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ULTRASONIC SIGNAL TRANSMITTER

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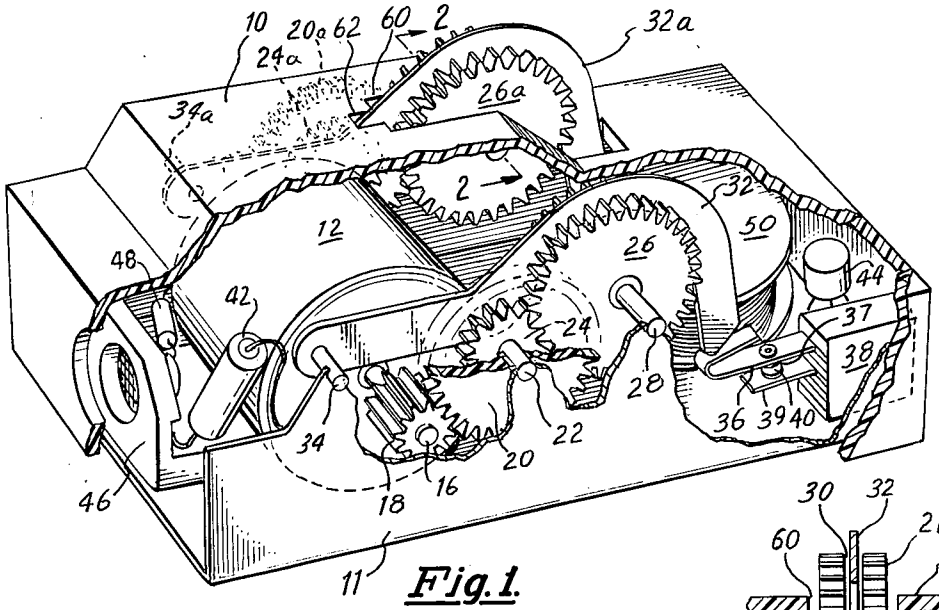


Fig. 1.

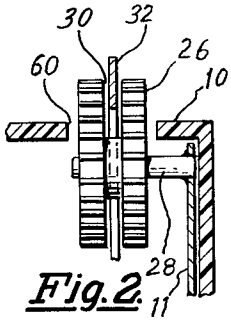


Fig. 2.

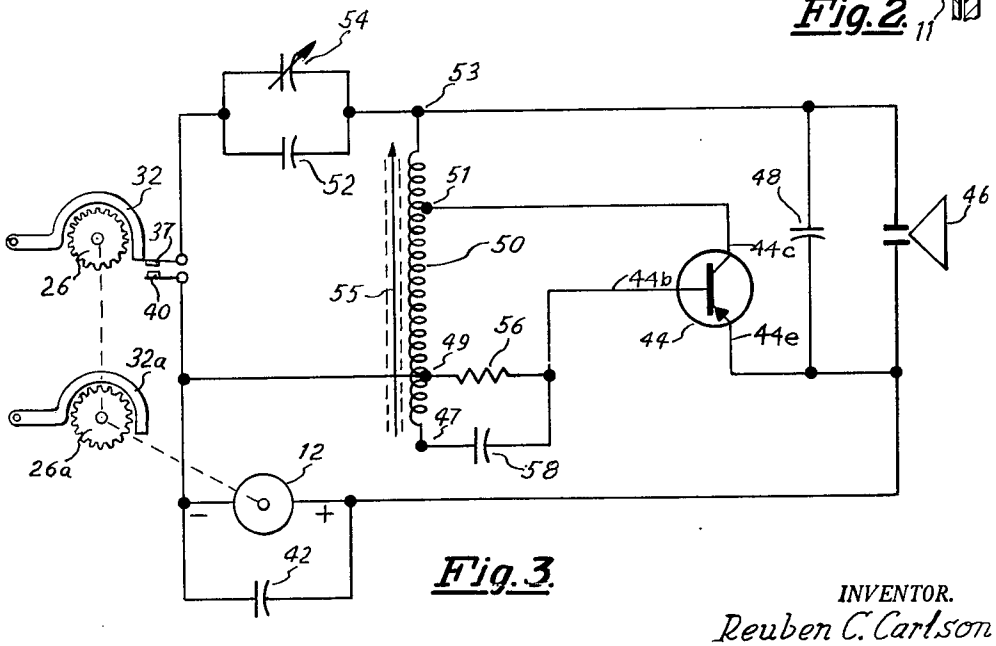


Fig. 3.

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ULTRASONIC SIGNAL TRANSMITTER

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This invention relates to an electrical device for generating and transmitting ultrasonic signals to be used in a remote control system, and more particularly, to means for selectively generating any of a plurality of such signals from unitary generating means.

The present invention contemplates a manually operable generator for use in powering a transistorized tuned circuit to drive a transducer output means. It incorporates novel switching means that are responsive to a selected mode of manual operation of said generator to introduce additional impedance into the circuitry and alter the ultrasonic frequency thus produced. Transmitters made in accordance with the present invention can replace the currently popular mechanical actuators and battery operated ultrasonic signal generating devices. They obviate the need for replacing batteries while giving the reliable, strong response of electrically generated signals. They can be designed to produce ultrasonic signals of a plurality of different frequencies without greatly increasing the number of components over that required for a single frequency transmitter since most of the components are reused in generating the different frequencies and simple impedance changes are all that are required.

Therefore, it is an object of this invention to provide an ultrasonic signal generator that is simple in construction and of reliable effectiveness while not normally requiring replacement of components.

It is a further object of this invention to provide ultrasonic signal transmitting means that are handpowered by any of a plurality of input means, and switching means in conjunction with one or more of said input means that are effected simultaneously with operation of said input means.

It is another object of this invention to provide means for manually actuating a generator and simultaneously selecting a circuit of predetermined impedance to be powered by said generator for selectively producing oscillations of predetermined frequency.

An additional object of this invention is to provide a hand operated generator with selective input means for remotely controlling a plurality of functions of an electrical circuit means such as a television receiver.

Still other advantages and objectives of the present invention will become apparent from an examination of the detailed disclosure and drawing in this case and from a reading of the claims.

A preferred embodiment of this invention in which either of two predetermined ultrasonic frequencies may be generated is illustrated by the accompanying drawing in which:

FIG. 1 is a partially cut-away perspective view of a hand unit for transmitting ultrasonic signals.

FIG. 2 is a fragmentary view of the thumb operated input gear and switch lever of FIG. 1.

FIG. 3 is an electrical diagram of the generator powered transistorized circuit incorporated in the unit of FIG. 1.

Referring now, more specifically, to the drawing, in which like elements are designated by like reference numbers, a decorative plastic case **10** of convenient size for holding in the palm of the hand is provided as a cover for the electrical components of the unit of FIG. 1. A sheet metal frame **11** is secured to the case **10** and is provided with a rectangular base section and two opposed walls inwardly adjacent to the sides of the case **10**. A generator **12** is mounted transversely within the frame **11** and

secured to its base by any convenient bracket means. The generator **12** has an input shaft **16** with two pinions **18** secured thereto, one such pinion **18** extending from each end of the generator **12**. A large intermediate gear **20** is journaled for rotation on a shaft **22** in continuous meshing engagement with one of the pinions **18**. A small gear **24**, affixed to gear **20**, is also journaled on shaft **22**, and a split gear **26** of approximately the diameter of gear **20** is journaled for rotation on a shaft **28** so as to protrude through the top face of the plastic case **10**. Gear **26** is positioned to constantly mesh with small gear **24** and is adapted to be rotated by a person's thumb as he holds the actuator in his hand. The shafts **22** and **28** extend laterally from one of the side walls of the frame **11**, and are affixed thereto by any convenient means. The thumb engaging gear **26** is a one piece split gear with a peripheral annular groove **30** separating its two similar halves. A thin brass switch operating lever **32** in the form of a question mark is received at its arcuate portion in the groove **30** and is pivotally mounted at its other end to the metal case **11** through a pin **34**. The arcuate portion farthest removed from the pivot pin **34** extends downwardly into contact with a resilient switch leaf **36** having a contact **37** on its underside. The leaf **36** is mounted between adjacent insulators of an insulator stack **38** that is affixed to the frame **11**. A cooperating switch leaf **39** is similarly mounted to stack **38** below leaf **36** for cooperation therewith through a contact **40** thereon. The switch operating lever **32** protrudes above the gear **26** in its normal position, but when a person places his thumb on the serrated edge of gear **26** to actuate the transmitter he simultaneously depresses the lever **32** against the resilient action of spring leaf **36** to close the contacts **37, 40**.

Thus, the mechanisms appearing in the front portion of the FIG. 1 perspective have been described. Similarly, in the rear portion of the FIG. 1 perspective, a split gear **26*a*** receives a switch operating lever **32*a*** pivotally mounted to the metal housing **11** at its adjacent sidewall through a pivot pin **34*a*** in such manner that the arcuate portion of lever **32*a*** extends above the serrated edge of gear **26*a*** and is depressed by the operator's thumb when he contacts the gear **26*a*** to actuate the generator **12**. A spring leaf **36*a*** (not shown) is provided to engage the downwardly extending portion of lever **32*a***, but in the rear portion, no switching operation is effected by the depression of lever **32*a***, since lever **32*a*** is provided only for the purposes of symmetry. This will be more thoroughly understood following consideration of the circuitry described below and illustrated in FIG. 3.

Referring now to the circuit diagram of FIG. 3, the generator **12** is shown with a bridging capacitor **42**, a transistor **44** having an emitter **44*e***, a base **44*b*** and a collector **44*c***, which is shown in FIG. 1 at the right side of the drawing, and a transducer **46**, which is shown at the left side of FIG. 1. The transducer **46** acts as a capacitance in the oscillatory circuit of FIG. 3, together with a capacitor **48** that bridges the transducer **46**. A coil **50** with an adjustable core and two tapped points **49** and **51** is shown as supported by the base of frame **11** at the right of FIG. 1. A fixed capacitance **52** and a variable capacitance **54** are connected in parallel with one another and in series with the switch **37, 40**. A resistor **56** and a capacitor **58** are connected between the base **44*b*** of the transistor **44** and the coil points **49** and **47**, respectively.

As the generator **12** is energized by manual rotation of the gear **26*a*** acting through the gear train **24*a***, **20*a***, and **18*a*** (not shown), a voltage is applied across the emitter and, through resistor **56**, of the base of transistor **44**. Bias current flows from the generator, through the emitter and base of transistor **44**, through resistor **56**, and back to the generator. Voltage is also supplied from the

generator to collector 44c, through the portion of coil 50 between taps 49 and 51. A current now flows from the generator, through the emitter and collector of the transistor 44, the central portion of the coil 50 (between taps 51 and 49) and back to the generator. The load current passing through the center portion of the coil 50 induces a voltage in the entire coil and energizes the oscillatory circuit including the upper two portions of coil 50 (tap 49 to terminal 53), and transducer 46 and capacitor 48. Capacitor 42 bridging the generator 12 provides a low impedance bypass around the generator. A feedback current flows, as a result of the voltage induced in the lower portion of coil 50 (terminal 47 to tap 49), through the base and emitter of transistor 44, bridging capacitor 42, and back to the coil 50. The tuned feedback circuit voltage is amplified by transistor 44 to resupply the oscillatory circuit with energy to drive the transducer 46, and a signal is transmitted so long as generator 12 operates.

The transducer 46 is a piezoelectric transducer of conventional form including a piezoelectric element with suitable electrical terminals and physical mounting such that electrical excitation of the element through the terminals causes a mechanical vibration thereof which is transmitted to the surrounding air. It should be understood that "transducer" as used herein may include microphones of the natural crystal, artificial crystal, or non-crystal type. The piezoelectric element is selected to have natural or resonant frequencies in the range of 38.285 kc. and 41.805 kc., or in any other frequency range that might be chosen as desirable for operation of a remote control system. The transducer 46 is connected across the upper portions of coil 50 between tap 49 and terminal 53 as can be seen in FIG. 3. It is in series with the capacitor 42 that bypassses the generator 12 and is part of an LC circuit including the capacitor 48, and the coil, that has a resonant frequency of 41.805 kc. The coil 50 may be tuned by adjusting a slug 55 in its core in a manner well known in the art. Obviously, additional capacitance may be arranged in parallel with the transducer or elsewhere in the circuit in keeping with the various parameters of the circuitry, and tuning may alternatively be effected by a variable capacitance in the oscillatory circuit.

In the illustrated embodiment of the invention, the LC circuit described above is excited by apparatus including a junction type transistor 44, having the generator 12 as its power source. The collector lead of the transistor is connected to a tapped point 51 on the coil 50, while the negative terminal of the generator 12 is connected to another tapped point 49 on the coil below point 51. The output circuit of the transistor 44 is completed by connecting the emitter lead of the transistor to the opposite or positive side of the generator.

The feedback circuit connects a portion of the transistor output voltage back to the transistor through the capacitor 58, and the oscillator so provided is of the Hartley type. However, it is obvious that other forms of oscillators may be employed.

With the coil 50 adjusted such that the LC circuit comprising the coil 50 and transducer 46 resonates at the upper resonant frequency of the transducer, 41.805 kc., an ultrasonic wave of substantial magnitude may be emitted with small power input. Thus, the input gear 26a may be easily rotated by the viewer's thumb to cause the generator to produce the necessary input power, and the signal produced will be of sufficient strength to be easily detected at the television receiver or other electrical circuit means for effecting the desired control function. Recommended intermediate frequencies for expansion of the remote control system to a four frequency system are 39.285 kc. and 40.805 kc.

In the embodiment of FIGS. 1, 2, and 3, when the gear 26 is rotated by the viewer, lever 32 is depressed and switch contacts 37, 40 are closed, thereby introducing additional capacitance, capacitors 52 and 54, into the circuit. Capacitors 52 and 54 are then in parallel with the branch that includes capacitor 42 and parallel capacitors 46 (the transducer) and 48. This increases the capacitance by a controlled amount, the amount being adjustable by varying the capacitance of variable capacitor 52, and decreases the resonant frequency of the oscillatory circuit. Thus, as the generator is actuated through gear 26, the transducer is caused to emit an ultrasonic compressional wave of 38.285 kc.

Further input gears might be connected to pinions on extensions of shaft 16 and be provided with levers similar to levers 32 and 32a that would, simultaneous with operation of the generator 12 through the associated gear, close switch contacts similar to contacts 37, 40 which would introduce capacitances into the circuit to change the frequency transmitted to third and fourth predetermined values (39.285 kc. or 40.805 kc.).

The shape of the enclosing plastic case 10 is not a critical feature of the present invention, but it has been found convenient to provide openings 60 in the top of the case 10 to accommodate each of the gears 26 and 26a and provide lateral support therefor. These openings 60 should be of sufficient width to avoid interfering with the free rotation of the gears 26 and 26a, and should accommodate the levers 32 and 32a as by the narrow, centrally disposed extensions 62 of openings 60 in the direction of the pivot 34. Thus the upward movement of the levers in response to the resilient action of switch leafs 36 and 36a is restricted by contact of the lever with the case at the extension 62.

If a plurality of transducers are employed, as described in the copending application of Meyer Marks, Serial Number 809,052, filed April 27, 1959, switching means similar to those described above and illustrated in the drawings of this application could be utilized to selectively effectuate any of the transducers and its corresponding tuned circuitry as a selected generator input wheel is rotated. The external appearance of such an actuator, as well as its internal mechanical features, with regard to the switching function, could be identical with that disclosed above for the single transducer embodiment.

Numerous other modifications not specifically mentioned herein could 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.

Now, therefore, what is claimed is:

1. In combination, a direct current generator, tuned electrical circuit means having impedances preselected to produce oscillation at a first predetermined frequency, said circuit means being powered by said generator and including transducer means for converting a portion of said oscillation into a compressional air-born energy wave, first and second manually operable means for driving said generator, and switching means for introducing additional impedance into said circuit means to change the produced oscillations of said circuit means to a second predetermined frequency, said switching means being so disposed relative to said second manually operable means as to be operable therewith in response to a unitary manual movement, whereby either of said first and second predetermined frequencies may be selectively applied to said transducer means by selectively driving said generator from said first and second manually operable means.

2. In apparatus for producing compressional waves of predetermined frequency, a piezoelectric transducer resonant at said predetermined frequency for producing said waves in response to electrical excitation thereof, an inductive element, said piezoelectric transducer element and said inductive element providing at least part of the capacitive and inductive reactance respectively of an LC circuit resonant at said predetermined frequency, and exciting means for exciting said LC circuit, said exciting means including a generator source of electrical power, a transistor connected to said source, the output circuit of said transistor being inductively coupled to said LC

circuit and including said generator, and feedback means for causing oscillation of said output circuit at the resonant frequency of said LC circuit, said apparatus including aditional impedance, mechanical means for selectively introducing and excluding said additional impedance from said LC circuit to thereby change its resonant frequency, manual input means for said generator, said mechanical means being coupled to said manual input means in such manner that the operation of both is effected by a unitary manual movement.

3. A mechanism comprising support means, a plurality of input gear means mounted on said support means for rotation with respect thereto, an electrical generator having a shaft, linkage means between each of said input gear means and said generator shaft, signal translating means and LC circuit means connected to the output of said generator, transducer means coupled to said LC circuit means for emitting compressional waves of a predetermined frequency determined by the impedance values of said LC circuit means, additional impedance elements, switching means for selectively including and excluding selected ones of said additional impedance elements in said LC circuit, whereby a plurality of resonant frequencies of said LC circuit may be selectively effected, operating means for operating said switching means, said operating means being resiliently received by one of said gear means and protruding outwardly from the periphery of said one gear means, contact with said periphery during manual rotation of said one gear means providing motive power for said generator and actuation of said operating means to effect operation of said switching means, whereby the frequency transmitted by said transducer means will correspond to the operator's choice of input gear means.

4. In combination, first gear train means having a first input gear and a first output gear, said first input gear being adapted to be manually rotated, an electrical generator, said first output gear being drivingly engageable with said generator, LC circuit means having a first resonant frequency and being excitable by said generator, second gear train means having a second input gear and a second output gear, said second input gear being adapted to be manually rotated, said second output gear being drivingly engageable with said generator, switch means disposed adjacent said second input gear operable responsive to the manual movement that rotates said second input gear, an impedance element selectively includable in said LC circuit means in accordance with the operating condition of said switch means, whereby the resonant frequency of said LC circuit means has a second resonant frequency alterable during manual operation of said generator through said second gear train.

5. The combination of claim 4 wherein each of said input gears are manually rotatable by a tangential movement of an operator's thumb, and wherein said switch means is resiliently urged into a normal position disposed outwardly of the periphery of said second input gear so that contact of said operator's thumb with said second input gear simultaneously depresses and operates said switch means.

6. The combination of claim 5 wherein said second input gear is a split gear and said switch means is a lever received loosely between the halves of said split gear, switch means being radially movable inwardly with respect to said split gear in response to thumb pressure and resiliently biased radially outwardly.

References Cited in the file of this patent

UNITED STATES PATENTS

1,131,063	Klemmer	Mar. 9, 1915
1,229,308	Morgan	June 12, 1917
2,832,952	Bagno	Apr. 29, 1958