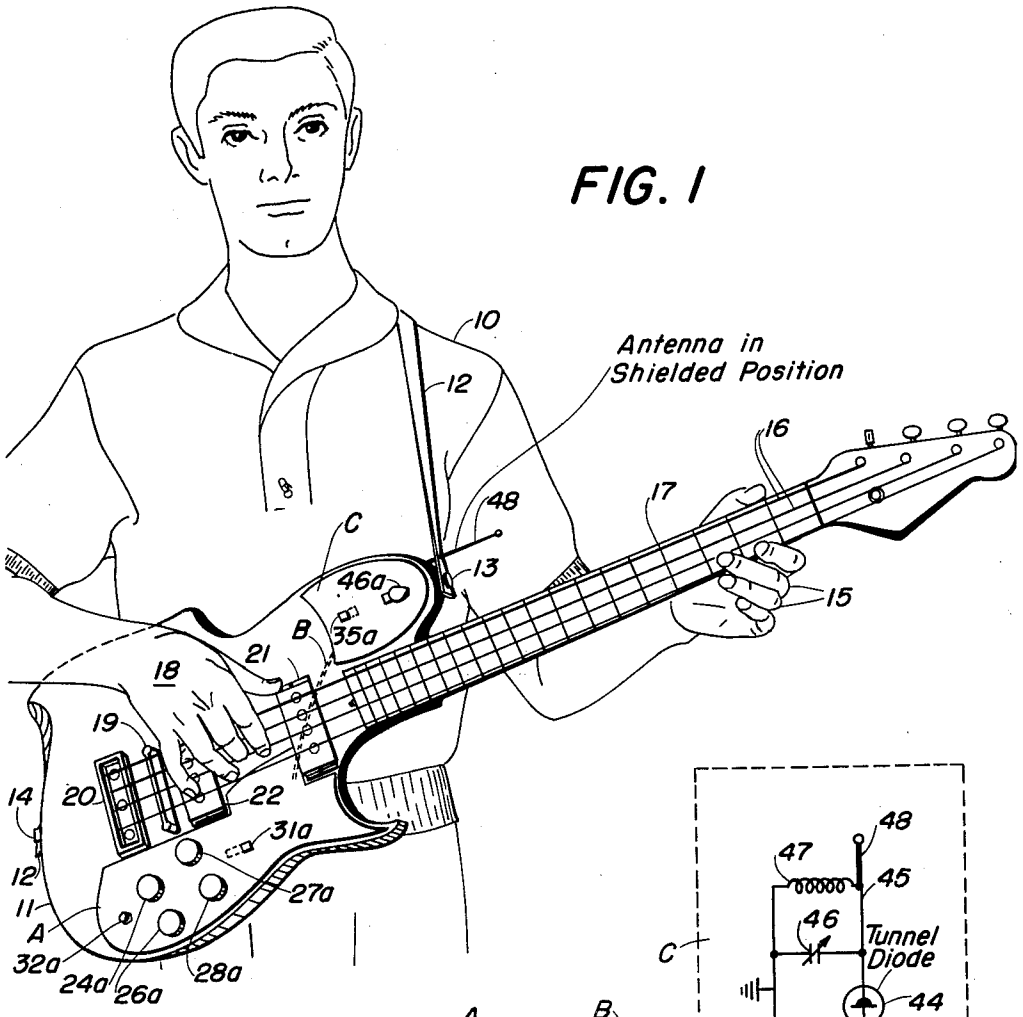
April 16, 1963 T. C. EDWARDS 3,085,460

PORTABLE ELECTRONIC MUSICAL INSTRUMENTS

Filed Aug. 14, 1961

FIG. 1



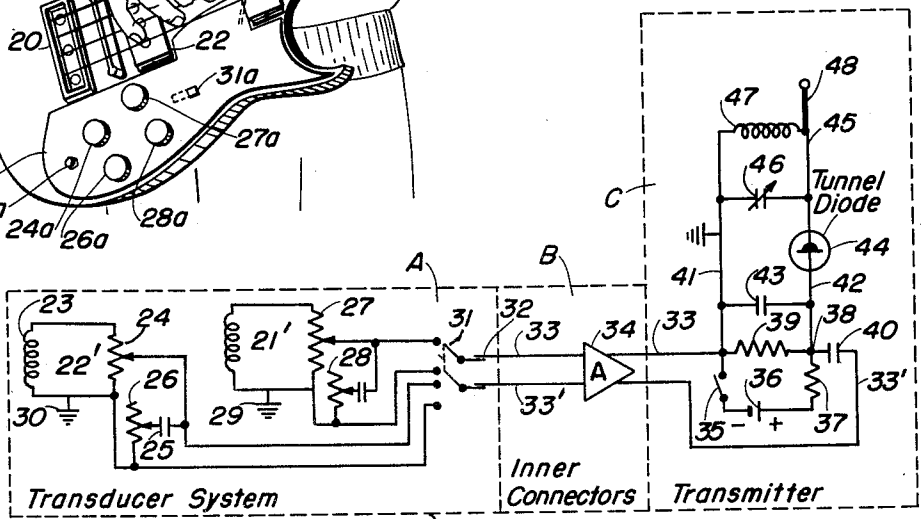


FIG. 2



INVENTOR.
Thomas C. Edwards
BY Donald E. Payne

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PORTABLE ELECTRONIC MUSICAL INSTRUMENTS

Thomas C. Edwards, Los Alamos, N. Mex.
(351-C, Rte. 1, Espanola, N. Mex.)

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This invention relates to a portable electronic musical instrument, i.e., one which is to be carried by a performer, and it pertains more particularly to an improved system for eliminating the external connector-cable which has heretofore been used with such electronic musical instruments.

Although radio link sound pickups have long been known (U.S. 2,710,345, "Walkie-Talkies," etc.) electronic guitars, which are also old and well know, have heretofore required a cable between said guitar and a speaker; an object of this invention is to eliminate the necessity of such external cable. A further object is to provide an improved transmitter-power assembly for portable electronic musical instruments with the antenna thereof so positioned that it does not come close enough to any part of the performer's body to distort or interfere with transmitted signals and does not protrude in a direction which might bring it into contact or too close proximity to other performers or objects. A further object of the invention is to provide new tone and sound effects which cannot be duplicated with cable-to-speaker systems without the use of expensive and complicated circuitry. Other objects will become apparent as the detailed desription of the invention proceeds.

Briefly, I employ a small transmitter powered by a small battery in an assembly small enough to fit into the musical instrument which provides the source of mechanical sound vibrations. For an electronic guitar this assembly may be about 1.5" x 2" x 3", or even smaller. A conventional transducer system may be employed for converting the sound vibrations to electrical signals, but these signals are conducted within the instrument itself to the transmitter-power assembly instead of being connected by an external cable to a speaker. The transmitter circuit is preferably one which employs a "tunnel-diode," i.e., is a tunnel diode oscillator circuit, though other transmitting circuits may be used. A tunnel diode is a germanium semiconductor device described and characterized in detail in "Tunnel Diode Manual," copyright 1961 by General Electric Co., the ratings and characteristics of such tunnel diodes being set forth on pages 11 to 17, 87 and 95 of said manual; tunnel diode oscillator circuits are shown on pages 33 to 42 of said manual and are exemplified by the circuit on page 41 thereof using the 1N2939 tunnel diode.

The transmitter and particularly the antenna thereof should be so mounted as to provide shielding from too close proximity to parts of a performer's body or to external objects; nothing having a capacitance effect should come closer than about an inch and preferably not closer than two inches to the antenna. By mounting the antenna on or within a guitar or other stringed instrument about 2 to 3 inches above the fretted neck and substantially parallel thereto, it is protected by the flexed left arm of the performer from external physical contacts or electrical disturbance or drift. To avoid "dead spots," a plurality of antennas may be used, i.e., either the instrument or the receiver-speaker may have at least two antennas spaced about one to three feet or more apart; it is usually undesirable to have a second antenna on the instrument and hence it is preferred that the receiver be provided with spaced antennas.

The transmitter and receiver should of course be tuned

to the same frequency and it is desirable that a variable frequency transmitting circuit be employed, the variation being obtainable by using a variable condenser or by plugging in crystals of different frequency or by any other known means. When a number of electronic musical instruments are playing together as in a band or orchestra, each should be tuned to its respective receiver. A microphone may be plugged into a jack on the instrument for transmitting the performer's voice with the guitar music.

The invention will be more clearly understood from the following detailed description of a preferred example thereof read in conjunction with the accompanying drawings which form a part of this disclosure and in which:

FIGURE 1 is a view of an electronic guitar showing the position of the transmitter and antenna with respect to the body of the performer playing the instrument.

FIGURE 2 is a schematic diagram of the transmitter circuit showing its relationship with the other parts of the combination.

While an electronic guitar will be described in detail as my preferred example, it should be understood that my invention is applicable to any other electronic musical instrument that is carried by a performer, particularly to those characterized by vibrating strings or reeds.

Referring to FIGURE 1, performer **10** is playing an electronic guitar **11** which is supported by shoulder strap **12** with end openings engaging supporting buttons **13** and **14**. The performer's left hand **15** normally comes under and around the fretted neck so that the fingers of the left hand may press strings **16** against frets **17**, the lower part of the instrument being curved inwardly adjacent the fretted neck to permit the fingers of the left hand to reach the lowermost frets. The performer's right hand **18** is normally above strings **16** just beyond bridge **19**, the strings being strummed, plucked or otherwise vibrated by the fingers and/or thumb of said right hand. The strings are anchored to holding plate **20** in any known manner, and they are tuned at the upper end of the fretted neck by any means known to the art.

Since the guitar is an electronic instrument, it is provided with the usual transducer system, which includes one or more transducers. I preferably employ one transducer **21** spaced about six inches from the bridge **19** and another transducer **22** spaced quite close (within an inch or so) to said bridge. Transducer systems are well known and hence require no detailed description. The system diagrammatically represented in FIGURE 2 includes a winding **23** around strong magnets of the permanent type on each side of magnetic poles under each string so that differences in sound vibrations cause corresponding differences in electrical signals that are generated. Winding or inductance **23** is connected across variable resistance **24** which is actuated by knob **24***a* on the instrument to control volume. The sliding contact on resistance **24** is connected through condenser **25** to the sliding contact of variable resistance **26**, which is actuated by knob **26***a* on the instrument to control tone quality. In the other transducer circuit **21'**, knob **27***a* actuates variable resistance **27** for volume control and knob **28***a* actuates variable resistance **28** for tone control. Transducer circuit **21'** is grounded at **29** and circuit **22'** at **30**. Switch **31**, which is actuated by button **31***a* on the instrument, enables the performer to select the transducer **21** or **22** which he desires, and this switch may be designed to enable any number of transducers to be connected in series or parallel to obtain desired sound effects. Sliding connection or "jack" **32** was heretofore used for plugging in a cable leading to a speaker.

With my invention no external cable is plugged into the instrument, and it may be freely moved for distances of about 2 to 25 feet or more. Internal connectors **33** and

33' lead from the transducer system A through an opening B in the instrument itself to my improved transmitter-power assembly C, which is in a part of the instrument remote from the transducer system to avoid electrical disturbance and to facilitate physical control. The transmitter portion of the assembly is preferably a tunnel diode circuit as will be hereinafter described. As shown in FIG. 1, the transmitter-power assembly is mounted within the instrument under a plate above the fretted neck while the transducer system is under the so-called "scratch plate" at the lower part of the instrument when it is in playing position. The power source may be a battery, but it may alternatively be a receiver for transmitted electrical energy, the important feature being that I do not employ any external cable or connector leading from the instrument to a separate power source. The transmitter-power assembly is preferably shielded in any conventional manner to minimize frequency drift.

As for the tunnel diode circuit, conductors 33 and 33' are connected, preferably through an audio amplifier stage 34, to an oscillating circuit. Conductor 33 is connected through switch 35, battery 36 and resistance 37 to terminal point 38 and it is also connected to point 38 through resistance 39. Switch 35 is actuated by button 35*a* on the instrument. Connector 33' is connected to point 38 through condenser 40. Connector 33 leads to copper strip connector 41 and point 38 is connected to copper strip 42, a condenser 43 being connected between strips 42 and 41. A tunnel diode 44 is connected to strip 42 and to another strip 45, a variable condenser 46 (actuated by knob 46*a* on the instrument) being connected between conductor strips 41 and 45. An inductance 47 is connected between the ends of conductor strips 41 and 45, said inductance 47 cooperating with variable condenser 46 to form a so-called "tank circuit." The transmitting antenna is connected to conductor strip 45. In this example the copper strips are secured to a plastic base sheet, they are about ⅜" wide and very thin. The values of the respective elements in the specific example are as follows:

Element:	Value
Battery 36	1.5 volt mercury cell.
Resistance 37	270 ohms.
Resistance 39	22 ohms.
Condenser 40	50 microfarads.
Condenser 43	0.001 microfarad.
Tunnel diode 44	G.E. 1N2939 (see tunnel diode manual).
Variable condenser 46	1.5 micromicrofarads to 5.0 mmf.
Inductance 47	0.2 micro henrys.
Antenna 48	4.75 inches long.

The operation of the invention should be obvious from the foregoing description. The strings of the guitar are manually tuned as usual. Switch 31 is placed in the desired position by manipulating button 31*a*. Switch 35 is closed by means of button 35*a*. Knob 46*a* is set to position variable condenser 46 and to obtain the desired frequency, which may for example be about 70 to 117 mc./sec., e.g. 107 mc./sec. Volume and tone quality are adjusted by positioning knobs 24*a* and 26*a* and/or 27*a* and 28*a*. Thenceforth the instrument may be handled and played as if it were an ordinary non-electronic guitar, but with a wide range of volume and tonal effects not attainable with a simple acoustical instrument. The signal transmitted from antenna 48 is picked up by the antennae 49 and 50 of receiver-speaker assembly 51 which is usually also provided with one or more amplifying stages and which is tuned to the frequency of the transmitter. The transmitter circuit may be tuned to a frequency in the conventional radio broadcasting band

(550 to 1700 kc./sec.) so that the transmitted signals may be picked up by an ordinary radio and the sound may come from the speaker thereof.

I have discovered that the tonal effects obtainable by use of my transmitter are unexpectedly quite different under some conditions than those obtained when the instrument is connected to the speaker with a cable. When the audio amplifier stage is used with the transmitting circuit, it may be manually controlled by one or more knobs (not shown) on the instrument, thus giving the performer even more latitude with respect to tone volume and sound effects.

While the invention has been described by reference to a specific example, it is not limited thereto. Other more simple or more elaborate circuits may be used either in the transducer system or in the transmitting circuit. The transmitting antenna may be encased in a shielding element. The values and arrangement of the various elements may vary widely as will be apparent from the above description to those skilled in the art.

I claim:

1. An electronic guitar having a fretted neck; a power source, a variable frequency transmitter circuit, a transducer system and connections from the transducer system and the power source to the transmitter circuit, all carried in said guitar; and a transmitting antenna connected to the transmitter circuit and mounted about 2 to 3 inches above said fretted neck and substantially parallel thereto so that when the guitar is played by a performer, the antenna is protected by the flexed left arm of said performer from external physical contacts and electrical disturbance and drift, and signals may be broadcast from said antenna to a receiver spaced therefrom and without any electrical connector therebetween.

2. In combination, a portable, electronic, stringed, musical instrument having a neck adapted to be held by a performer's left hand curved under and in front of it and having strings adapted to be vibrated by the thumb and fingers of the performer's right hand; a power source, a variable frequency transmitter circuit, a transducer system and connections from the transducer system and the power source to the transmitter circuit, all carried in said musical instrument; and a transmitting antenna connected to the transmitter circuit and carried by the musical instrument about 2 to 3 inches above said neck so that it is in shielded position when the instrument is being played and so that it is protected from external physical contacts and from electrical disturbance and drift, whereby signals may be broadcast from said antenna to a receiver spaced therefrom and in tune with the frequency of said transmitter circuit without any electrical connector between said musical instrument and said receiver.

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