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MECHANICAL VIBRATOR SIGNALLING DEVICE

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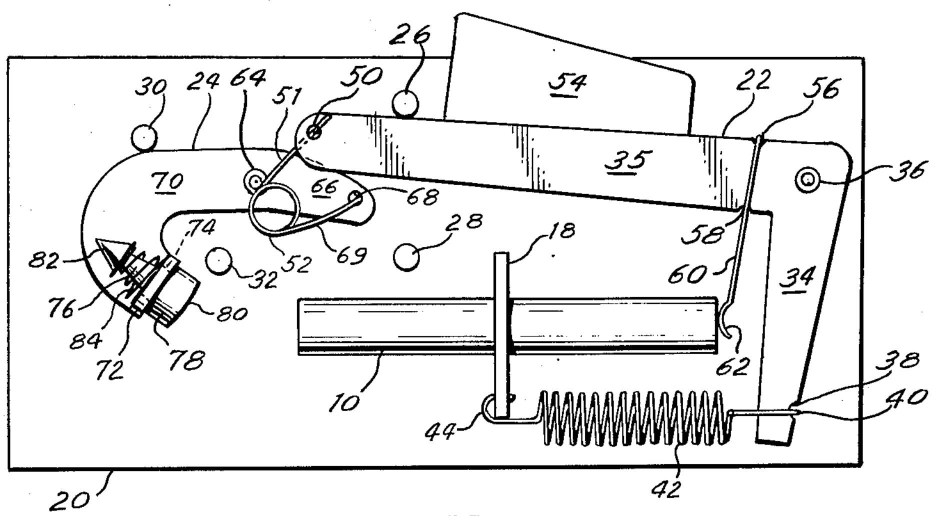

Fig.1.

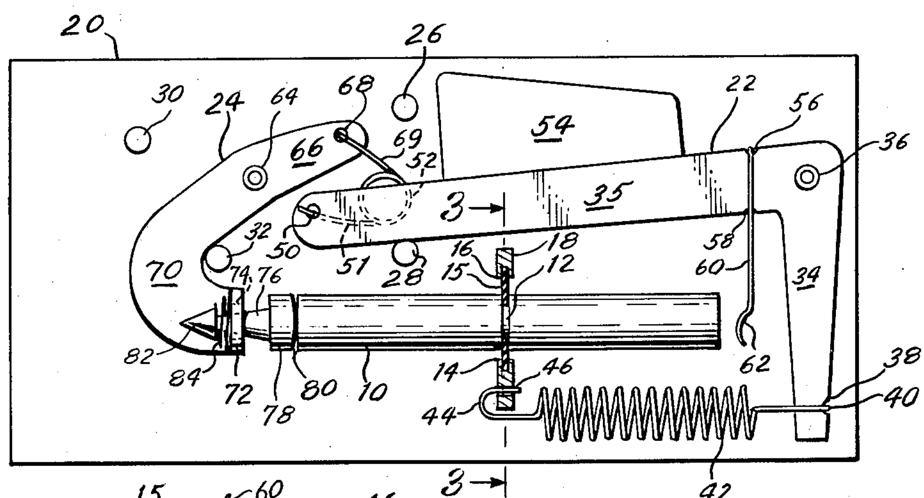

Fig.2.

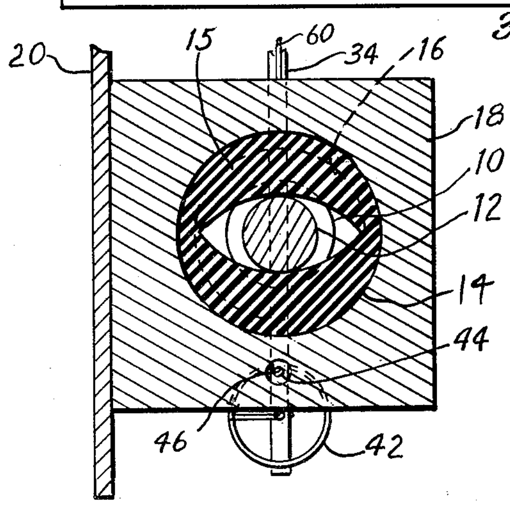

Fig.3.

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MECHANICAL VIBRATOR SIGNALLING DEVICE

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This invention relates to a signal generating device of the sonic or supersonic resonator variety, and more specifically to a novel means of exciting the resonator of such a device and automatically resetting the exciting mechanisms.

Signal generating units of the type generally employing a longitudinal-mode resonator rod and a striking hammer are now well known in the art of remote control electronic devices. Vibrations of accurately predetermined frequency and prolonged intensity can be produced mechanically by applying a single, discrete blow to one end of such a resonator if it is nodally supported for minimum damping. In order to be commercially feasible the mechanical means for delivering the required discrete blow and resetting itself must be easily operated, effective, and economical to manufacture. For most effective operation the hammer applying the actuating blow must strike with considerable energy but be definitely restrained from striking a second time and damping the resultant vibration.

Accordingly, it is an object of this invention to provide a manually operable striking mechanism for a longitudinal-mode resonator rod that will impart maximal vibrational energy to the rod with minimal damping.

Another object of this invention is to provide an economical but easily operable ultrasonic transmitter capable of producing a signal of predetermined frequency and prolonged high amplitude.

A further object of this invention is to provide a simple resonator-actuating mechanism that can deliver a single, discrete blow to the resonator and return itself to its original pre-actuation position.

An additional object of this invention is to provide a novel combination of a toggle mechanism, a spring restrained striking hammer actuated through the toggle mechanism and associated linkage to deliver a single, discrete blow to the end of a longitudinal-mode resonator rod, and an overriding return spring.

Moreover, it is an object of this invention to provide a novel remote control transmitter with a high energy signal produced by entirely mechanical means.

Other objects of this invention are to provide the above features and advantages together with a damping element that is selectively engageable with the resonator rod to halt signal transmission when desired.

Still other and further advantages and objects of the present invention will become apparent from examination of the detailed disclosure and drawings in this case and from a reading of the claims.

A preferred embodiment of this invention is illustrated by the accompaning drawings in which:

FIGURE 1 is a side elevation of the signalling device, showing it in its unactuated or rest position.

FIGURE 2 is a side elevation, with the resonator rod mounting shown in section, of the signalling device, of FIGURE 1 in its actuated position at the instant of impact between the hammer and the resonator rod.

FIGURE 3 is an enlarged cross-sectional view taken along line 3—3 of FIGURE 2 and showing in detail the mounting for the resonator bar.

Referring now to the drawings, in which like elements are designated by like reference numbers, a solid cylindrical, longitudinal-mode resonator rod 10 is provided with an annular groove 12 midway between its ends, by means of which the rod 10 is received and supported between two portions of a flexible diaphragm. Diaphragm

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portion 14 is disposed in the lower half and diaphragm portion 15 in the upper half of a circular hole 16 in a projecting flange portion 18 of a flat mounting plate 20, so that the resonator rod is loosely held between the portions 14 and 15 and caused to lie parallel to and adjacently spaced apart from the mounting plate 20.

Also mounted on plate 20 are first and second lever assemblies 22 and 24 respectively and four stops (26, 28, 30 and 32). The first lever assembly 22 is spaced farther from the plate 20 than is the second lever assembly 24 so as to provide rotational clearance between their overlapping arms.

First lever assembly 22 comprises a short arm 34 extending vertically past the right end of the horizontally disposed rod 10 and a long arm 35 extending horizontally above rod 10 and being integrally attached to short arm 34 at its upper end. The assembly 22 is pivotally mounted on vertical plate 20 through a pin 36. A notch 38 is provided in the lower right portion of short arm 34 for receiving the end hook portion 40 of a horizontally disposed helical tension spring 42. The left end of spring 42 is provided with a hook portion 44 which is received in a hole 46 in flange 18 so that spring 42 acts in tension between flange 18 and short arm 34 to provide a strong clockwise moment to assembly 22. A push button 54 is mounted on the top portion of long arm 35 approximately mid-way between its ends. Notches 56 and 58 are provided in long arm 35 near its pivot end for receiving a heavy damping wire 60. The damping wire 60 is securely wrapped around arm 35 and extends downwardly from arm 35, terminating in a curved portion 62 that lies opposite rod 10 and is engageable with its right end to effect dampening of its vibrations. Stops 26 and 28 are vertically spaced apart on plate 20 and are engageable with the upper and lower edges respectively of long arm 35 thereby limiting its rotational movement to about ten degrees. Arm 35 is provided at its free end with a small hole 50 adapted to receive one leg 51 of a bi-stable torsion spring 52.

Second lever assembly 24 is pivotally mounted on plate 20 through a shaft 64 that is positioned slightly to the left of the free end of arm 35 and opposite the approximate center of the ten degree arc segment described by its free end. The assembly 24 comprises a short leg 66 extending generally to the right from shaft 64 and an integral, longer, arcuate leg 70 extending generally to the left from shaft 64, then downwardly, and finally to the right, terminating in an upturned flange portion 72. The flange portion 72 is provided with a hole 74 for loosely receiving the shaft 76 of a hammer 78. Stops 30 and 32 are angularly spaced apart on plate 20 and are engageable with the top (or back) edge and the bottom (or front) edge, respectively, of arcuate arm 70, thereby limiting its rotational movement to about 45 degrees. Flange 72 is positioned to be vertically perpendicular to plate 20 and opposite the left end of rod 10 when arm 70 is against its lower stop 32. The hammer 78 is provided with a curved striking face 80 aligned for percussive engagement with the left end of rod 10. The left end of hammer 78 is provided with a pyramidal knob 82, the base of which provides a shoulder for restraining a compression spring 84 that is helically wound about shaft 76. The right end of spring 84 bears against the back of flange 72 and normally urges the hammer 78 into engagement with the front surface of flange 72 and out of engagement with the adjacent left face of the resonator rod 10. Short leg 66 is provided at its free end with a small hole 68 adapted to receive a second leg 69 of torsion spring 52.

The bi-stable torsion spring 52 comprises a single segment of spring wire helically wound about 420 degrees so that its two end portions 51 and 69 are of equal length, protruding from the coil portion at an angle of about 120 degrees from one another in the unstressed position. The end of each portion 51 and 69 is crooked away from the plane of the coil portion and is adapted for reception in holes 50 and 68 respectively of the first and second lever assemblies. The spring 52 is inserted in the assembly of FIGURE 1 or FIGURE 2 by elastically pinching together the leg portions 51 and 69 so they diverge by about 30 degrees and inserting the crooked portions in the holes provided. Spring 52 will then be disposed between the planes of lever assembly 22 and lever assembly 24 so as not to interfere with the rotational movement of either, and it will constantly urge the arm 35 apart from the leg 66 in the manner of a compression spring. As will be seen from the ensuing description of the actuation and recovery movements, the spring 52 may apply either the combination of a clockwise moment to lever assembly 24 and a counter-clockwise moment to lever assembly 22 (FIGURE 1) or the opposite combination (FIGURE 2) depending on the relative positions of the arm 35 and the leg 66.

Excitation of the resonator rod 10 through the mechanisms just described requires only that the knob 54 be pressed downward. When the knob is released, the mechanisms will return to their rest positions of FIGURE 1 and the vibrations will be damped. These reciprocal movements of "actuation" and "recovery" are described in detail in the following paragraphs.

During the actuation movement, as the button 54 is depressed, the first lever assembly 22 is caused to rotate counter-clockwise about its pivotal pin 36 and away from its rest-position stop 26. The bi-stable torsion spring 52, which is biased to urge its leg portions 51 and 69 away from one another and thereby acts as a special type of compression spring between its points of connection to lever assemblies 22 and 24, first urges the second lever assembly 24 against its rest-position stop 30 because its effective moment on lever assembly 24 is clockwise. However, as the point of connection between the first lever assembly 22 and its leg 51 of the torsion spring 52 passes the radial line between the axis of rotation of the second lever assembly 24 and the point of connection of the second lever assembly 24 with its leg 69 of the torsion spring 52, the torsion spring 52 begins to effect a counter-clockwise moment on the second lever assembly 24 away from its rest-position stop 30. Since this counter-clockwise moment is resisted only by the inertia of the second lever assembly 24 and by small frictional forces, the second lever assembly 24 and the hammer assembly 78 mounted thereon are rapidly accelerated counter-clockwise until the lever assembly 24 strikes the actuation-position stop 32. At this moment the lever assembly 24 suddenly stops, but the momentum of the hammer 78 continues to carry it forward against the compressive force of its associated spring 84. The springs 52 and 84, the spacing between the resonator rod 10 and the hammer face 80, and the masses of the hammer and lever parts are carefully designed so that the hammer 78 will have enough momentum to enable it to strike the rod 10 in a single sharp blow, but that after rebounding from the rod 10 the hammer will be restrained by spring 84 from rebounding off of flange 72 and again striking the resonator rod 10. This single sharp blow is necessary to produce the greatest amplitude of emitted vibration from the resonator rod.

It should also be noted that the actuation movement rotates the damping wire 60 away from contact with the resonator rod 10 before the hammer 78 strikes, and that the return spring 42 is additionally energized by the same counter-clockwise rotation of the first lever assembly 22.

The return spring 42 is so designed and located as to apply a greater rotational moment to the first lever 22 than does the torsion spring 52 when in the actuation position, so when the pressure on button 54 is released the

clockwise moment of spring 42 will overpower the counter-clockwise moment of spring 52 and return the mechanisms to their rest-positions. During the recovery movement, the torsion spring 52 will apply a counter-clockwise moment to the second lever assembly 24, urging it against its actuation position stop 32 until the point of connection between the first lever assembly 22 and its leg 51 of the torsion spring 52 reaches the radial line between the axis of rotation of the second lever assembly 24 and the point of connection of the second lever assembly 24 with the leg 69 of the torsion spring 52. Then the torsion spring 52 begins to apply a clockwise moment to the second lever assembly 24 which is resisted only by small inertial and frictional forces and causes the second lever assembly 24 to snap back against its rest-position stop 30. The recovery movement brings damping wire 60 back against the end of rod 10, rapidly damping the vibrations of rod 10.

The materials of construction of the mounting plate, the stops, the lever assemblies, shafts and flange portions are not critical, but may be of cast iron, rolled steel or lighter weight metal, or even plastics. The resonator rod should be of brass, aluminum, or other specially chosen material with low internal damping. It should be cut precisely to the length required for the frequency desired to be emitted and should be nodally mounted, as at its exact longitudinal center, through a flexible, non-restraining mount having minimal area of contact with the rod. The hammer should be of hard steel or alloy material and have a mass chosen to provide optimum striking characteristics. The diaphragm may be of rubber or various other suitable material, and may be held in position on its flange by an adhesive or by an auxiliary clamping plate. The stops may be cushioned and should preferably be positioned opposite the center of percussion of the levers with which they act. The knob may be of any suitable plastic material, and the damping wire may be of steel or other metal.

Numerous other modifications not specifically mentioned herein may be employed without departing from the spirit and scope of this invention, and it is not intended to limit the scope of the appended claims by the omission from this disclosure of such modifications.

What is claimed is:

1. In combination with a mechanical vibrational wave generator element for generating a vibrational wave of predetermined frequency and high initial amplitude responsive to impact by a hammer, exciter means including: a hammer carrier mounted for rotational movement; a hammer mounted to said hammer carrier for percussive engagement with said generator element; means, including a coil spring resiliently mounting said hammer on said hammer carrier, said spring normally maintaining said hammer in a first position relative to said hammer carrier; an operating lever having an actuated and a rest position; an over-center spring coupled between said operating lever and said hammer carrier; means normally biasing said operating lever to said rest position; said over-center spring being effective to rotationally accelerate said hammer carrier toward said generator element upon said operating lever being moved from said rest to said actuated position; and stop means abruptly stopping the movement of said hammer carrier near said generator element, said hammer rapidly moving into percussive engagement with said generator element and rebounding therefrom; said coil spring being effective to retract said hammer to said first position, whereby a single percussive contact between said hammer and said generator element is obtained.

2. A mechanical generator for generating an ultrasonic wave of predetermined frequency comprising: support means, a longitudinal mode vibrator element resonant at said predetermined frequency and nodally mounted on said support means; a hammer for percussive engagement with one end of said vibrator element; hammer carrying

means rotationally mounted on said support means; means resiliently mounting said hammer on said hammer carrying means; an actuation lever movably mounted on said support means; means normally urging said actuation lever to its rest position; toggle action spring means coupling said actuation lever and said hammer carrying means; first and second stop elements mounted on said support means, said hammer carrying means being normally urged against said first stop element by said actuation lever and said toggle action spring means; said toggle action spring means rotationally accelerating said hammer carrying means away from said first stop element and into engagement with said second stop element responsive to said actuation lever being moved to its actuated position, whereby said hammer carrying means is stopped abruptly; said hammer rapidly moving into percussive engagement with said end of said vibrator element and rebounding therefrom; the means resiliently mounting said hammer acting to retract said hammer upon rebound after initial impact to prevent further contact between said hammer and said vibrator element.

3. A mechanical generator for generating a compressional wave of predetermined frequency comprising: support means, a vibrator element resonant at said predetermined frequency mounted on said support means; a hammer for percussive engagement with said vibrator element; hammer carrying means rotationally mounted on said support means; means resiliently mounting said hammer on said hammer carrying means; an actuation lever movably mounted on said support means; means normally urging said actuation lever to its rest position; toggle action spring means coupling said actuation lever and said hammer carrying means; first and second stop elements mounted on said support means, said hammer carrying means being normally urged against said first stop element by said actuation lever and said toggle action spring means; said toggle action spring means rotationally accelerating said hammer carrying means away from said first stop element and into engagement with said second stop element responsive to said actuation lever being moved to its actuated position, whereby said hammer carrying means is stopped abruptly; said hammer rapidly moving into percussive engagement with said vibrator element and rebounding therefrom; the means resiliently mounting said hammer acting to retract said hammer upon rebound after initial impact to prevent further contact between said hammer and said vibrator element; and damping means coupled to and movable with said actuation lever contacting said vibrator element when said actuation lever is in said rest position.

4. A mechanical generator for generating an ultrasonic wave of predetermined frequency comprising: support means, a longitudinal mode vibrator element resonant at said predetermined frequency and nodally mounted on said support means; a hammer for percussive engagement with one end of said vibrator element; a vibration damper engaging said vibrator element at its other end; hammer carrying means rotationally mounted on said support means; a coil spring resiliently mounting said hammer on said hammer carrying means; an actuation lever movably mounted on said support means; means normally urging said actuation lever to its rest position; an over center spring coupling said actuation lever and said hammer carrying means; first and second stop elements mounted on said support means, said hammer carrying means being normally urged against said first stop element by said actuation lever and said over center spring; said over center spring rotationally accelerating said hammer carrying means away from said first stop element and into engagement with said second stop element responsive to said actuation lever being moved to its actuated position, whereby said hammer carrying means is stopped abruptly; said hammer rapidly moving into percussive engagement with said end of said vibrator element and rebounding therefrom; the coil spring resiliently mounting said hammer acting to retract said hammer upon rebound after initial impact to prevent further contact between said hammer and said vibrator element; and means coupled to said actuation lever moving said vibration damper out of engagement with said vibrator whenever said actuation lever is out of its rest position.

5. A mechanical generator for generating an ultrasonic wave of predetermined frequency comprising: support means, a longitudinal mode vibrator element resonant at said predetermined frequency and nodally mounted on said support means; a hammer for percussive engagement with one end of said vibrator element; a vibration damper engaging said vibrator element at its other end; hammer carrying means rotationally mounted on said support means; a coil spring resiliently mounting said hammer on said hammer carrying means; an actuation lever movably mounted on said support means; spring means normally urging said actuation lever to its rest position; an over center spring coupling said actuation lever and said hammer carrying means; first and second stop elements mounted on said support means, said hammer carrying means being normally urged against said first stop element by said actuation lever and said over center spring; said over center spring rotationally accelerating said hammer carrying means away from said first stop element and into engagement with said second stop element responsive to said actuation lever being moved to its actuated position, whereby said hammer carrying means is stopped abruptly; said hammer rapidly moving into percussive engagement with said one end of said vibrator element and rebounding therefrom; the coil spring resiliently mounting said hammer acting to retract said hammer upon rebound after initial impact to prevent further contact between said hammer and said vibrator element; means coupled to said actuation lever moving said vibration damper out of engagement with said vibrator element whenever said actuation lever is out of its rest position, said spring means being stronger than said over center spring to insure return of said actuation lever to its rest position upon release thereof.

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