessened, and at very high speed the tongue may not have opportunity to get back fully between the teeth, the wear piece skipping, as it were, upon the tops of the cam projections. Here, also, the diaphragm is plain and imperforate in its working portion.

Fig. 5 shows a spring tongue $13^b$, which is anchored to the diaphragm, as by the rivet 20, preferably to the center thereof. In this instance the tongue is supported entirely by the diaphragm, and may be formed as a closed loop, having the wear piece $18^a$ riveted to the middle of the outer side thereof. The rotor 10 is here shown as of the same form as in Figs. 1 to 3, so that the diaphragm may be vibrated by rotation in either direction.

Fig. 6 shows an assemblage in which the thrust is applied to the diaphragm at a plurality of points around the center by a cushioning connection permanently coupled to the diaphragm and entirely supported thereby. In this case the connection $13^c$ may be in the form of an arched spider, the ends of the legs of which are riveted or otherwise suitably secured to the diaphragm, as shown at 21, and which is apertured at the junction of the legs for the reception of the wear piece $18^a$, which is shown riveted thereto. Or there may be a plurality of separately formed tongues united at their inner ends over the diaphragm by the riveted wear piece. This form of connection is useful for causing the diaphragm to vibrate in a unitary manner, by reason of the distribution of the thrust over a considerable portion of the diaphragm.

In Fig. 7 I have shown a spring tongue anchored at one point to the diaphragm and at another point to a stationary part, with the driver coacting with the tongue at an intermediate point. In the particular construction illustrated, the tongue $13^d$ is in the nature of a flat strip, secured at one end to the center of the diaphragm, as indicated at 25 and at the other end held between the clamping members at the margin of the diaphragm. The tongue is slightly bent away from the diaphragm ad-

jacent, its anchorage thereto, and its main portion may lie substantially parallel to but spaced from the diaphragm. The wear piece $18^a$ is riveted to the tongue intermediate its ends, and the driver is placed in a corresponding eccentric position with reference to the diaphragm. In this construction the spring tongue operates to some extent as a lever in transmitting the thrust in a cushioned manner to the diaphragm.

In Fig. 8 I have shown a cushioning connection other than a spring tongue. A slidable plug or the like $13^e$ of fiber or other semi-yielding material is mounted in a stationary guide 30, in which it reciprocates under the alternating impulses of the driver and the diaphragm.

Fig. 9 also shows a guided thrust connection, in this instance a hollow cylinder $13^f$ of spring metal, mounted in a stationary guide 31, the assemblage being that shown in my prior application Serial No. 494,688, previously referred to. This view illustrates the fact that, if desired, the diaphragm may be provided with a wear piece 40 riveted or otherwise directly anchored thereto, for receiving the thrust of the cushioning connection, in this instance the spring cylinder.

I claim:

1. In an alarm or signaling device, a diaphragm, rotary mechanical means for producing bodily vibration thereof, and a cushioning member normally in contact with the face of the diaphragm and having a portion adjacent to the center of the diaphragm but spaced therefrom to receive the impulses from said mechanical means, the cushioning movement of said member being predetermined so as not to interfere with harmonized bodily swings of the diaphragm in response to each forcing impulse.

2. A mechanically actuated diaphragm horn or signal, comprising a diaphragm, a rotary driver with projecting actuating portions, and a spring tongue coupled to said diaphragm and provided with a wear piece adjacent to but spaced from the center of the diaphragm adapted to receive actuating impulses from said driver and said tongue serving to transmit said impulses to said diaphragm so that the forcing impulses of the rotary driver are harmonized with the natural bodily movements of the diaphragm.

3. A mechanically actuated diaphragm horn or signal, comprising a diaphragm, a mechanical actuator, and a motor for driving said actuator, in combination with a cushioning member constituting the connection between said actuator and said diaphragm, said member being constructed and arranged to distribute each impulse and apply it at comparatively remote points over the diaphragm to impart vibrations to said diaphragm harmonized with the forcing movements of said actuator.

4. A mechanically actuated diaphragm horn or signal, comprising a diaphragm, high speed means for vibrating the same including a mechanical driver, and cushioning means for distributing and applying each impulse at regions at opposite sides of the center of the diaphragm, the extent of yielding movement of said cushioning means being so predetermined as not to interfere with harmonized bodily swings of the diaphragm in response to each forcing impulse of said driver.

5. A mechanically actuated diaphragm horn or signal, comprising a diaphragm, a motor, a rotary driver, and cushioning means normally applied to said diaphragm at spaced points about the center thereof and adapted to receive the impulses from said driver and impart them to said diaphragm to effect vibrations of the latter harmonized with the forcing impulses of said driver.

Signed at New York city, in the county of New York and State of New York, this 9th day of May, A. D. 1911.

MILLER REESE HUTCHISON.

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