Jan. 12, 1965 T. D. SMITH 3,165,090

HIGH-FREQUENCY SONIC SIGNAL TRANSMITTER MECHANISM

Filed June 7, 1962

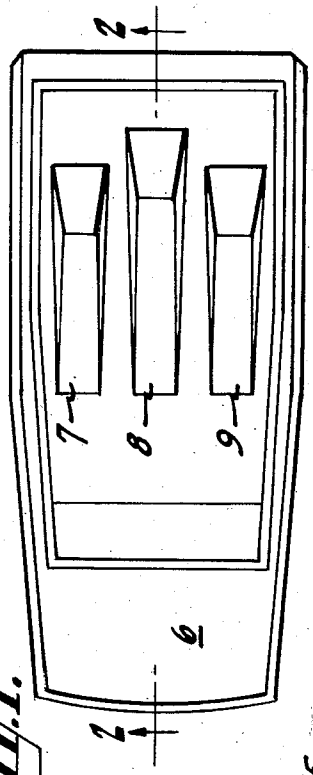


Fig. 1.

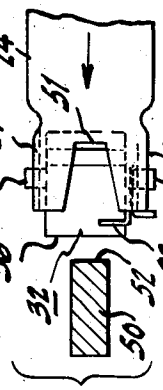


Fig. 3.

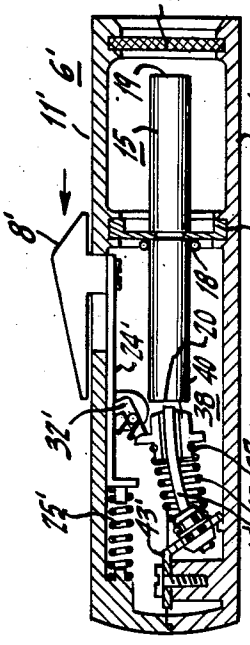


Fig. 4.

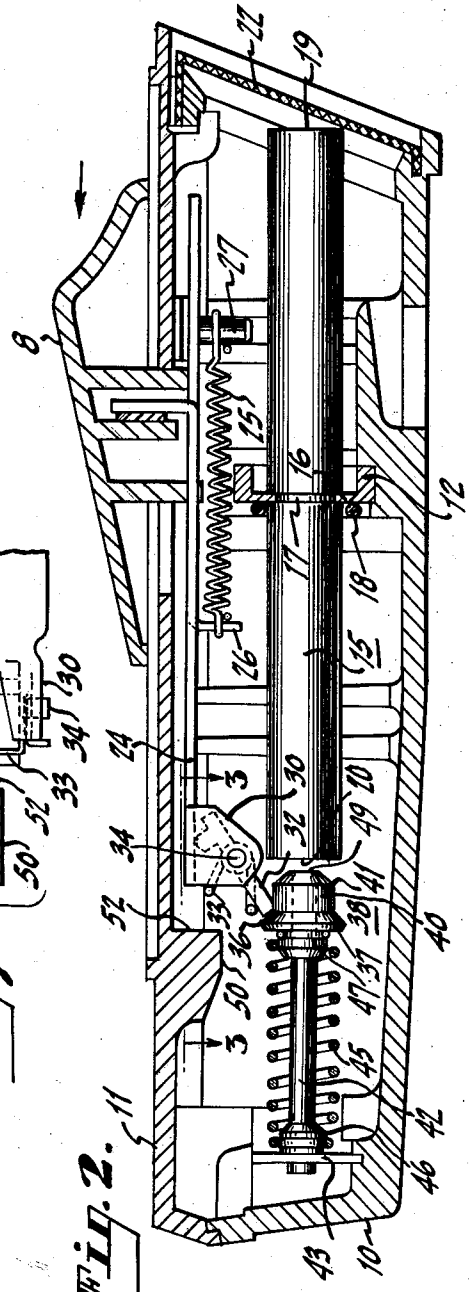


Fig. 2.

INVENTOR.
THEODORE D. SMITH
BY Eugene M. Whitacre
Attorney

United States Patent Office 3,165,090 Patented Jan. 12, 1965

3,165,090
HIGH-FREQUENCY SONIC SIGNAL TRANSMITTER MECHANISM

Theodore D. Smith, Indianapolis, Ind., assignor to Radio Corporation of America, a corporation of Delaware

Filed June 7, 1962, Ser. No. 200,870
6 Claims. (Cl. 116—137)

The present invention relates to high-frequency sonic signal transmitters of the unitary portable type now extensively used for remote control of television receivers and the like, and wherein a rod-type transducer or resonator element vibrating in the longitudinal mode is provided for converting mechanical energy, imparted thereto by hammer blows, into high-frequency sonic waves or sound signals. These are of predetermined frequency above a normal audible range, for radiation and transmission through the air to operate remote receiver and like control devices which are acoustically attuned and conditioned for response thereto.

A transmitter to which the invention relates thus includes a rod-like body of suitable material adapted to generate high-frequency sonic or like signals or signal pulses preferably above the generally audible sound range and of a predetermined frenquency, by mechanical vibration in the longitudinal mode in response to discrete hammer blows or like mechanical excitation delivered at one end thereof. Each hammer blow generates a train of exponentially-decaying longitudinal vibrations in the rod-like body at the natural longitudinal vibration frequency thereof, which is dependent upon its length and composition. The decay time may be controlled by applied damping.

As is known also, the length of the rod or body generally represents one-half wavelength of the fundamental frequency of vibration, and the rod or body is, therefore, held or supported at its center or midway between its ends in a plane normal to the axis and representing a nodal point of minimum vibration or displacement in response to longitudinal excitation. Maximum vibration then occurs at the ends of the rod or body for maximum-amplitude sonic signal or signal pulse radiation into space. Damping controls the duration of each signal or pulse.

It is an object of this invention to provide an improved actuator or excitation mechanism for a rod-type longitudinal-mode mechanical resonator unit for remote-control sonic signal transmission and the like.

It is also an object of this invention to provide an improved operating mechanism for a high-frequency sonic signal remote-control transmitter, for television receivers and the like, of the type having a longitudinal-mode mechanical resonator or transducer element responsive to hammer-blow excitation at one end.

It is a further and specific object of this invention to provide an actuator mechanism for a unitary portable sonic signal transmitter including improved striker or hammer means and mounting and operating means therefor, of simplified and low-cost construction and highly resistant to mechanical fatigue and failure in operation.

The actuator or operating mechanism of the present invention, for striking or mechanically exciting sound transducers of the type referred to, is of improved construction. For example it departs from the conventional or established mounting of the hammer or striker means on the free end of a cantilever spring element, which has several disadvantages in structure as well as manufacturing costs. In accordance with one embodiment of the invention, the hammer or striker means slides or moves in a guided path which is aligned with the axis of the transducer rod, and is under control of dual-function hammer-spring means of the helical coiled type which is structurally strong and not subject to fatigue after repeated operation. This provides improved cocking or loading and triggering action for the hammer or striker means.

The hammer, per se, is flanged and is pawl-operated or driven in response to reciprocating movement of a slide or carrier element which operates longitudinally and in parallel relation with respect to the rod-like resonator element. The hammer spring is preferably a helical coiled compression spring as referred to, which is loaded during each striking operation. In response to release or triggering of the hammer by a pawl element, it is driven forward to strike the transducer. The spring goes through a short extension and retraction action to withdraw and provide relief for the hammer from the transducer after the striking action. Central guide means for the hammer in coaxial relation to the hammer spring, together with improved mounting means, may provide further features of the actuator or operating mechanism of the present invention. Parallel or divergent directions of movement may be imparted to the hammer means with respect to the slide and driving pawl, for detent or self-tripping of the guided hammer means. In either case a single center guide rod may be provided.

The invention will, however, be further understood from the following description of certain embodiments thereof, when considered in connection with the accompanying drawing, and its scope is pointed out in the appended claims.

In the drawing:

FIGURE 1 is a top or plan view of a high-frequency sonic signal transmitter of the unitary portable type embodying the invention;

FIGURE 2 is a cross-sectional view, and on an enlarged scale, of the transmitter unit of FIGURE 1, taken on the section lines 2—2 thereof, showing various details of construction in accordance with the invention;

FIGURE 3 is a partial sectional plan view of the transmitter unit, taken on the section line 3—3 of FIGURE 2, showing further details of construction in accordance with the invention; and

FIGURE 4 is a longitudinal sectional view, in the manner of FIGURE 2, of a sonic signal transmitter of the type shown in the preceding figures and illustrating certain modifications thereof in accordance with the invention.

Referring to the drawing, wherein like elements are designated by like reference characters throughout the various figures, and referring particularly to FIGURES 1–3 inclusive, the high-frequency sonic signal transmitter shown includes a housing or casing 6, of any suitable material such as metal or plastic and of a size adapted to be held in the hand of an operator. The transmitter casing is provided on one portion thereof, such as the top, with suitable manual operating elements or buttons 7, 8 and 9 which are movable longitudinally of the casing in the present example.

Each button operates interior sound signal generating means of the tuned rod type with longitudinal-mode operation, as shown in FIGURE 2 for the center operating button 8. As is understood, any suitable number of operating elements may be provided, depending upon the number of remote functions to be controlled. Therefore, a description of the mechanism for the one operating element is sufficient for a consideration of the operation of one or more of the elements of such a transmitter in accordance with the invention.

As indicated in FIGURE 2, the casing or housing 6 is preferably constructed in two separable complementary parts comprising a base 10 and a cover 11 adapted to be assembled in contacting closed unitary relation as indicated. The casting parts are further adapted for receiving and holding the various parts of the multi-channel mechanism, including a resilient mounting block 12 of plastic material for an elongated rod-like transducer or resonator

element 15. The latter extends longitudinally of the casing and is gripped and held in position by a thin circular flexible web 16 provided at one face or side of the mounting block 12 and seating in a relatively narrow circumferential mounting groove 17 in the rod 15. A damping control element or ring 18 is also mounted on the rod 15 adjacent to the groove 17 on the input side thereof, and the latter is located substantially midway between the forward and rear ends 19 and 20, respectively, of the rod 15, whereby it is at the nodal point of minimum longitudinal vibration of the rod 15 in operation. The forward or output end 19 of the rod faces the open end of the casing which is provided with a sound transmitting perforated grille 22. The rear or input end 20 of the rod is presented for longitudinal-mode excitation or striking by the improved hammer and actuating mechanism located adjacent thereto as shown in FIGURES 2 and 3.

The button 8 is slidable longitudinally of the case, as indicated by the arrow adjacent thereto, and is attached as indicated to a longitudinally-movable metallic carrier plate or slide 24, which is held in the retracted position shown, by a slide return spring 25 connected between a stud 26 on the slide and a fixed pin 27 connected with the casing top portion or cover 11 in which the slide is mounted. The spring 25 is of the coiled helical type operating under tension. The slide 24 thus moves from the position shown, against the return action of the spring 25 in response to operating movement of the button 8 to the left in the direction of the arrow, as viewed in FIGURE 2.

The rear end of the carrier or slide 24 is provided with two integral down-turned ears or brackets 30 and 31. A pawl or pawl element 32 is pivoted on the lower side of the slide or carrier 24 between the brackets 30 and 31, and is spring loaded to rotate in a counterclockwise direction by a pawl spring 33. The pawl is substantially rectangular in shape and is pivoted, intermediate between its ends on each side, on integral bearing or pivot pins 34 and 35 extending laterally therefrom and journaled in the dependent ears or bracket elements 30 and 31 respectively.

At an acute angle with respect to the direction of motion of the slide 24, substantially as shown, the pawl rests at its forward end against the underside of the slide 24, being limited thereby in its counterclockwise rotation. The rear operating end or edge 36 of the pawl 32 rests on the front or forward side of an annular flange 37 on the hammer means 38 which is positioned in axial or longitudinal relation to the transducer rod 15 at the rear end 20 thereof as shown. The hammer means 38 includes a round hammer or striker 40 with a convex forward face 41, and is provided with a center or axial opening for a guide pin or rod 42.

The guide pin 42 is secured at one end, in a cantilever manner, to fixed support means, such as a metallic or like stiff plate 43, rigidly mounted in the base or lower part 10 of the casing. The guide pin passes through the axial hole or opening in the hammer which is made sufficiently large for the hammer to slide freely on the guide pin and at the same time is sufficiently tight to guide the hammer to axial movement rearwardly in extension of the axis of the resonator element 15. The guide rod 42 and the resonator element 15 are thus located in end-to-end relation on substantially the same general longitudinal axis in the unit.

A helical coiled compression spring 45 for operating the hammer 40 is also mounted in coaxial relation to the guide pin 42. This spring is connected between the hammer and the fixed support means 43 for the guide pin. In the present example, the rear end of the spring is connected to a suitably grooved guide pin bushing 46 at the support means 43, and at the forward or hammer end is connected similarly to a grooved hub or anchor means 47 on the hammer 40 at the rear of the circular flange 37. The hammer spring is thus anchored or fixed at its rear end to the support means and guide rod, and at its forward end it is likewise anchored or connected to the hammer, so that the latter is free only to the extent that it can move on the guide rod axis and compressor extend the coiled hammer spring 45.

The free length of the hammer spring 45 is such that it holds the hammer 40 or the convex face 41 thereof, at a predetermined distance from the rod or transducer element 15 at its rear end 20. The free end 49 of the guide pin 42 is located so that it is on the axial centerline of the rod or transducer element 15, without touching the rear end 20 thereof, but close enough to it so that the hammer 40 cannot fall or move off the end of the guide pin 42 when the hammer moves forward to strike the rod or transducer element. The hammer 40 and the transducer element 15 are thus held in spaced end-to-end relation with the mechanism at rest.

When the operating button, such as the button 8, is pulled backward in the direction of the arrow, it causes the pawl 32 to move in the same direction, that is, rearwardly and longitudinally of the casing and of the transducer element 15. The pawl, traveling in a fixed longitudinal direction along a horizontal line, pushes against the flange 37 on the hammer 40, thereby causing the hammer to move back longitudinally and axially with respect to the transducer 15 along the guide pin 42. This movement loads or compresses the hammer spring 45 until the hammer is tripped or triggered by the pawl 32 as the rear edge or operating end 36 moves upwardly along the sloping cam surface of the flange 37, against the biasing action of the pawl spring 33, until the pawl end 36 rises above the edge of the flange 37, thus releasing the hammer.

In the present example, release of the hammer by the pawl is caused by tripping the pawl against a fixed abutment or finger element 50 carried by the casing and presently formed as part of or integral with the top or cover portion 11 of the casing. This abutment or element is sufficiently narrow, as indicated in FIGURE 3, to enter a central longitudinal slot 51 in the rear end of the slide 24, so that the forward edge 52 meets the rearward-moving pawl 32 and as the slide movement continues, causes clockwise rotation about the pivot pins 34 and 35 to raise the operating end 36 clear of the flange 37, and thereby releasing the hammer which at this point flies forward, guided by the pin 42, until it strikes the transducer 15. When the hammer is released and flies forward it has to overextend the hammer spring 45 to be able to strike the transducer 15. This causes the hammer spring 45, which functioned as a compression spring when the hammer was being cocked or loaded, to act now as an extension spring which retracts to return the hammer to its normal position of rest as indicated in FIGURE 2. Thus, the hammer 40 strikes the transducer 15 only once and does not again engage the transducer rear face or end 20, which would cause damping of vibration and result in defective signal output from the transducer 15.

When the operating button 8 is released, the slide return spring 25, which was extended when the button was pulled to the rear, now causes the button, the slide 24 and the pawl 32 to return to their original positions of rest as shown in FIGURE 2. As the pawl returns, it strikes the rear side of the flange element 37 on the hammer 40 and rides up over the flange to drop down into the engaging or driving position shown, with the operating end 36 in contact with the flange 37 on its forward slope or cam face. The pawl is moved into this position by the force of the pawl spring 33 which, as before noted, biases the pawl to rotate in the counterclockwise direction and bring the stop or opposite end up against the lower side of the slide or carrier 24. The transmitter mechanism is then in condition for a new signal-transmitting cycle of operation.

From the foregoing description, it will be seen that the elongated rod-like transducer element 15, flexibly supported by the mounting element 12 through the medium of the thin web 16, is free to vibrate in the longitudinal

mode following each striking operation and to transmit a sound signal through the forward or grille end of the transmitter to operate any remotely-located device or element (not shown) which is attuned to the natural frequency of operation of the body 15 in the longitudinal mode. This may, for example, be in the frequency range of from 35 to 45 kilocycles with an aluminum alloy rod of slightly greater than 3/10 inch in diameter and between two and three inches in length, the showing in FIGURE 2 being substantially enlarged to provide greater detail showing of the construction of the transmitter and operating mechanism. The rate of decay of vibration is determined by the position of the damper ring 18, and the mass thereof. However, as both the ring 18 and the mounting means 12 together with the construction of the rod or transducer element do not concern the present invention, further description thereof is believed to be unnecessary.

In a sonic signal transmitter actuator or operating mechanism in accordance with the invention, it will be seen that in a preferred form, the hammer may have an elongated round head with a circular flange at the rear thereof and is loaded or cocked against the biasing or forward-driving action of a coiled hammer spring along an axis defined by a central guide pin anchored at its rear end in a fixed support means such as a casing element or mass. The cocking action is applied to the hammer by a spring loaded pawl or driver element which is mounted on and moves rearwardly with a carrier or slide under control of a manual operating element or button. The hammer spring is substantially free of mechanical failure due to fatigue in operation over an extended life, and also functions as a retracting spring for the hammer, while the hammer guiding means may be the single cantilever mounted guide pin which passes freely through a central guide opening in the hammer body and to which the hammer body is secured by the spring. The free end of the guide pin and the face of the hammer, are both held in spaced relation to and axially aligned with the rear end of the transducer rod or element. The hammer and the transducer element are thus in spaced end-to-end relation, with the mechanism at rest.

To simplify the release of the hammer by the slide and pawl operation, the guide pin for the hammer may be placed generally at an angle to the axis of the transducer element and the direction of movement of the slide, but intercepting the axis of the transducer element at a point adjacent to the rear face thereof, as shown in the modification in FIGURE 4, which may now be considered along with the preceding figures.

In this modification, a cross-sectional view of a transmitter casing 6', similar to that of the preceding figures, is divided to provide a base portion 10' and a cover portion 11', and in which is mounted the transducer rod 15. The latter is provided with its flexible mount 12 and damping means 18 as in the preceding modification, whereby it is free to vibrate in the longitudinal mode when struck at the rear end or face 20 by the hammer 40 of the hammer means 38, to transmit high-frequency sonic signals forwardly from the operating end 19 through the front grille 22' of the casing.

The hammer spring 45 surrounds a curved or angled guide rod 42', the forward end of which is in alignment with the axis of the transducer element 15, and the rear end of which is anchored in a fixed support plate 43' secured to the interior of the casing as indicated. An operating button 8' is connected with a movable slide or carrier 24' to move it rearwardly against a compression slide spring 25'. A pawl 32', spring-biased to rotate in a counter-clockwise direction, engages the flange of the hammer element 40 as in the preceding embodiment, to drive it rearwardly when the slide is operated by the button 8'. The guide pin 42' is formed to describe a lateral or downward arc or angular path from its free end to the fixed support plate 43'. The hammer, movable on the guide pin, thus travels in a divergent path or direction with respect to that of the slide and the axis of the transducer element.

When the operating button is pulled back toward the hammer the pawl moves in the same direction, as in the preceding embodiment, and travelling in the horizontal line, pushes against the flange on the hammer, causing the latter to move backward against the biasing or forward driving action of the hammer spring. The hammer is guided to move back through the arc or angular path provided by the guide pin 42', which is thus at an angle to the axis of the resonator or transducer 15 and the line of movement of the slide and pawl. Thus the hammer spring is loaded until it has reached a point where the flange on the hammer drops below, or laterally out of, the line described by the movement of the pawl, whereupon the hammer is released to fly forward through the arc described by the guide pin until it strikes the transducer 15. As in the preceding example, the hammer overextends the hammer spring to strike the transducer and this spring, now acting as an extension spring, withdraws the hammer to its normal retracted position. This prevents the hammer from damping the sound vibrations resulting from the hammer blow, as before, the normal length of the hammer spring being such that it holds the hammer at a predetermined distance from the transducer or resonator. The free end of the guide pin is located so that it is substantially axially aligned with the transducer but spaced therefrom sufficiently closely so that the hammer cannot fall off the end of the guide pin.

In all other respects the construction and operation of the modification shown in FIGURE 4 is the same as that of the preceding embodiment, and the operation of the elements thereof is the same and for the same purpose. As in the preceding embodiment, a plurality of the transducer devices may be provided in a single casing and actuated by separate buttons or other manual control means as desired.

From the foregoing description, it will be seen that high-frequency sonic signal transmitters of the unitary portable type, operative with transducer or resonator elements vibrating in the longitudinal mode, may be provided with an improved actuator or operating mechanism, including guided hammer and coiled hammer-spring elements operating mainly in compression. The actuator or operating mechanism shown and described thus departs from the established pivotal mounting of the hammer element on the free end of a cantilever leaf spring which has several disadvantages, structurally and cost-wise, as pointed out. The present mechanism is of compact, simplified, low-cost construction, and resilient and effective in operation, thus avoiding certain defects and disadvantages inherent in the use of conventional devices in this field.

What is claimed is:

1. In a high-frequency sonic signal transmitter, the combination with a tuned rod-type longitudinal-mode transducer element of an actuator mechanism therefor comprising, a movable hammer positioned in extension of and spaced from one end of said transducer element, means providing a fixed support in said transmitter, a coiled compression spring connected at one end with said support and at the opposite end with said hammer, a fixed guide rod mounted on said support means for mounting said hammer on said fixed guide rod so that said fixed guide rod guides the movement of said hammer, a pivotally mounted pawl spring-biased to engage said hammer, a manually operable slide for moving said pawl and the hammer to compress said spring, said slide and said rod being relatively oriented with respect to one another so that said hammer and said pawl move in divergent directions as said pawl moves said hammer in a direction to compress said spring, whereby said hammer and said pawl disengage after a predetermined move-

ment of said slide, releasing said hammer to follow said rod guide and strike said transducer element under the force of said spring.

2. In a high-frequency sonic signal transmitter, the combination with a tuned rod-type longitudinal-mode transducer element, of an actuator mechanism therefor comprising, a movable hammer positioned in extension of and spaced from one end of said transducer element, means providing a fixed support in said transmitter, a coiled compression spring connected at one end with said support and at the opposite end with said hammer, a pivotally mounted pawl spring biased to engage said hammer, a manually operable slide for moving said pawl and the hammer to compress said spring and, said hammer having a central opening therethrough, a guide pin extending through said opening into close spaced relation to said one end of the transducer element and being rigidly mounted in connection with said support means at the opposite end for guiding the movement of the hammer with respect to and divergent from the axis of the transducer element and away from said pawl, means on the hammer for receiving the thrust of the pawl and for effecting disengagement therewith in response to compression of said spring to a predetermined degree, thereby to release the hammer or striking the resonator element.

3. In a high-frequency sonic signal transmitter, the combination with a tuned rod-type longitudinal-mode transducer element, of an actuator mechanism therefor comprising, a movable hammer positioned for striking one end of said transducer element, a coiled compression spring fixed in position at one end and connected with said hammer at the opposite end, a manually-operable slide having a pivotally-movable pawl for engaging and moving said hammer to compress said spring, means on the hammer for receiving the thrust of the pawl, a fixed guide rod, means for mounting said hammer on said fixed guide rod so that said fixed guide rod guides the movement of said hammer in a predetermined path with respect to and divergent from the path of said pawl, whereby said hammer and said pawl disengage after a predetermined movement of said slide, releasing said hammer to follow the guide rod and strike said transducer element under the force of said spring.

4. In a high-frequency sonic signal transmitter, the combination with a rod-type longitudinal-mode transducer element, of an actuator mechanism therefor comprising, a hammer axially spaced from and movable with respect to one end of said transducer element, means including a fixed guide rod for guiding the movement of the hammer with respect to and divergent from the axis of the transducer element, a fixed coiled compression spring surrounding said guide rod and connected at one end with said hammer to hold said hammer retracted from the transducer element, a movable pawl resiliently engaging said hammer, a manually-operable slide movable from a stop position longitudinally with respect to the axis of said transducer element for driving said pawl and hammer to compress said spring, means including a flange on the hammer for receiving the thrust of the pawl and disengaging therefrom in response to predetermined divergent movement of said hammer and slide in compressing said spring, thereby to release the hammer for striking the transducer element, and spring means for retracting said slide to said stop position.

5. In a high-frequency sonic signal transmitter, the combination with a rod-type longitudinal-mode transducer element, of an actuator mechanism therefor comprising, a movable hammer positioned in end-to-end spaced relation to said transducer element, a coiled compression spring fixed at one end and connected to said hammer at the opposite end, said spring being of a length at rest to retract said hammer to said spaced relation with respect to said transducer element, a manually-operable slide movable in substantially-parallel relation to the longitudinal axis of said transducer element means including a fixed pin extending freely through the hammer for guiding the movement of said hammer in a predetermined path with respect to and divergent from the axis of the transducer element and manually operable slide, a pivotally movable pawl mounted on said slide and having an edge positioned to engage said hammer, thereby to compress said spring in response to movement of said slide and, means on the hammer for receiving the thrust of the pawl, said means disengaging said pawl in response to compression of said spring to a predetermined point of divergence with respect to the direction of the movement of the slide and pawl elements, thereby to release the hammer for striking the transducer element.

6. In a high frequency sonic signal transmitter, the combination with a rod type longitudinal mode type transducer element, of an actuation mechanism therefor comprising,

a movable hammer positioned for striking one end of said transducer element;

a coil compression spring connected for actuating and retracting said hammer;

a manually operable longitudinally movable slide;

means for guiding the movement of said hammer in a predetermined path including an axial guide opening through said hammer and a fixed curved guide pin extending therethrough into close spaced and to end relation with said transducer element and axially of said compression spring, said hammer guide pin extending from said transducer element in a direction divergent from the axis of said element and the direction of the movement of said slide and pawl element;

said manually operable longitudinally movable slide having a pawl element mounted for engaging and moving said hammer to compress said spring; and

said hammer including a flange for receiving the thrust of the pawl element wherein the hammer flange is released from engagement with the pawl element in response to movement of said hammer to a predetermined point of divergence with respect to the direction of the movement of the slide and pawl element.

References Cited in the file of this patent

UNITED STATES PATENTS

2,868,156	De Cola et al.	Jan. 13, 1959
2,979,022	Adel	Apr. 11, 1961
3,046,933	Kemeny	July 31, 1962