

Dec. 25, 1934.

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1,985,389

SOUND REPRODUCING DEVICE

Filed Oct. 22, 1931

2 Sheets-Sheet 1

Fig. 1.

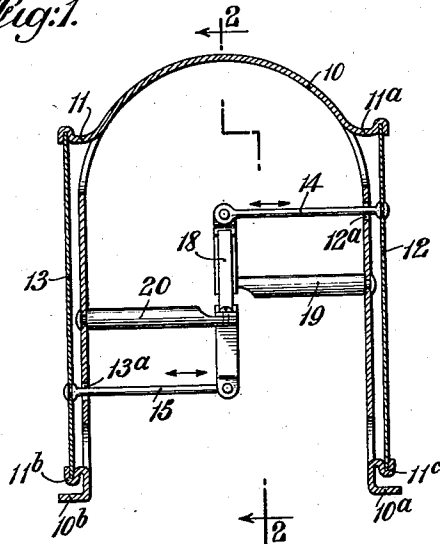


Fig. 2.

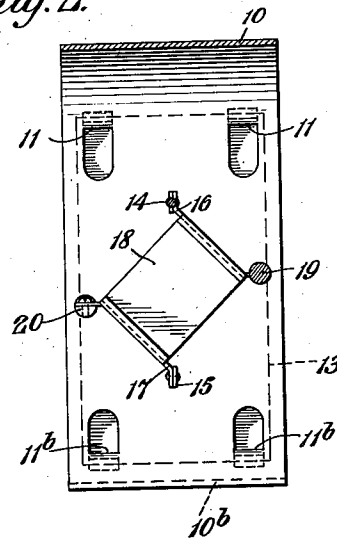


Fig. 3.

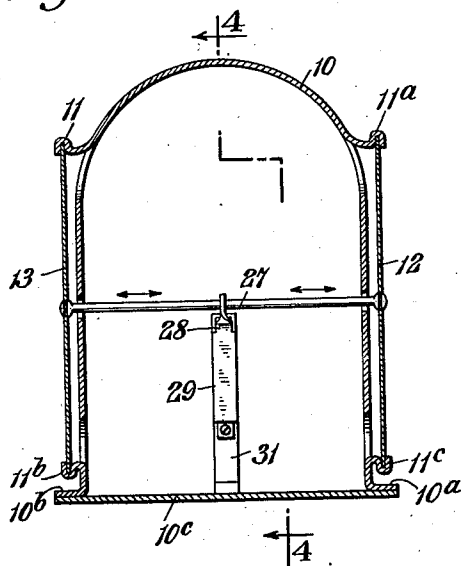
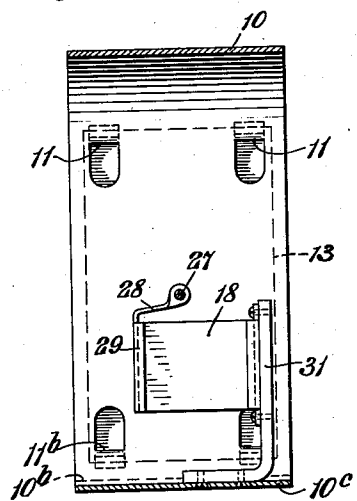


Fig. 4.



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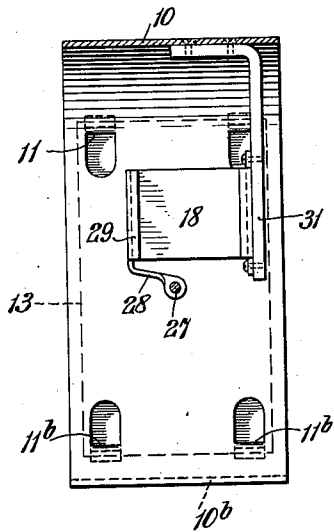
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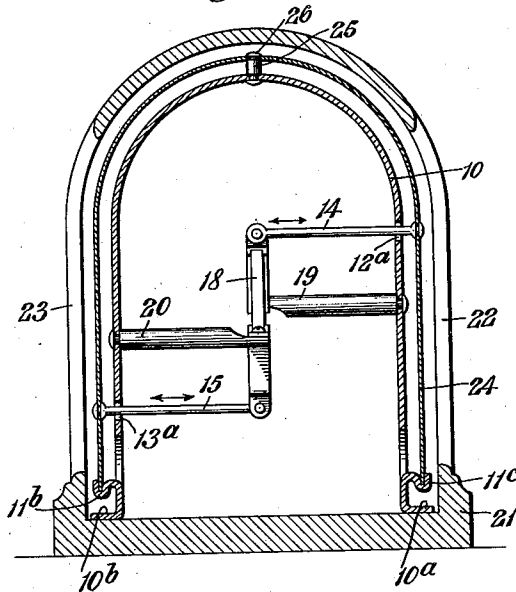
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2 Sheets-Sheet 2

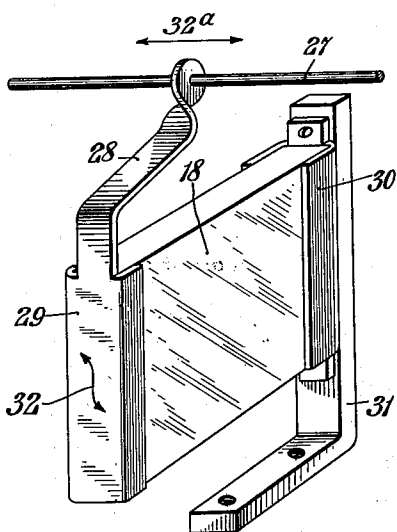
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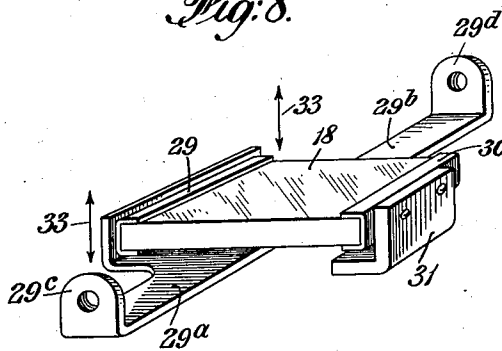
Pig. 6.



Pig. 7.



Pig. 8.



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SOUND REPRODUCING DEVICE

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13 Claims. (Cl. 179-110)

This invention relates to improvements in sound reproducing devices such as are employed in loud speakers as used with talking motion pictures, radio receiving sets, etc., and has for its principal object the production of a simple, efficient and economical unit for the reproduction of sound waves from an electrical or similar type of source.

Another object of the invention is to provide a device of this character for use in relatively small cabinets in which it is impossible to mount the ordinary type of cone speaker having a diaphragm sufficiently large enough to faithfully produce sound waves in sufficient volume.

A further object of the invention is to provide a device of this character wherein faithful reproduction of speech, music or other sounds is secured with maximum volume and clarity and with minimum distortion.

The invention consists substantially in the construction, combination, location and relative arrangement of parts, all as will be more fully hereinafter set forth as shown by the accompanying drawings and finally pointed out in the appended claims.

In many modern radio receiving sets or small outfits for talking motion pictures in the home, the sound reproducing device, hereinafter termed the loud speaker, is assembled with and mounted in the cabinet of the set. The standard practice with such speakers (in order to secure satisfactory and adequate sound reproduction) has been to employ a diaphragm at least 8 to 12 inches in diameter. The diameter of the diaphragm of the average cone speaker of the dynamic type is seldom less than 8 inches and when the diameter of the diaphragm becomes 5 inches or less, the reproduction and volume becomes unsatisfactory.

It is desirable, particularly in the case of clock-radio receiving sets, to make the set as small and compact as possible. These sets comprise a motor driven clock mechanism enclosed in a casing which is usually not over 10 inches high, 7½ inches wide and 4½ inches deep. In the front of this cabinet is located the clock face about 5½ inches in diameter, which leaves sufficient space for a speaker having a diaphragm not over 3½ inches in diameter. Obviously, such a speaker is unsatisfactory as it does not possess sufficient diaphragm area to faithfully reproduce speech, music or other sounds with maximum volume and clarity. As the side of such a radio set is only 4½ inches wide by 10 inches high, obviously the speaker cannot be put in the side and for evident reasons should not be placed with the diaphragm in the back of the set.

The present invention, however, permits of placing a loud speaker in a cabinet of the foregoing and even smaller dimensions, and yet the speaker will have a diaphragm area sufficiently large to reproduce speech, music or other sounds

with maximum volume and clarity and minimum distortion, and the invention will be described herein for purposes of illustration as applied to a combination clock-radio receiving set of the type and dimensions just described.

The invention will also be described as utilizing a piezo electric device for vibrating the speaker diaphragm as said piezo electric device is particularly compact and efficient when used in combination with the diaphragm arrangement herein described. Said piezo electric device may be of any suitable type and construction, such, for example, as the crystalline element shown and described in U. S. Patent 1,574,302 dated February 23, 1926, or U. S. Patent 1,803,275 dated April 28, 1931.

Figure 1 is a view, partly in section, of a radio receiving set chassis showing two diaphragms mounted thereon and the piezo electric device, hereinafter termed the crystal, connected to said diaphragms for actuating the same;

Figure 2 is a view on the line 2-2, Figure 1;

Figure 3 is a view of the chassis, diaphragms and crystal showing an alternate method of connecting the crystal to the diaphragms;

Figure 4 is a view on the line 4-4, Figure 3;

Figure 5 shows an alternate method of mounting the crystal at the top instead of the bottom of the chassis frame;

Figure 6 is a view, partly in section, of a chassis and crystal mounted within a cabinet and with a modified diaphragm construction wherein a single diaphragm is flexed to form a portion of a cylinder and surrounds and embraces the chassis and the parts therein;

Figure 7 is an isometric view of a crystal unit showing the details of mounting the same in the manner employed in connection with Figures 3, 4 and 5; and

Figure 8 shows an alternate form of mounting for the crystal and an alternate form of actuating arm connected therewith.

The chassis or supporting frame may be made of any suitable material of any form of construction. It may be a stamping of sheet steel and forms a supporting framework upon which is mounted and assembled in proper cooperative relationship the usual electric clock movement, the tuning condensers, coils, tubes and other parts that go to make a combined clock and radio receiver. The construction and arrangement of these parts may be varied within wide limits and have no bearing on the present invention and are therefore not shown and described in detail, it being sufficient to state that within a cabinet of the size heretofore referred to, all necessary parts can be assembled to produce a combined electric clock and radio receiver suitable for ordinary broadcast reception and adapted by means of the usual connecting cord and plug to be con-

nected to the usual house current supply for its operation.

Obviously, if it were necessary to assemble in this same cabinet a speaker of the magnetic or dynamic type, it would be difficult to find room for the mechanism. Therefore, the crystal heretofore referred to has been selected as the most suitable means for actuating the diaphragms.

It should also be noted that if, in a cabinet of the dimensions aforesaid, a cone speaker is to be used it would be difficult to employ a cone of more than 4 inches in diameter, in which event said cone would have a total area not exceeding 15 square inches, whereas by the arrangement herein described utilizing two diaphragms, each diaphragm 4 x 8 inches, it is possible to obtain a total effective diaphragm area of approximately 64 square inches which would make this arrangement practically equivalent to a cone diaphragm approximately 8 inches in diameter or over four times the area of the cone it is possible to place in a cabinet of the dimensions herein referred to. The same condition applies when using a single diaphragm of the form described in connection with Figure 6. As the advantages incident to the use of the larger diaphragm area are well understood, it is not necessary to herein refer to them in detail.

The chassis 10 is provided on each side with a plurality of lugs 11, 11a, 11b and 11c, the lugs on each side being the same and having their ends turned over to form hooks to support and (if desired) to clamp the diaphragms 12, 13 in place on each side of the chassis, as shown.

The side walls of the chassis immediately behind the diaphragms are apertured as shown at 12a and 13a to admit the actuating rods or members 14, 15 which are connected at their outer ends to the diaphragms and at their inner ends to the arms 16, 17 rigidly secured to the clamps on the ends of the piezo electric crystal 18.

The crystal 18 is, by means of said metal ends or clamps, rigidly secured at two of its corners to the mounting posts 19, 20, which are riveted or otherwise secured to the chassis, preferably to the side walls thereof.

The chassis may be provided with feet 10a, 10b in order that the complete assembly comprising the chassis and all of the parts mounted thereon may be securely positioned within the cabinet 21, the chassis being pushed into the cabinet from the back and being secured therein by screws through said feet or in any suitable manner.

The cabinet has openings 22, 23 in its side walls. When the chassis is in place, the diaphragms 12, 13 are positioned immediately behind these openings and therefore the vibrations or sound waves produced by the said diaphragms find egress through these openings. The openings 22, 23 may each be 4 x 8 inches in a cabinet of the size referred to, and this is the effective total area of the diaphragms behind these openings when two diaphragms are used as shown in Figure 1.

Instead of the two diaphragms as shown in Figures 1 and 2, a single diaphragm can be employed as shown in Figure 6, in which event the single diaphragm indicated by the numeral 24 is supported by the bottom lugs 11b, 11c on each side of the chassis, (or the entire bottom edge is clamped to the chassis) the upper lugs 11 and 11a on each side being omitted and the diaphragm being bent around the top of the chassis 10 as shown, thereby surrounding the sides and top of the chassis. A suitable support 25 may be attached to the chassis 10 at the top thereof, and the top bend

of the diaphragm supported thereon, being secured thereto if desired by any suitable means such as one or more screws 26. The diaphragm can be left free at the top, in which case it is only supported at the bottom edges on each side and by the actuating rods 14, 15.

In the event a single diaphragm is used with the crystal arranged as shown in Figure 6, the sides of the diaphragm are vibrated laterally and move away from and toward each other, as indicated by the arrows, Figure 6. This has been found to be a satisfactory method of vibrating a sound producing element of this description when mounted as shown and described.

The modification shown in Figures 3, 4 and 5 relate to a different method of connecting the crystal to the diaphragm or diaphragms and produce a different vibratory action. These modifications employ a crystal supported and connected as shown in Figure 7. Here a single actuating rod 27 is employed to actuate the diaphragm or diaphragms and this is connected to the arm 28 rigidly secured to the clamp 29 mounted on one end of the crystal. A second clamp 30 surrounds the opposite end of the crystal 18 to which it is rigidly secured, and this clamp is mounted in any suitable manner upon the fixed support 31 secured to and forming part of the chassis, same being preferably mounted upon the base 10c which may be welded or otherwise secured to the chassis 10. This arrangement has the advantage of bringing the actuating rod 27 directly in the center of the diaphragms 12, 13 and permits the crystal to be mounted in the top of the chassis as shown in Figure 5 if desired. With this arrangement the sides of the single diaphragm, or the two diaphragms vibrate laterally in the same direction, which effect is opposite from that described in connection with the crystal, Figure 6.

An alternate construction for mounting the crystal and applying the actuating rod or arm thereto is shown in Figure 8 in which the fixed support 31 holds the clamp 30 in which is rigidly mounted the crystal 18, to the outer end of which is secured the clamp 29 having the extending arms 29a and 29b having the upwardly turned lugs 29c, 29d adapted to be connected to the bottom edges of the single diaphragm, Figure 6, and supported thereby, the bottom lugs 11b, 11c on the chassis being omitted. This arrangement permits the crystal to be mounted flat in the bottom of the chassis by securing the support 31 to the base 10c or to any part of the chassis. The lugs 29c, 29d can project up through the bottom of the chassis through slots therein and the crystal mounted underneath the same, if desired, in which case the feet 10a, 10b may extend downward sufficiently to provide a space below the base 10c for the crystal when the complete assembly is in place in the cabinet. With this construction the diaphragm will receive vibrations from the crystal via the arms 29a, 29b tangentially to the plane of the diaphragm.

As the operation of the crystals herein referred to are fully described in the two patents hereinbefore mentioned it will not be described in detail, it being sufficient for the purpose of this specification to state that when a suitable current is applied in a known manner to the crystal, Figures 1, 2, 6, it twists about its fixed supports 19, 20 and the actuating rods 14, 15 move in the direction of the arrows, Figures 1 and 6.

The free end of the crystal 18, Figure 7, will vibrate or twist in the direction shown by the

arrow 32 which moves rod 27 back and forth as shown by arrow 32a.

The crystal 18, Figure 8, will twist in the direction of the arrow 33 which moves the lugs 29c, 29d of the actuating arm 29a in a vertical plane, thereby vibrating the diaphragm connected thereto tangentially to the plane thereof.

Regardless of the particular type of actuating member or device used, the arrangement herein described is particularly advantageous in connection with receiving sets of small dimensions as it permits of securing the largest possible diaphragm area with a small cabinet, a result impossible of attainment when using cone and other known types of speakers having the usual circular diaphragms.

The unit structure comprising the supporting frame or chassis, carrying the diaphragm, vibratory means, clock and radio parts, etc. may be assembled and tested as a unit before placing same in the cabinet, which is preferably made to enclose the side, top and bottom of the unit, the front and back of the cabinet or at least the back, being attached after the chassis is in place. The cabinet, therefore, forms no part of the operative mechanism as it does not support the working parts.

Although the invention has been disclosed in connection with the specific details of preferred embodiments thereof, it must be understood that such details are not intended to be limitative of the invention except in so far as set forth in the accompanying claims.

What is claimed is:

1. A sound reproducing device comprising a cabinet having apertures therein, a supporting frame adapted to fit within said cabinet, diaphragms secured at their edges to said frame and adapted when the latter is within the cabinet to have their vibrating areas positioned opposite the aforesaid openings, and vibratory means mounted on said frame, connected to said diaphragms and removable therewith together with said frame from said cabinet.

2. A sound reproducing device comprising a supporting frame having side walls and a base cooperating with said walls to form an enclosed chamber, diaphragms supported on the side walls of said frame, vibratory means in said chamber including members extending through the side walls thereof and engaging said diaphragms, and an enclosing cabinet adapted to enclose said frame, said cabinet having apertures therein to admit sound vibrations produced by said diaphragms to find egress from the cabinet.

3. A sound reproducing device comprising a supporting frame, a diaphragm flexed to form a portion of a cylinder mounted on said frame, vibratory means connected to said diaphragm and supported on said frame, and a cabinet surrounding and enclosing said supporting frame, said cabinet having apertures therein adjacent the vibratory surface of said diaphragm.

4. A sound reproducing device comprising a supporting frame, a diaphragm supported on said frame and extending along the sides and across the top thereof, vibratory means connected to said diaphragm and supported on said frame, and a cabinet surrounding and enclosing the top and sides of said frame, said cabinet having apertures in its sides adjacent the vibratory surface of said diaphragm.

5. In a radio receiving set, the combination of a cabinet, a supporting frame having side walls

and forming a chassis adapted to slide within said cabinet, diaphragms supported on said side walls, and vibratory means including members extending through said side walls and connected to said diaphragms for vibrating the same, said means being supported on said chassis and being removable therewith from said cabinet.

6. The combination as claimed in claim 5, wherein the means for vibrating the diaphragms is supported by the side walls of the supporting frame forming the chassis.

7. In a radio receiving set, the combination of a cabinet, a supporting frame forming a chassis adapted to slide within said cabinet, said frame having side walls and a plurality of supports extending from said walls and integral therewith, diaphragms mounted in said supports, and vibratory means carried by said frame and connected to said diaphragms.

8. A sound reproducing device comprising a supporting frame forming a chassis, a diaphragm flexed to form a portion of a cylinder mounted on said frame and having its free ends secured thereto, and vibratory means including a piezo electric crystal connected at two points on said diaphragm intermediate its ends.

9. A sound reproducing device comprising a supporting frame forming a chassis, a diaphragm flexed to form a portion of a cylinder mounted on said frame and having its free ends secured thereto, and vibratory means including a piezo electric crystal connected at two points on said diaphragm intermediate its ends, one of said points being nearer the center of the diaphragm than the other.

10. In a radio receiving set, the combination of a cabinet, a supporting frame forming a chassis adapted to slide within said cabinet, a diaphragm mounted on said chassis, a piezo electric crystal mounted on said chassis subjacent said diaphragm, and actuating means connecting said crystal and diaphragm.

11. In a radio receiving set, the combination of a cabinet, a supporting frame forming a chassis adapted to slide within said cabinet, a diaphragm supported on said chassis, a support secured to said chassis, a piezo electric crystal secured to said support, a clamp secured to said crystal and adapted to vibrate therewith, an arm extending laterally from said clamp, and means secured to said arm and adapted to vibrate said diaphragm.

12. In a radio receiving set, the combination of a cabinet, a supporting frame forming a chassis adapted to slide within said cabinet, a diaphragm carried by said chassis, a piezo electric crystal rigidly supported on said chassis and having a portion free to vibrate, and a plurality of arms extending from the free vibratory portion of said crystal adapted to engage said diaphragm and vibrate the same.

13. In a radio receiving set, the combination of a cabinet, a supporting frame forming a chassis adapted to slide within said cabinet, a diaphragm mounted on said chassis, a piezo electric crystal mounted on said chassis and adapted to lie flat therein with its plane surface parallel with the bottom of the chassis, a clamp rigidly securing one end of said crystal to said chassis, and an arm extending from a free vibratory portion of said crystal and adapted to engage and vibrate said diaphragm.

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