Aug. 11, 1970 W. MUNCH, JR 3,524,143

AMPLIFIER SYSTEMS FOR ELECTRIC GUITARS AND THE LIKE

Filed Dec. 15, 1965 5 Sheets-Sheet 1

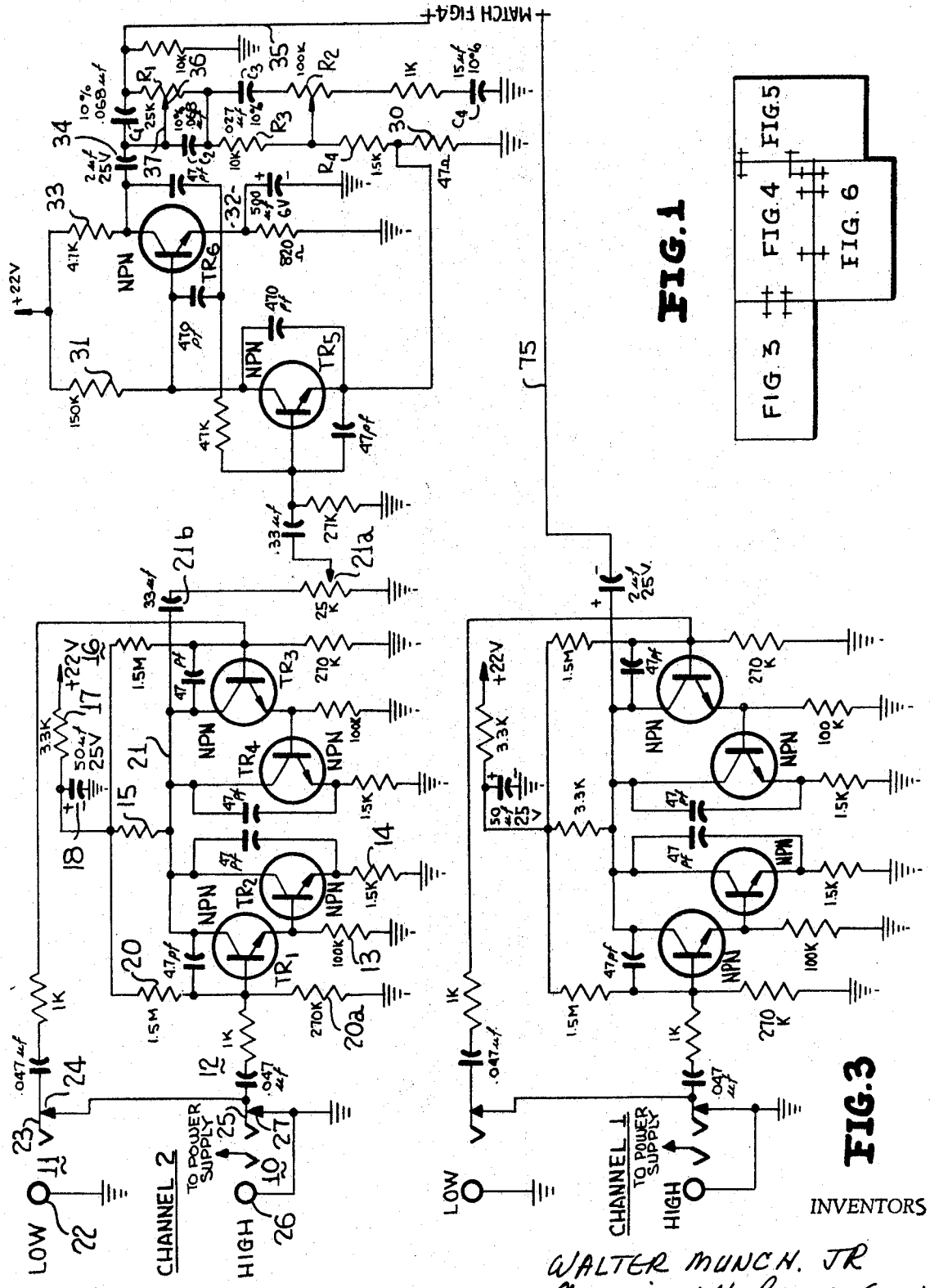


FIG. 1

FIG. 3

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AMPLIFIER SYSTEMS FOR ELECTRIC GUITARS AND THE LIKE

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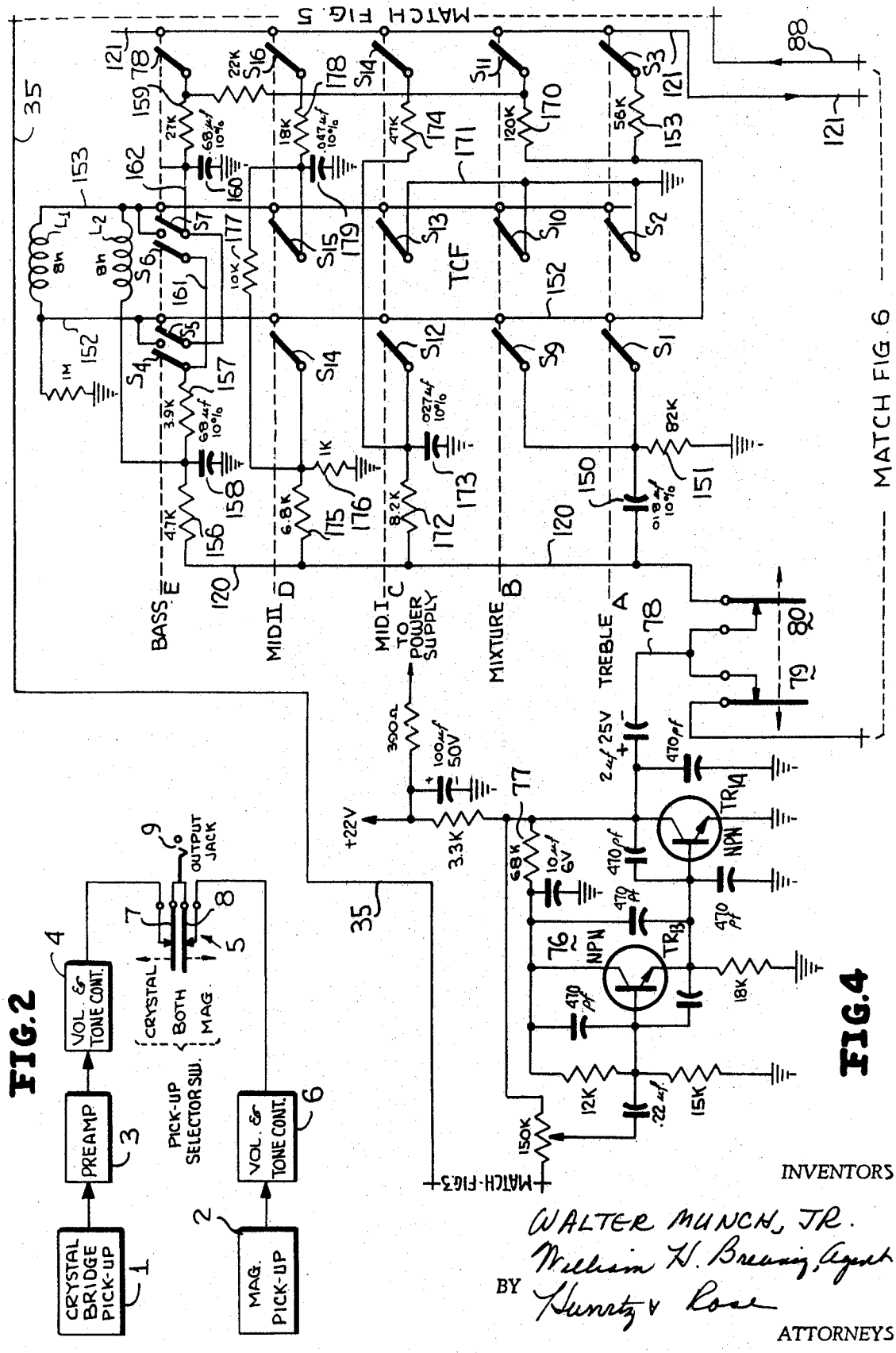


FIG.2

FIG.4

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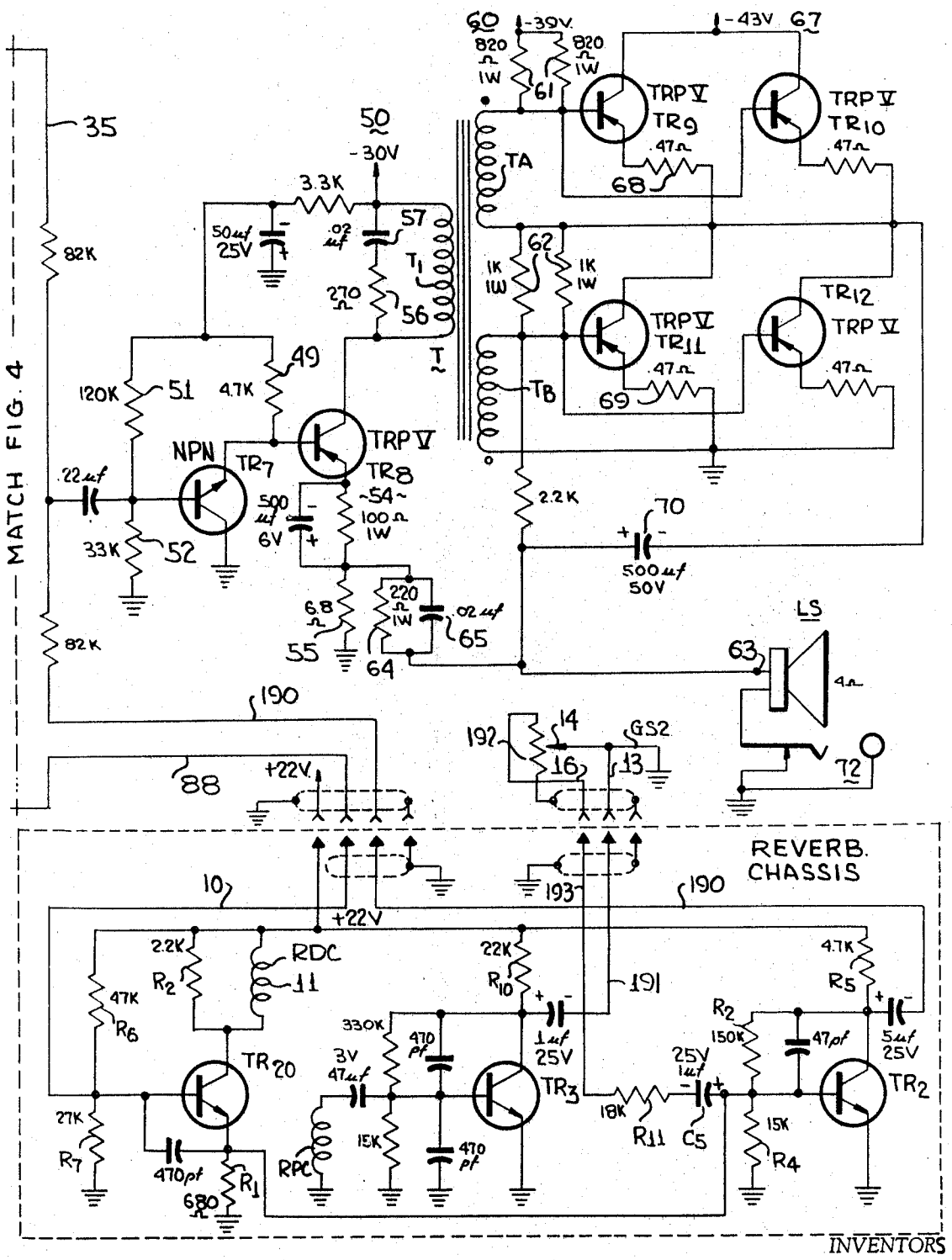
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AMPLIFIER SYSTEMS FOR ELECTRIC GUITARS AND THE LIKE

Filed Dec. 15, 1965 5 Sheets-Sheet 3



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FIG. 5

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AMPLIFIER SYSTEMS FOR ELECTRIC GUITARS AND THE LIKE

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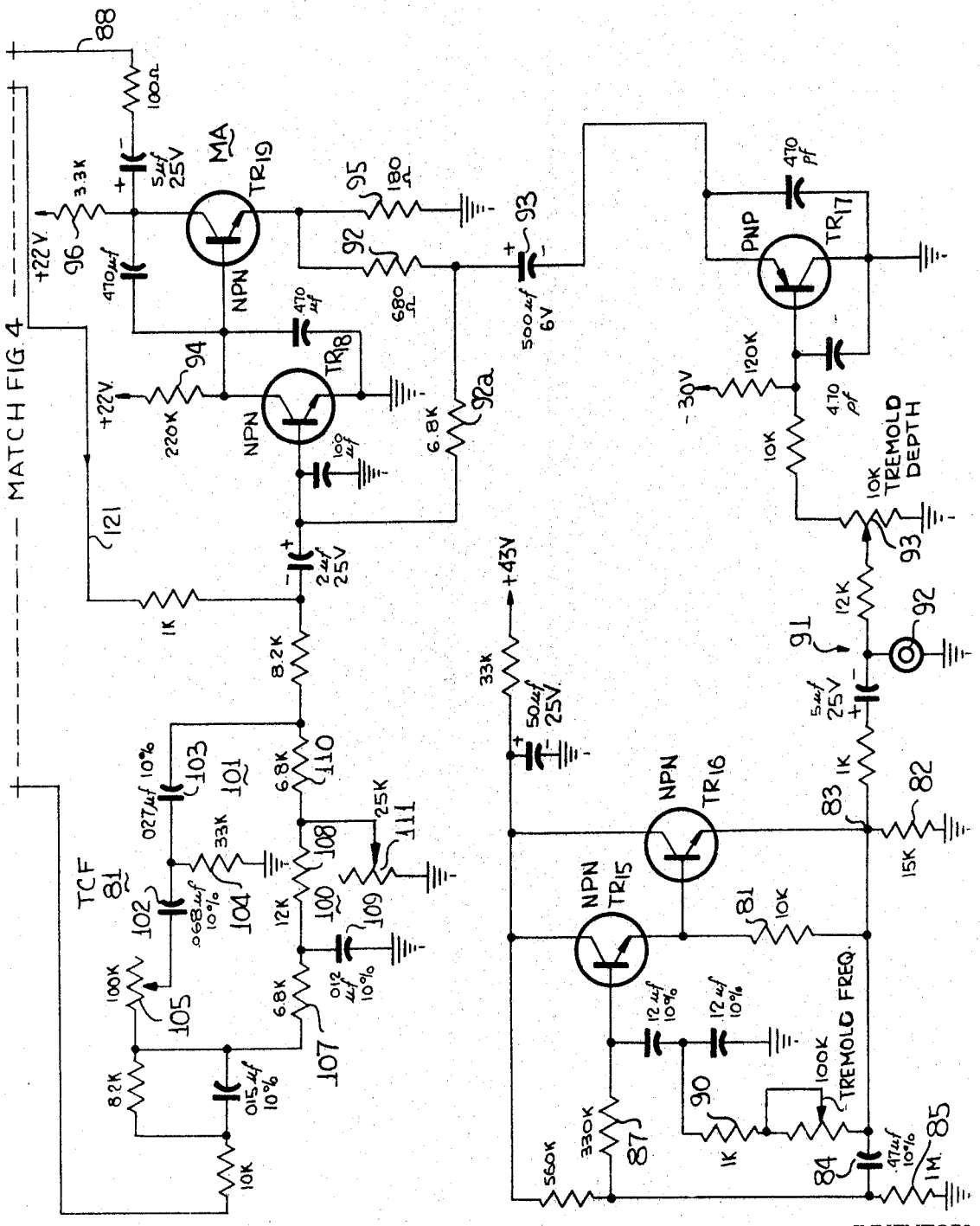


FIG.6

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AMPLIFIER SYSTEMS FOR ELECTRIC GUITARS AND THE LIKE

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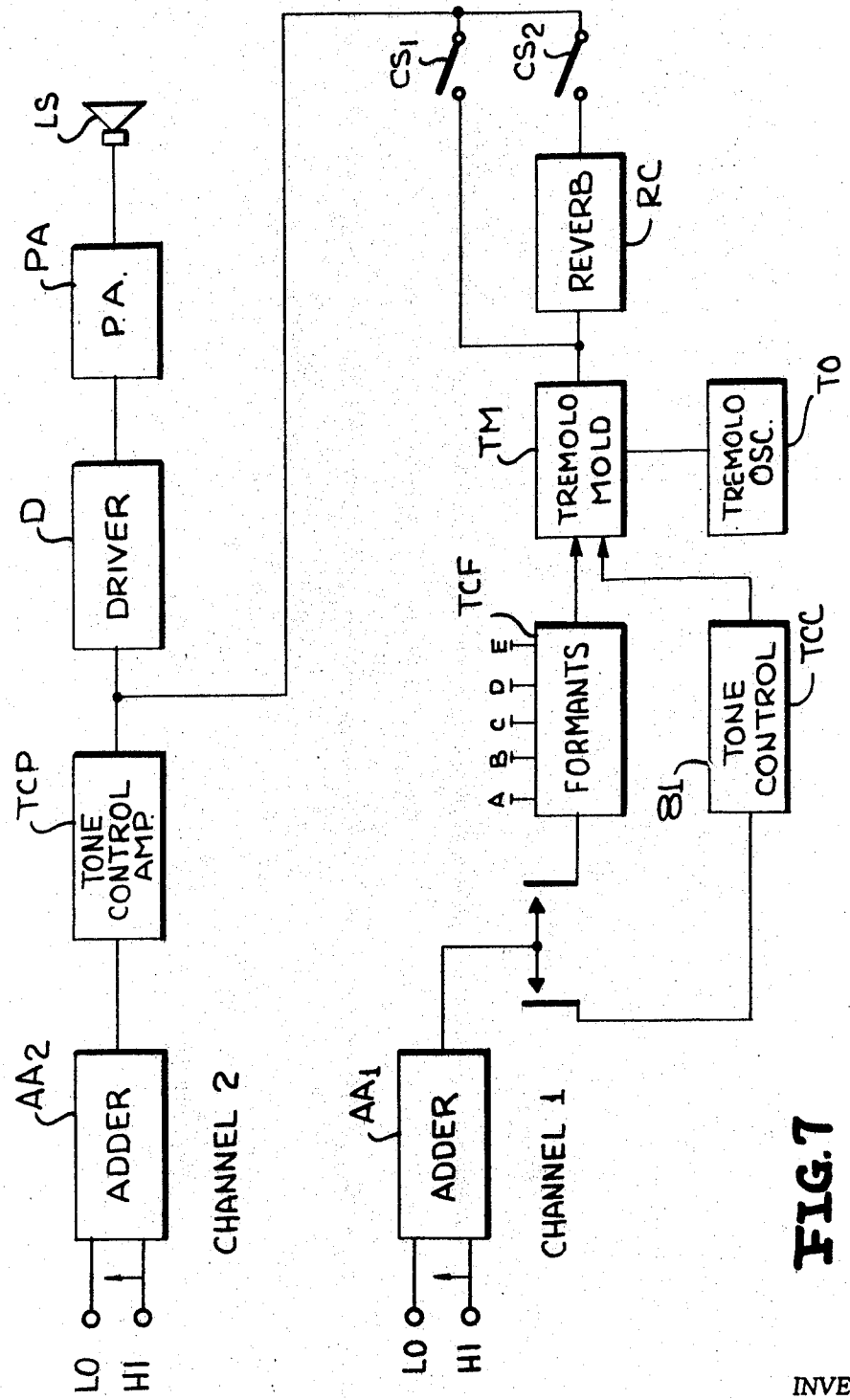


FIG. 7

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United States Patent Office

3,524,143

Patented Aug. 11, 1970

3,524,143

AMPLIFIER SYSTEMS FOR ELECTRIC GUITARS AND THE LIKE

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Filed Dec. 15, 1965, Ser. No. 513,955
Int. Cl. H03f 3/68
U.S. Cl. 330—30 5 Claims

ABSTRACT OF THE DISCLOSURE

An amplifier system having first and second sections which are connected to a common load. Each of the amplifier sections has an individual input circuit which may be connected through a jack operable switch to a signal source. The switches are interconnected to provide grounding of one amplifier section if a jack is inserted in the switch of the other.

The present invention relates generally to electronic musical instruments, and more particularly, to electronic stringed instruments, wherein transducers coupled to the strings are used as tone sources, and wherein the tonal outputs of the strings may be modified in a variety of ways in pre-established degrees by means of a limited number of simple on-off controls, and in such manner as to simulate at will the tonal output of at least some members of a family of stringed instruments.

Many instruments of a family, e.g. the guitar family, are made in various forms, sizes, and tone capabilities. In such cases, musicians may be impelled to own and to transport and have available for playing two or more instruments contained within the family, at considerable cost and inconvenience. Electric guitars are known which transduce the motion of the strings of a guitar to electrical signals, and filter the signals to modify the timbre or quality of the tone prior to electro-acoustical transduction and radiation of the signals. In a copending application in the names of Donald W. Elbrecht and Robert C. Scherer, entitled Tone Control Systems for Electric Guitars and the Like, Ser. No. 514,051, now U.S. Pat. No. 3,454,702 issued July 8, 1969 assigned to the same assignee as the present application, the filters employed to modify tone quality are specifically designed to produce a wide range of quickly-changeable tone qualities approaching several individuals of a family of instruments. For example, in the case of the guitar, there are the classic guitar, the type used for western music, the rock and roll guitar, the Hawaiian guitar, the bass guitar, the rhythm guitar, and the like.

The modification of timbre or tone quality alone does not exhaust the possibilities of modifying guitar tones electrically. In accordance with a further feature of the invention, a modulator is provided which can provide a range of tremolo frequencies, and a range of modulation depths for such tremolo. Further use may be made of a reverberation facility, in processing guitar tones.

It is, accordingly, a broad object of the invention to provide easily reproducible electrical simulations of, and enchantment of the tone, of several of a family of guitars, while only one member of the family is being played.

According to the invention, two channels are provided each of which provides two inputs. Four instruments can

therefore be accommodated at one time. But if only one instrument per channel is utilized, that channel can play at high level or at low level, according to selection of two jacks available in the channel.

One of the channels provides conventional facilities, per se, apart from the provision of double jacks. The other channel contains facilities not heretofore available in electric guitar amplifiers, i.e. push-button selection of tone colors and availability of circuitry for modifying the effect of tone color filters to afford fine gradations of tone.

It is, accordingly, a broad object of the invention to provide an electric guitar system having more sophisticated and expensive facilities than have heretofore been available in such systems.

The above and still further objects, features and advantages of the present invention will become apparent upon consideration of the following detailed description of one specific embodiment therof, especially when taken in conjunction with the accompanying drawings, wherein:

FIG. 1 is a diagram showing the correct assembly of the sheets of drawings to provide a complete circuit diagram;

FIG. 2 is a block diagram of circuitry and transduction equipment which may be employed as part of a guitar for providing signals to the electronic circuitry of the invention;

FIGS. 3, 4, 5, 6 taken together constitute a schematic circuit diagram of the electronic circuitry of the invention; and

FIG. 7 is a block diagram of the circuitry of FIGS. 3–6, inclusive.

Referring now to FIG. 2, a string motion transducer **1**, called a crystal bridge pick-up, is provided as part of an electric guitar. Such transducers are conventional and involve piezo electric crystals, usually mechanically coupled to the strings of the guitar by being located under or constituting the bridge of the guitar. Additionally, an electric guitar may be provided with an electromagnetic pick-up **2** which responds to the movement of metallic strings without contact therewith. Both facilities are not required, but may be available. A reason exists for having both in that each type of transducer can produce a different character of tonal output.

The output of crystal bridge pick-up **1** is amplified in amplifier **3**, since it is normally of low ampltiude, and applied via a conventional volume-tone control circuit **4** to one stationary contact of a switch **5**. The output of magnetic pick-up **2** is applied to another stationary contact of switch **5** via a volume and tone control circuit **6**. The switch **5** includes two movable arms **7** and **8**, cooperating with the stationary contacts, respectively, and these have a common output jack **9**. Accordingly, there is available at jack **9**, the tonal output of either transducer, or of both, according to the positions of movable contacts **7**, **8**. As illustrated both transducers provide such output to jack **9**.

ADDER (FIG. 3)

In channel **2**, a *high* input jack **10** and a *low* input jack **11** are provided. The high input jack **10** proceeds via a series RC coupling network **12** to the base of an NPN transistor TR_1, having an emitter load **13**. The emitter of TR_1 is directly connected to the base of NPN transistor TR_2, which in turn has an emitter load **14**. TR_1 and TR_2 have a common collector load **15**, which is in

series with a voltage source **16** via a voltage dropping resistance **17**, the junction of resistances **15** and **17** being by-passed to ground for alternating currents by capacitor **18**. The base of TR_1 is biased by a voltage divider comprising series resistances **20**, **20***a*. A common output lead **21** for the collectors TR_1 and TR_2 is provided, which is in series via capacitor **21***b* with a potentiometer **21***a*, acting as a volume control. TR_1 and TR_2 look, to resistance **15**, like a constant current source, so that a replica of the input signal appears across resistance **15**, except for a phase reversal.

The *low* input jack **11** utilizes a circuit similar to that of the high input jack **10**, utilizing NPN transistors TR_3 and TR_4 and identical circuit values associated with these as are associated with TR_1 and TR_2, and the collector load resistance **15** is common to all four transistors.

The jack **11** includes a grounded element **22** and a movable arm **23** normally contacting point **24**. The latter is connected to movable arm **25** of jack **10**, which includes a grounded element **26** and a contact point **27** which is grounded. When a male element is inserted in either jack the movable arm, as **23** or **25**, is raised, and becomes the hot element of the jack. Operation of jack **11** alone then implies disconnection of contacts **24** and **27**, so that no signal is applied to TR_1, TR_2. On the other hand, operation of jack **10** alone implies that signal is applied in parallel to TR_1 and TR_3. Collector load **15** then carries double signal current, and its voltage as seen on lead **21** is doubled. At the same time, if both jacks are operated, say in connecting two diverse inputs simultaneously, both inputs will respond at lead **21**, but the signal level will be twice that for the single low jack **11**, and may be the same as that for the high jack **10** alone.

PRE-AMPLIFIER

The section following volume control **21***a* is a pre-amplifier including tone control circuitry.

Transistor TR_5 is an NPN transistor having an unbypassed resistance **30** connected between its emitter and ground. A resistance **31** provides a collector load for TR_5 and the collector is connected to the base of transistor TR_6. The latter is provided with an emitter bias circuit **32** and a collector load **33**. The bias voltage developed by bias circuit **32** is connected back to the base of TR_5 and serves to bias the latter. A coupling capacitor **34** then couples the collector of TR_6 to tone control circuitry, capable of separately controlling bass and treble.

The tone control circuitry includes a small capacitor C_1 in series between capacitor **34** and output lead **35**. A capacitor C_2 of the same size, is connected from capacitor **34** in series with resistance **30**. Resistance R_1 is connected to across C_1 and C_2 in series, and a variable slider **36** is connected from the junction of C_1 and C_2 to the resistance R_1. C_2 then supplies feedback signal to resistance **30** while C_1 provides signal to the load. As slider **36** moves up, C_1 is progressively by-passed, which provides bass boost in output lead **35**. Since a zero impedance paht **37** is provided from C_2 to R_1 at their ground-adjacent points, moving slider **36** up decreases bass feedback. Thereby, moving the slider up boosts bass by decreasing feed through impedance and decreasing negative feedback; when slider **36** moves down, feedback capacitor C_2 is shunted out of circuit, progressively, while C_1 is cut in. Thereby, series attenuation to lead **35** increases while feedback signal increases.

Capacitor C_3, resistance R_2, resistance R_2', and capacitor C_4 are connected in series from resistance R_1 to ground. Slider **40** slides on R_2 and is connected back to the feedback path, at the junction of R_3, R_4, which are connected between C_2 and resistance **30**. As slider **40** moves up treble is cut, because degeneration is progressively added via C_3, while by-pass of treble frequencies to ground is decreased. As the slider moves down, treble is boosted because degeneration is decreased via C_3, and treble by-pass to ground increased via C_4.

DRIVER AND POWER AMPLIFIER (FIG. 5)

Signal appearing on lead **35** is coupled to the base of an NPN transistor TR_7 having a grounded collector and an emitter load **49** connected back to a negative voltage supply **50**. A voltage divider composed of resistances **51**, **52** connected back to the same supply **50** furnishes bias for TR_7 is directly connected to the base of a further PNP transistor TR_8. The emitter of the latter is connected to ground through a bias circuit **54** and a feedback resistance **55**, a primary winding T_1 of a transformer T being connected in the collector circuit as a load. Across winding T_1 is connected a small resistance **56** and a small capacitor **57**, in series, to provide a high-frequency by-pass to prevent supersonic oscillations.

Two secondary windings TA and TB are provided in transformer T. These are oppositely poled to provide a push-pull output for power amplifier transistors.

The transistors employed in the main power amplifier are denoted TR_9 and TR_{10}, in parallel and TR_{11} and TR_{12}, in parallel. Bias voltage for the transistors TR_9 to TR_{12} is provided from a negative bias voltage source **60**. The latter is connected through parallel resistances **61** to the base of TR_9, through windings TA, then via resistances **62** in parallel to the base of TR_{11} and thence to terminal **63** of loudspeaker LS, providing a path to ground through the speaker. Point **63** is connected back to resistance **55** through a resistance **64** which is by-passed for high audio frequencies by capacitor **65**. Accordingly, the signal appearing across loudspeaker LS is fed back degeneratively to the emitter of TR8.

The collector of PNP transistor TR_9 is connected directly to a negative voltage supply **67**, and its emitter is connected via a small fuse **68** directly to the collector of TR_{11}, the emitter of which is connected via a small fuse **69** directly to the ground. At the same time, the junction of the emitter of TR_9 and the collector of TR_{11} are coupled via a large capacitor **70** to terminal **63**. Accordingly as TR_9 and TR_{11} are driven out of phase from transformer T their relative impedances vary inversely. They act as variable voltage divider for point **63** and thereby serve to drive the loudspeaker LS. Coupling from point **63** to the emitter resistance **55** of TR_8 provides negative feedback to the driver stage.

Transistors TR_{10} and TR_{12} parallel TR_9 and TR_{11}, respectively, at all electrodes to enhance power handling capacity and their presence does not modify operation otherwise.

A jack **72** is provided between loudspeaker LS and ground to enable insertion of additional speakers in series with LS.

The system channel above described is "channel **2**." A further "channel **1**" is provided, which includes an adder amplifier and input jacks, and amplifier circuitry precisely the same as that above described under the heading ADDER. It is therefore not described in detail. The output of the latter appears on lead **75**, which is connected to the input of a pre-amplifier **76** which lacks tone control features, and which has a flat response. The signal on lead **75** is supplied to the base of NPN transistor TR_{13}, operated as an emitter follower. The emitter of TR_{13} is connected to the base of NPN transistor TR_{14}, which is emitter-grounded and collector-loaded by resistance **77**. The collector of TR_{14} is connected back as shown to the base of TR_{13} to provide considerable negative feeback, and output is provided at lead **78**.

The lead **78** proceeds to two normally-closed ganged switches **79** and **80**. In the normal position switches **79** and **80** provide "channel **1**" signal in parallel to a set of tone color filters TCF and to a tone control circuit **81**. When switch **80** is opened, the tone color filters TCF are disconnected, but the tone control circuit **81** remains in circuit. In the alternative, when switch **79** is opened, switch **80** remains closed and only the tone color filters TCF remain in circuit. The outputs of tone color filters TCF and of tone control circuit **81** are applied in parallel to

a modulator amplifier MA. The signal therefrom is passed along to the power amplifier driver via a reverberator which is described in detail hereinafter. At the power amplifier driver, the signals from channels **1** and **2** are combined.

TREMOLO OSCILLATOR

The tremolo oscillator of the present system, which supplies modulation signal to modulator amplifier MA, includes an NPN transistor TR_{15}, having its collector directly connected to a positive supply source **80**, and having a resistive emitter load **81**, **82**. The emitter of TR_{15} is connected directly to the base of an NPN transistor TR_{16}. The latter includes a collector directly connected to voltage supply **80**, an emitter connected to the junction **83** of resistances **81**, **82**. Junction **83** is coupled via a capacitor **84** across a 1M resistance **85**. The latter is connected to the base of TR_{15} via resistance **87**, so that the coupling is via a T-bridge having capacitor **84** as its shunt arm. From the base of TR_{15} to ground is connected, in series, a pair of capacitors **88**, **89**, from the junction of which a variable resistance **90** proceeds back to junction **83**, providing a T-bridge having resistance **90** as its shunt arm.

Feedback from the emitter of TR_{16} to the base of TR_{15} is positive, but different phase shifts exist in the two feedback paths from terminal **83**, one path subsisting through variable resistance **90** and the junction of capacitors **88**, **89**, and the other through capacitor **84** and the junction of resistances **85**, **87** and together serving to establish oscillatory conditions. Since frequency of an RC oscillator is determined by loop phase shift, the frequency of the oscillator can be adjusted by varying the value of resistance **90**. The frequencies selected are in the low sub-audio range, say 4–14 c.p.s. The tremolo oscillator is essentially of a conventional parallel-T type, and therefore its theory of operation is not expanded.

The output of the oscillator appears at terminal **83**. That point is coupled via a path **91** to the base of a PNP transistor TR_{17}. The path **91** can be shunted to ground by a foot operated switch **92**, and includes an interposed volume control **93**, which sets tremolo depth.

The modulator amplifier MA includes a first amplifier NPN transistor TR_{18}, which is emitter grounded and collector loaded by resistance **94**. The collector of TR_{18} is directly connected to the base of an NPN transistor TR_{19}, which includes a small feed-back emitter resistance **95**, and a larger collector resistance **96**. The collector of TR_{19} supplies signal to load **88**. The emitter of TR_{19} is coupled by a resistance **92** and large capacitor **93** to the emitter of PNP transistor TR_{17}, and via resistances **92** and **92***a* to the base of transistor TR_{18}, for feed-back.

TR_{17} includes a grounded collector and a base which is biased negative. It acts as a signal-controlled variable resistance in the emitter circuit of TR_{19}, in parallel to feed-back resistance **95** serving to vary the total feed-back of modulator amplifier MA.

As the resistance of TR_{17} varies, the feed-back to the base of TR_{18} varies. Thereby, the gain of amplifier modulator MA varies and the signal on lead **88** is tremolo modulated. The use of a PNP transistor TR_{17} permits a small feed-back resistance **95**, since the emitter resistance is small and highly sensitive to base voltage.

The tone control circuit **81** includes a base section **100** and a treble section **101**. The treble section **101** consists of a pass filter of conventional configuration, i.e., two series capacitors **102**, **103**, and a shunt resistance **104** to ground from their junction. Control is effected by a variable resistance **105** in series with the filter, so that the highs may be augmented or decreased. Filter **100** is a low pass filter of conventional configuration, i.e., two series resistances **107** and **108** and a shunt capacitor **109**, capable of by-passing highs. A further resistance **110** is connected in series with resistances **108**, and the junction of resistances **108**, **110** is variable shunted to ground via variable resistance **111**.

The combination of filters **100**, **101** can provide continuously-variable treble and bass tone control, independently.

TONE COLOR FILTERS (FIG. 4)

Tone color filters TCF constitute a set of components providing resistance, capacitance, and inductance, and which can be selected in various combinations to form any one of five filters in response to five switch assemblies which are mutually exclusive, so that closure of one set opens all others. Such switches, and the mechanical features thereof, are well known and therefore are not described in detail, or illustrated.

Lead **120**, connected to switch **80**, is a common input lead for the filters, and lead **121** a common output lead.

On closure of ganged switches S_1, S_2, S_3, series capacitor **150** and shunt resistance **151** are connected via lead **152** in series with inductance L_1, and thence to ground via line **153** and S_2. At the same time a circuit is completed from resistance **151** via S_1 to resistance **153** and via S_3 to output lead **121**. The lead **121** is thus connected to the junction of capacitor **150** and inductance L_1, and the circuit values are selected to provide a treble filter, having shunt inductance and resistance and series capacity.

When switches S_4, S_5, S_6, S_7 and S_8 are simultaneously closed, a low pass filter section composed of series resistances **156**, **157** and shunt capacitor **158** is provided connected to input lead **120**, and a further low pass section composed of series resistance **159** and shunt capacitor **160** is connected via S_8 to output lead **121**. Connecting these sections in series are lead **161**, S_6, S_7, and lead **162**.

Inductance L_2 is directly connected from the junction of resistance **156** and **157** to resistance **159**. The total configuration passes bass and attenuates treble.

Switches S_9, S_{10}, S_{11} provide a circuit which is similar to that provided by S_1, S_2, S_3 except for the inclusion of a resistance **170** in place of **153** and the inclusion of the low-pass filter section composed of series resistance **156**, shunt capacitor **158**, inductance L_2, shunt capacitor **160** and resistance **159**. Accordingly, the "mixture" switches permit passage of both treble and bass, reducing the mid-tones.

Switches S_{12}, S_{13}, S_{14} insert a low pass section composed of series resistance **172** and shunt capacitor **173**, and resistance **174** in series, between leads **120** and **121**. In addition, inductance L_1 is connected in shunt, via S_{12}, lead **152**, L_1, lead **153**, S_3 and lead **171**. The combination provides a band pass at a mid frequency.

For closure of switches S_{14}, S_{15}, S_{16}, there is inserted series resistance **175**, and shunt resistance **176**, resistance **177** and low-pass section composed of series resistance **178** and shunt capacitor **179**. In addition, L_2 is shunted around resistance **177** via S_{14} and S_{15}. The resultant filter provides a low-pass circuit which accentuates mid-range frequencies.

The output lead **121** deriving from tone color filters TCF proceeds to the base of TR_{18}, in parallel with the output of tone control circuitry **81**, to provide "dual" control so that the tone color selected can be shaded by the additive tones provided by the tone control circuitry **81**.

REVERBERATOR

The signal present on lead **88**, deriving from modulator amplifier MA proceeds to the base of an NPN transistor TR_{20}, which is provided with an emitter load R_1 and a collector load consisting of a reverberator drive coil RDC for the input transducer of a reverberator coil or spring. The latter is shunted by a resistance R_2, so selected that excessive voltage is never developed across RDC due to its increasing impedance as a function of frequency. RDC can respond to about 2000 cps., but carries the entire audio spectrum and is mechanicaly operative at all times during operation of the system.

The signal developed across R_1 is applied to the base of NPN transistor TR_{21}, which is collector loaded by R_5, and supplies signal to the input lead **190** of TR_7.

The pick-up coil of the reverberator spring transducer, RPC, is connected to the base of NPN transistor TR_{22}, loaded by resistance R_{10} at its collector. Reverberated output proceeds via lead **191**, a potentiometer **192** which sets depth, and a lead **193** to the base of TR_{21}, so that both reverberated and unreverberated signal is presented on lead **190**. To remove reverberation the potentiometer **192** is shorted to ground via a foot switch CS.

Accordingly, the reverberator is always operative, unless CS is closed, but unreverberated signal is always supplied to TR_7 so long as signal is supplied to "channel" **1**.

SUMMARY

Referring to FIG. 7, two adder amplifiers AA_1 and AA_2 are provided, constituting channel **1** and channel **2** of the system. Each adder amplifier is provided with two inputs, each for low input, and each of which utilizes a different one half of the adder amplifier, if two inputs are provided. If an input is provided to only input LO, one half the adder amplifier is employed, while if only one input is provided for jack HI, the adders are both utilized in parallel to provide double amplitude output.

Adder AA_2 proceeds, in cascade, to a tone control preamplifier TCP, a driver D, a power amplifier PA, and a loudspeaker LS.

Adder AA_1 proceeds selectively via tone control filters **81** and/or formant filters TCF, to a tremolo modulator TM modulated from tremolo oscillator TO. Tremolo modulator TM drives reverberator circuit RC, and control switch CS indicates that unreverberated signal is provided to driver D, with or/without reverberated signal.

A wide capability is thus provided. A total of four guitar inputs can be accepted, via the two adder amplifiers AA_1 and AA_2. In the alternative two guitar inputs can be accepted, at high level or low level jacks in each case. One guitar tone may be provided at high level and two additional guitars each at low level. These capabilities do not involve manipulation of gain controls.

Channel **2** involves a wide range level and tone control, having capability of controlling base and treble tone independently, and the output of the control drives a driver and power amplifier which is common to both channels.

Channel **1** includes facility for passing tone signals either via pre-set tone color filter TCF, or via a tone control circuit TCC, or both. The outputs of the filters are applied to a tremolo modulator. The output of the latter can, selectively, be reverberated (in the reverberator), or not reverberated, and the thus processed signal is then amplified and electro-acoustically transduced.

The tone control amplifier TCP is essentially a high fidelity pre-amplifier, so that channel **2** can be used not only for guitars, but also for microphone input, tape recorder input, and the like. The tone control circuitry TCC and TCF are designed for forming guitar tones of a wide variety of characters. The tone control circuits TCF provides five distinct tones, available by operation of push button switches, labeled A, B, C, D, E for purposes of identification. Each filter is selected by operating one push button, the push buttons being interrelated mechanically so that operation of any one disables all others. Switches A (see FIG. 4) provide treble tone only, switches E provide bass tones only, switches B provide a mixture of bass and treble, while switches C and D provide emphasis of different mid-range frequencies. For many purposes this set of filters suffices in reproducing guitar music, and the arrangement has the advantage of being reproducible and obviating knob-controlled adjustments which are difficult to reset.

The tone control filters TCC provide a bass section and a treble section essentially, either of which can be largely disabled, as by inserting full series resistance **105** (FIG. 6) or full shunting at the slider of potentiometer **111**.

The filter TCC may therefore add bass or treble or both to the output of the system, over and above that provided by filters TCF, and therefore modify the characteristics provided by each individual filter of TCF. This modification can subsist in the addition of treble, or bass, by selectively cutting in or out the filter sections **100** and **101**, individually or together. The filters TCC have a null or near-null attenuation point in the mid-band, which is not substantially affected by the adjustments of the filters.

While I have described and illustrated one specific embodiment of my invention, it will be clear that variations of the details of construction which are specifically illustrated and described may be resorted to without departing from the true spirit and scope of the invention as defined in the appended claims.

What is claimed is:

1. An amplifier, including
a first amplifier section,
a second amplifier section,
a common load for said first and second amplifier sections,
a first input jack including a first movable contact and a first stationary contact for said first amplifier section, said first contacts being normally closed,
a second input jack including a second movable contact and a second stationary contact for said second amplifier section, said second contacts being normally closed,
a lead interconnecting said movable contacts,
a ground connected to said second stationary contact,
said jacks being responsive only to insertion of a plug in either of said jacks for separating the movable contact from the stationary contact of that jack, and
means connecting said amplifier sections respectively to said movable contacts.

2. An amplifier system, comprising
a first amplifier section,
a second amplifier section,
a common resistive load arranged for adding the outputs of said first and second amplifier sections,
a first input jack for said first amplifier section,
a second input jack for said second amplifier section,
said first jack including a first movable signal input contact and a first stationary contact normally contacting said second movable contact,
said second movable jack including a second movable signal input contact and a second stationary contact normally contacting said second movable contact,
said first amplifier section having an input terminal, coupled to said first movable contact, said second amplifier section having a second input terminal coupled to said second movable terminal,
a lead coupling said first movable contact to said second movable contact, and a ground point permanently connected only to said second stationary contact.

3. The combination according to claim **2**, wherein each of said amplifier sections includes first and second cascaded NPN transistors, each of said transistors having a collector, an emitter and a base, the first of said transistors being solely emitter loaded, the second of said transistors being emitter loaded and collector loaded, the collector load consisting of a resistance and being common to said amplifier sections and a lead of negligible resistance connecting the collectors of said transistors.

4. An amplifier system including
a first amplifier,
a second amplifier,
means coupling said amplifiers to a common load,
a first signal input device connected to said first amplifier including a first normally closed switch having first and second contacts,
a second input device connected to said second ampli-

fier including a second normally closed switch having third and fourth contacts,

said first amplifier having an input terminal connected to said first contact,

said second amplifier having an input terminal connected to said third contact,

a lead connecting said second contact to said third contact, and

a ground connection for said fourth contact.

5. The combination according to claim 3, wherein are provided separate signal input devices selectively couplable at will with said first and third contacts, respectively.

References Cited

UNITED STATES PATENTS

2,805,289 9/1957 Buijs ---------- 330—47 X

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U.S. Cl. X.R.

84—1.16