Nov. 22, 1966 J. W. RYAN 3,286,396

TOY SOUND DEVICE ADAPTED TO ACTUATE A RESONATOR BY A CYCLIC SERIES OF IMPULSES

Filed March 26, 1965 2 Sheets-Sheet 1

Fig-1

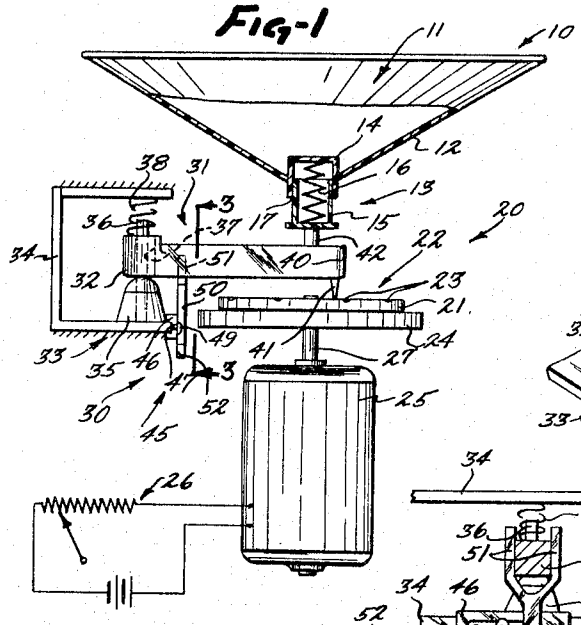


Fig-2

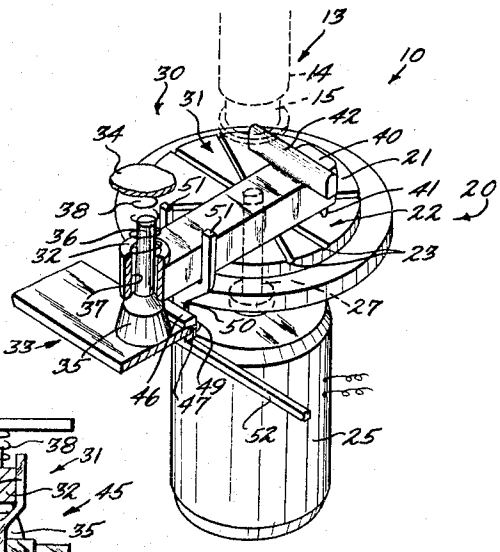


Fig-3

Fig-4

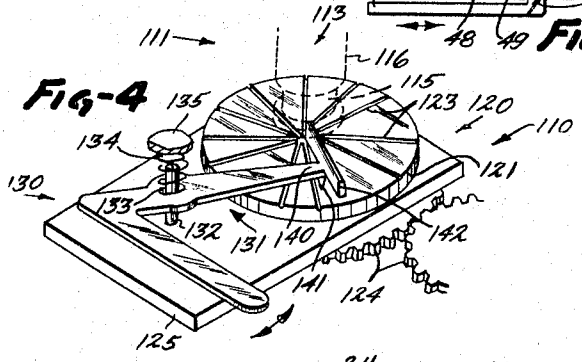


Fig-6

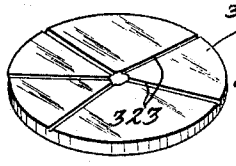


Fig-7

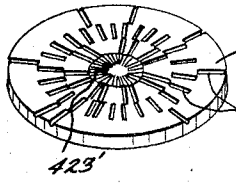


Fig-5

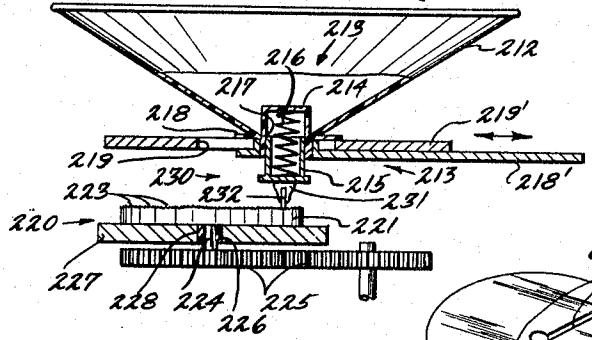
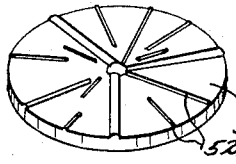


Fig-8



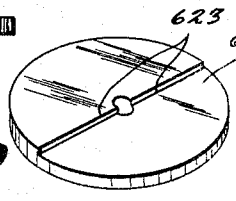


Fig-9

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Nov. 22, 1966 J. W. RYAN 3,286,396

TOY SOUND DEVICE ADAPTED TO ACTUATE A RESONATOR BY A CYCLIC SERIES OF IMPULSES

Filed March 26, 1965 2 Sheets-Sheet 2

FIG-10

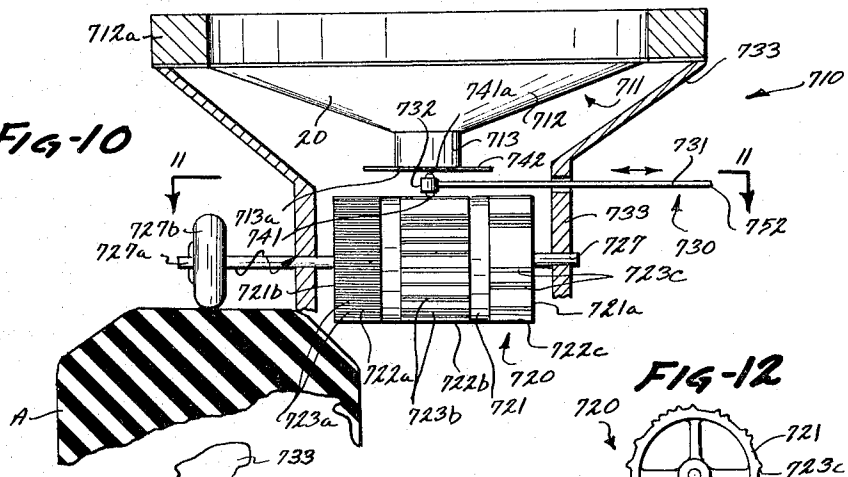


FIG-11

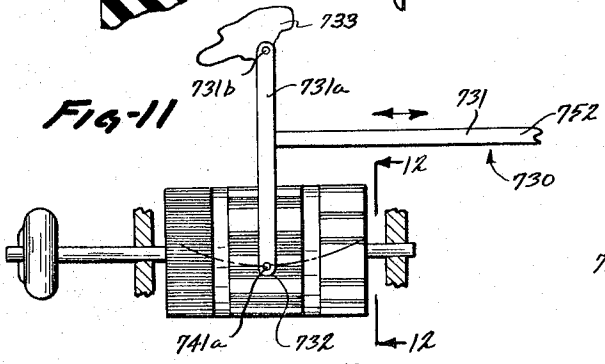


FIG-12

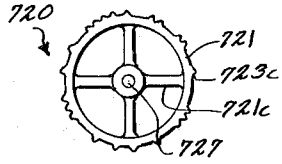


FIG-13

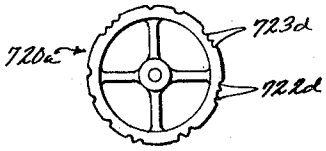


FIG-14

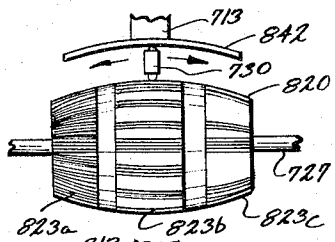


FIG-15

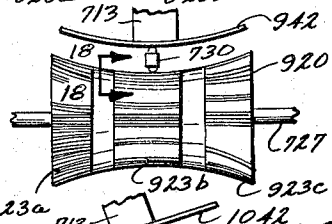


FIG-16

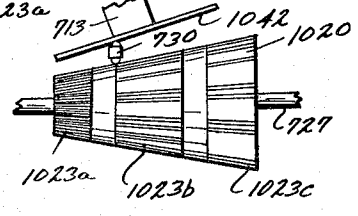


FIG-17

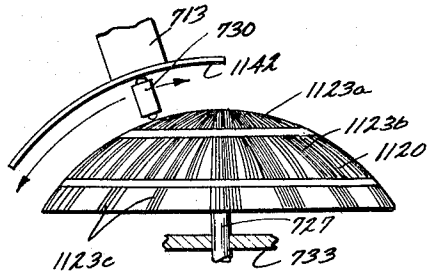


FIG-18



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3,286,396

TOY SOUND DEVICE ADAPTED TO ACTUATE A RESONATOR BY A CYCLIC SERIES OF IMPULSES

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Filed Mar. 26, 1965, Ser. No. 443,051
16 Claims. (Cl. 46—232)

This application is a continuation-in-part of copending application Serial No. 340,002 now abandoned which was filed January 24, 1964, by the applicant herein.

In general, the present invention relates to a simply constructed and operated toy sound device adapted to actuate a resonator by a cyclic series of blows thereto.

In said copending application Serial No. 340,002 now abandoned it was noted that, in the past, there have been a wide variety of toy sound devices, particularly sound devices which are adapted to simulate a motor sound or siren sound. For example, a common toy sound device which has been employed involves a reed fixed at one end and the other end extending free and engaged with a rotating gear wheel so that the reed is vibrated to admit sounds. However, such prior art sound devices, particularly motor sound devices, customarily were limited to a single, relatively high-pitched uniform sound which was far removed from the desired sound, such as the sound of a truck or car motor which is customarily low-pitched and usually includes a cyclic variation in sound. On the other hand, such sound was usually not sufficiently high-pitched to reproduce the shrill sound of a siren or the rise and falling siren sound of a vehicle, such as an ambulance. Furthermore, the usual prior art sound device involved a substantial period of contact between the portion of the device emitting the sound and portion of the device actuating the sound emitter. Thus, a considerable portion of the vibrational energy was lost and the resulting sound device was relatively inefficient. Also, prior art sound devices usually utilized direct contact between the sound emitter and the actuator for the sound emitter, so that the stresses and strains were put on the sound emitter which did not contribute to the volume of sound being emitted. Consequently, the usual prior art devices had a relatively short life because of the intense strains and stresses put on the sound emitter apart from the function of the emitting sound. Finally, the usual prior art sound devices normally required a change in the rate of operation of the actuator in order to change the intensity of the sound and was normally strictly limited to a specific sound.

As also noted in said copending application Serial No. 340,002, now abandoned, some of these prior art shortcomings have been effectively solved by applicant's earlier invention entitled, Motor Sounds, and filed as application, Serial No. 313,285, filed October 2, 1963, now Patent No. 3,236,008. However, applicant's motor sounds invention was specifically designed to reproduce a specific range of sounds i.e., motor sounds. Hence, such earlier device is not adapted to change the range of sounds or the type of sounds, as is possible in the present invention. For example, applicant's earlier device could not vary the particular motor sound cycle without substantially changing the structure of the device and could only vary the impulse by varying the speed of the turntable means. Moreover, applicant's earlier device was not adapted to simply change the sound emitted, as in the devices of copending application Serial No. 340,002 now abandoned and of the present application.

Consequently, an object of the present invention is a toy sound device wherein the intensity of the sound or other variation in the sound may be simply achieved.

Another object of the present invention is a toy sound device adapted to vary the intensity of the sound emitted, but not requiring a variation in the rate of operation of the actuating portion of the sound device.

Still another object of the present invention is a toy sound device which is adapted to vary the sound emitted simply by regulating the relative positions of the various portions of the sound device.

Other objects and advantages of the present invention will be readily apparent from the following description and drawings which illustrate a preferred exemplary embodiment of the present invention, as well as alternative embodiments of the present invention.

As pointed out in copending application Serial No. 419,270, now Patent No. 3,190,034, which was filed December 9, 1964, and which is a continuation-in-part of said application Serial No. 313,285, now Patent No. 3,236,008, the spectral analysis of the sound produced by a typical automobile engine indicates that, for optimum reproduction, the maximum energy contained in the spectrum should be below approximately 2500 c.p.s. However, in an automobile engine and in a system for simulating motor sounds, the frequency of the sound alone is insufficient to define a reasonable simulation of a motor sound. The spectrum should be one in which a broad sweep of frequencies is indiscriminately produced without sharply defined and well-separated peaks. Sharply defined and well separated peaks produce a musical sound like a low-pitched horn or bell. When such peaks do not exist, a "noise" results and, if the noise is in a relatively low frequency range, it simulates a motor sound.

The devices for simulating motor sounds of the present invention include systems which are shock-excited with a lot of resonance. This shock-exciting is done repetitively, without necessarily having a fixed period. The exciting of the system is done in a "free mode." This means the system is simply shocked; it is not rigidly coupled to a driving means. Thus, the present invention relates only to vibratile systems in which there is not a rigid coupling and direct drive of the resonator.

Vibratile systems which are capable of producing sound within the frequency ranges which characterize the noise produced by internal combustion engines may, within broad limits, be made of many different types of materials whether a single compound, such as polyethylene, or an extremely complex mixture of compounds, such as cardboard. The material may be homogeneous, laminate, or randomly discontinuous, such as chipboard. Also, the material may be solid, porous or of varying density and cross section, such as a woven or pressed fiber structure like fiberboard.

Such vibratile systems may also be made with almost any geometry. For example, a cone, a plane disc and a cup with nearly cylindrical side walls may be employed. These changes in geometry have a marked effect on the resonance characteristics of the system. The same mass of the same material reacts differently acoustically if it is shaped as a cone or cup rather than as a flat disc.

Similarly, the same object will react quite differently acoustically if it is mounted differently. A complaint mounting, in which the object is held loosely and flexibly, will cause it to have different resonance characteristics from a mounting in which it is held rigidly at some one point.

The natural or resonant frequency of a vibratile system is the basic frequency at which it resonates in response to shock excitation. Although it is difficult to measure this with great precision, it is a characteristic of the system and usually can be discerned on a spectral analysis of the sound produced by the system as the lowest-frequency substantial peak produced by the system. For example, the spectral analysis of certain toy motor unit

cones show a number of peaks, with the last major peak in the vicinity of 2,500 c.p.s. Thus the "bulk" of the acoustic energy produced in simulation of a motor sound should be below 2,500 c.p.s. The natural or resonant frequency of that same cone, however, is about 250 or 350 cycles. Repeated shock excitation of a vibratile system thus may produce the bulk of the energy at frequencies well above the natural or resonant frequency of the particular resonator employed.

The characteristics of vibratile systems which are capable of producing motor sounds may be defined in terms of the "stiffness" of the system. The natural or resonant frequency of the system is defined by the equation

$$f_r=\frac{1}{2\pi}\sqrt{\frac{\text{stiffness}}{\text{mass}}}$$

Stiffness is measured in dynes per centimeter.

This equation reflects the obvious fact that the same material with the same geometry produces different resonances, as its mass is varied. A small brass bell has a high pitch; a heavy brass bell may have an extremely low pitch. This formula makes it possible to define a physical characteristic of the vibratile systems—their stiffness—which is a necessary condition for any system within a range of weights that is practical for toy use (e.g., 1/10 gram to 100 grams) which is capable of producing a reasonable simulation of a motor sound. However, this necessary condition is not in and of itself a sufficient condition; it still must be qualified—i.e., the system must be of a size and nature normal and practical for a toy. With such a limitation, the more extreme combinations of characteristics are eliminated (e.g., an extremely tiny disc of very small mass and very high stiffness, which will produce sounds within the proper frequencies but which will be inaudible or nearly inaudible and may have a more nearly musical distribution of peaks rather than the noise-like distribution which is necessary to simulate a motor sound).

A sound limiting factor is that the impedance of the vibratile system is defined by the equation:

$$Z_0=\sqrt{(\text{mass})\,(\text{stiffness})}$$

The impedance is a measure of the efficiency of the system; i.e., the effort required to produce sound from it. If the impedance is very high, the system is impractically inefficient. This equation supports the fact that the use of an extremely stiff system (e.g., an ordinary metal bell) which is so heavy that its natural frequency is within the desired range, is impractical for a toy because of the great weight required to attain this and the energy required to excite the system. It is also eliminated because of the necessary condition that the spectrum produced by such a system be one in which there are not clearly defined and well-separated peaks, producing a musical sound rather than a noise.

Investigation of these matters has resulted in the conclusion that a stiffness between 10^4 and 10^8 dynes per centimeter is the range within which a practical toy device to simulate motor sounds can be made. These limits of stiffness, applied to systems weighing between 1/10 gram and 100 grams, produced natural frequencies (within the limits of practically discussed above) which are in the range necessary to produce a motor sound. The more extreme combinations of high mass and low stiffness, and low mass with high stiffness, have to be omitted. For example, a 100 gram system with a stiffness of 10^1 (which would be something like a very heavy, floppy, loose piece of rubber) is quite impractical, producing a natural frequency of about 1½ cycles per second. The extreme combination of a stiffness of 10^8 and a weight of 1/10 gram, which would be something like a very tiny disc of hard plastic or soft metal, produces a frequency which is far too high—well above 5,000 cycles per second. Taking the more reasonable combinations, even at the outer limits of the ranges, such as a stiffness of 10^4 and a weight of 1/10 gram (producing a natural resonance of 50 cycles per second), or a stiffness of 10^8 and a weight of 100 grams (producing a natural frequency of 155 cycles) the range of 10^4 to 10^8 stiffness demonstrates that by using the more stiff systems with greater masses or the less stiff systems with lesser masses within the ranges of mass and stiffness, that 10^4 to 10^8 dynes per centimeter are the outer limits of stiffness which may be utilized effectively in toys to simulate motor sounds.

The following chart is a listing of 21 different sorts of vibratile systems, ranging from bicycle bells to toy motor sound cones and flat plates of polyethylene, paper, cardboard, styrene, brass, steel and rubber:

Type of resonator	Dia., inches	Material	f_r (c.p.s.)	Mass (gm.)	Stiffness (dynes/cm.)
Bell #1		Steel	1,850	47	6.4×10^9
Bell #2		do	2,050	55	9.1×10^9
Bell #3		do	1,700	23	2.6×10^9
Bell #4		do	1,400	64	5.0×10^9
Engine cone		Styrene	250	1.6	4.0×10^6
Racer cone		do	555	1.1	1.4×10^7
Voice unit cone		do	230	0.9	1.9×10^6
.5 mil flat plate, free	3	P.E. [1]	25	0.1	2.5×10^3
.5 mil flat plate, tight	3	P.E.	200	.1	1.6×10^5
9 mil flat plate, free	3	Paper	145	1.0	8.3×10^5
24 mil flat plate, free	3	Cardboard	360	2.8	1.4×10^7
6 mil flat plate, tight	3	P.E.	150	0.8	7.1×10^5
Do	8	P.E.	41	4.2	2.8×10^5
24 mil flat plate, free	8	Cardboard	60	13.8	1.9×10^6
15 mil flat plate, free	3	Styrene	180	2.5	3.2×10^6
5 mil flat plate, free	3	Brass	500	6.7	6.6×10^7
2 mil flat plate, free	3	Steel	160	1.2	1.2×10^6
8 mil flat plate, tight	3	Rubber	120	1.5	8.5×10^5
60 mil flat plate, free	3	Styrene	480	10.2	9.3×10^7
Do	8	do	120	53.8	3.1×10^7

[1] Polyethylene.

For each of the above systems, some of which were mounted freely and others of which were mounted rather tightly, the mass was determined and the natural frequency was determined. The stiffnesses were then computed and, as can be seen, all the practical simulations of a motor sound fell within the stiffnesses between approximately 10^4 and 10^8. The measurements of the frequencies recorded in the table are approximations which are accurate to the first digit. The list shows that practical weights of very stiff metals (such as bicycle bells with stiffnesses in the range of 10^9), produced natural resonances above 1,000 cycles per second. In order to obtain a system where repetitive shock-excitation produces a noise wherein the bulk of the noise is below 2,500 c.p.s., the natural frequency of the resonator should be below 1,000 c.p.s. Thus, steel bells were not satisfactory. An extremely light and thin disc of polyethylene, with a stiffness below 10^4 did produce a natural frequency of 25 cycles per second (which might conceivably simulate a motor sound), but such a tiny disc is much too fragile to be practical for a toy.

In general, the present invention involves a device for

simulating siren sounds and motor sounds. The device has a vibratile system including resonator means which is adapted to produce a noise simulating the noise produced by a siren and by an internal combustion engine when subjected to repetitive shock-excitation in different operating modes. Rotatably mounted adjacent the resonator means are turntable means for subjecting the resonator means to the repetitive shock-excitation. The turntable means includes axially-extending striker means or obstructions. Operatively mounted between the resonator means and the turntable means are transfer means which are adapted to be actuated by the striker means and to conduct the impulses imparted thereby to the resonator means in such a manner that it is subjected to repetitive shock-excitation. The turntable means is driven with sufficient angular velocity to shock-excite the resonator means with a lot of resonance.

The resonator means may have a conical shape and may have a stiffness between approximately 10^4 to 10^8 dynes per centimeter for a mass of from $\frac{1}{10}$ to 100 grams. The cone is suspended within a frame in such a manner as to produce its desired low frequency resonance with the mass of the cone used. The cone has an amplitude capability within the stress limits of the material used, thereby permitting production of a high level of low-frequency energy.

The mass of and the types of material employed in both the turntable means and the resonator means is such that undamped resonances are minimized and so that the output from the resonator means has a spectrum containing a maximum of energy in frequencies below approximately 2500 c.p.s.

In order to facilitate understanding of the present invention, reference will now be made to the appended drawings of a preferred specific embodiment of the present invention, as well as alternative embodiments of the present invention. Such drawings should not be construed as limiting the invention which is properly set forth in the appended claims.

In the drawings:

FIGURE 1 is a semi-schematic side elevation partially in cross-section of the toy sound device of the present invention;

FIGURE 2 is a perspective view partially broken away of the toy sound device of FIGURE 1;

FIGURE 3 is a cross-sectional view of FIGURE 1 taken along line 3—3 of FIGURE 1;

FIGURE 4 is a perspective view of another embodiment of the toy sound device of the present invention;

FIGURE 5 is a partially broken-away side elevation of still another embodiment of the toy sound device of the present invention;

FIGURES 6, 7, 8 and 9 show various embodiments of the disc portion of the turntable means of the present invention which may be employed in any of the alternate embodiments shown in FIGURES 1–5;

FIGURE 10 is a semi-schematic elevational view partially in cross-section of a further embodiment of the toy sound device of the present invention;

FIGURE 11 is a cross-sectional view taken along line 11—11 of FIGURE 10;

FIGURE 12 is a cross-sectional view taken along line 12—12 of FIGURE 11;

FIGURE 13 is a cross-sectional view similar to FIGURE 12 showing a modified form of the turntable portion thereof;

FIGURES 14–17 show various embodiments of the turntable means of the present invention which may be employed in the embodiment shown in FIGURES 10–12; and

FIGURE 18 is an enlarged, partial cross-sectional view taken along line 18—18 of FIGURE 15.

As illustrated in FIGURES 1–3, the toy sound device 10 of the present invention comprises a resonator means 11 adapted to emit a sound when struck, a rotatably mounted turntable means 20 having at least one radially extending obstruction 22 and transfer means 30 operatively mounted between the resonator means 11 and the turntable means 20 and adapted to be actuated by movement across the turntable obstruction 22 and to conduct the impulse imparted thereby to the resonator means 11. The resonator means 11 comprises a flexible cone 12 held securely about its circumference (cone holding means not shown) with its apex 13 adjoining the transfer means 30. The apex 13 of the cone 12 is preferably formed with a first tubular member 14 attached to the cone 12 and a second tubular member 15 slidably mounted therein with a spring means 16 biasing the second tubular member 15 into contact with the transfer means 30. Between the first and second tubular members 14 and 15 is a grease means 17 adapted to transmit vibrations in the sonic frequency from the transfer means to the cone 12. Such cone apex is described in greater detail in applicant's United States Patent No. 3,095,201 issued on June 25, 1963. However, other means, such as a rigid apex, may be used to transmit the vibrations of the transfer means to the resonator means 11.

The rotatably mounted turntable means 20 comprises a disc 21 having at least one radially extending obstruction 22. As shown in FIGURES 1–3, the obstruction 22 is formed out of radially extending grooves 23. The disc 21 is mounted on a rotatable platform 24 which is preferably formed of a heavy material, such as metal, so that when the rotation of the platform 24 is initiated and when it is stopped, such process is prolonged because of the large inertia of the platform 24. Thus, the platform 24 produces a fly-wheel effect which achieves a start-up sound and slowing-down sound of the sound device which is particularly desirable if a motor sound is being reproduced. The platform 24 is rotated by a motor 25 through the connection of the shaft 27. The rate of rotation of the motor 25 is controlled by a control circuit 26 so that the motor 25 is adapted to vary its speed over a wide range.

Operatively mounted between the resonator means 11 and the turntable means 20 is a transfer means 30 which is adapted to be actuated by movement across the turntable obstruction 22 and to conduct the impulse imparted thereby to the resonator means 11. The transfer means 30 comprises a tone arm 31 with its first end 32 mounted on a separate support means 33. The support means 33 comprises a housing 34 on which is fixed a column 35 with a post 36 mounted on the column 35 and extending upwardly therefrom. The first end 32 of the tone arm 31 has a bore 37 therethrough and the post 36 is slidably received in the bore 37 so that the tone arm 31 is pivotally mounted thereon. A spring means 38 biases the first end 32 of the tone arm 31 into contact with the column 35. The free end 40 of the tone arm 31 has a needle 41 mounted thereon which is adapted to contact the turntable means 20. Also, the free end 40 of the tone arm 31 has a cross arm 42 which is in sliding contact with the second tubular member 15 of the resonator means 11.

The transfer means 30 is adapted to have its radial position relative to the turntable means 20 adjustable whereby the impulse of the blows to the transfer means 30 caused by the obstructions 22 of the turntable means 20 may be varied over a wide range. As shown, the adjustment means 45 comprises a slide clamp 46 slidably mounted on the housing 34 by means of a pin 47 extending through a slot 48 in the slide clamp 46 and having an enlarged head 49 to hold the slide clamp 46 in place. Mounted on the side clamp 46 is a bar 50 having upwardly extending yoke arms 51 which receive the tone arm 31 therebetween. The bar 50 has an extension 52 extending out to its side by which it may be manipulated. By moving the extension 52 inwardly or outwardly, the position of the needle 41 of the transfer means 30 is effectively varied over the radius of the disc 21, while the

cross arm 42 of the tone arm 31 maintains contact with the resonator means 11.

As can be seen from FIGURES 1–3, the operation of the toy sound device of the present invention is very simple. The disc 21 is initially mounted on the platform 24 and the needle 41 is positioned the desired radial distance from the center of the disc 21. The motor 25 is then started, but due to the inertia of the platform 24, the disc 21 starts its rotation slowly and then builds up to the desired speed of rotation. As the disc 21 rotates, the needle 41 traverses a circumferential path determined by its radial position. During such movement, the needle 41 moves across the radially extending grooves 23. Such movement imparts an impulse to the needle 41 which is conducted to the cone 12 of the resonator means 11 to cause a sound. For example, the sound may be that of an internal combustion motor. Such sound may be conveniently varied for the disc shown in FIGURES 1–3 by speeding up or slowing down the motor 25 through the control circuit by varying the resistance in the control circuit 26. Alternatively, by varying the position of the needle 41, the number of impulses per complete rotation of the disc 21 is unchanged, but the individual impulses are changed. For example, if the needle 41 is moved radially outwardly, the velocity at which the needle 41 strikes the grooves 23 is increased proportionately so that a sharper impulse is caused and thus a sharper sound. Similarly, if the needle 41 is moved radially inwardly, the resulting impulse is softer and the resulting sound is softer.

As shown in FIGURE 4, the toy sound device 110 includes a resonator means 111 of which only the apex 113 is shown, but which is of a similar construction to that shown in FIGURES 1–3. Thus, the apex 113 has a first tubular member 116, with a second tubular member 115 slidably mounted therein. The turntable means 120 includes a disc 121 having a series of radially extending grooves 123 and is connected to a series of gears 124 by which the disc 121 is rotated at a substantially constant speed. The disc 121 is rotatably mounted on a table 125. The transfer means 130 comprise a tone arm 131 which is pivotally mounted on the table 125 by means of a post 132 extending upwardly from the table 125 and through a bore 133 in the central portion of the tone arm 131. The tone arm 131 is maintained in its pivoted mounting on the post 132 by means of a spring 134 which is biased against a stop 135. At its free end 140 the tone arm 131 has a needle 141 which is in slidable contact with the surface of the disc 121 and a cross arm 142 which is in slidable contact with the first member 115 of the resonator means 111. The position of the tone arm 131 is varied by means of an angle arm 136 which extends outwardly adjacent the pivot post 132.

Still another embodiment of the present invention is illustrated in FIGURE 5, wherein the resonator means 211 comprises a cone 212 with the apex 213 joining the transfer means 230. The apex 213 includes a first member 214 mounted on the cone 212 and a second member 215 slidably received within the first tubular member 214 with a spring means 216 biasing the second tubular member 215 and transfer means 230 into contact with the turntable means 220. Between the first and second tubular members 214 and 215 in a grease 217 adapted to transmit sonic vibrations. Extending outwardly from the apex 213 of the resonator means 211 is a slide clamp 218 which extends through a slot 219 in a support platform 219'. Extending outwardly from the slide clamp 218 is an extension 218' by which the position of the resonator means 211 with reference to the turntable means 220 may be varied. The turntable means 220 comprises a disc 221 having a plurality of radially extending grooves 223. The disc 221 is rotated by means of a shaft 224 connected to a series of gears 225. The shaft 224 extends through an aperture 226 in a support table 227 and is separated therefrom by a sleeve bearing 228. The transfer means 230 comprises simply a needle 232 mounted on a clamp 231 which is in turn mounted on the resonator means 211 by being affixed to the bottom of the second tubular member 215. The needle 232 is thereby adapted to contact the disc 221 of the turntable means 220.

As shown in FIGURES 6–9, a plurality of discs 321, 421, 521 and 621 may be utilized in the various embodiments of the present invention shown in FIGURES 1–5. The disc 321 shown in FIGURE 6 has five radially extending grooves 232 which are spaced in irregular intervals about the circumference of the disc 321. The disc 421 shown in FIGURE 7 has a plurality of radially extending grooves 423 wherein the number of said grooves is varied relative to their radial location. Thus, adjacent the center of the disc 421 are a large number of radially extending grooves 423' which are adapted to produce a siren sound, while the remaining grooves 423 are adapted to produce a varied motor sounds. As shown in FIGURE 8, the disc 521 has a plurality of radially extending ridges 523 and the number of ridges is varied relative to the radial location. In addition, the size and the shape of the various ridges are varied to produce a variety of motor sounds. As shown in FIGURE 9, the disc 621 is split in equal halves separated by a step 623 which produces its own particular motor sound.

A further embodiment of the present invention, generally designated 710, includes a frame 733 in which a resonator means 711 may be mounted. A turntable means 720 is also mounted in the frame 733 adjacent the resonator means 711 and a transfer means 730 is swingably mounted in the frame 733 between the resonator means 711 and the turntable means 720.

The resonator means 711 includes a speaker cone 712 which may be affixed to a ring member 712*a* provided in the frame 733 and which includes an apex-plug portion 713 having a closed bottom wall 713*a*. A bar 742 is affixed to the underside of the bottom wall 713*a* and is of sufficient length to extend over first, second and third sets of axially-extending striker means or obstructions 722*a*, 722*b* and 722*c* provided on the turntable means 720.

The transfer means 730 includes a T-shaped lever or tone arm 731 having a first end 752 extending to the exterior of the frame 733 for manipulation by a user of the device 710. The lever 731 also has a second end 731*a* which is pivotally connected to the frame 733 by a pin 731*b* and a third end 732. The end 732 has a first bulbus portion 741 which engages the turntable means 720 and a second bulbus portion 741*a* which engages the bar 742 to transfer vibrations to the resonator means 711 for subjecting it to the repetitive shock-excitation.

The turntable means 720 comprises a hollow cylindrical member 721 having open ends 721*a* and 721*b* in which hub members, such as the one shown at 721*c* in FIGURE 12, are mounted. The hub members 721*c* are affixed to a shaft 727 for rotation therewith and the shaft 727 is, in turn, rotatably mounted in the frame 733 and includes an end 727*a* to which a friction wheel 727*b* is affixed. The friction wheel 727*b* is adapted to be driven by a vehicle wheel A adjacent which the device 710 may be mounted. The wheel A may constitute a wheel of any suitable vehicle (not shown), such as a child's coaster wagon, a bicycle, a tricycle or the like so that rotation of the wheel A through motion of the vehicle will operate the device 710 to produce simulated motor sounds or simulated siren sounds, as will be hereinafter described.

The first set of striker means 722*a* include a plurality of closely-spaced parallel axially-extending ridges 723*a* which may be engaged by the end 732 of the transfer means 730 when it is swung to the left, as viewed in FIGURES 10 and 11, by manipulating the end 752. The

ridges **723***a* cause the transfer means **730** to subject the resonator means **711** to repetitive shock-excitation when the turntable means **720** is rotated about its major axis by wheel A. This produces a noise simulating the noise produced by a siren.

The striker means **722***b* comprises a plurality of axially-extending ridges **723***b* which are spaced further apart than the ridges **722***a* so that they will subject the resonator means **711** to repetitive shock-excitation in such a manner that it will produce a noise simulating the noise produced by an internal combustion engine when it is operating at full speed.

The striker means **722***c* comprise a plurality of axially-extending ridges **723***c* which are spaced even further apart than the ridges **723***b* so that they will excite the resonator **711** in such a manner that it produces a noise simulating the noise produced by an internal combustion engine at low speeds.

Although a number of different types and sizes of cones **712** will manifest themseves, a cone approximately 2¼ inches in diameter and ½ inch deep, which has a wall thickness of approximately 15 millimeters and which is made from a cellulose acetate butyral having a mass of 1.6 grams and a stiffness of 4.0×10^6 dynes per centimeter has been found to be satisfactory. Such a cone has a natural frequency of approximately 250 c.p.s. which is low enough to permit it to respond with a lot of resonance to shock-excitation by the striker means **722***a*, **722***b* and **722***c*. The support of the cone **712** in ring member **712***a* is such that low frequency resonance is obtainable with the mass of the cone used. In addition, the cone **712** has satisfactory amplitude capabilities with material stress limits which permit producton of a high level of low-frequency energy. When excited by the striker means **722***b* and **722***c*, the output from the cone **712** has an acoustical spectrum containing a maximum of energy in the lower frequencies, i.e., below approximately 2500 c.p.s. However, when the cone **712** is excited by the striker means **722***a*, the output from the cone has an acoustical spectrum containing sufficient energy in the higher frequencies to produce a high-pitched siren sound.

The turntable means **720** may be made from any suitable material such as an acetal-resin.

A child user of the device **710** may grasp the end **752** of the lever **731** and selectively position it on any one of the ridges **723***a*, **723***b* or **723***c* to produce noises ranging from a simulated siren noise to a simulated internal combustion engine idling or operating at full throttle.

Referring now to FIGURE 13, the turntable means **720** may be modified, as indicated generally at **720***a*, by providing modified striker means **722***d* in the form of grooves **723***d* instead of the ridges shown in FIGURE 12.

As shown in FIGURES 14–17, a plurality of turntable means **820**, **920**, **1020** and **1120** may be utilized in the embodiment shown in FIGURES 10 and 11. The turntable means **820** shown in FIGURE 14 is barrel shaped and has first, second and third sets of axially-extending grooves **823***a*, **823***b* and **823***c*, respectively.

The grooves **823***a* are closely spaced for producing siren sounds; the grooves **823***b* spaced somewhat further apart to imitate the sound of an internal combustion engine operating at full speed and the grooves **823***c* are spaced still further apart to imitate the sound of an internal combustion engine which is idling. An arcuate bar **842** is attached to the apex-plug portion **713** for maintaining the transfer means **730** in engagement with the turntable means **820** in all operating positions of the transfer means **730**. The turntable means **820** may be mounted on the shaft **727** for rotation thereby.

The turntable means **920** shown in FIGURE 15 is rotated by the shaft **727** and has a concave surface which is provided with first, second and third sets of axially-extending grooves **923***a*, **923***b* and **923***c* for producing siren sounds, accelerated motor sounds and idling motor sounds, respectively. A concave bar **942** is attached to the apex-plug portion **713** for maintaining the transfer means **730** in engagement with the turntable means **920**.

The turntable means **1020** shown in FIGURE 16 is rotated by the shaft **727** and has a frusto-conical shape. The turntable means **1020** is provided with first, second and third sets of axially extending grooves **1023***a*, **1023***b* and **1023***c* for producing siren sounds, accelerated motor sounds and idling motor sounds, respectively. A bar **1042** is attached to the apex-plug portion **713** in spaced, parallel relation with the surface of turntable means **1020** for maintaining the transfer means **730** in engagement therewith.

The turntable means **1120** shown in FIGURE 17 is rotated by the shaft **727** and is hemispherically shaped. The turntable means **1120** is provided with first, second and third sets of radially-extending grooves **1123***a*, **1123***b* and **1123***c* for producing siren sounds, accelerated motor sounds and idling motor sounds, respectively. An arcuate bar **1142** is attached to the apex-plug portion **713** for maintaining the transfer means **730** in engagement with the turntable means **1120**.

Many other specific embodiments of the present invention will be obvious to one skilled in the art in view of this disclosure. For example, as illustrated, a variety of turntable means and transfer means may be utilized in the top sound device. Also, the variation in radial and axial positions of the transfer means may be achieved by movement of the transfer means, either by itself or by the movement of the cone of the resonator means when the transfer means is mounted thereon or by movement of the turntable means with reference to the transfer means. In addition, the obstructions on the turntable means may be formed either by ridges, grooves or steps. Also, in place of the flat disc means illustrated in FIGURES 1–9, the turntable means may dispense with disc means by shaping the turntable means as shown in FIGURES 10–17.

There are many features of the present invention which clearly show the significant advance it represents over the prior art. Consequently, only a few of the more outstanding features will be pointed out to illustrate the unexpected and unusual results obtained by the present invention. One feature of the present invention is that the impulse which may be imparted to the resonator means by the transfer means may be simply varied over a wide range without varying the speed of the turntable means. Thus, by adjusting the position of the transfer means, the impulse imparted thereto by the obstructions on the turntable means is varied, since the speed of contact between the transfer means and the obstructions is varied. Another feature of the present invention is the variation in the cycle of the sound produced by the toy sound device by varying the position of the transfer means. Thus, by varying the number of ridges or grooves, a wide variety of sounds may be achieved from various motor sounds to even a siren sound. Still another feature of the present invention is the utilization of changeable discs on the turntable means so that the sound produced by the toy sound device may be varied as desired.

It will be understood that the foregoing description and examples are only illustrative of the present invention and it is not intended that the invention be limited thereto. All substitutions, alterations and modifications of the present invention which come within the scope of the following claims or to which the present invention is readily susceptible, without departing from the spirit and scope of this disclosure are considered part of the present invention.

What is claimed is:

1. A simply constructed and operated toy sound device adapted to actuate a resonator by a repetitive series of shock-exciting impulses thereto, comprising:

a resonator means adapted to emit a sound when shock-excited;

a rotatably mounted turntable means having at least one abrupt obstruction, said turntable means com-

prising a disc having a plurality of discrete radially extending elements comprising said abrupt obstruction; and

transfer means operatively mounted between said resonator means and said turntable means and adapted to be actuated only by engagement with said turntable obstructions to conduct the shock impulse imparted by said obstruction to said resonator means, said resonator means and said transfer means being free of securement to each other whereby said resonator means may vibrate independently of movement of said transfer means.

2. A simply constructed and operated toy sound device adapted to actuate a resonator by a repetitive series of shock-exciting impulses thereto, comprising:

a resonator means adapted to emit a sound when shock-excited;

a rotatably mounted turntable means having at least one abrupt obstruction, said turntable means comprising a cylindrical member and having thereon a plurality of discrete axially extending elements defining abrupt obstructions; and

transfer means operatively mounted between said resonator means and said turntable means and adapted to be actuated only by engagement with said turntable obstruction to conduct the shock impulse imparted by said obstructions to said resonator means, said resonator means and said transfer means being free of securement to each other whereby said resonator means may vibrate independently of movement of said transfer means.

3. A toy sound device adapted to actuate a resonator by a cyclic series of blows thereto, comprising:

a resonator means adapted to emit a sound when struck;

a rotatably mounted turntable means having at least one abrupt obstruction, said obstruction extending radially on said turntable means;

transfer means operatively mounted between said resonator means and said turntable means and adapted to be actuated only by said turntable obstruction and to conduct impulses to said resonator means, means for adjusting the radial position of said transfer means relative to said turntable means to engage said obstruction at a different radial position thereof, whereby the sharpness of said impulses may be varied over a wide range, means for relatively moving said turntable and transfer means so that said transfer means moves across said obstruction in a direction transverse to its longitudinal axis.

4. A sound device as stated in claim 3 wherein said urntable means comprises a disc and wherein said obtruction comprises a plurality of radially extending rooves thereon.

5. A sound device as stated in claim 4 wherein the umber of said grooves is varied relative to their radial ocation.

6. A sound device as stated in claim 3 wherein said urntable means comprises a disc and wherein said obtruction comprises a plurality of radially extending ridges.

7. A sound device as stated in claim 6 wherein the umber of said ridges is varied relative to their radial ocation.

8. A sound device as stated in claim 3 wherein said ransfer means comprises a separately mounted and ivoted tone arm, the free end of said tone arm having a eedle mounted thereon adapted to contact said obstrucions.

9. A simply constructed and operated toy sound device adapted to actuate a resonator by a repetitive series of shock-exciting impulses thereto, comprising:

a resonator means adapted to emit a sound when shock-excited;

a rotatably mounted turntable means having at least one abrupt obstruction thereon;

transfer means operatively mounted between said resonator means and said turntable means and adapted to be actuated only by engagement with said turntable obstruction and to conduct the shock impulses imparted by said obstruction to said resonator means, said obstruction extending transversely to the path of relative movement between said obstruction and said transfer means, said resonator means and said transfer means being free of securement to each other whereby said resonator means may vibrate independently of movement of said transfer means; and

means for relatively moving said turntable and transfer means so that said transfer means moves across said obstruction in a direction transverse to its longitudinal axis.

10. A device as stated in claim 9 wherein said resonator means has a mass within a range of approximately 0.1 gram to approximately 100 grams and a stiffness within a range of approximately 10^4 to 10^8 dynes per centimeter.

11. A device as stated in claim 9 wherein said turntable means has a concave surface on which said obstruction is positioned.

12. A device as stated in claim 9 wherein said turntable means is frusto-conically shaped.

13. A device as stated in claim 9 wherein said turntable means is hemispherically shaped.

14. A sound device as stated in claim 9 wherein the radial position of said transfer means relative to said turntable means is adjustable, whereby the frequency of said impulses is varied over a wide range.

15. A sound device as stated in claim 9 which includes motor means for rotating said turntable and control means connected to said motor means for varying its speed over a wide range.

16. A sound device as stated in claim 9 wherein said transfer means comprises a separately mounted and pivoted tone arm, the free end of said tone arm having a needle mounted thereon adapted to be engaged by said obstruction.

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