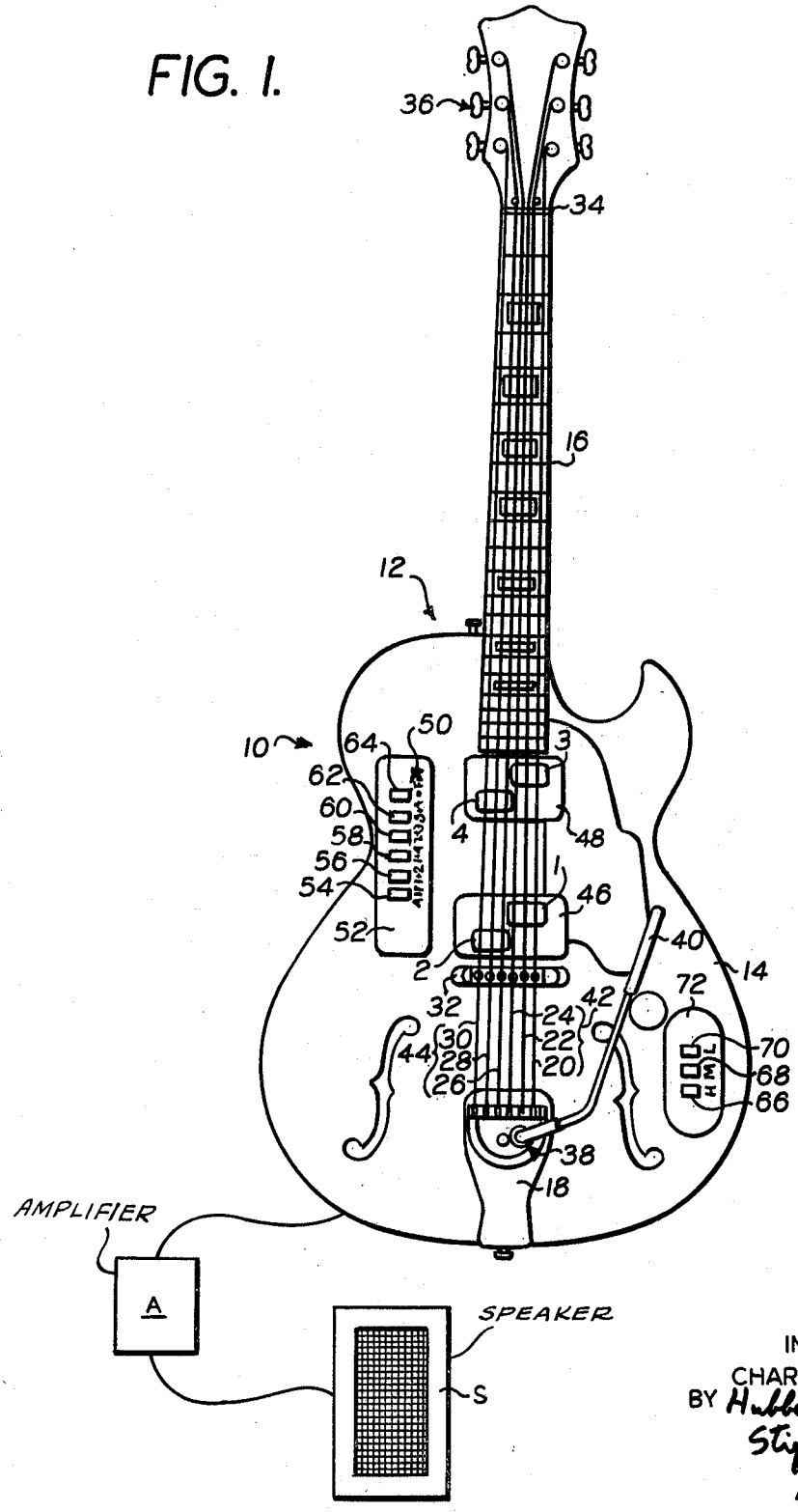
Nov. 11, 1969 C. C. TRAINOR 3,478,158

TONE CONTROL MEANS FOR ELECTRIC GUITARS AND THE LIKE

Filed May 19, 1966 2 Sheets-Sheet 1

FIG. 1.



INVENTOR
CHARLES C. TRAINOR
BY Hubbell, Cohen, Stiefel + Fiddler
ATTORNEYS.

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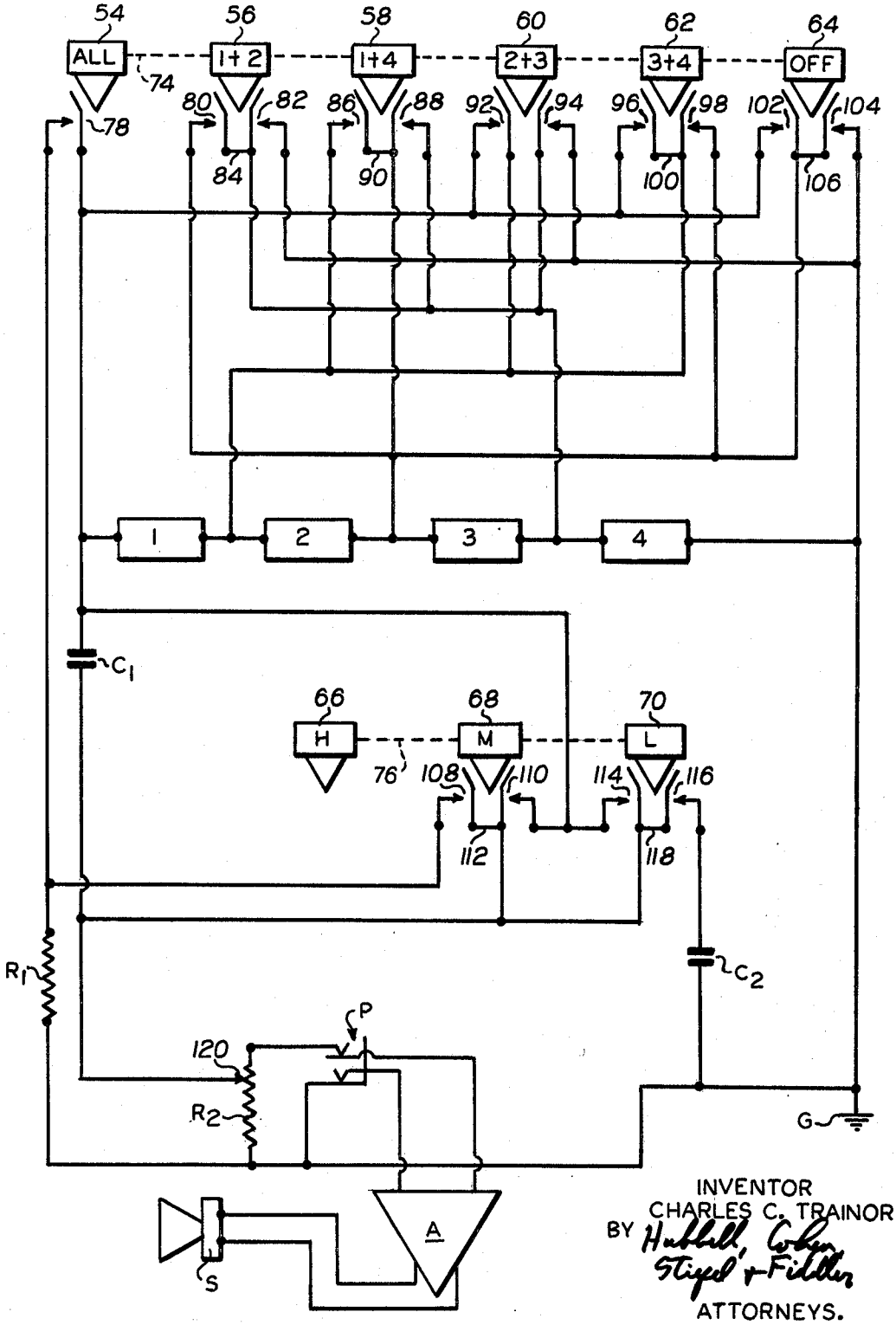
FIG. 2.



INVENTOR
CHARLES C. TRAINOR
BY Hubbell, Cohen, Stiefel & Fidler
ATTORNEYS.

United States Patent Office 3,478,158
Patented Nov. 11, 1969

3,478,158

TONE CONTROL MEANS FOR ELECTRIC GUITARS AND THE LIKE

Charles C. Trainor, Bronx, N.Y., assignor, by mesne assignments, to Avnet, Inc., a corporation of New York

Filed May 19, 1966, Ser. No. 551,438
Int. Cl. G10h 3/00
U.S. Cl. 84—1.16 10 Claims

ABSTRACT OF THE DISCLOSURE

Tone control means for electric guitars including first and second transducers near the bridge for responding respectively to treble and base, and third and fourth transducers remote from the bridge for respectively transducing treble and base. Switching means are included for selectively connecting to the amplifier at least one treble and one base pickup.

This invention relates to tone control means for electric guitars and the like.

With recent improvements in electronic technology, electric string instruments and especially electric guitars are enjoying a great vogue. Such instruments have steel strings or the like in close proximity to electrical transducers or pickups which generate electric signals proportional to the amplitude and in accord with the frequency of vibration of the associated strings. The output from the pickups is normally applied to the input terminals of an amplifier which amplifies these signals and energizes a loudspeaker.

In most string instruments including electrical string instruments, the strings are secured to a tailpiece fixed near one end of the sound box of the instrument and extend over a bridge which fixes one point support for the strings, and thence over the sound box of the instrument and the neck to the nut which provides the other point support, and then to the threaded pegs at the end of the neck on which the strings may be taken up to adjust the tension thereof. It has been known that the portions of the strings immediately adjacent the bridge yield a sharper tone than the portions of strings more remote therefrom, such as in the area where the neck joins the sound box. Armed with this knowledge various workers in the art have attempted to provide instruments which yield a variable tone output. However none of the previous attempts to accomplish this desirable goal have been altogether successful in that they have not been precise, or they have been cumbersome, or they have been extremely costly.

The main object of the present invention is the provision of a new and improved apparatus for providing for tonal control of an electric string instrument.

A further object of the present invention is the provision of a new and improved apparatus for conveniently and easily changing the tonal output of an electric string instrument such as an electric guitar while the instrument is in actual use.

Yet a further object of the present invention is the provision of a new and improved tonal quality selection mechanism for electric guitars and the like which mechanism is adapted to yield a wide variety of tonal effects by ready selection during the operation of the instrument.

In accordance with the present invention, the strings of a string instrument such as an electric guitar are divided into two groups. A pair of pickups are provided adjacent the bridge, one pickup for each group of strings. A second pair of pickups are provided adjacent the end of the neck of the instrument joining the sound box, associating one pickup from each of the second pair with

one of the groups of strings. Switching means are incorporated to interconnect at least one of the pickups associated with one of the groups of strings with at least one of the pickups associated with the other of the groups of strings whereby to yield a number of permutations and combinations resulting in a variety of tonal qualities.

The above and other objects, characteristics and features of the present invention will be more fully understood from the following description taken in connection with the accompanying illustrative drawings.

In the drawings:

FIG. 1 is a plan view of an electric guitar embodying the present invention in combination with a schematically represented amplifier and loudspeaker; and

FIG. 2 is a schematic circuit diagram of the electric pickup and switching apparatus embodying the present invention.

Referring now to the drawings in detail, an electric string instrument here shown as an electric guitar **10** is shown in FIG. 1. The instrument includes the guitar **12** proper, an electronic amplifier A for amplifying the electric signals put out by the guitar **12** and a loudspeaker S for transducing the electric signals amplified by the amplifier A into sound waves. The guitar **12** comprises a sound box **14** and a neck **16** secured to one end of the sound box **14** and extending longitudinally away therefrom. Mounted on the box **14** is a tailpiece **18** for securing one end of each of the strings **20**, **22**, **24**, **26**, **28** and **30** thereto. The strings **20** to **30** inclusive extend over a transversely extending bridge **32** mounted at a mid-portion of the sound box **14** which bridge determines the forwardmost vibrational point for each of the strings. The strings then extend away from the tailpiece in spaced relation with the upper surface of the sound box **14** and neck **16** to the nut **34** and thence over the nut to the adjustable winding pegs **36**, there being one winding peg for each string. The tension of the strings and, therefore, their vibrational characteristics, can be adjusted by the winding pegs **36** in the well-known manner. If it is desired to simultaneously vary the tension of all strings during the playing of the instrument, the tailpiece, as shown, may include an adjusting crank mechanism **38** manually actuated by a crank handle **40** which may be moved forwardly and rearwardly to change the tension on all of the strings simultaneously and thereby give a tonal change.

In accordance with one feature of the present invention the strings **20** to **30** inclusive are divided into two groups. Preferably, although not necessarily, the three treble strings **20**, **22** and **24** comprise one group of strings **42** and the base strings **26**, **28** and **30** comprise a second group of strings **44**. Further, in accordance with the present invention, separate transducers are provided for each group of strings at each of two separate locations. That is to say at a location closely adjacent the bridge **32** a transducer assembly **46** is provided including a first transducer **1** associated only with the string group **42** and a second transducer **2** associated only with the string group **44**. Additionally, a second transducer assembly **48** is provided at a location substantially spaced from the bridge **32**, such as closely adjacent the end of the neck joined to the sound box which transducer assembly includes a third transducer **3** associated only with the string group **42** and a fourth transducer **4** associated only with the string group **44**. Thus it will be seen that at each of two locations which are longitudinally spaced from one another along the strings separate transducers are provided for the treble strings and the bass strings. The specific construction of the transducers forms no portion of this invention per se and any suitable transducing means may be employed. However, it has been found most convenient to employ

variable reluctance-type transducers in the present invention in combination with magnetically permeable steel strings.

As noted in the introductory remarks of this specification, the strings **20** to **30** tend to give a higher pitched tone adjacent the bridge **32** than adjacent the end of the neck **16**. Therefore, for any given vibrating string, the transducer in the transducer assembly **46** will tend to pick up a higher or sharper tone than the corresponding transducer in the transducer assembly **48**. This gives rise to the opportunity of giving a wide variety of tonal qualities to the music being played on the instrument **12** merely by selecting which of the transducers **1**, **2**, **3** and **4** will be operating at any given time. However, it will be obvious in making such selection that in order to get the full range of tone of the instrument, that at least one transducer associated with each string group must be operating.

For example, if the player desires to have the instrument playing slightly sharp, he would desire to have pickups **1** and **2** operating and energizing the amplifier A which in turn energizes the speaker S, while pickups **3** and **4** are out of circuit. Likewise if the player desired only lower tone qualities from the instrument, he would desire to have pickups **3** and **4** actuated for energizing the amplifier A and the speaker S while the pickups **1** and **2** would be deactivated or out of circuit. In addition, various tonal combinations are potentially available with this arrangement. For example, it may be desired to pick up the high tones of the treble string group **42** and the low tones of the bass string group **44** in which event transducers **1** and **4** would be connected in circuit and transducers **2** and **3** would be out of circuit. Conversely, if it is desired to have the slightly sharper bass tones and slightly deeper treble tones, transducers **2** and **3** could be connected into circuit and transducers **1** and **4** could be out of circuit. Moreover, if it is desired for the instrument to give a complete range of tone qualities, it is potentially available to connect into circuit all four transducers **1**, **2**, **3** and **4** which, when so combined, would yield a normal sound of wide range at the speaker S through the single amplifier A.

Thus it will be seen by splitting the transducers into two groups of two each at two longitudinally spaced locations, there is potentially available a wide range of tonal qualities from a given electric guitar. However, in order to avail oneself of the potentialities of the system it is desirable to provide a simple, easily operated switching mechanism for making such selections. Such a mechanism is designated in the drawings by the reference numeral **50** and includes an apertured mounting plate **52** mounted on the upper or outer surface of the sound box **14** through which are disposed a plurality of selector keys or push buttons designated by the reference numerals **54**, **56**, **58**, **60** and **62**. The push buttons **54** through **62** inclusive are of the well known mechanically interlocked type so that no two buttons can be depressed at the same time. As shown by the indicia on the plate **52** the button **54** is adapted to operate switches to include in circuit all four transducers **1**, **2**, **3** and **4**, the button **56** is adapted to include in circuit transducers **1** and **2** and to exclude transducers **3** and **4**, the button **58** is adapted to include transducers **1** and **4** and to exclude transducers **2** and **3**, the button **60** is adapted to include in circuit transducers **2** and **3** and to exclude transducers **1** and **4**, and the button **62** is adapted to include in circuit transducers **3** and **4** and to exclude transducers **1** and **2**. The button **64** is adapted to de-energize the entire mechanism and take out of circuit all four transducers. The manner of the buttons accomplishing these ends will be described hereinafter in connection with the circuit diagram of FIG. 2.

To give additional opportunity for range of tonal selection, various electronic filtering means may be included in the circuitry between the transducers **1**, **2**, **3** and **4** and the amplifier A which filtering means may give a normal or medium tonal response, or tend to filter out the lower frequencies whereby to permit only the higher frequencies to pass through or, inversely, to filter out the higher frequencies and let only the low frequencies pass through. To operate the electronic filtering means three selector buttons **66**, **68** and **70** of the well known mechanically interlocked type are mounted on a mounting plate **72** secured to the upper surface of the sound box **14** for operating switch means for connecting into and out of circuit various filtering means to yield the tone selection above described. As can be seen from the indicia on the plate **72** in FIG. 1 the button **66** when depressed assures that the filtering means which filters out low frequencies and passes through to the amplifier input the higher frequencies is connected in circuit, the button **68** when depressed operates switches to establish circuits which pass the full range of frequencies produced by the transducers to the input of amplifier A, and the button **70** when depressed actuates switches which connect in a filtering circuit to filter out most of the higher frequencies and pass to the amplifier input only the lower frequencies.

In the various means above described for controlling tone, it will be understood by those skilled in the art that the tonal differences between the outputs of transducers **1** and **3** or **2** and **4** are not large but they are clearly discernible to the ear, as between, for example a note which is slightly sharp and one which is slightly flat. On the other hand, the electronic filtering circuits controlled by push buttons **66**, **68** and **70** provide for the attenuation primarily of harmonic frequencies. While there will be some attenuation of fundamental frequencies, this is comparatively small as compared with attenuation of harmonics. Thus, the two tone controlling means perform different functions which combine to yield a highly flexible instrument.

The circuit means for selectively connecting the transducers **1**, **2**, **3** and **4** to the input of the monaural amplifier A and for selectively connecting in and out of circuit high and low filtering means is shown schematically in FIG. 2. As previously stated the switch actuating buttons **54** to **64** inclusive are all mechanically interlocked so that only one of said buttons can be depressed at a given time whereby to close the contacts of the switch associated therewith and to thereby leave open all other switches associated with the other buttons in this set. The mechanical interlocking mechanism is thoroughly conventional and well known in the art and is merely shown in the drawing by dotted lines designated by the reference numeral **74**. Likewise the buttons **66**, **68** and **70** controlling the switch means for connecting into and out of the circuit the electronic filtering means are also mechanically interlocked so that only one of said three buttons can be depressed at a single time whereby to give one of the three filtering conditions above described. The mechanical interlocking linkage for the three buttons **66**, **68** and **70** is likewise thoroughly conventional and is merely represented herein by a dotted line designated by the reference numeral **76**.

The button **54** which is adapted to connect all of the transducers **1**, **2**, **3** and **4** to the amplifier A controls a single contact **78** which is open when the button **54** is in its raised position and is closed when the button is in its down and depressed position. Button **56** controls a pair of contacts **80** and **82** which are here shown as being connected by a jumper **84**, which contacts are open when the button **56** is in its raised position and closed when the button **56** is in its depressed or down position. The button **58** similarly controls a pair of contacts **86** and **88** which are connected by a jumper **90**. Push button **60** controls a pair of contacts **92** and **94** which are open when the push button is in its raised position and which are closed when the push button **60** is in its depressed or down position. Likewise push button **62** is associated with a pair of contacts **96** and **98** which are interconnected by a jumper **100**, which contacts are open with the button

in its raised position and are closed with the button **62** in its depressed condition. Push button **64** is associated with a pair of contacts **102** and **104** which contacts are interconnected by a jumper **106** and which contacts are normally opened with the button **64** in its raised position and are closed with the button **64** in its depressed condition.

The electronic tone selecting buttons, as previously described, actuate electronic filtering means through switches. The high frequency selection button **66** is not associated with any electrical contact means but must be included for its mechanical interlock so as to deactuate or raise either button **68** or button **70** when it is desired to filter out lower frequencies. The medium range button **68** is associated with a pair of contacts **108** and **110** which are interconnected by a jumper **112**, the contacts **108** and **110** being open with the button **68** in its raised position and being closed with the button **68** in its depressed condition. Similarly the low frequency selector button **70** is associated with a pair of contacts **114** and **116** which are interconnected by a jumper **118** and which are open when the button **70** is in its raised condition and which are closed when the button **70** is in its depressed condition. It will be understood that the mechanical interlocking linkages **74** and **76** both operate to hold a depressed button in its depressed condition without application of external force until another button is manually depressed. Accordingly, if for example the button **56** is pushed down by a player, the buttons **54**, **58**, **60**, **62** and **64** will all be pushed upwardly by the linkage **74** and the button **56** will be retained in its depressed condition until operation of one of these other buttons. Interlock mechanism **76** cooperates in the same manner with respect to the buttons **66**, **68** and **70**.

It will be seen that the four transducers **1**, **2**, **3** and **4** are all connected in series and are especially connected in a series additive or sequence circuit so that the outputs of all four will combine for application to the amplifier A. One of the endmost transducers, here shown as the transducer **4** has its outside terminal grounded at G as shown in FIG. 2. Let it be assumed that the "All" button **54** is depressed whereby to insure that the buttons **56**, **58**, **60**, **62** and **64** are all in their extended or up position. Accordingly, contact **78** associated with button **54** will be closed and all other contacts associated with the buttons **56** to **64** inclusive will be open. Let it further be assumed that the high frequency button **66** is depressed whereby to insure the extension of buttons **68** and **70** and the opening of their associated contacts. With these conditions persisting transducers **1**, **2**, **3** and **4** will all be generating voltages responsive to the string vibrations immediately above them and will collectively generate signals between the left hand terminal of transducer **1** and the right hand grounded terminal of transducer **4**. It will be noted that the ground for transducer **4** is also the ground for the volume control resistor or potentiometer R2. The left hand terminal of transducer **1** which makes up the left hand terminal of the entire signal generating means will be applied to the slide **120** of the potentiometer R2 through a low frequency blocking capacitor C1. This circuit may be traced from the left hand terminal of transducer **1** through the capacitor C1 and to the slide **120**. As capacitor C1 is adapted to provide a low impedance path to relatively high frequency signals and a high impedance path to low frequency signals, it is obvious that the high frequency signals will pass through capacitor C1 and be applied to the potentiometer R2. In view of the high impedance presented by capacitor C1 to the low frequency signals, these signals will tend to take a lower impedance path which may be traced from the left hand terminal of transducer **1**, over contact **78**, through attenuator resistor R1 to ground G. Thus a fairly high frequency signal will be applied across the potentiometer R2 and through the plug connector P to the amplifier A and thence to the speaker S. However, it will be seen that these high frequencies have been generated by all four transducers **1**, **2**, **3** and **4**.

If it is desired to operate with less than all of the transducers **1**, **2**, **3** and **4** then one of the buttons **56**, **58**, **60** or **62** must be depressed whereby to retract the "All" button **54** to open contact **78** and to close the contacts associated with the newly depressed button. In every case, upon doing this, certain transducers will be short circuited whereby to effectively take them out of circuit and leave in circuit as signal generating means only those transducers which have not been so short circuited. For example, if it is desired to obtain the signal output of only transducers **1** and **2** both of which are located near the bridge **32** of the instrument, then button **56** is depressed to close contacts **80** and **82** and to thereby short circuit transducers **3** and **4**. Such short circuiting can be traced from the left hand terminal of transducer **3** over contact **80** which is now closed, over the jumper **84**, over the now closed contact **82** to the right hand terminal of transducer **4**. In addition to short circuiting transducers **3** and **4**, the closing of the contacts **80** and **82** effectively connects the right hand terminal of transducer **2** to ground connection G leaving the left hand terminal of transducer **1** connected as previously described. Accordingly the signal flow through the tone control mechanism will be precisely the same as above described.

Likewise, if it is desired to utilize the signals generated only by transducers **1** and **4**, it becomes necessary to take transducers **2** and **3** out of circuit as by short circuiting. This may be accomplished by depressing button **58** whereby to raise the previously depressed button **56** to open contacts **80** and **82** and to close contacts **86** and **88**. This effectively short circuits transducers **2** and **3** from the left hand terminal transducer **2**, over contact **86**. through jumper **90**, over contact **88**, and then to the right hand terminal of transducer **3**. The short circuit path is also effective for connecting the right hand terminal of transducer **1** to the left hand terminal of transducer **4** whereby to keep them in series additive relationship so that they can continue to cooperate and produce a signal as previously described. If it is desired to operate with only transducers **2** and **3** whereby to necessitate the removal of transducers **1** and **4** from circuit as by short circuiting, button **60** is depressed whereby to retract button **58** through the mechanical linkage **74** and to close contacts **92** and **94**. Transducer **1** becomes short circuited over a circuit that can be traced from the left hand terminal of transducer **1**, over contact **92**, and back to the right hand terminal of transducer **1**. At the same time transducer **4** is short circuited over a circuit which may be traced from the left hand terminal of transducer **4**, over contact **94** back to the right hand terminal of transducer **4**. The short circuits above traced effectively connect the left hand terminal of transducer **2** to the capacitor C1 and the right hand terminal of transducer **3** to the ground connection G. Accordingly, the remainder of the circuit functions as previously described. Likewise, when it is desired to operate with just transducers **3** and **4** and therefore to short circuit transducers **1** and **2** button **62** is depressed whereby to cause the withdrawal of button **60** through mechanical linkage **74** to open contacts **92** and **94** and to close contacts **96** and **98**. The closing of contacts **96** and **98** will provide for the short circuiting of transducers **1** and **2** which short circuit may be traced from the left hand terminal of transducer **1** over contact **96**, through jumper **100**, over contact **98** to the right hand terminal of transducer **2**. This short circuit path will also effectively connect the left hand terminal of transducer **3** to capacitor C1 so that the circuit will operate in a normal manner. Likewise when it is desired to de-energize the guitar **10** the off button **64** is depressed to thereby retract all the buttons including the last depressed button **62** to open contacts **96** and **98** and close contacts **102** and **104**. This will effectively short circuit all four series connected transducers over a circuit which

may be traced from the left hand terminal of transducer 1 over contact 102, through jumper 106 and over contact 104 to the right hand terminal of transducer 4. If desired additional contact means (not shown) can be associated with the push button 64 to control the power supply to the amplifier A whereby to de-energize the entire system through the operation of the one push button 64.

It will be noted that additional short circuit paths are included in the circuit of FIG. 2 although they are not necessary to the operation. Thus by connecting the common terminal of transducers 3 and 4 to jumper 84, the closing of contacts 80 and 82 by the depression of button 56 will individually short circuit them to give added assurance of no signal "leaking" from the transducers. Similar connections are made from jumper 90 to the common terminal of transducers 2 and 3 and from jumper 100 to the common terminals of transducers 1 and 2 and from jumper 104 to the common terminals of transducers 2 and 3. As already stated, while such added short circuit means are desirable, they are not wholly necessary to the present invention.

It will be noted that the circuit means associated with push buttons 54 through 64 inclusive are arranged to insure that at least one transducer associated with each group of strings 42 and 44 is connected in circuit, whereby to insure that there is pick up from each of the six strings on the instrument. While it is conceivable that someone might desire to operate at some point with only the treble strings or only the bass strings, this can be effected by the manner of play and need not be effected through the use of electrical switching means.

The above description of the tone selector means including push buttons 54 through 64 inclusive has been described in combination with the electronic tone control means set for high frequency operation. As already stated the high frequency filtering is accomplished by interposing in the circuit between the transducers and the amplifier a capacitor C1 which is adapted to pass high frequencies at low impedance and to present high impedance to low frequency signals. Thus the low frequencies tend more to pass off to ground through the attenuating resistor R1. If a more balanced mode of operation is desired where there is substantially no filtering, then the button 68 is depressed to retract or raise the button 66 through the mechanical linkage 76 and to close contacts 108 and 110. The closing of these contacts effectively short circuits the capacitor C1 which short circuiting can be traced from the upper terminal of the capacitor C1, through the contact 110, to the lower terminal of the capacitor C1 and thence to the potentiometer slide 120 of potentiometer R2. With such a connection all frequencies can be passed through to amplifier A whereby to give balance control. It will be noted that the closing of contact 108 provides a circuit path from the left hand terminal of transducer 1 to resistor R1 and thence through that resistor to ground. This circuit path tends to attenuate all frequencies and to compensate for any losses in the capacitor C1.

When it is desired to filter out the higher frequencies and pass to the potentiometer R2 (and amplifier A) only the lower frequencies generated by the transducers 1, 2, 3 and 4, the push button 70 is depressed whereby to raise the button 68 through the mechanical interlocking means 76 to open contacts 108 and 110 and to close contacts 114 and 116. The closing of contacts 114 establishes a second short circuit path around capacitor C1 which path may be traced from the upper terminal of capacitor C1. This provides for a bypassing of the capacitor C1 by the low frequency signals whereby to insure their application to the slide 120 of the potentiometer R2. In addition, the closing of contact 116 establishes a high frequency shunt path to ground connection G, whereby to filter off through this low impedance shunt path the high frequency signals. The shunt path may be traced from the left hand terminal of transducer 1, over contact 114, through jumper 118, over contact 116, and through capacitor C2 to ground. As stated capacitor C2 is adapted to present a low impedance to high frequency signals and a high impedance to low frequency signals. Therefore the high frequency signals will pass readily therethrough to ground and hence be shunted off from the potentiometer R2. However, the low frequency signals will not pass readily therethrough and therefore will be applied through the previously traced circuit to the slide 120 of the transducer R2.

It will be recognized that other types of switching arrangements can be made for taking various circuit elements hereindescribed into and out of the circuit arrangement without departing from the present invention. Thus, for example, means could be provided for open circuiting a given transducer to take it out of circuit rather than short circuiting said transducer. Such circuit design is well within the capacity of any one skilled in the art once the basic invention is presented as it is herein. Accordingly, for the purpose of this specification and the claims to follow, the term "out of circuit" may mean either open circuiting of a particular circuit element or the short circuiting of that element.

By dividing the strings of the instrument into two groups and by associating with each group of strings two longitudinally spaced transducers, one adjacent the area of vibration yielding sharp tones and one adjacent an area of vibration yielding deeper tones, and by interconnecting such transducers in such a manner as to be able to select various tonal combinations, an instrument with a great variety of tonal output can be achieved in accordance with this invention. The wide variety of tonal output so achievable can be further enhanced by adding to the tonal selection means electronic filtering circuits to give further selection of ultimate tonal output. Further frequency control may be effected manually as by the mechanical crank means 40 for simultaneously varying the tension on all strings to yield further tonal control. All of the selected frequencies, as already noted, are applied to a volume control potentiometer R2 which in turn is connected to a plug connector P or other connecting means to a single amplifier A which is adapted to amplify all signals in the audio range and to put out to a matched speaker S electric signals so amplified for transducing back into sound waves. Thus with a single amplifier and a single speaker a very wide variety of tonal effects can be accomplished by practicing the present invention.

While I have herein shown and described the preferred form of the present invention and have suggested modifications therein, other changes and modifications may be made therein within the scope of the appended claims without departing from the spirit and scope of this invention.

What is claimed is:

1. An electric stringed instrument comprising a plurality of side by side strings including a first group and a second group; a bridge extending transversely of said strings in engaging relation therewith; a first transducer means disposed adjacent said bridge and including a first transducer in transducing relation with said first group of strings and being out of transducing relation with said second group of strings, and a second transducer in transducing relation with said second group of strings and being out of transducing relation with said first group of strings; a second transducer means disposed remote from said bridge and including a third transducer in transducing relation with said first group of strings and being out of transducing relation with said second group of strings, and a fourth transducer in transducing relation with said second group of strings and being out of transducing relation with said first group of strings; an amplifier having input and output means; a speaker connected to said amplifier output means; circuit means for connecting said two transducer means to said amplifier means; said circuit means including switch

means for selectively and collectively connecting said transducers into and out of said circuit means.

2. The instrument of claim 1 wherein said switch means includes switches for simultaneously connecting at least one even numbered transducer and at least one odd numbered transducer into said circuit means.

3. The instrument of claim 1, wherein said circuit means includes first, second, third, fourth and fifth circuits for connecting said transducer to said amplifier input, and said switch means includes a first switch for establishing said first circuit with all four transducers in said first circuit, and a second switch for establishing said second circuit with said first and second transducers in said second circuit and said third and fourth transducers out of said second circuit, a third switch for establishing said third circuit with said first and fourth transducers in said third circuit and said second and third transducers out of said third circuit, a fourth switch for establishing said fourth circuit with said second and third transducers in said fourth circuit and said first and fourth transducers out of said fourth circuit, and a fifth switch for establishing said fifth circuit with said third and fourth transducers in said fifth circuit and said first and second transducers out of said fifth circuit.

4. The instrument of claim 1, further comprising frequency discriminating means, and means for connecting said frequency discriminating means into and for removing said frequency discriminating means from said circuit means.

5. The instrument of claim 3, further comprising frequency discriminating means, and means for connecting said frequency discriminating means into and for removing said frequency discriminating means from said circuit means.

6. The instrument of claim 5, wherein said frequency discriminating means includes a low frequency filter for substantially preventing the passage of low frequency signals therethrough, a high frequency filter for substantially preventing the passage of high frequency signals therethrough, and switch means for connecting said filters into and for removing said filters from said circuit means.

7. The instrument of claim 3, further comprising a plurality of mechanically interlocked pushbuttons, one for each switch, for operating said switches.

8. The instrument of claim 4, further comprising a mechanical means for simultaneously adjusting the tension on all of said strings.

9. The instrument of claim 8, wherein said instrument is an electric guitar comprising a sound box and a neck having one end secured to said sound box, said bridge being mounted on the upper surface of said sound box, a tail piece on said upper surface of said sound box between the end thereof remote from said necek and said bridge for anchoring one end of each of said strings, means adjacent the other end of said neck for anchoring the other ends of said strings, said first and second transducers being mounted in said upper surface of said sound box adjacent said bridge in underlying relation with said strings, said third and fourth transducers being mounted in said upper surface of said sound box adjacent said one end of said neck in underlying relation with said strings, said pushbuttons being mounted in said upper surface of said sound box.

10. The electric guitar of claim 10, further comprising manually operable means for moving said tail piece toward and away from said bridge to simultaneously adjust the tension on all of said strings.

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HERMAN KARL SAALBACH, Primary Examiner

S. CHATMON, JR., Assistant Examiner

U.S. Cl. X.R.

84—1.14, 1.17

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,478,158 Dated November 11, 1969

Inventor(s) Charles C. Trainor

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 4, line 1: "lower" should read -- low --. Column 6, line, line 34: "86." should read -- 86, --. Column 9, line 3:"claim 1 wherein" should read -- claim 1, wherein --. Column 10, line 4: "claim 4," should read -- claim 3, --; line 7: "claim 8," should read -- claim 7,--; line 12: "necek" should read -- neck --; line 23: "claim 10," should read -- claim 9, --.

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(SEAL)
Attest:

Edward M. Fletcher, Jr.
Attesting Officer

WILLIAM E. SCHUYLER, JR.
Commissioner of Patents