

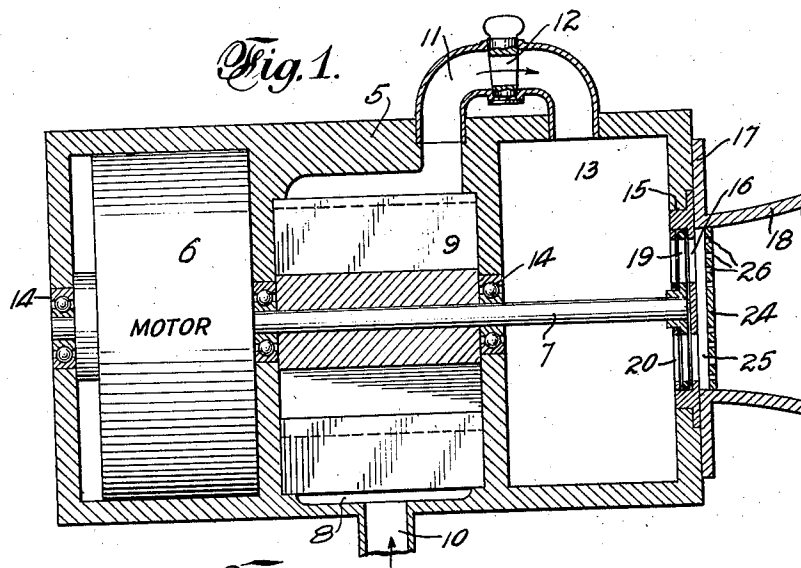
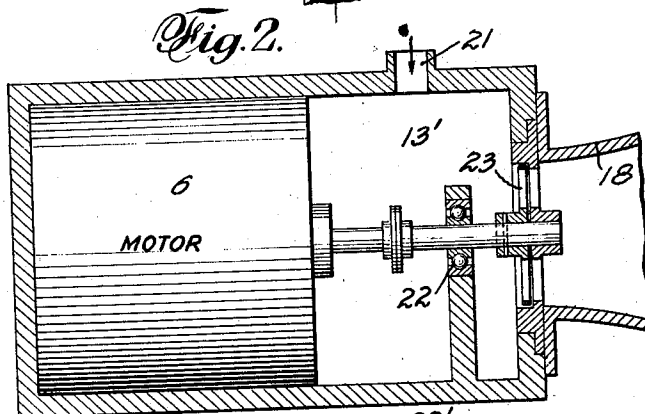
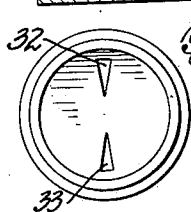
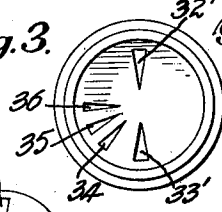
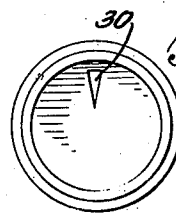
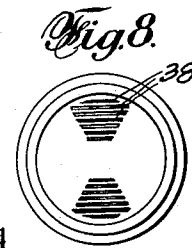
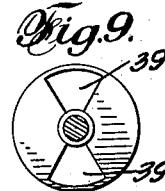
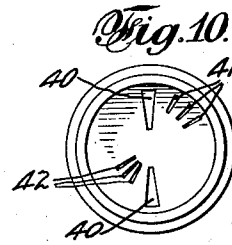
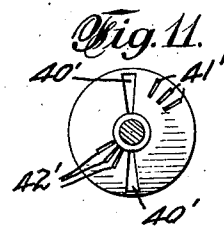
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SOUND DEVICE

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2,153,500

SOUND DEVICE

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3 Claims. (Cl. 116—147)

My invention relates to a sound or signal device. Sound devices have heretofore been contemplated in which there is a fixed grid or plate and a movable plate or grid positioned over said fixed grid, together with means for vibrating the movable grid so as to modulate the flow of air through said grids when compressed air is applied to the grids. Such devices, while being capable of producing various sounds depending upon the characteristics of the grids, speed of vibration, etc., have a considerable number of limitations, among others being a speed of vibration which is within practicable limits. Furthermore, at high speed vibration there may be considerable wear and heating of various parts of the device and the entire device itself may be vibrated to an objectionable extent, and the efficiency is relatively low due to imperfect closing of the grids with consequent loss of air at high frequency vibration.

It is one of the objects of my present invention to provide a sound producing device in which the rate of vibration or the rate of modulation of compressed air to produce sound waves is practically unlimited.

It is a further object to provide a sound device of the character indicated in which the sound to be produced may be readily predetermined and in which variations may be very readily produced.

Another object is to provide a device of the character indicated, in which the volume of sound produced may be readily predetermined and controlled.

Another object is to provide a sound device in which wear is reduced to a minimum and in which the mechanism itself is substantially vibrationless and quiet.

A further object is to provide a sound device in which a movable grid member is substantially balanced.

A further object is to provide a sound device of the air modulating or grid type, together with an intensifying grid.

Another object is to provide a movable grid type device which is exceedingly economical in power for operating the same and economical of air.

Still another object is to provide a novel form of simple, compact, self contained sound device.

Other objects and features of invention will be hereinafter pointed out or will become apparent to those skilled in the art upon a reading of the specification in connection with the drawing.

In the drawing which shows, for illustrative

purposes only, preferred forms of the invention—

Fig. 1 is a longitudinal, sectional view through a sound device, illustrating features of the invention;

Fig. 2 is a view similar to Fig. 1 but illustrating a slight modification;

Figs. 3, 4 and 5 are views in elevation of grids which may be fixed grids;

Figs. 6 and 7 are views in elevation of two different grids which may be rotating grids;

Figs. 8 and 9 are views in elevation of relatively rotatable grids in which the grid shown in Fig. 8 may be a fixed grid; and

Figs. 10 and 11 are views respectively similar to Figs. 8 and 9, illustrating other forms of grids.

In the form shown in Fig. 1, which is merely an illustrative drawing rather than a commercially practicable form of device so far as concerns the casing, at least, 5 represents a housing or casing in which is mounted a motor 6 of any suitable type, such as an electric motor, for rotating the shaft 7. 8 indicates an air compressor cylinder in which the compressor rotor 9, carrying blades, is mounted. The rotor 9 is carried by the shaft 7, as will be understood, and when the shaft is rotated air will be taken in through the inlet 10 and discharged through the outlet 11 and past the cock 12 into an air chamber 13, which, in the form illustrated in Fig. 1, is in a part of the main housing 5. The motor, compressor and shaft 7 are preferably mounted on deep race ball bearings 14—14, so as to reduce friction to a minimum and so as to sustain the end thrust loads on the shaft 7.

The housing 5 is provided with an opening 15 for mounting grids forming an important feature of my invention. In the form shown 16 represents a fixed grid mounted in the opening 15 and which may be held in place by means of a base flange 17 of a horn 18 of suitable type and design. The grid 16 is of the type disclosed in Fig. 3. Adjacent the fixed grid 16 is a rotatable grid 19, carried by and rotatable with the shaft 7. The rotatable grid 19 is of the type shown in Fig. 6, except that it has two grid openings instead of one grid opening, as shown in Fig. 6. In order to prevent the air under pressure in chamber 13 from urging the rotatable grid 19 too forcibly into engagement with the fixed grid 16 and thus causing friction between those two grids, particularly should the rotatable grid be flexed under pressure, I prefer to provide a substantial pressure sustaining grid 20, which is mounted in fixed position relatively to the grid 16, so that the rotatable grid 19 may rotate between the grids 16

and 20 and have merely a running fit or be perfectly free of the two fixed grids during rotation. It will be observed that with compressed air in the chamber 13, when the rotatable grid 19 is rotated air will flow through the grids when the openings therein come into registry with each other and the flow will be cut off when the openings are out of registry. By thus modulating the air flow sound waves are set up and are emitted from the horn 18 and the volume, intensity and other characteristics of the sound emitted will depend on a number of factors, including size and number of grid openings, spacing of grid openings, speed of rotation, air pressure and possibly some other factors.

The form shown in Fig. 2 may be constructed in substantially the same manner as that shown in Fig. 1, except that compressed air is supplied to the chamber 13' through a compressed air inlet 21 from some outside source. In the modification shown in Fig. 2 I have provided a substantial bearing 22 on a web in the air chamber and located in close proximity to the rotating grid 23. In the form shown in Fig. 2 the balancing or pressure sustaining grid 20 has been omitted but it is to be understood that it may be employed if desired. Otherwise the operation of that form shown in Fig. 2 is the same as that of Fig. 1.

While the sound waves are generated by the modulation of the air in passing the grids and in the horn, I prefer to employ what may be termed an intensifying grid 24, slightly spaced from the grids on the horn side thereof so as to provide a chamber 25. The air modulations or waves produced by the relatively fixed and rotating grids are impressed upon the body of air in the chamber 25 so that the puffs of air instead of setting up local vibrations in the horn directly in front of the grid openings vibrate the body of air in the chamber 25 and the vibrations are transmitted through the grid openings in the intensity grid 24 and a more extensive wave front is produced in the horn.

It should be noted that the variations possible with my sound device are almost infinite. For example, if a fixed grid as shown in Fig. 5, that is, with a single grid opening 30, be employed, together with a rotating grid as shown in Fig. 6 having a single grid opening 31, it will be observed that for each rotation of the shaft 7 there will be one passage of air through the grid openings 30-31. The number of modulations will therefore be one per revolution and by varying the speed of the rotating grid the number of modulations may be varied at will. Furthermore, if a rotating grid as shown in Fig. 6 be employed with a fixed grid as shown in Fig. 3, that is, with two diametrically spaced grid openings 32-33, there will be two modulations for each rotation of the shaft 7 and the modulations will be equally spaced, not only during each revolution of the shaft but equally spaced per second and there will be twice the number of modulations per second as would be produced with the single grid opening 30, as in Fig. 5. If the fixed grid shown in Fig. 3 be modified as shown in Fig. 4 so as to have in addition to the diametrically spaced openings 32'-33' corresponding to openings in the grid of Fig. 3, three additional grid openings 34-35-36, it will be seen that in addition to the modulations produced by the grid openings 32'-33' there will be three additional modulations produced by the grid openings 34-35-36. The modulations produced by the combination of grids of Figs. 4 and 6 will be five per revolution

of the rotating grid but it should be observed that since there are really four fixed grid openings in a single quadrant of the fixed grid the rate of modulation per revolution will be four times what it would be for equally spaced grid openings. The characteristics of the sound waves produced may be varied at will by various spacings of the grid openings while maintaining the rate of rotation of the rotatable grid fixed. With the same number of grid openings equally spaced circumferentially, the number of modulations per second will be a given number and with the same number of grid openings but unequally spaced, the number of modulations per second will be the same, but during each revolution the rate of modulation for unequal spacings will be varied and the sound effects produced will be different. By proper spacing and sizing of the openings it is even possible to modulate the air so as to produce a sound wave and to immediately thereafter and with the proper lag produce in effect a fortifying wave to enhance the sound effect of the first impressed wave. In the examples heretofore given, we have assumed only a single opening 31 in the rotating grid. Further variations can be made by increasing the number and spacing of the grid openings in the rotating grid, all without changing the speed of rotation thereof. Still further variations may be attained for any selected number and spacing of grid openings by variations in the speed of the rotatable grid.

In the grid form shown in Figs. 3 to 6 it will be noted that the grid openings are generally of sector form, that is, the side edges of the openings extend radially. Such grid formation produces a sharp opening and sharp closing of the grid openings with consequent effect on the air modulations produced. In the form of rotatable grid shown in Fig. 7 the grid openings 37 are all parallel to each other and with such a rotating grid there will be in effect a continuous undulating modulation of the air with consequent effect upon the sound waves produced. The opening and closing of the grid openings will not be sharp as with radial openings but will be gradual on the opening and trailing or wire drawing on the closing if, in fact, the grid openings are ever completely closed. If a fixed grid of the same form as the rotating grid of Fig. 7 be employed, there may be a distinct cut-off when the openings of the fixed and rotatable grids are out of registry with each other, and immediately the rotatable grid is rotated, there will be a gradual opening and a rather prolonged closing or wire drawing so as to cause what may be termed an intermittent undulating modulation. A fixed grid of a type similar to that of the rotating grid of Fig. 7 is shown in Fig. 8, that is, the fixed grid is provided with a parallel chordal opening 38. The grid openings of Fig. 8, considered as a whole, may be considered as a pair of radial grid openings but modified so as to form by the chordal lands or partitions extending thereacross. A rotating grid of the type shown in Fig. 9 may be employed with a fixed grid as shown in Fig. 8. The rotating grid of Fig. 9 is provided with two oppositely spaced relatively large radial openings 39-39.

The fixed and rotatable grids shown respectively in Figs. 10 and 11 have openings of equal size and similar spacings, that is, the fixed grid has a pair of large oppositely spaced grid openings 40-40, a plurality of smaller spaced apart grid openings 41 in the first quadrant and a plu-

5 rality of small equally spaced grid openings 42 in the third quadrant. The relative spacing of the openings 41 are different from the relative spacings of the openings 42. The rotatable grid has corresponding openings designated the same as those in Fig. 10 distinguished by the prime. When the rotatable grid is superposed on the fixed grid in the relative positions shown, all of the grid openings will be in registry and when 10 the rotatable grid rotates clockwise, there will be a sharp cut-off of the major grid openings 40-40' and subsequently there will be a continuous or intermittent grid opening of lesser extent when the major grid openings 40' pass over the minor grid openings 41-42, so that the modulating effect may produce what may be termed a powerful wave and reinforced by minor waves during the first quarter rotation and still further modification during the third quarter rotation 20 when after a relatively powerful modulation or wave production at the end of the second quarter revolution, the grid openings 42' in sequence pass over the openings 41 and the relatively wider spaced grid openings 41' pass over the relatively closer spaced openings 42.

25 The few grids herein described will be sufficient to indicate to those skilled in the art the very great number of variations which may be produced by varying the size, extent and circumferential spacing of grid openings in either the fixed or rotating grid, or in both, and it may be noted that an almost infinite number of further variations may be made by variations in the speed of rotation of the rotatable grid and such speed 30 could, of course, be effected by the relative rotation of the grids, that is, by rotating both the rotatable grid and what I have herein termed the fixed grid, in either opposite or the same direction at various speeds. It is further to be noted that there is practically no limit to the speed of modulation possible with my improved device and waves may be impressed so as to go beyond the range of audible frequencies. Such frequencies may be valuable in sound or signal transmission in that such high frequency waves may 35 be picked up and modified at the receiver, so as to come within an audible range. Furthermore, it will be seen that with relatively rotating grids there will be little wear or vibration regardless of the speeds, and the grids may be so balanced and counterbalanced as to reduce vibration to a negligible quantity even at very high speeds. Sounds of any desired characteristics may be produced and a predetermined sound may be produced by variations in the grid forms and speeds 40 of rotation.

55 The device will operate with high or low air

pressures and the intensity and volume of the sound produced depends upon the air pressure as one factor. Other forms of openings, such as round holes, may at times be employed to good effect. Due to the possibility of full closing of grid openings when out of registry there will be relatively little leakage and the efficiency will be high and the device economical of air and power for rotating the grid. By bringing the rotary grid up to full speed before supplying the air 5 under pressure will produce sharp sounds, otherwise a trailing effect will be produced. By the term "air" as used herein I desire to include any gas or vapor capable of use for sound production.

10 While the invention has been described in considerable detail and a few illustrative forms shown, it is to be understood that various changes, modifications, additions and omissions may be made within the scope of the invention as defined in the appended claims.

I claim:

1. In a device of the character indicated, relatively movable grids for causing a flow of air passing through said relatively movable grids to be modulated thereby, and an intensity grid substantially spaced from said relatively movable grids so as to leave a substantial body of air between said intensity grid and said relatively movable grids, whereby vibrations impressed upon said body of air may be transmitted through said intensity grid upon a more extensive wave front than that produced by said relatively movable grids.

2. In a device of the character indicated, relatively rotatable grids having a running fit with each other for causing a flow of air passing through said relatively rotatable grids to be modulated thereby, and an intensity grid substantially spaced from said relatively rotatable grids so as to leave a substantial body of air between said intensity grid and said relatively rotatable grids, whereby vibrations impressed upon said body of air may be transmitted through said intensity grid upon a more extensive wave front than that produced by said relatively rotatable grids.

3. In a device of the character indicated, a casing including a pump and pump chamber and a separate storage chamber, a passage means connecting said chambers together with valve means controlling said passage means, a pair of relatively rotatable grids having openings therein and in communication with said storage chamber, and means for rotating one of said grids and actuating said pump in said pump chamber.

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