April 10, 1962 G. L. GRUNDMANN 3,028,830

ULTRASONIC TRANSMITTER MECHANISM

Filed March 23, 1959 2 Sheets-Sheet 1

Fig. 1.

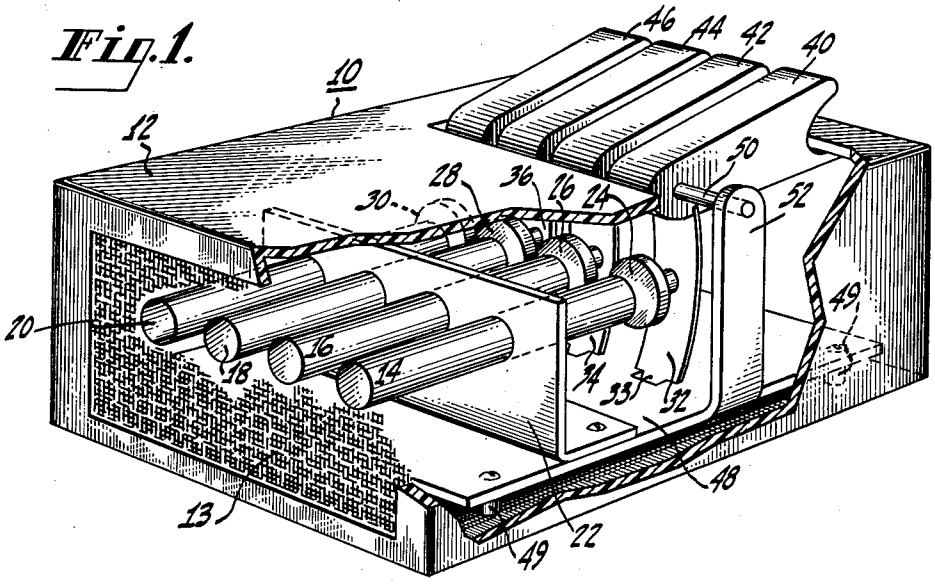


Fig. 2.

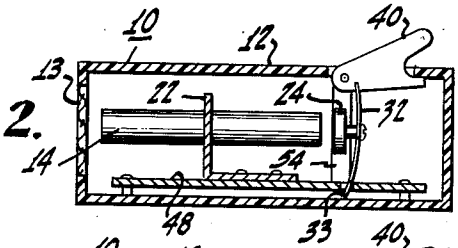


Fig. 3.

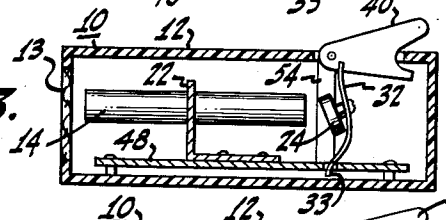


Fig. 4.

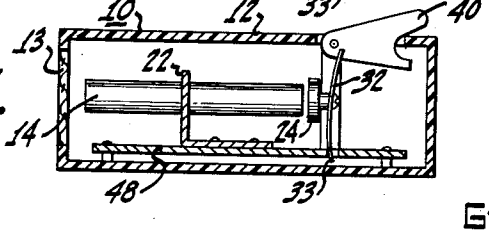


Fig. 5a.

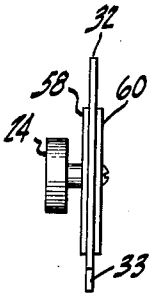
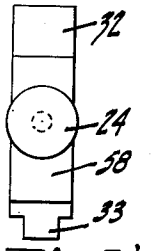


Fig. 5b.



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April 10, 1962 G. L. GRUNDMANN 3,028,830

ULTRASONIC TRANSMITTER MECHANISM

Filed March 23, 1959 2 Sheets-Sheet 2

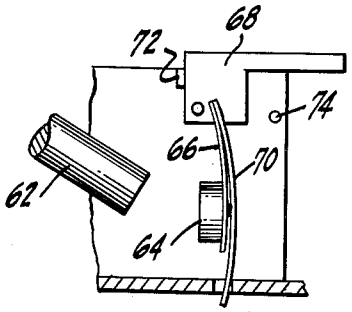


Fig. 6.

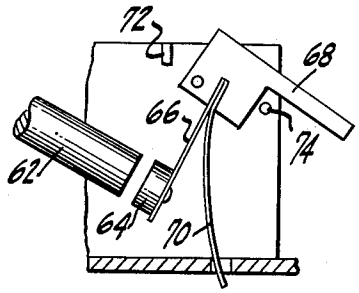


Fig. 7.

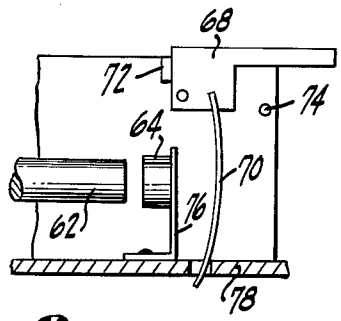


Fig. 8.

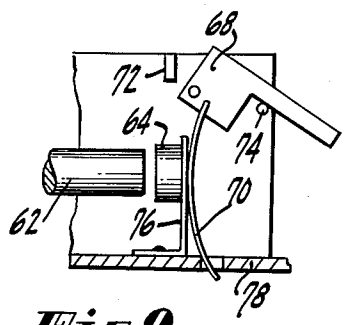


Fig. 9.

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ULTRASONIC TRANSMITTER MECHANISM

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Filed Mar. 23, 1959, Ser. No. 801,296
4 Claims. (Cl. 116—137)

The present invention relates to ultrasonic transmitters of the type using mechanical resonator elements to develop signals of predetermined frequency above the normal sonic range. More particularly, this invention relates to new and improved mechanisms for imparting mechanical energy to the resonator elements of such transmitters.

It is well known that ultrasonic waves can be generated by imparting mechanical energy to a resonant rod, or the like. If this energy is delivered to a portion of such a rod or resonator in the form of a sharp blow, vibrations occur in the resonator at a frequency determined by the physical dimensions of the resonator and the propagation velocity of sound in the material from which the resonator is formed. It is desirable that the hammer or other striking mechanism contact the resonator only during the actual delivery of mechanical energy thereto. Should the striking element be permitted to contact the resonator subsequent to the delivery of a blow, the resonator vibration will be damped, and the amount of vibratory energy available for radiation will be reduced. Mechanisms heretofore devised for causing a single striking of a mechanical resonator to impart mechanical energy thereto have been of complicated construction, requiring a relatively large number of component parts, and thereby increase the cost of the transmitter.

It is an object of the present invention to provide an improved mechanism for delivering mechanical energy to the resonator element used to generate a signal of predetermined frequency above the normal sonic range.

Another object of this invention is to provide an improved mechanism for imparting mechanical energy to a rod, or the like, which is extremely simple in construction and lends itself to large quantity production at low cost.

An ultrasonic generator in accordance with the invention includes a mechanical resonator element such as a cylindrical rod of suitable material which may be excited into vibration by a sharp blow imparted thereto. The resonator striking mechanism includes a striking element or hammer and an associated resilient member, such as a leaf spring. An operating member, such as a manually operable push-button directly connected to the resilient member, is actuatable to exert flexing and compressive forces on the resilient member to cause it to snap suddenly from a first position to a second position. The resilient member is associated with a hammer in a manner that the snap action imparts mechanical energy to the hammer causing it to deliver a single sharp blow to the resonator. The impingement of the hammer on the resonator excites the resonator into vibration causing an ultrasonic wave to be radiated, the frequency of which corresponds to the natural frequency of the resonator. Upon release of the compressive force exerted by the operating member, the resilient member snaps back to its first position and in so doing provides the restoring force necessary to return the operating device to its initial position.

The novel features that are considered characteristic of this invention are set forth with particularity in the appended claims. The invention itself, however, both as to its organization and method of operation, as well as

additional objects and advantages thereof, will best be understood from the following description when read in connection with the accompanying drawing in which:

FIGURE 1 is a perspective view, partly broken away, of an ultrasonic transmitter constructed in accordance with the present invention;

FIGURES 2, 3 and 4 are diagrammatic views on a smaller scale, of the ultrasonic transmitter shown in FIGURE 1 illustrating the operation of the striking mechanism of the invention;

FIGURES *5a* and *5b* are side and front views, respectively, of a modification of the leaf spring construction used in the ultrasonic transmitter shown in FIGURE 1.

FIGURES 6 and 7 are diagrammatic representations on a reduced scale of another embodiment of the striking mechanism of the invention; and

FIGURES 8 and 9 are diagrammatic representations on a reduced scale of still another embodiment of the striking mechanism of the invention.

Referring now to the drawings wherein like reference numerals will be used to designated similar elements throughout, and particularly to FIGURES 1 through 4, an ultrasonic trnasmitter **10** is provided which is particularly adapted for remote control applications, such as, for example, the remote control of signal receivers, phonographs, etc. The transmitter **10** includes a casing **12** having an opening in one end thereof covered by a suitable grillwork **13** which permits supersonic waves to be radiated from the casing. Enclosed within the casing **12** are four cylindrically shaped longitudinal mode mechanical resonators **14**, **16**, **18** and **20** which are loosely supported at their centers by a bracket **22**. The resonators preferably comprise a rod of aluminum or other material having an inherently low internal damping factor. Separate striking elements or hammers **24**, **26**, **28** and **30** are provided for each of the resonators **14** through **20** respectively. The hammers are carried respectively by the resilient members **32**, **34**, **36** and another resilient member (not shown), and are affixed thereto by screws or other suitable fastening means. As shown in the drawings, the resilient members comprise leaf springs. The upper end of each of the resilient members **32** through **38** are securely affixed to operating members such as the push-buttons **40**, **42**, **44** and **46**, respectively, by adapting each of the push buttons **40**, **42**, **44** and **46** to provide supporting means therefor. The opposite ends of the resilient members are provided with tabs **33** which extend through an aperture in a frame member **48** to provide supporting means to retain the springs in the desired positions. To prevent the casing **12** from interfering with the tab ends of the resilient members, the frame **48** is spaced from the casing by spacers **49**.

The push-buttons are bifurcated and are pivotally supported on mounting means such as a rod **50** which extends between a pair of end plates **52** and **54** which are integral with the frame **48**.

Where the transmitter is designed for use in a television receiver remote control system, the transmitted ultrasonic signals are received by a special receiver usually located in a television receiver cabinet. The remote control receiver is responsive to ultrasonic signals of different frequencies to actuate different control circuits. For example, ultrasonic signals of one frequency may be used to actuate the television receiver power on-off control circuit, whereas ultrasonic signals of other differing frequencies might be used to control the television receiver volume, tuning in a forward direction, or tuning in a reverse direction. For such an application each of the resonators incorporated in the ultrasonic transmitter **10** are made to resonate at different ultrasonic frequencies

so that depression of different ones of the push-buttons cause supersonic signals of different frequencies to be radiated. For example, the push-button 40 causes excitation of the resonator 14 to produce a first ultrasonic signal that may control the application of power to a television receiver and the push-buttons 42, 44 and 46 respectively could control the television receiver volume, tuning in a forward direction, and tuning in a reverse direction.

The manner in which the push-buttons cause the hammer to strike the mechanical resonators is best shown diagrammatically in FIGURES 2, 3 and 4 by illustrating the operation of one of them, such as the push-button 40. The initial position of the striking mechanism is shown in FIGURE 2. In this position, due to the relative positioning of the pivotal mounting means or rod 50 (not shown) location on the push-button 40 at which the resilient member 32 is supported or secured, the push-button is biased in a counter-clockwise direction due to the force exerted by the resilient member 32. However, the push-button 40 is bifurcated and the lower bifurcation engages the underside of the top of the cabinet structure preventing further counter-clockwise movement of the push-button 40, thus defining a first limit position therefor. As the push-button 40 is depressed, the upper end of the resilient member 32 is flexed in a clockwise direction. The depression of the push-button 40 also exerts a compressive force on the resilient member 32, which together with the flexing action causes it to deform in the manner indicated in FIGURE 3. Further depression (that is clockwise rotation) of the push-button 40 causes the resilient member 32 to suddenly snap to the position shown in FIGURE 4. Further, clockwise movement of the push-button 40 is prevented due to the engagement of the upper bifurcation of the push-button 40 with the top surface of the casing 12, thus defining a second limit position for the push-button 40.

FIGURE 4 shows the hammer 24 in its rest position after striking the resonator 14 with the push-button 40 still depressed. In this position it will be noted that the hammer 24 does not touch the end of the resonator 14. However, when the resilient member 32 snaps, sufficient mechanical energy is imparted to the hammer to cause it to overtravel and solidly strike the resonator 14. The restoring force of the resilient member 32 prevents multiple contacts between the hammer 24 and the resonator 14 and thereby avoids damping of the resonator which would reduce the amount of vibratory energy available for radiation. When the push-button 40 is released, the resilient member 32, which is under stress, applies an upward force to the push-button 40 causing it to return to its original position as shown in FIGURE 2.

In order to impart a greater amount of mechanical energy to the hammer 24 when the resilient member 32 snaps from the position shown in FIGURE 3 to the position shown in FIGURE 4, the resilient member 32 may be modified as shown in FIGURES 5*a* and 5*b*. In the modified form, the resilient member 32 is sandwiched between a pair of helper springs 58 and 60 which extend over a major portion of the length of the resilient member. The helper springs are urged tightly against the resilient member 32 by a screw or other suitable fastening means for supporting the hammer 24. The helper springs 58 and 60 not only enhance the snap action but also increase the restoring force for returning the push-button 40 to its normal rest position as shown in FIGURE 2.

FIGURES 6 and 7 diagrammatically illustrate (partially in outline form) a modification of the invention wherein the hammer is not directly supported on the resilient member. In this modification, a mechanical cylindrical rod resonator 62 for generating ultrasonic signals, which is shown partly broken away, is positioned at an angle to a striking member or hammer 64 in the initial or rest position as shown in FIGURE 6. The hammer is supported at one end of a cantilever leaf spring 66 which extends from a manually operable push-button 68. A resilient member 70, which in the normal rest position is directly behind the cantilever spring 66 and in engagement therewith, is also supported by the push-button 68. As described above in connection with FIGURES 1 to 4, the push-button is normally urged upwardly against a stop 72 by the resilient member 70. The action of the resilient member as the push-button 68 is depressed is substantially the same as that shown in FIGURES 2 to 4 in that the snap action of the resilient member 70 from the position shown in FIGURE 6 to that shown in FIGURE 7 imparts mechanical energy to the hammer 64 causing it to overtravel and strike the end of the resonator 62. The restoring force of the cantilever spring 66 prevents multiple contacts between the hammer 64 and the resonator and thereby avoids undesirable damping of the vibrations set up in the resonator. As shown in FIGURE 6 and 7, clockwise movement of the push-button 68 is limited by a stop 74. The stops 72 and 74 may be mounted on or from a portion of the frame work (shown in outline form) which supports the components shown in FIGURE 6. After the push-button is released, the resilient member 70 provides the restoring force necessary to move the push-button 68 back to its original position.

FIGURES 8 and 9 show still another modification of the striking mechanism of the invention wherein the hammer 24 is supported by a cantilever spring 74 which is mounted on a supporting frame 78 for the transmitter apparatus. Thus, as the push-button is depressed, the resilient member 70 is caused to snap from the position shown in FIGURE 8 to the position shown in FIGURE 9 where it engages the spring 66 and causes mechanical energy to be imparted to the hammer 64. This causes the hammer 64 to deflect and strike the end of the resonator 62 to produce ultrasonic vibration therein. After striking the rod 72 the spring 66 causes the hammer 64 to be restored to its initial position so that multiple contacts between the hammer 64 and the resonator 62 are prevented.

What is claimed is:

1. A striking mechanism for an ultrasonic generator of the type including a mechanical resonator element which is excited into longitudinal mode vibration by a striking thereof, comprising, a pivotally mounted push-button, a frame member, a first flat spring member fixedly connected to said push-button and held in compression between said push-button and said frame member in proximity to but spaced from one end of said resonator element, a second flat spring member fixedly connected to said push-button in juxtaposition with said first spring member and on the side thereof facing said resonator element, a hammer supported on said second spring member adjacent said resonator, said push-button adapted to be manually depressed to cause pivoting thereof in a direction to flex and exert additional compression force on said first spring member to cause it to snap from its initial position to a second position imparting mechanical energy to said hammer causing it to strike said resonator.

2. An ultrasonic generator comprising, a rod shaped resonator element of the type which may be shock excited into vibration by a blow imparted thereto, a frame member, a pivotally mounted push-button, a leaf spring positioned in spaced relation to an end of said resonator and held under compression between said frame member and said push-button so that said leaf spring bows concavely with respect to said resonator, said push-button being actuatable in a direction to flex and exert further compression on said leaf spring causing it to snap from said concave position to a convex position with respect to said end of said resonator, means providing a striking element positioned in close proximity to but spaced from

said end of said resonator, a cantilever leaf spring mounted on said frame member for supporting said striking element, said striking element adapted to be engaged by said leaf spring in a manner that the snap action imparts mechanical energy to said striking element causing it to strike said resonator, and said leaf spring providing a restoring force for returning said push-button to the first position thereof.

3. In a signalling device of the type including a frame member on which is mounted a mechanical resonator excited into vibration by a striking thereof; the combination comprising an operating member for actuating said mechanical resonator; means adapting said operating member to provide first support means; means adapting said frame member to provide second support means; a leaf spring mounted between said first and second support means and having a length such that it is mounted under compression in a first position bowed concavely with respect to said mechanical resonator when said operating member is unactuated; means for pivotally mounting said operating member on said frame member for movement between a first and a second position such that said pivotal mounting means is positioned between said first support means and at least one end of said

mechanical resonator for both positions of said operating member; said operating member being adapted to pivot in response to a force applied thereto so as to exert a further compressive and rotatable force on said leaf spring to cause it to snap to a second position bowed convexly with respect to said mechanical resonator; said leaf spring in both the first and second position thereof urging said operating member in the same direction, whereby the further compressive force in said spring in the second position thereof provides a restoring force which returns said spring to the first position thereof when the applied force is removed; and striking means positioned to receive energy from the snap action of said spring to strike said mechanical resonator setting up vibrations therein.

4. A signalling device as defined in claim 3 wherein said striking means is affixed to said leaf spring.

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