C. L. CHISHOLM.

MEANS FOR REPRODUCING SOUNDS FROM SOUND RECORDS.

APPLICATION FILED FEB. 13, 1909.

968,539.

Patented Aug. 30, 1910.

3 SHEETS—SHEET 1.

Fig. 1.

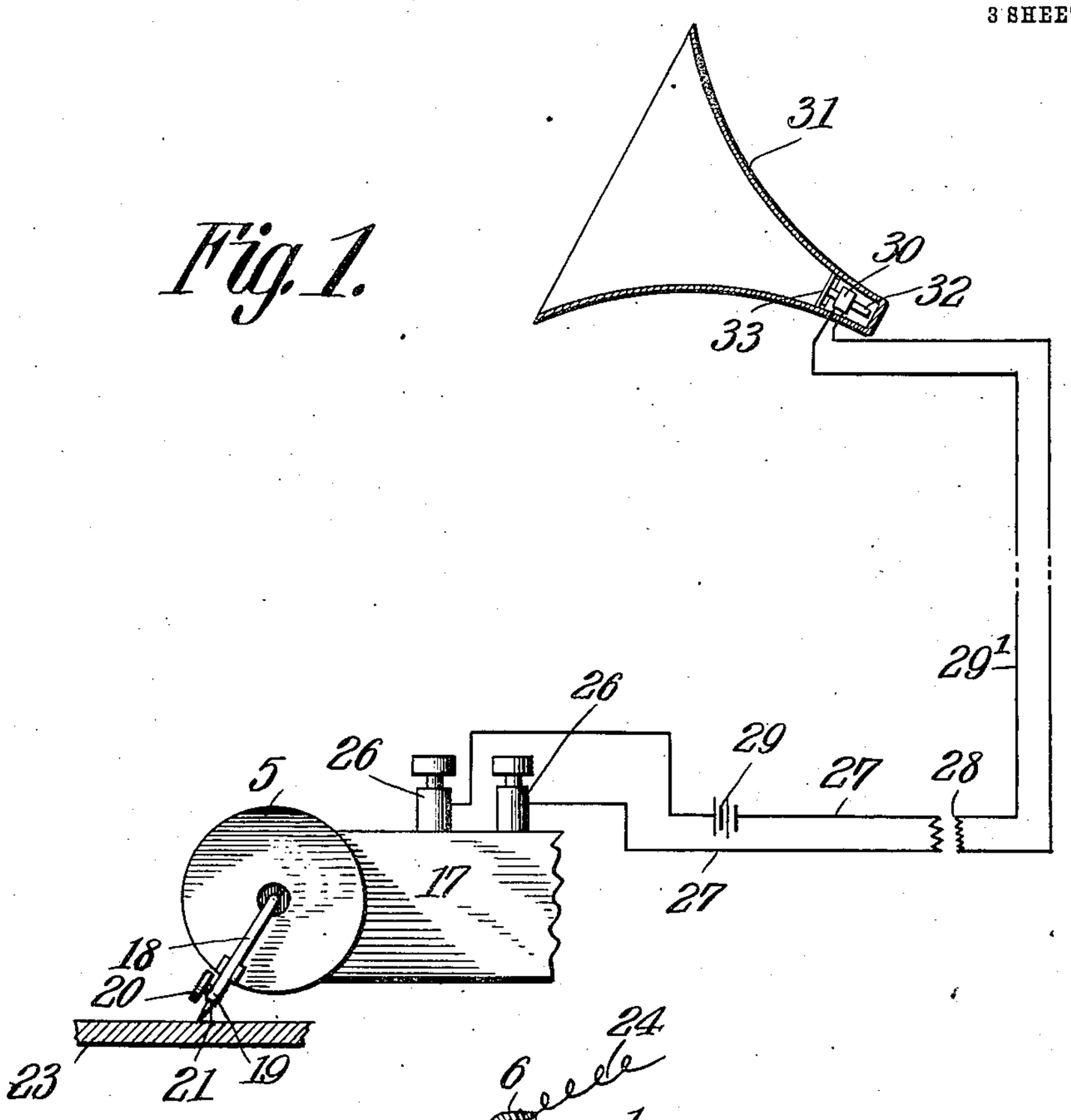
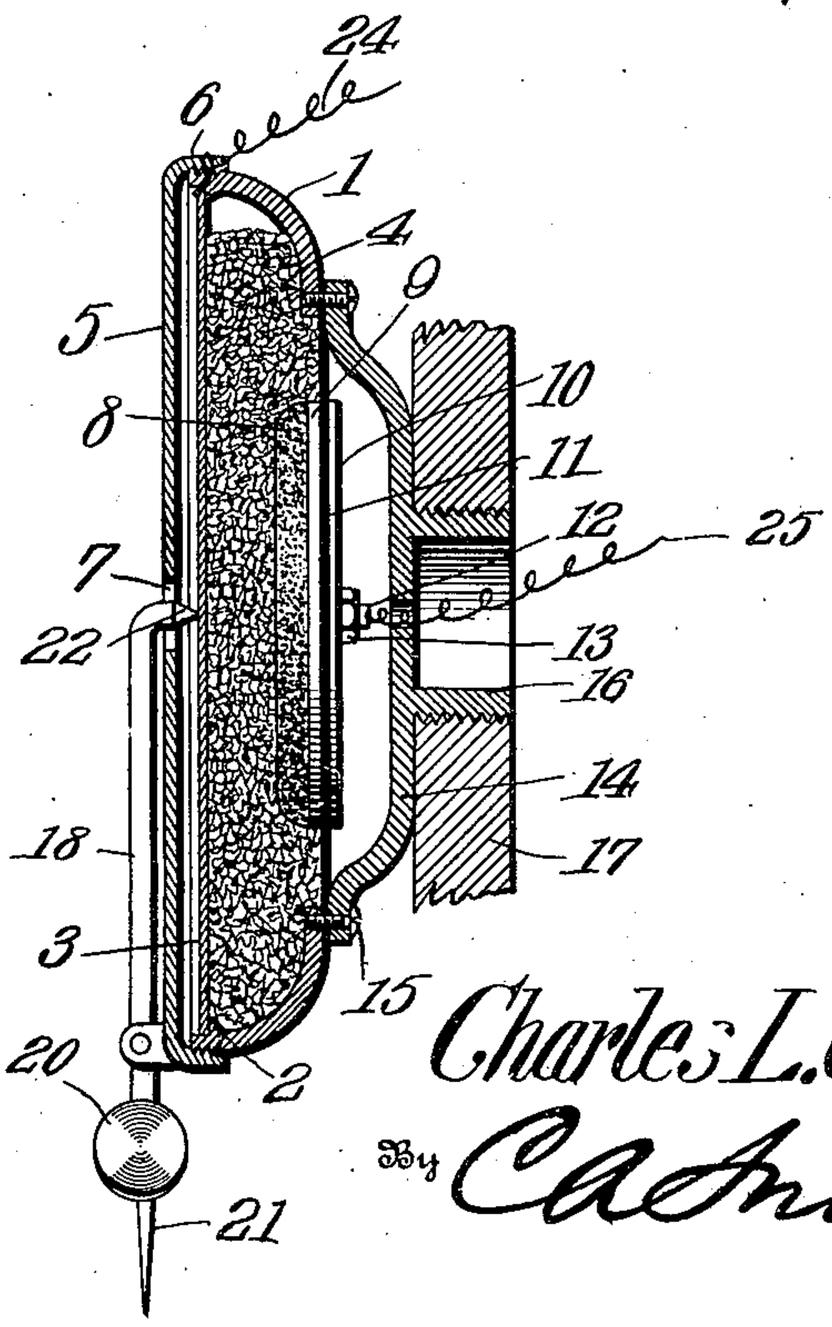


Fig. 2.



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3 SHEETS—SHEET 2.

Fig. 3.

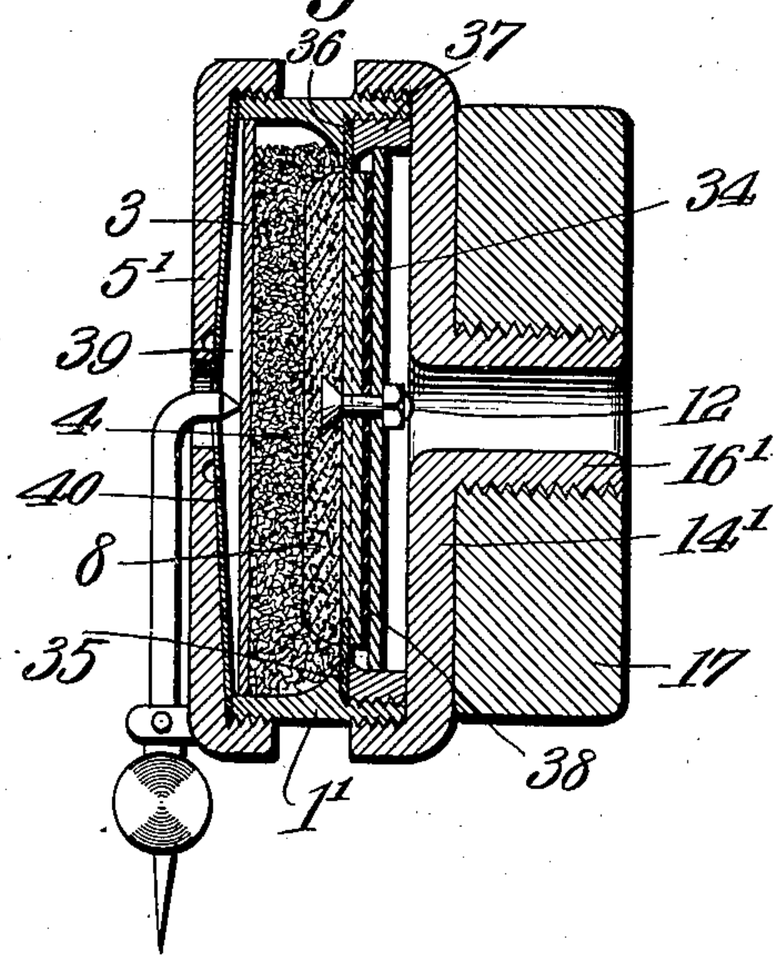
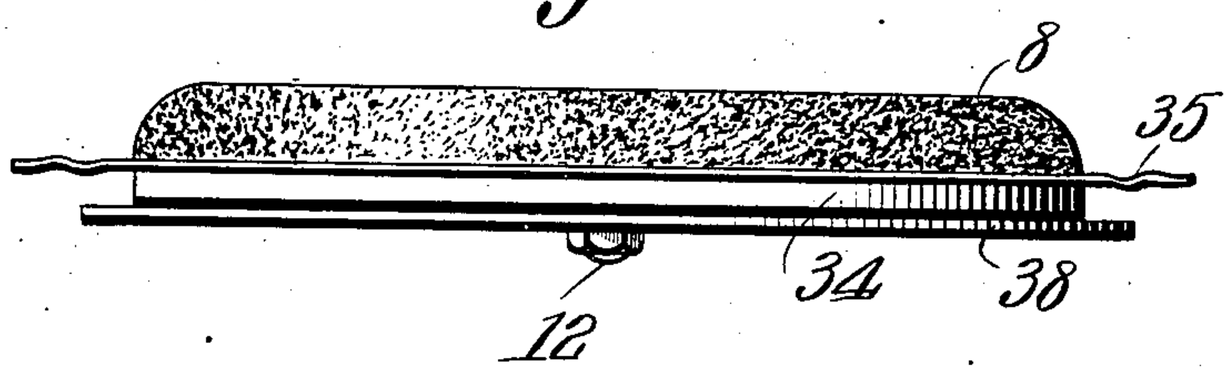


Fig. 4.



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3 SHEETS—SHEET 3.

Fig. 5.

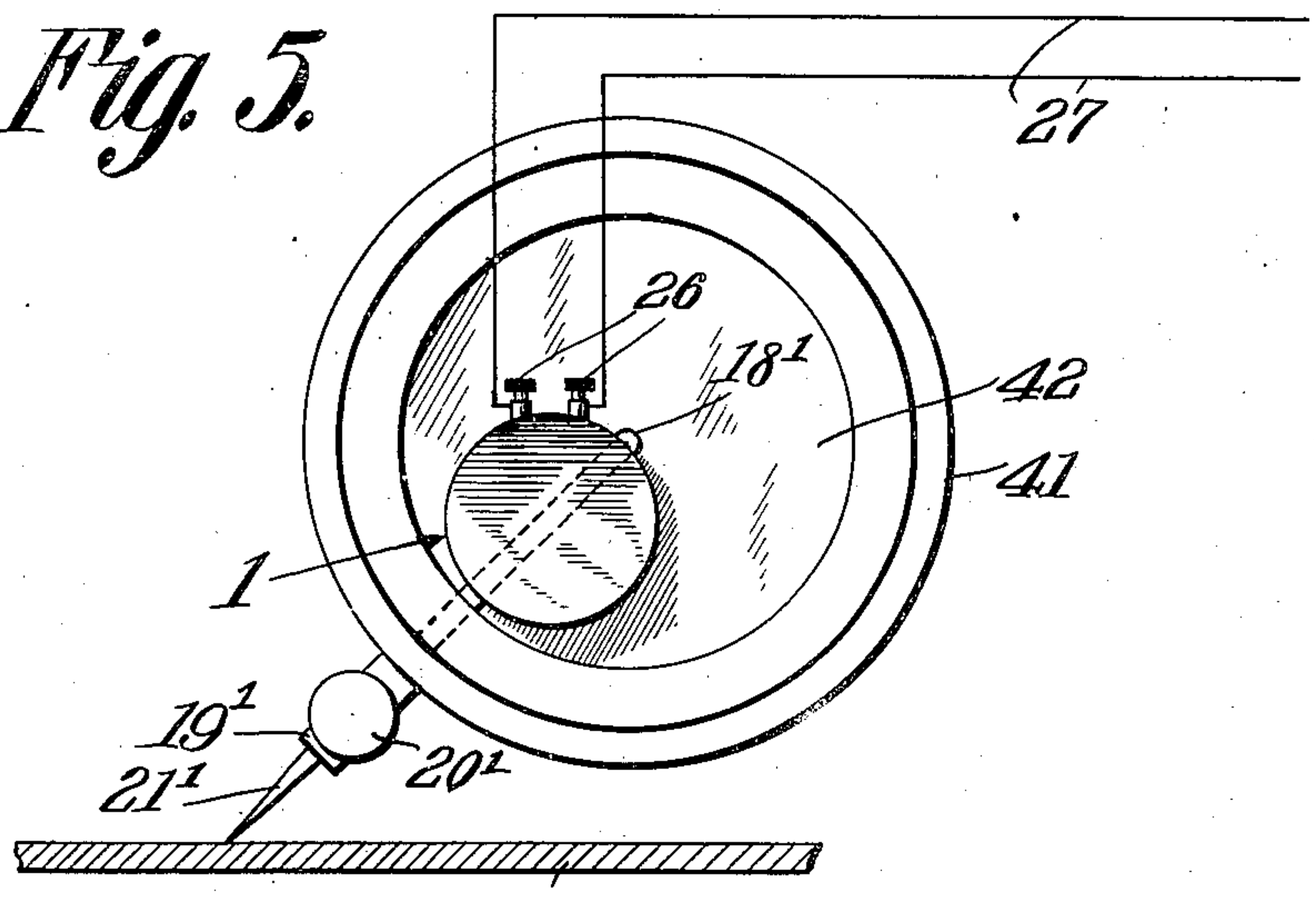


Fig. 6.

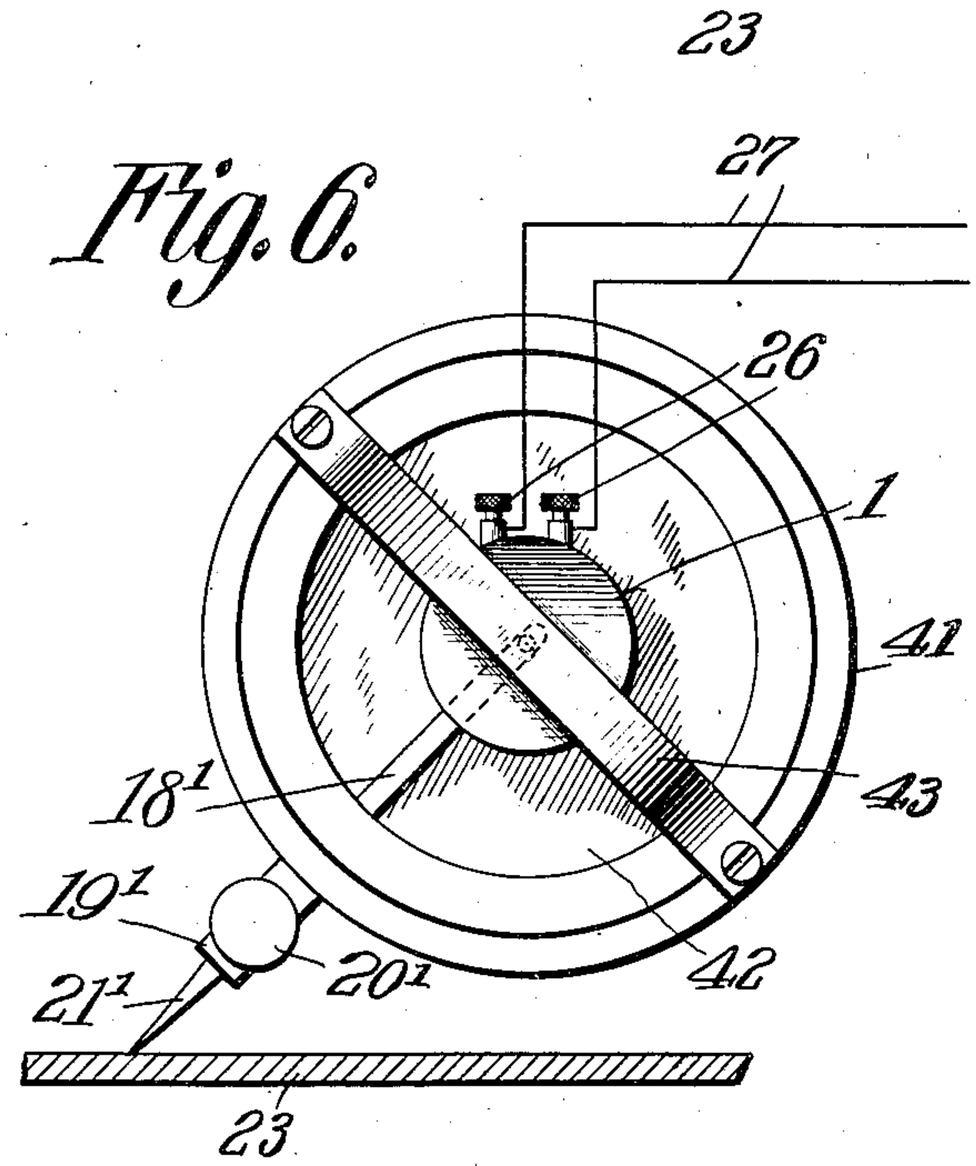
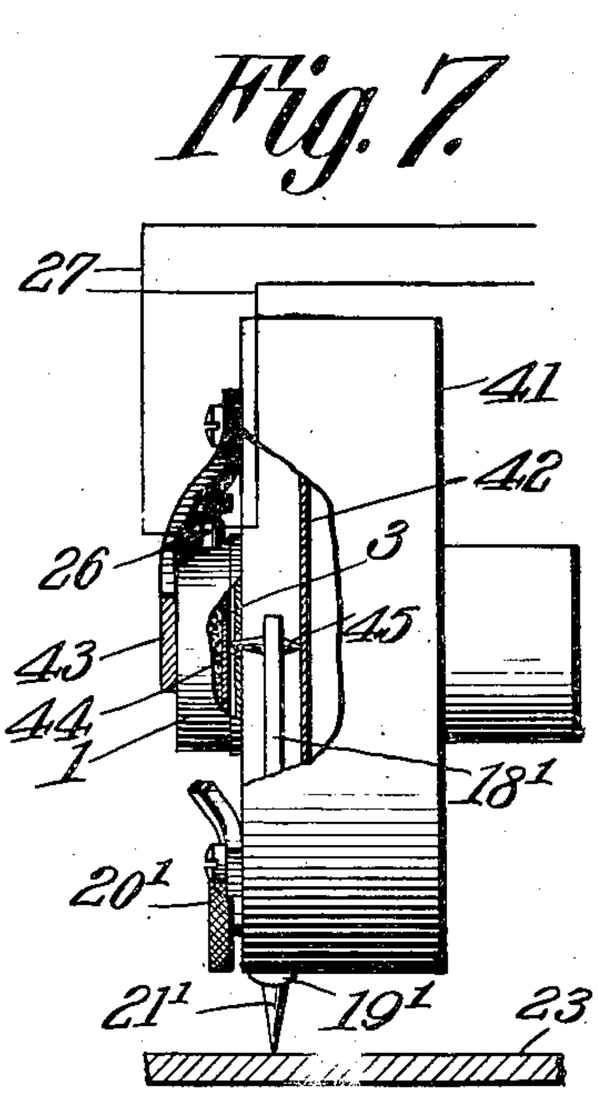


Fig. 7.



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MEANS FOR REPRODUCING SOUNDS FROM SOUND-RECORDS.

968,539. Specification of Letters Patent. Patented Aug. 30, 1910.

Application filed February 13, 1909. Serial No. 477,799.

To all whom it may concern:

Be it known that I, CHARLES L. CHISHOLM, a subject of the King of England, residing at Marysville, in the Province of New Brunswick, Canada, have invented a new and useful Means for Reproducing Sounds from Sound-Records, of which the following is a specification.

This invention has reference to improvements in means for reproducing sounds from sound records and its object is to provide a means whereby higher and more delicate overtones upon which that quality of the sound known as the timbre so largely depends, are reproduced.

The grosser sound waves represent forces of comparatively considerable magnitude and so are able to overcome without serious effect on themselves opposing forces of commensurate magnitude. The actual power of such sound waves is of course quite small or minute, but the overtones are so small that highly attenuated opposing forces may actually become great when compared with the forces developed by some of the overtones. Still it is upon such overtones that the quality of the voice or sound which is termed timbre depends and it is upon this timbre that one is enabled to individualize and recognize voices and other sounds. The utilization of these extremely minute forces is vital to the present invention which aims to the elimination of certain conditions which have been found to be detrimental to the proper reproduction of sounds.

In accordance with the present invention the ordinary sound box of the sound reproducing machine is replaced by or carries a microphonic element, which as will hereinafter appear is specially constructed and by which it is possible to transmit the sounds to an indefinite distance in the form of electrical undulations corresponding to the sound waves and at a distant point convert these undulations into air waves which will correspond to and reproduce the original sounds not only as to volume and general quality but by saving the overtones usually lost in sound reproduction the purity and recognizability of the sounds is greatly enhanced.

The invention will be best understood from a consideration of the following detail description taken in connection with the accompanying drawings, forming a part of this specification, in which drawings,

Figure 1 is a diagrammatic representation of the application of the invention to a sound reproducing machine for distant reproduction. Fig. 2 is a central section through one form of microphonic element with the stylus carrier applied thereto. Fig. 3 is a central section through another form of microphonic element with the stylus carrier applied thereto. Fig. 4 is an elevation of the back contact of the microphonic element and parts carrying the contact. Fig. 5 is a view of the ordinary type of sound box of a sound reproducing machine with the microphonic element applied to the stylus carrying arm or lever. Fig. 6 is a similar view showing a somewhat different arrangement than shown in Fig. 5. Fig. 7 is a side elevation, partly in section, of the structure shown in Fig. 6.

Referring to the drawings, there is shown in Fig. 2 a casing 1 for the microphonic element and this casing has rounded walls in the direction of the axis thereof, and is generally cylindrical or annular in shape while it is to be understood that the inner wall of this casing is highly polished. The wider end of the casing is provided with an inwardly directed annular flange or ledge 2 for the reception of a diaphragm 3 which latter is preferably made of carbon or metal and against which engage granules 4, preferably though not necessarily of carbon.

It is of importance in the practical embodiment of this invention that the diaphragm be secured to the casing without stresses or strains of any kind, either local or general. Still the diaphragm should be rigidly held in place and be evenly sensitive over its entire area. It is found to be impossible with the ordinary screw cap to get a perfectly even pressure around the periphery of the diaphragm since there will always be more or less unequal stress or tension of the adjacent parts of the surface of the diaphragm nearest the periphery so that there are lines or zones in the surface of the diaphragm which do not respond with equal sensitiveness to the rest of the surface of the diaphragm and consequently the diaphragm may offer very great resistance, comparatively, to the next extremely delicate overtones so that the action of these overtones upon the diaphragm will become entirely lost and no electric currents will be developed corresponding to such overtones consequently the voice at the receiving end of the

line will have an entirely different quality from that of the speaker at the transmitting end of the line, or the quality or timbre of other sounds will be likewise changed, because of the obliteration of the overtones.

In order to properly seat the diaphragm the ledge 2 is made as narrow as is practically possible and the diaphragm is cemented thereto by some hard firm cement, and this cementing is performed without putting the diaphragm under strain or stress and more especially uneven strains or stresses such as are liable to occur when the diaphragm is clamped in place. The diaphragm is thus peripherally supported without local or general transverse buckling or strain. The inner face of the diaphragm is highly polished.

The outer edge of the casing 1 may be screw-threaded and to this screw-threaded portion is applied a cover plate 5 having an annular flange 6 at its periphery internally threaded to receive the outer surface portion of the casing 1 and the plate 5 has a central perforation.

There is provided a back contact 8 in the form of a circular block of carbon with rounded peripheral edges with the face and edges highly polished. The back contact block 8 may be made fast in any suitable manner to a metal block 9 of brass or other suitable material and between this block 9 and a plate 10 is secured a mica or other suitable insulating plate 11 which is clamped between the block 9 and plate 10 by means of a clamp screw 12 and nut 13 applied thereto. The plate 11 is of such diameter as to extend to and slightly beyond the back edges of the casing 1 and is secured to the casing by a back cap 14 and suitable screws 15. The back cap 14 is provided with a central sleeve 16 which may be externally threaded and screwed into a suitable opening in an arm 17 which latter may correspond to the swinging arm of certain types of sound reproducing machines.

Secured to the plate 5 in the form of instrument shown in Fig. 1, is a stylus carrying lever 18 provided at the outer end with a socket 19 and clamp screw 20 for holding a stylus 21 in place as is customary in the gramophone type of sound reproducing machines. The other end of the stylus carrier 18 is bent toward the diaphragm 3 and projects through the opening 7 and terminates in a point 22, this point bearing against the diaphragm with the smallest practical area of contact. Theoretically this area of contact should be a mathematical point, but since this is obviously impossible the contact is made as small as practicable. The stylus 21 is assumed to engage the sound record groove of a sound record the latter being indicated at 23.

The circuit connections from the microphonic element are diagrammatically represented in Fig. 2 by the conductors 24 and 25, one being connected to the diaphragm 3 either directly or through the casing 1 and the other to the back contact 8 through the stud or screw 12. These conductors are carried to binding posts 26 on the arm 17 and the local microphone circuit is connected to the binding posts being represented by the conductors 27 leading to the primary winding of an induction coil 28 and including a battery 29 or other suitable source of electric current. The secondary winding of the coil 28 is coupled up to line wires 29′ which may be extended to any desired distance, and be there connected to a receiver coil 30 housed in one end of an amplifying horn 31 if it be desired to increase the reproduced sound and to make it audible to a number of persons or over a large space. The receiver coil is placed about a receiver magnet 32 as is usual while the diaphragm 33 is mounted similar to the mounting of the diaphragm 3, that is without stress or strain, other than what it receives from the receiver magnet 32. All the surfaces with which the carbon granules of the microphonic element come in contact are highly polished thus correspondingly reducing the frictional contact between the surfaces with which the granules are in engagement. There is therefore less resistance of a mechanical nature to the movements of the carbon granules than is the case where they come in contact with rough surfaces.

It has been found from many tests that when the inner surface of the diaphragm and the surface of the back contact and the inner surface of the casing are highly polished the overtones are transmitted to the line to such an extent as to sensibly increase the richness of reproduction and the naturalness of the tones reproduced. It is also found that by making the receptacle for carbon granules co-extensive with the diaphragm there is a marked improvement in the transmission of the sound including the overtones.

In Figs. 3 and 4 there is shown a structure which is preferable to that shown in Fig. 2 so far as the reproducer or transmitter is concerned, while the circuit connections will be the same as shown in Fig. 1. In the structure shown in Fig. 3 there is a cylindrical box or casing 1′ having the inner walls curved in the direction of the longitudinal axis of the box the same as in the structure shown in Fig. 2. The diaphragm 3 is the same as described with reference to the structure of Fig. 2 and is co-extensive with the chamber formed by the inner wall of the box or casing 1′. In this form the supporting ledge has no area and therefore corresponds to the theoretical condition.

The diaphragm is secured to the inner wall of the box 1′ without stress or strains by having its periphery cemented directly to the walls of the box preferably by a metallic cement such as solder. In the case of a metal diaphragm which is preferably made of silver with the inner face gold plated, the soldering is easily accomplished. In the case of a carbon diaphragm the periphery may be electro-plated and then the diaphragm is readily soldered to the inner wall of the casing 1′, which casing it will be understood is made of metal. The diaphragm may thus be secured firmly in place without stress or strain and will vibrate as a whole with the greatest freedom to the forces caused by the impact of the sound waves on the receiving side of the diaphragm. The back contact 8 is the same as in Fig. 2 but the manner of supporting the same is different. Secured to the back contact 8 is a plate 34 and clamped around the edges of the back contact where joined by the plate 34 is an annular membrane 35 of gold beater's skin or of delicate silk or of some other like highly flexible material. This annular member 35 is secured at its outer edge to the casing 1′, against a shoulder 36 formed by thickening the casing at this point and is there held by a clamp ring 37 screwed into a suitably threaded portion of the casing 1′ at the end remote from that carrying the diaphragm 3.

There is formed within the casing 1′ a chamber for the granules 4 which, as before stated, are preferably though not necessarily made of carbon, and this chamber is defined on one side by the diaphragm 3, on the other side by the back contact 8 and the annular membrane or flexible wall 35 while the curved wall of the casing 1′ completes the chamber. The inner walls of the casing 1′ may be metallic or of insulating material, but in either event these walls as well as the inner surface of the diaphragm and the exposed surface of the back contact 8 must be highly polished.

Secured to the face of the plate 34 remote from the back contact 8 is another diaphragm 38. This diaphragm may be made of metal or mica, but if made of metal should be suitably insulated from the casing 1′. The diaphragm 38 is secured to the inner face of the sleeve 37 in the same manner as is secured the diaphragm 3 to the inner wall of the casing 1′, that is it should be secured to the sleeve 37 without being under stress or strain due to the manner of securing it. In the case of a mica or similar insulating diaphragm a very narrow ledge such as the ledge 2 of the structure shown in Fig. 2 may be employed, and in the case of a metal diaphragm then the periphery of the diaphragm may be soldered or otherwise cemented directly to the wall of the sleeve 37, in which latter case, considering the sleeve 37 to be of metal, the diaphragm 38 must be insulated from the plate 34 if the latter be made of metal, and be in conducting contact with the back contact 8.

The diaphragm 38 should be somewhat more responsive to the sound impulses than is the diaphragm 3 but in each case the diaphragm 3 and diaphragm 38 are of such size and thickness that their fundamental tones or rates of vibration are higher than the rates of vibration of the normal human voice. Since the actual diameter of these diaphragms is only about three-quarters of an inch, this diameter having been found to operate successfully in practice, the thickness of the diaphragms will be chosen accordingly to attain the high fundamental tone desired. It is to be understood however that while the diaphragms are to be small as compared to the diaphragms used with the commercial types of sound reproducing machines, the particular dimension given is not to be taken as the only diameter which may be used but some variation on each side of the stated diameter is permissible, other parts being adjusted accordingly.

The diaphragm 3 is protected by a cover 5′ between the inner face of which and the outer face of the diaphragm there is a small air chamber 39 which air chamber is made non-resonant by its minute size and also by lining the interior of the cap 5′ with some non-resonant material such as felt or cloth and which material is indicated in the drawings at 40. Other means for rendering the chamber 39 non-resonant may be employed.

The microphonic reproducer of Fig. 3 is provided with a back cap 14′ having a neck 16′ which may be threaded to enter a corresponding passage in the arm 17, or any other suitable means for attaching the reproducer to the arm 17 or to any other suitable carrier by means of which the reproducer is caused to properly engage a sound record may be employed.

It is evident that sound records as found on the market contain recorded sounds which the reproducing sound boxes usually employed are incapable of transmitting to the air. These usually unreproducable sound waves are apparently the higher overtones since by using the microphonic unit of this invention I am enabled to get a reproduction from sound records markedly excelling in richness any reproduction of which the usual sound reproducing devices are capable.

While the reproducing sound box or microphonic unit embodying the present invention is indicated as of the type used with disk records of the gramophone sound reproducing machines, it will be understood that it may be used with the graphophone type of sound records with a suitable change in the stylus carrier and stylus. Consequently the

showing of the drawings is to be taken as indicative only so far as the type of sound reproducing machine is concerned.

Actual tests made with a practical embodiment of the invention show that the resultant reproduction is clear, sharp and brilliant, and the reproduction of the timbre of the original sound is very marked.

In Figs. 5, 6 and 7 there is shown a sound box 41 such as is used on sound reproducing machines of the gramophone type, the stylus carrier being shown at 18′, the stylus socket at 19′, the clamp screw at 20′, and the stylus at 21′. The microphonic unit of Figs. 2 or 3 is designated generally by the reference numeral 1. In the form shown in Fig. 5, the microphonic unit is mounted directly upon the stylus arm or lever 18′ and participates in its movements under the action of the sound record groove in the tablet 23, transmitted to the stylus arm 18′ through the stylus 21′ in the usual manner. The microphonic unit 1 is made fast to the stylus carrier 18′ in any suitable manner, and while it may dampen the action of the stylus carrier and through it, the action of the diaphragm 42 of the sound box 41, this damping will not be material or excessive. In Figs. 5 and 6 the sound box 41 carries a bridge piece 43 spanning the sound-box frame diametrically, and spaced from the diaphragm 42. This bridge piece 43 carries the microphonic unit 1 in operative relation to the stylus carrier 18′, the latter being provided with a pin or stud 44, engaging the microphone diaphragm 3 at, or near the center and is there pointed to provide a contact of the least practical area which contact is not connected to the diaphragm 3 but simply bears thereagainst. The best results in the sound box 41 are obtained when the stylus arm 18′ is provided with a pointed contact 45 bearing against the center of the diaphragm 42 with a bearing area of inconsiderable extent and without positive connection between the diaphragm 42 and the contact 45. This, however, does not preclude the use of the invention in connection with sound boxes wherein the stylus carrier is fixed to the diaphragm.

By means of the structures shown in Figs. 5, 6 and 7 the sound record is reproduced both locally and distantly.

What is claimed is:—

1. A means for reproducing sound from sound records, comprising a microphonic unit having a diaphragm with a fundamental higher than the rate of vibration of the normal human voice, a stylus carrier in contact with but unconnected to the center of the diaphragm of the microphone, and a telephonic reproducer in electrical connection with the microphone.

2. A reproducer for sound reproducing machines comprising a sound box provided with a diaphragm and a stylus carrier in operative relation to the diaphragm, and a microphonic unit having a diaphragm also in operative relation to the stylus carrier.

3. A reproducer for sound reproducing machines comprising a sound box provided with a diaphragm and a stylus carrier in operative relation to the diaphragm, and a microphonic unit having a diaphragm also in operative relation to the stylus carrier, the microphone diaphragm having a higher fundamental rate of vibration than that of the sound box diaphragm.

4. A reproducer for sound reproducing machines comprising a sound box provided with a diaphragm and a stylus carrier in operative relation to the diaphragm, and a microphonic unit having a diaphragm also in operative relation to the stylus carrier, the microphone diaphragm having a fundamental rate of vibration higher than that of the normal human voice.

5. A reproducer for reproducing machines comprising a microphonic unit and a stylus carrier in operative relation thereto, the microphonic unit having a diaphragm the fundamental of which is higher than the normal rate of vibration of the human voice.

In testimony that I claim the foregoing as my own, I have hereto affixed my signature in the presence of two witnesses.

CHARLES L. CHISHOLM.

Witnesses:
LOUIS MASON,
JOHN W. G. MORRISON.