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R. S. JOHN, JR
PREAMPLIFIER

2,697,757

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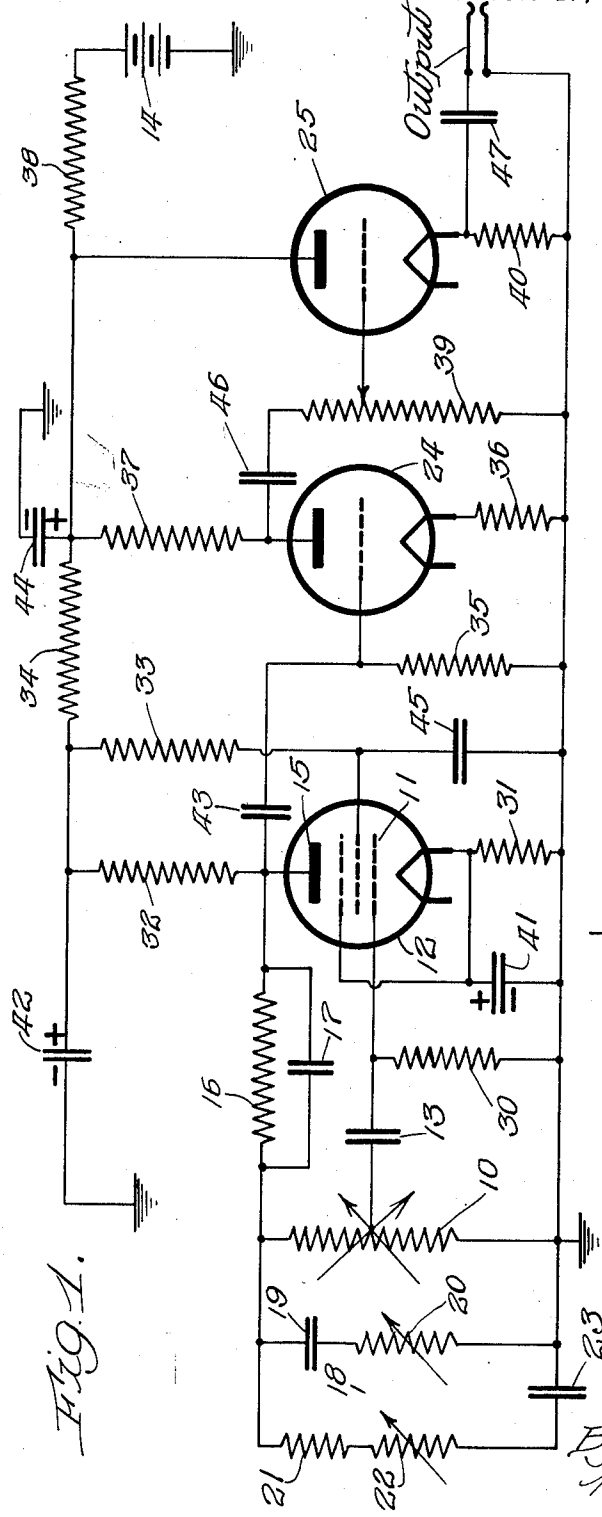


Fig. 1.

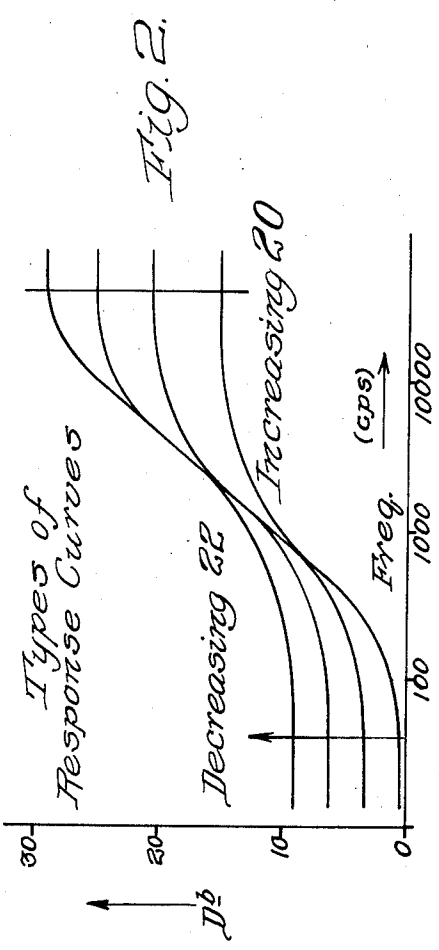


Fig. 2.

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2,697,757

PREAMPLIFIER

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10 Claims. (Cl. 179—100.4)

This invention relates to a preamplifier, especially of the type used in conjunction with phonograph pick-ups. More particularly it relates to a preamplifier for use with a transducer which converts mechanical variations into electrical signals.

It is an object of this invention to produce a preamplifier for use with a phonograph pick-up which will give sound reproduction of the highest fidelity. Another object of the invention is to produce a sound pick-up preamplifier which will give faithful sound reproduction over a wide range of frequencies. Another object of the invention is to produce a sound reproducing element wherein feedback control reduces distortion of the sound to a minimum. A further object of the invention is to provide a preamplifying unit in which feedback from the plate of a tube to the grid of a tube passes through a transducer and is modified by a circuit having manual impedance control. A further object of this invention is to provide a preamplifier in which a by-pass capacitance around a resistor in a feedback circuit enables high fidelity reproduction of frequencies above 10 kc. A still further object of the invention is to produce a preamplifier in which stray capacitance effects are reduced to a point where they are negligible.

Other features and advantages of this invention will be apparent from the following specification and from the drawing in which:

Fig. 1 is a schematic diagram of a circuit including the feedback control of this invention; and

Fig. 2 is a graph showing the type of response possible under various settings of the manual controls of the device of this invention.

The purpose of a preamplifier used in conjunction with a transducer is to match current recording characteristics of a sound production device as closely as possible. It is well known that the ordinary sound reproduction device such as a phonograph is apt to be limited to frequencies below 10,000 C. P. S. and it is likewise apt to amplify certain portions of the spectrum to an undue degree while omitting others entirely, thereby distorting the signal and giving sound reproduction of low quality. In recent years more and more members of the public have come to appreciate and insist upon high fidelity reproduction of recorded music. In order to produce sound reproducing apparatus which will give this high fidelity, it is necessary to take into consideration the different approaches of the various manufacturers of record discs. Thus, a phonograph which will give very faithful reproduction of records sold by one manufacturer will not necessarily be in proper balance to give reproduction of equal quality from the records of another manufacturer.

Manufacturers have for many years sold records which will produce a signal which is distorted within a certain range of low and high frequencies. This is done deliberately since it improves the sound quality coming from the average phonograph. The low frequency level below which signals are distorted is known as the "low frequency turnover." On the high frequency side this point is known as the "high frequency turnover." There are "cut-off" points on both the high frequency and low frequency sides. The "cut-off" points of records sold by different manufacturers vary widely. The intentional distortion which is present in the range between the high frequency turnover and high frequency cut-off on the one hand and the low frequency turnover and low frequency cut-off on the other hand may also vary in degree.

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In other words, the slope of the response curve within a distorted range will vary among the various manufacturers. In the magazine "Audio Engineering" of March 1949 at page 14, Messrs. Paul W. St. George and Benjamin B. Drisko list the following information with regard to the turnover points of records put out by several manufacturers of long standing:

	Low Freq. Turnover	High Freq. Turnover
Columbia 78.....	300	1,590
Columbia 33 $\frac{1}{2}$	500	1,590
Decca ffr.....	400	3,000
R. C. A.....	500	1,000
Technicoord.....	650	2,500
Mercury.....	300	7,000

From the above table it may be seen that a phonograph properly compensated to give good reproduction on a Decca ffr record would give comparatively poor reproduction on a Mercury record since their low frequency turnover points are 100 cycles apart and their high frequency turnover points are 5,000 cycles apart. Applicant's preamplifier will give high fidelity reproduction of any manufacturer's production due to the fact that the preamplifier includes a feedback circuit in which a pair of manually controlled potentiometers may be manually adjusted to give the best reproduction irrespective of the manufacturing source of the record being played.

While applicant's preamplifier is particularly useful in conjunction with a strain sensitive resistance type pick-up it will work with satisfactory results with other types of sound reproducing transducers. Referring to Fig. 1 a pick-up device 10 is connected to the grid 11 of a vacuum tube 12 through a condenser 13. Plate current for the tube 12 is supplied from a 300 volt source 14 shown at the right side of the diagram. The tube 12 may be a pentode of the type 6AU6, 6SH7, 6SJ7 or a tube having characteristics similar to any of these. A feedback circuit connects a plate 15 of the tube 12 through a resistor 16 and by-pass condenser 17 back to the pick-up or transducer 10.

A variable impedance circuit indicated generally at 18 is shown to the left of the transducer 10. A capacitor 19 and variable resistor 20 are connected in series across the transducer 10. Also connected across the transducer 10 are a fixed resistor 21 and a variable resistor 22 as well as a capacitor 23 in series. The capacitor 19 and variable resistor 20 are connected in parallel with the resistors 21 and 22 and the capacitor 23. The variable impedance circuit 18 serves to modify feedback signals passing between the plate 15 and the grid 11 of the tube 12. Since the feedback circuit is inverse, the circuit is arranged so as to provide less feedback at the higher frequencies thereby giving a higher response at these frequencies for the stage as a whole.

Thus, the capacitor 19 attenuates the feedback signal more at high frequencies in order to provide a treble boost. The variable resistor or potentiometer 20 serves to vary continuously the upper turnover frequency by limiting the action of capacitor 19 at some high frequency where the effect of the capacitor 19 becomes negligible compared to the potentiometer 20. With the potentiometer 20 at maximum the lowest treble turnover point is about 1500 C. P. S. where the value of the capacitor 19 is 0.008 μ f. and the value of the resistor 20 is 25,000 ohms. The potentiometer or resistor 22 serves to vary continuously the lower turnover frequency by changing the impedance of the member 18. Decreasing the potentiometer 22 raises the bass turnover. The resistor 21 serves merely to limit the uppermost bass turnover. If the resistor 21 is of about 39,000 ohms the uppermost bass turnover will be about 800 C. P. S. With the potentiometer 22 at maximum, the lowest turnover available is about 300 C. P. S. for the value of the capacitor 19 previously given. Thus, a continuous range of turnover control is available from 300-800 C. P. S. in the bass and from 1,500-10,000 C. P. S. in the treble. A capacitance 23 serves merely to prevent any direct current from passing through the resistors 21 and 22.

The pick-up or transducer 10 requires energization by a voltage across it of about 50 volts D. C. This polarizing voltage is applied from the plate 15 of the tube 12 rather than the plate supply 14 and the pick-up itself then serves also as the path by which the feedback signal is returned to the grid 11. The isolating resistance normally required in series with the grid circuit in plate-to-plate feedback circuits is thus eliminated. There is in consequence no attenuation of the input signal by such an isolating resistance. At the same time the required polarizing voltage is obtained from the source of the feedback voltage rather than a voltage dropping resistor from the plate supply.

The feedback resistor 16 is by-passed by the capacitance 17. The resistor 16 is of about 220,000 ohms resistance and the capacitor 17 is about 10-15 μ f. capacitance. Since there is no grid isolating resistor in the grid circuit the stray capacitance effects are reduced to a minimum by the circuit shown. With this circuit there is less feedback at extremely high frequency, a factor which tends to hold up the response at this level.

The remaining circuit shown in Fig. 1 is standard for a preamplifier circuit and will not be discussed in great detail. The output from the plate 15 is passed to the grid of a triode 24. The output from the plate of the triode 24 is passed through a variable resistor to the grid of a triode 25. Both the triodes 24 and 25 may be of the type known to the trade as 12AU7 or 6SN7. Other tubes having comparable characteristics may be substituted. The output of the triode 25 may go directly to a standard amplifier (not shown).

The values to be assigned to the various resistors and capacitors not discussed are well known to those skilled in the art; however, in order to dispel any doubt as to the suitable values of these various elements they are given numerals running from 30 to 47 and the values which have proved satisfactory are listed below opposite the numeral assigned in Fig. 1.

30	-----	meg--	1.2
31	-----	ohms--	1200
32	-----	do--	220,000
33	-----	do--	820,000
34	-----	do--	10,000
35	-----	meg--	1.2
36	-----	ohms--	1500
37	-----	do--	100,000
38	-----	do--	10,000
39	-----	do--	500,000
40	-----	do--	47,000
41	-----	μ f--	40
42	-----	μ f--	30
43	-----	μ f--	0.01
44	-----	μ f--	30
45	-----	μ f--	0.25
46	-----	μ f--	0.05
47	-----	μ f--	0.05

Fig. 2 shows a response curve of db vs. frequency plotted on semi-logarithmic paper where the frequency component is plotted on the logarithmic scale. As shown, decreasing the potentiometer 22 increases the response in the base frequency range thereby raising the bass turnover whereas increasing the potentiometer 20 decreases the treble turnover available.

The variable impedance element 18 is shown as being preferably connected across a transducer or pick-up device 10. It is obvious that it could be connected in series with this element in the feedback circuit. The transducer 10 may be a strain-sensitive element of the character shown in Germeshausen Patent No. 2,373,676 and John Patent No. 2,492,429, for which type of pick-up this circuit is particularly advantageous; or it may be a magnetic pick-up or other type of pick-up wherein an impedance is varied to produce the signal. It is obvious that my invention is capable of many modifications and it is my intention therefor to be limited only by the scope of the invention as disclosed in the appended claims.

I claim:

1. A preamplifier of the character described comprising: a transducer for converting mechanical variations in a recording member into electrical signals, said transducer including a variable impedance; a vacuum tube having a plate and grid; a circuit connecting said grid to said transducer; a feedback circuit from the plate to the grid of said tube completed through the impedance

circuit of said transducer; and a control circuit having an adjustable impedance therein connected to the feedback circuit to regulate the amount of feedback at certain predetermined frequencies.

2. A preamplifier of the character described, comprising: a variable impedance transducer for converting mechanical variations into electrical signals; a vacuum tube having a plate and grid; a circuit connecting the grid of said tube to said transducer; a feedback circuit from the plate to the grid of said tube completed through the impedance circuit of said transducer; and a variable impedance element connected across said transducer, said variable impedance element serving to modify the amplitude of signals in certain frequency ranges passing through said feedback circuit.

3. A preamplifier of the character described, comprising: a transducer for converting mechanical variations into electrical signals, said transducer including a variable impedance; a vacuum tube having a plate and grid; a circuit connecting the grid of said tube to said transducer; a feedback circuit from the plate to the grid of said tube completed through the impedance circuit of said transducer; and an adjustable impedance element connected in series in said feedback circuit to regulate the amount of feedback in certain regulating frequencies.

4. A preamplifier of the character described, comprising: a strain sensitive transducer for contacting the grooves of a record and converting mechanical variations therein into electrical signals; a vacuum tube having a plate and grid; a circuit connecting said grid to said transducer; a feedback circuit from the plate to the grid of said tube completed through the strain sensitive element of said transducer; and an adjustable impedance element connected across said strain sensitive element to regulate the amount of feedback passing therethrough at certain predetermined frequencies.

5. A preamplifier of the character described, comprising: a strain-sensitive transducer for contacting the waves of a record and converting mechanical variations therein into electrical signals; a vacuum tube having a plate and grid; a circuit connecting said grid to said transducer; a feedback circuit from the plate to the grid of said tube completed through the strain sensitive element of said transducer; and an adjustable impedance element connected in series in said feedback circuit to regulate the amount of feedback at certain predetermined frequencies.

6. A preamplifier of the character described comprising: a transducer for converting mechanical variations into electrical signals; a vacuum tube having a plate and grid; a circuit connecting the grid of said tube to said transducer; a feedback circuit from the plate to the grid of said tube completed through said transducer; and a variable impedance circuit connected across said transducer, said variable impedance circuit having a capacitance in series with a first variable resistor and a second variable resistor connected across said capacitance and first variable resistor, said feedback circuit cooperating with said variable impedance circuit whereby feedback signals in the treble range are attenuated in accordance with the setting of said first variable resistor and feedback signals in the bass range are varied by said second variable resistor, said feedback signals being passed through said transducer to the grid of said vacuum tube.

7. A preamplifier of the character described comprising: a transducer for converting mechanical variations into electrical signals; said transducer including a variable impedance; a vacuum tube having a plate and grid; a circuit connecting said grid to said transducer; a feedback circuit from the plate to the grid of said tube connected through the impedance circuit of said transducer; a resistor in said feedback circuit; a capacitance shunting said resistor; and a control circuit having an impedance which varies as a function of the signal passing therethrough, said control circuit being connected to the feedback circuit to regulate the amount of feedback at said predetermined frequencies.

8. A preamplifier of the character described comprising: a strain-sensitive transducer for converting mechanical variations into electrical signals, said transducer including a variable impedance; a vacuum tube having a plate and grid; a circuit connecting said grid to said transducer; a feedback circuit from the plate to the grid of said tube completed through the impedance circuit of said transducer; a resistor in said feedback circuit; a

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capacitance by-passing said resistor; and means connected to said feedback circuit for modifying a feedback signal passing therethrough in accordance with the frequency thereof.

9. A preamplifier of the character described, comprising: a strain-sensitive transducer for converting mechanical variations into an electrical signal, said transducer including a variable impedance; a vacuum tube having a plate and grid; a circuit connecting said grid to said transducer; a variable RC circuit connected across said transducer, said RC circuit having a capacitance in series with a first variable resistor and a second variable resistor connected across said capacitance and first variable resistor; and an inverse feedback circuit connecting the plate of said tube to said grid through said transducer, said feedback circuit cooperating with said RC circuit whereby feedback signals in the treble range are attenuated in accordance with the setting of said first variable resistor and feedback signals in the bass range are varied by the impedance control of said second variable resistor.

10. A preamplifier of the character described, comprising: a strain-sensitive transducer for converting the mechanical variations of a record to electrical signals; a vacuum tube having a plate and grid; a circuit connect-

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ing said grid to said transducer; a variable RC circuit in parallel with said transducer; a first capacitance in said RC circuit; a first potentiometer in said RC circuit in series with said first capacitance; a second potentiometer; a second capacitance in series with said second potentiometer, said first capacitance and potentiometer being connected in parallel with said second capacitance and potentiometer; and an inverse feedback circuit connecting the plate to the grid of said tube through said transducer, said feedback circuit cooperating with said RC circuit whereby feedback signal impulses in the treble range are attenuated in accordance with the setting of said first potentiometer and feedback signals in the bass range are varied in accordance with the setting of said second potentiometer.

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