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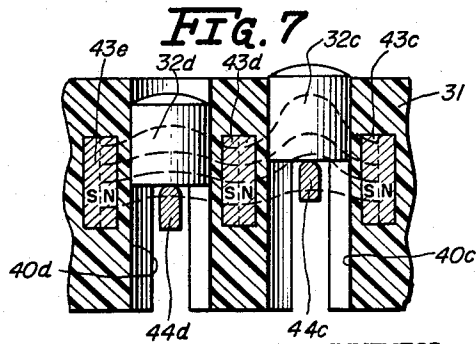
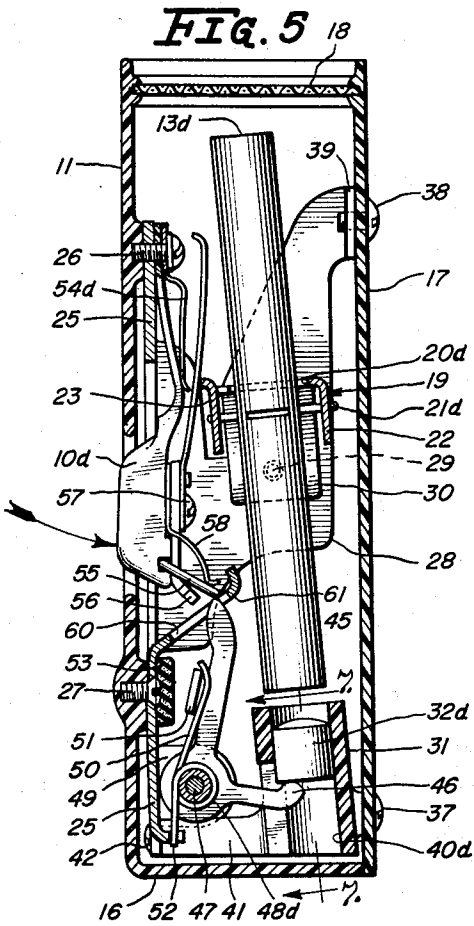
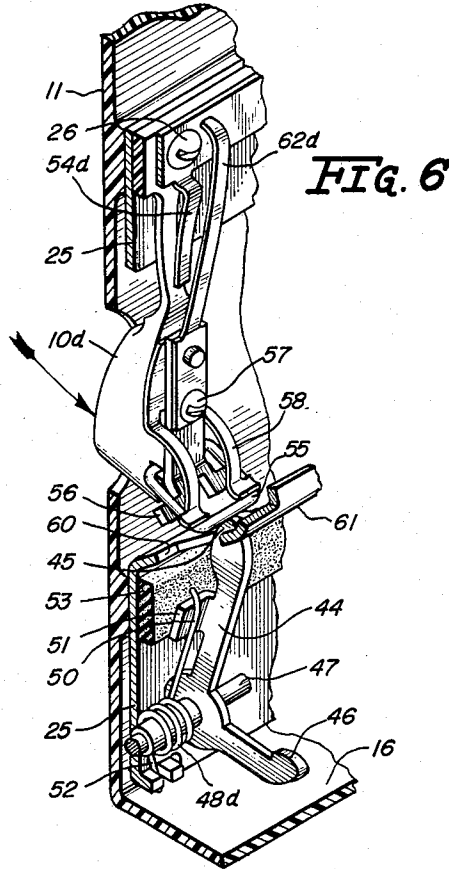
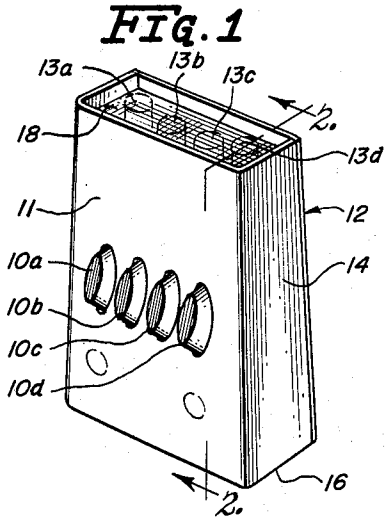
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3,118,423

ULTRASONIC SIGNAL GENERATORS

Filed Oct. 9, 1961

2 Sheets-Sheet 1



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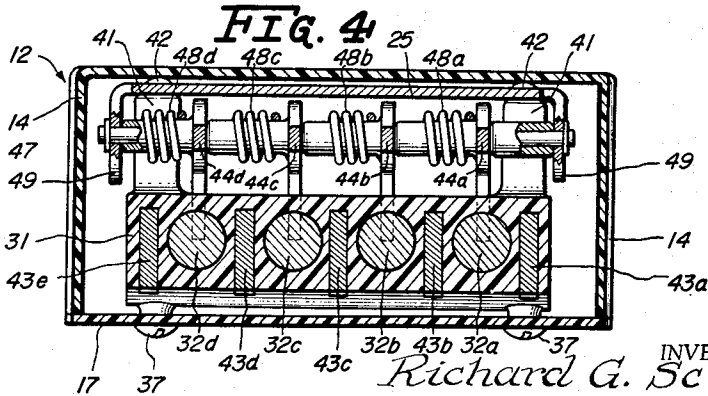
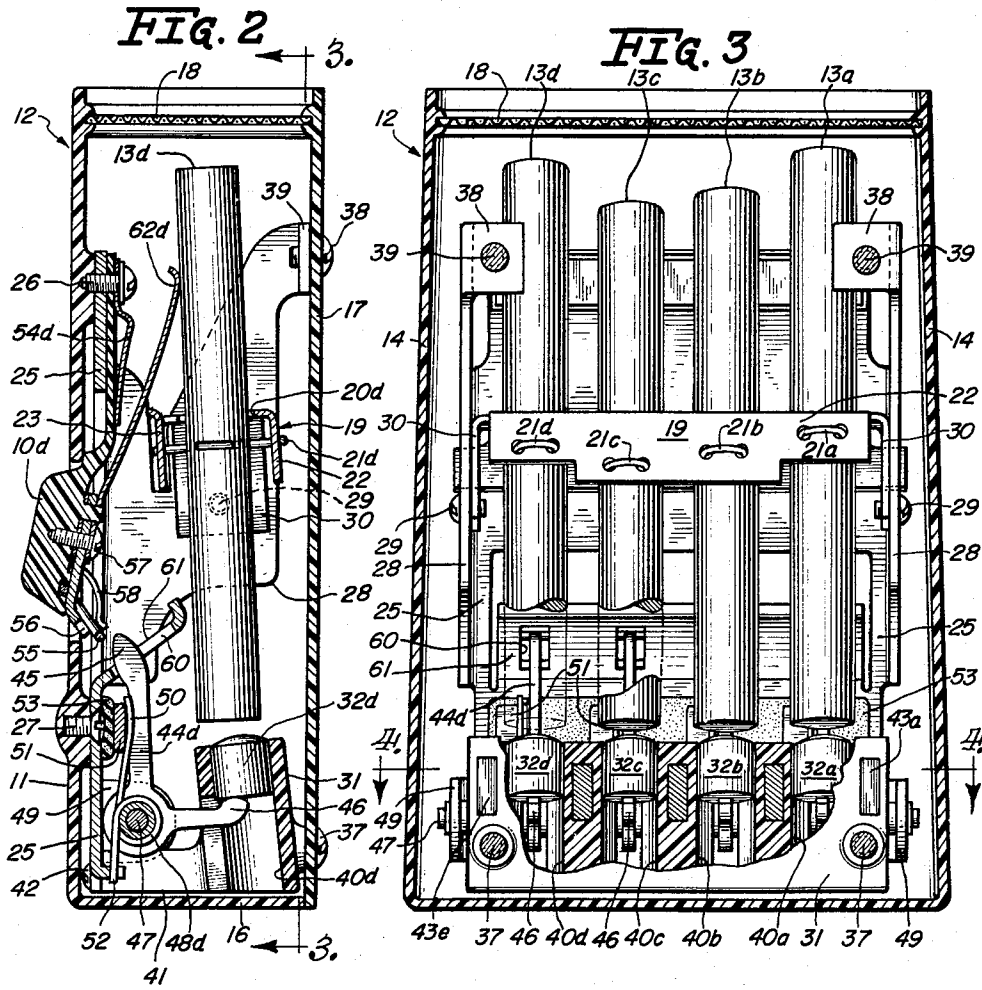
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2 Sheets-Sheet 2



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ULTRASONIC SIGNAL GENERATORS

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 Filed Oct. 9, 1961, Ser. No. 143,335
 8 Claims. (Cl. 116—137)

The present invention relates to a signal generator of the type using a mechanical resonator element to generate a signal of predetermined frequency, preferably above the normal sonic range. More particularly, it relates to such a transmitter featuring a new and improved mechanism for imparting mechanical energy to the resonator element.

Ultrasonic transmitters for use in remote control systems are well known in the television art. An example of such a transmitter is described and claimed in Patent No. 2,821,955—Ehlers et al. assigned to the present assignee. Several similar transmitters operating on the same principle have been used throughout the television industry for remote control purposes. While these transmitters are generally satisfactory, at least some have such complexity as to result in increased cost and attendant problems of adjustment and service.

For the user's standpoint, the previous forms of mechanical transmitters are at times so large in size as to make their hand-held operation unwieldy. Moreover, it has been difficult to actuate certain of the transmitters, and their operation has created objectionable noise.

Accordingly, it is an object of the present invention to provide a new and improved signal generator of the type using a mechanical resonator element.

It is another object of the invention to provide an ultrasonic signal generator which is more compact than predecessor devices.

It is still another object of this invention to provide an ultrasonic signal generator of more economical and simple construction.

It is still another object of this invention to provide an ultrasonic signal generator which has improved efficiency as compared to similar signal generators of the prior art.

It is a particular object of this invention to provide an ultrasonic signal generator which is relatively noiseless in operation.

A signal generator constructed in accordance with the present invention comprises a vibrator and a mechanical exciter. Permanent magnet means are provided for magnetically captivating the exciter and additional means are provided for launching the exciter into contact with the vibrator to set it into vibration.

In accordance with another aspect of the invention, an ultrasonic signal generator includes a support member supporting a mechanical vibrator. A guide member having a guide channel is provided in juxtaposition with the vibrator and a projectile is movable from a rest position along the guide channel into contact with the vibrator. Means are provided including a manually operated actuator for propelling the projectile along the channel to impact the vibrator to initiate vibrations. Finally, means are provided for restoring the projectile to its rest position.

The features of the present invention which are believed to be novel are set forth with particularity in the appended claims. The invention, together with further objects and advantages thereof, may best be understood by reference to the following description taken in connection with the accompanying drawings, in the several figures of which like reference numerals identify like elements, and in which:

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

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FIGURE 2 is an enlarged partial sectional view taken along line 2—2 of FIGURE 1;

FIGURE 3 is a sectional view, partially cut away, taken along line 3—3 of FIGURE 2;

FIGURE 4 is a sectional view taken along line 4—4 of FIGURE 3;

FIGURE 5 is a partial sectional view similar to FIGURE 2 showing the operating mechanism in a different position;

FIGURE 6 is a fragmentary perspective view, partially in section, of a portion of the device shown in FIGURE 5; and

FIGURE 7 is a further enlarged partial sectional view taken along line 7—7 of FIGURE 5.

The ultrasonic transmitter shown in FIGURE 1 is capable of controlling several operating characteristics of a television receiver. It is of such a size and weight as to be conveniently portable and hand held by the user and includes four ultrasonic signal generators of similar construction. The components of the individual generators are distinguished from one another by subscripts *a*, *b*, *c* and *d* although it is convenient, when referring to the generators without particularizing as to any one, to emit the subscript in the text. For example, each generator has a push button actuator 10, identified individually in FIGURE 1 by reference characters 10*a*, 10*b*, 10*c* and 10*d*. The actuating buttons extend through a front panel 11 of a housing 12. Each push button is associated with a vibrator rod 13 constructed of aluminum or other metal having a suitable mechanical Q or ring time to serve as a longitudinal mode vibrator. The user may selectively actuate or set into vibration any one of the rods by pressing the button associated with this rod.

When a signal is generated in response to the user's pressing a transmitter button the signal transmitted has a frequency determined by the rod that has been set into vibration and the remotely controlled television receiver is equipped with a receiving arrangement to receive and utilize this signal. A very successful remote control receiving system, featuring the use of a multiplicity of command signals distinguished from one another by the frequency of the transmitted energy is the subject of United States Letters Patent No. 2,817,025, issued on December 17, 1957 in the name of Robert Adler and assigned to the same assignee as the present invention. As there described, the controlled functions of the television receiver are on-off switching, channel selection, and sound muting. Channel selection is achieved by appropriate energization of a bi-directional motor which drives a turret type tuner in either clockwise or counterclockwise direction. Since four separate and distinct functions are contemplated, the arrangement requires a companion transmitter capable of generating four different command signals, two to permit control of the tuning motor in each of two directions and one each for the on-off and sound muting. The transmitter of FIGURE 1 is especially suited for use with this type of receiver.

The command signals generated take the form of bursts or pulses of acoustical energy generated and transmitted upon the actuation of ultrasonic vibrator rods 13. The length of each vibrator in combination with the velocity of signal propagation therein, determines the signal frequency resulting from its being excited.

The transmitter housing 12 includes in addition to front panel 11, two side portions 14, a bottom portion 16 shown in FIGURES 2 and 3, a back panel 17 and a wire mesh 18 placed in front of the vibrator rods and serving as a sound outlet. The mesh is retained in position by engagement with front panel 11, side portions 14, and back panel 17. Since the ultrasonic command signal generated by any vibrator rod must pass through this screen, the spacing of the grid elements forming the screen is chosen

for minimum signal attenuation for the band of ultrasonic signals which are to be used in the remote control system. In the system, disclosed in the Adler patent it has been found expedient to use an ultrasonic frequency band centered at approximately 40 kilocycles.

Vibrator rods 13 are mounted by means of a support assembly 19, shown in FIGURES 2 and 3, which is a U-shaped member having four circular apertures 20 through which vibrator rods 13 extend. Apertures 20 are of sufficient diameter to allow the rods to vibrate freely without physically contacting the aperture. The rods are held in the center of the apertures by means of four U-shaped spring wires 21. The bite of the spring-wire U is positioned on one side 22 of support member 19 while the two leg portions pass through support member 19 and through space opposed slots milled in the rod finally to be captivated by a bottom portion 23 of the support assembly as best shown in FIGURE 2. Each rod is securely held at its nodal plane located approximately midway between the two ends of the rod and the wire-spring mounting at the nodal plane allows full freedom of vibration while at the same time holding the rod firmly against dislodgement even though it is excited by a hammer or similar blow applied at one end and along the axial direction of the rod. The details of the spring wire mount at a nodal plane are fully described and claimed in Patent No. 2,821,956 by O. E. Wold assigned to the present assignee.

Support member 19 and the associated actuating mechanism for the vibrator rods are mounted on a frame 25 which is affixed to front panel 11 by threaded fasteners 26 and 27 as illustrated by the two fasteners shown in FIGURE 2. Support frame 25 includes two side members 28 which project upwardly from frame 25 on opposite sides of member 19 which is affixed thereto by means of a pair of threaded fasteners 29 extending through side members 28 and folded-down tab extensions 30 of member 19. Back panel 17 of the transmitter case also serves to anchor frame 25, being affixed to side members 28 by means of threaded fasteners 38 which are threaded into tab portions 39 extending from side members 28.

Vibrator rods 13 may be selectively excited by being struck on an end by means of exciters guided in a suitable guide member 31. More specifically, guide structure 31 which is secured to back panel 17 of the transmitter case by screws 37 contains four cylindrical guide channels 40 positioned to be associated with the end portions of respective vibrator rods 13a-d. The rod exciters take the form of projectiles 32 slidably mounted in the cylindrical guides.

Each guide channel 40 has a front termination adjacent an assigned one of the vibrator rods 13 and a back termination adjacent bottom panel 16. The guide channels are long enough to accommodate both the projectile and the travel of a launching device to be discussed in detail below. The entire guide member structure 31 is fastened to support frame 25, as best shown in FIGURE 4, by a pair of legs 41 which are affixed to the frame by a pair of threaded fasteners 42. Guide member 31 is positioned on frame 25 so that the front terminations of the four guide channels are spaced from their respective vibrator rods a distance less than the axial length of an individual projectile. This spacing will, of course, prevent the projectile from falling out of the guide channel when striking a rod. Furthermore, the central axis of each channel is substantially coincident with the axis of a vibrator rod thereby insuring that the projectile will impact a rod at its center to effect the greatest transfer of mechanical energy.

Means are provided for establishing a magnetic field transversing guide channels 40. These magnetic field means comprise strip magnets 43, shown in FIGURES 3 and 4, frictionally mounted in slots in guide member 31 adjacent guide channels 40, each guide channel having a permanent magnet positioned on each side thereof. The magnets are transversely polarized, as shown in FIGURE

7, one side being a north pole and the other side a south pole, and are so arranged with relation to one another that a magnetic field running from a north to a south pole is produced across a given guide channel as illustrated in the figure.

Projectiles 32 are made of magnetic material such as soft steel and constitute a portion of the magnetic circuit for the field, the circuit exhibiting a condition of minimum reluctance when the projectiles are in a predetermined position. This position of minimum reluctance is that in which the projectile is more completely within the magnetic field path. More specifically, a condition of minimum reluctance is achieved, referring to FIGURE 7, when the center of mass of projectile 32 coincides with a median line drawn between adjacent strip magnets 43. In the operation of the transmitter a projectile never actually reaches such a position.

In accordance with magnetic field theory, any displacement of a projectile 32 from its position of minimum reluctance causes a magnetic captivating force to be set up which urges the projectile to return toward its position of minimum reluctance provided of course that while the projectile has been displaced from its position of minimum reluctance, it remains at least partially within the magnetic field. The theoretical basis for this is that the so called magnetic lines of flux seek the easiest path between the poles of the magnets.

Assuming the rest or normal position of the projectile to be close to its theoretical minimum reluctance position, it must be displaced therefrom and driven against the end of its associated vibrator in order to generate a command signal. This is accomplished by a launching mechanism. The means for launching projectiles 32 into contact with vibrator rods 13 include actuating levers 44 shown in FIGURES 2-4. These levers are pivoted bell cranks having a first end portion 45 to be displaced by actuation of a push button 10 and a second end portion 46 projecting into guide channel 40 into engagement with a projectile 32. The levers are pivoted intermediate their end portions on a common axis 47 which is journaled on a pair of tabs 49 struck from support frame 25.

Springs 48 coiled about pivot 47 serve as resilient means for biasing each bell crank 44 in a counterclockwise direction to present end portion 46 toward the front end of guide channel 40. One end 50 of each spring is retained, as best shown in FIGURE 2, by a tab 51 which extends from and across bell crank 44. The other end of spring 48 abuts against an upstruck tab 52 of support frame 25. A resilient stop member 53, which may be a piece of rubber or sponge, is mounted on support frame 25 to engage tab 51 and limit counterclockwise movement of the bell crank lever.

As shown in FIGURE 2, bell crank 44 is in its normal or rest position. While in this position, the lever acts as one of the equilibrium forces holding the projectile 32 associated with the lever in a rest position illustrated by projectile 32c in FIGURE 7. The opposing equilibrium force is the magnetic field between magnets 43c and 43d. If the position of minimum reluctance is near that shown for projectile 32d in the same figure, it is apparent that bell crank lever 44 in its rest position holds projectile 43 displaced a predetermined distance from the position of minimum reluctance. Accordingly, the magnetic field urges the projectile into contact with end portion 46 of the bell crank thus captivating the projectile in its guide channel.

Manually operable push buttons 10 constitute means for actuating bell crank levers 44. The push buttons are mounted from support frame 25 by threaded fasteners 26 and move in a continuous path from a first position to a second position the first or rest position being shown in FIGURE 2. The second position is reached when the user presses the button to actuate the ultrasonic signal generator and is shown in FIGURES 5 and 6. The buttons themselves are constructed of a plastic type material

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and are provided with leaf springs 54 which are mounted on frame 25 by fasteners 26, the springs urging the buttons to their first or rest position.

An elongated flexible leaf spring 62 is attached to each button 10 by a fastener 57 and serves as a vibration damper for its associated rod 13. As shown in FIGURE 2 when button 10 is in its rest position an end of spring 62 contacts the side surface of vibrator rod 13 as a damper.

Flexible moving means mounted on push button 10 and responsive to movement of the push button through a first portion of its path of movement engage end portion 45 of bell crank 44 to actuate it. This means is clearly shown in FIGURE 6 and comprises a bail 55 pivotably mounted within a channel or recess on the underside of the button. The bail is abutted on one side by a retainer 56 which is affixed to the bottom side of the same button by fastener 57 and is flexibly or yieldably held on its other side by a bifurcated leaf spring 58 also retained on the rear side of the push button by fastener 57. In FIGURE 2, button 10 is shown in its first position with bail 55 out of contact with end portion 45 of bell crank 44 and in FIGURES 5 and 6, the bail is shown in contact with bell crank 44 rotating it in a clockwise direction against the bias of spring 48. The length of the bail is sufficient that its path of travel, in response to movement of push button 10, intercepts end portion 45 of its associated bell crank. Thus, when button 10 is actuated by the user, lever 44 is rotated storing energy in spring 48d.

End portions 45 of bell cranks 44 extend through slots 60 in a ramp 61 of support frame 25. The ramp is a trip means responsive to movement of the push button through a subsequent portion of its path of movement to displace bail 55 out of contact with end portion 45 of the bell crank 44. In FIGURES 5 and 6, bail 55 is shown displaced by ramp 61 to the point of allowing bell crank 44 to be released.

Operation

Each push button of the transmitter bears a suitable legend identifying the particular function of the controlled receiver which may be accomplished by actuating that button. When the user wishes to control that function, he actuates the push button. As the button is depressed into the body of transmitter case 12, its bail 55 moves into contact with end portion 45 of bell crank lever 44 to rotate it clockwise from its rest position of FIGURE 2 to an actuated position shown in FIGURES 5 and 6. During this movement, spring 48 is tensioned and bail 55 is cammed by ramp 61 to displace the bail away from engagement with end portion 45, allowing the bell crank to be rotated in a counterclockwise direction under the force of bias spring 48.

During the initial clockwise rotation of bell crank 44, projectile 32 is urged toward the rear of its guide channel 40 by the force of the magnetic field, always remaining in engagement with terminal portion 46 of the bell crank. In FIGURE 7 the position of projectile 32d represents the position which the projectile assumes when bell crank lever 44 is in its rearmost or actuated position. As shown contact is still retained between the projectile and terminal portion 46 of the lever since the projectile is displaced from a position of minimum reluctance. As mentioned above, whenever a projectile is not in its position of minimum reluctance a magnetic force urges the projectile toward this position. The final movement of button 10 past the position shown in FIGURES 5 and 6 releases bell crank lever 44 from bail 55 whereupon spring 48 drives the bell crank in a counterclockwise direction, thrusting its terminal portion 46 toward the front end of guide channel 40 and launching projectile 32 down the guide channel into impact with rod 13 to set it into vibration.

After having impacted the rod, projectile 32 rebounds toward the back end of guide channel 40. This return travel of projectile 32 is limited by terminal portion 46

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of bell crank 44 which has now returned to the position shown at 44c in FIGURE 7. The magnetic field in the channel captivates projectile 32 in its restored position resetting this portion of the transmitter for its next actuation. Therefore, magnets 43 may be considered as means for restoring the projectile to its rest position shown in FIGURES 2 and 3. The magnetic field essentially damps further movement of projectile 32 preventing multiple impact with rod 13 in response to a single actuation of push button 10. Thus the magnetic captivation provides for the desirable single-impact contact feature of the transmitter.

When push button 10 is actuated, leaf spring 62 is cammed out of contact with vibrator rod 13 by bottom portion 23 of support 19 to allow free longitudinal mode vibration of the rod when hit by projectile 32. After push button 10 is released spring 62 returns to its normal position in contact with the side of rod 13 and vibration of the rod is again damped. This terminates the command signal and avoids the possibility of multiple response in the receiver if the rod vibration were permitted to continue until terminated by self damping of the rod.

Bell crank lever 44 in "shooting" projectile 32 to impact vibrator rod 13 returns to its rest position shown in FIGURE 2. The release of push button 10 by the user, allows the button to return to normal under the urging of spring 54. The bifurcated spring 58 retaining bail 55 against support member 56 allows the bail to by-pass end portion 45 of bell crank lever 44 and return to its rest position. The device is now completely reset and is ready for another actuating at the will of the user.

Thus, the invention provides an ultrasonic transmitter which is less complex and inexpensive and yet is more efficient, quiet, and compact than transmitters which have previously been used in the remote control of television receivers.

While a particular embodiment of the invention has been shown and described, it will be obvious to those skilled in the art that changes and modifications may be made without departing from the invention in its broader aspects, and, therefore, the aim in the appended claims is to cover all such changes and modifications as fall within the true spirit and scope of the invention.

I claim:

1. A portable signal generator comprising: a vibrator; a mechanical exciter; permanent magnet means for magnetically captivating said exciter; and means for launching said exciter into contact with said vibrator to set it into vibration.

2. A portable hand-held ultrasonic signal generator comprising: a vibrator; a mechanical exciter supported for movement from a rest position to impact said vibrator; permanent magnet means for magnetically captivating said exciter in its aforesaid rest position; and means for launching said exciter into single impact contact with said vibrator.

3. A portable hand-held, hand-actuated ultrasonic signal generator for use in remote control systems and the like comprising: a support member; a mechanical vibrator mounted on said support member; a guide member having a channel in juxtaposition with said vibrator; an exciter of ferromagnetic material movable along said channel; means including a manually operated actuator for propelling said exciter along said channel to impact said vibrator and initiate vibration thereof; and permanent magnet means for subjecting said exciter to a magnetic field attracting it in a direction away from said vibrator.

4. A portable hand-held, hand actuated ultrasonic signal generator for use in remote control systems and the like comprising: a support member; a mechanical vibrator mounted on said support member; a guide member provided with a guide channel in juxtaposition with said vibrator; a projectile of ferromagnetic material movable from a rest position along said guide channel into contact with said vibrator; means including a manually op-

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erated actuator for propelling said projectile from its rest position along said channel to impact said vibrator and initiate vibration thereof; and permanent magnet means for releasably restraining said projectile in said rest position.

5. A portable hand-held, hand actuated ultrasonic signal generator for use in remote control systems and the like comprising: a support member; a mechanical vibrator mounted on said support member; a guide member having a guide channel substantially cylindrical in cross-section in juxtaposition with said vibrator; a cylindrical projectile of ferromagnetic material confined in said guide channel and movable from a rest position along said guide channel into contact with said vibrator; mechanical means including a manually operated actuator for propelling said projectile along said channel to impact said vibrator and initiate vibration thereof; and permanent magnet means for restoring said projectile to said rest position.

6. A portable hand-held, hand actuated ultrasonic signal generator for use in remote control systems and the like comprising: a support member; a mechanical vibrator; means for mounting said vibrator on said support member; a guide member fixed to said support member and provided with a guide channel in juxtaposition with said vibrator; a projectile of ferromagnetic material positioned within said guide channel; permanent magnet means for establishing a magnetic field substantially traversing said guide channel for resiliently retaining said projectile in a rest position within said guide channel; and manually operable means for launching said projectile from said rest position to impact with said vibrator with sufficient force to initiate vibrations in said vibrator and to rebound said projectile to said rest position.

7. A portable hand-held, hand actuated ultrasonic signal generator for use in remote control systems and the like comprising: a support member; a vibrator rod mounted on said support member; a guide member having a channel in substantial coaxial alignment with said rod; permanent magnet means for establishing a magnetic field transversely of said channel; a ferromagnetic projectile slidable in said channel from a rest position in which said projectile constitutes a portion of the magnetic circuit for said magnetic field which field urges said projectile toward said rest position; an actuating lever having an end portion projecting into said channel into engagement with said projectile and movable from a rest to an actuated position to propel said projectile along said channel to impact said rod; resilient biasing means for biasing said lever to its aforesaid rest position; and manually operable

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means for displacing said actuating lever to said actuated position against the force of said bias means to launch said projectile into impact with said rod and initiate vibrations therein.

8. A portable hand-held, hand actuated ultrasonic signal generator for use in remote control systems and the like comprising: a support member; a cylindrical vibrator rod mounted on said support member; a guide member having a cylindrical channel with front and back terminations and a central axis which is substantially coincident with the axis of said vibrator rod, said front termination being spaced a predetermined distance from said vibrator; a cylindrical ferromagnetic projectile slidable in said guide channel and having a length greater than said predetermined distance; means for establishing a magnetic field traversing said guide channel and urging said projectile towards a rest position said projectile constituting a portion of the magnetic circuit for said field which circuit exhibits a condition of minimum reluctance when said projectile is in a predetermined position; an actuating lever having a first end portion and a second end portion and pivoted intermediate such portions; resilient biasing means for biasing said first end portion of said lever in a direction toward said front termination of said guide channel for displacing said projectile a predetermined distance from said position of minimum reluctance, said projectile being retained in engagement with said first end portion by the magnetic force urging said projectile toward said position; a manually operable push button mounted to move in a continuous path from a first position to a second position; resilient means for urging said push button to said first position; flexible moving means responsive to movement of said button through a first portion of said path to engage said second end portion of said actuating lever and rotate the lever about its pivot against the bias of said resilient biasing means; and trip means responsive to movement of said push button through a second and subsequent portion of said path to displace said moving means out of contact with said second end portion of said lever to allow said resilient biasing means to rotate said lever causing said first end portion to launch said projectile into impact with said rod to initiate vibrations therein.

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