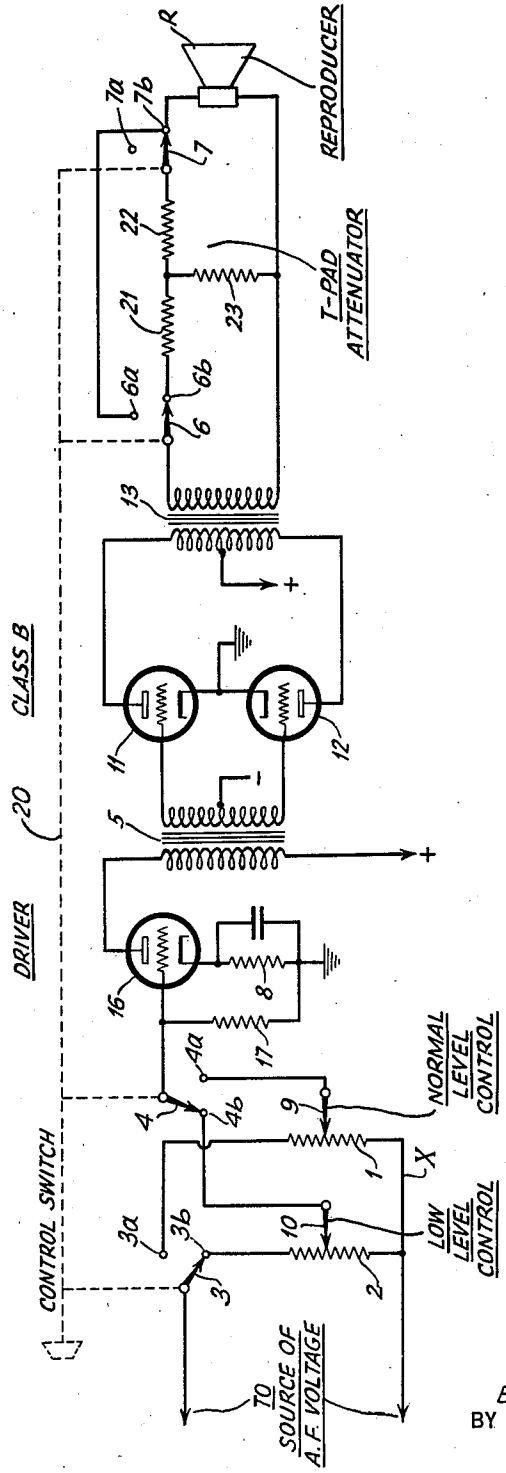
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DISTORTION CONTROL

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DISTORTION CONTROL

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My present invention relates to a novel switch for distortion reduction at low levels in amplifiers of the class B type.

One of the main objects of my invention may be stated to reside in a novel method for improving the quality of reproduction obtained at low levels with class B audio amplifiers by raising the audio input level to the less curved portion of the amplifier tube characteristic, while simultaneously reducing the power supplied to the speaker to an agreeable low level.

Another important object of the invention is to provide in an audio system of the class B type, an audio input network having separate controls for low and normal input signal levels, a switch being utilized to select the input level control to be employed, and an attenuator element being utilized for operation with the said low level control.

Still other objects of my invention are to improve switching arrangements for class B amplifiers, and more especially to provide such arrangements in a compact, economical and efficient manner.

The novel features which I believe to be characteristic of my invention are set forth in particularity in the appended claims; the invention itself, however, as to both its organization and method of operation will best be understood by reference to the following description taken in connection with the drawing in which I have indicated diagrammatically a circuit organization whereby my invention may be carried into effect.

Referring, now, to the accompanying drawing, let it be understood that the audio input source may be of any desired nature. For example, it can be the audio output circuit of a radio receiver detector, a public address microphone, a phonograph pick-up and the like. The reproducer R may be any known type of loud speaker. Further, the tubes 11 and 12 are to be understood as having their input electrodes and output electrodes arranged in well known class B push-pull connection. The push-pull stage is driven by the driver tube 16 which may be of the class A type. The driver tube has its control grid connected to the audio source through circuit elements to be described at a later point. The bias necessary for the grid of tube 16 may be provided by the usual by-passed resistor 8 arranged in the grounded cathode lead of the tube, and grid leak resistor 17 provides the bias path to the grid.

The audio transformer 5 couples the output electrode of tube 16 to the control grids of tubes 11 and 12. Bias may be provided for the control grids of the push-pull tubes from any desired source. The audio output transformer 13 couples the output electrodes of the tubes 11—12 to the reproducer through an attenuator network to be described in detail at a later point. The class B stage, as is very well known to those skilled in the art, is biased so that in the absence of audio signals the plate current flowing through the tubes 11 and 12 is cut off. In other words, tubes 11 and 12 are normally biased to plate current cut-off. At low level of audio input signal, therefore, the operation would take place along the lower curved portion of each tube characteristic, assuming my present invention were not employed. Such operation would give rise to distortion. By increasing the audio level, operation may be secured along a more linear portion of the characteristics. However, it is then necessary to reduce the audio level at a point between the class B stage and the reproducer. In the present invention such control selection at input of the amplifier system and attenuation at the reproducer input is effected in a simple, effective and efficient manner.

The "normal level control" potentiometer is designated by numeral 1. The resistor thereof is connected between a contact point 3*a* and the low potential side of the audio input terminals. The slidable tap 9 is connected to a contact point 4*a*. The "low level control" potentiometer 2 has its resistor connected between the low potential side of the input terminals and the contact point 3*b*, while slidable tap 10 is connected to contact point 4*b*. Switch arm 3 is connected to the high potential side of the input circuit. The arm 3 is arranged for selective electrical connection to either of contacts 3*a* or 3*b*. Similarly, arm 4 is arranged for selective electrical connection with either of contacts 4*a* or 4*b*. The arm 4 is directly connected to the control grid of the driver tube 16. A common control switch 20, shown in dotted lines, is constructed to actuate arms 3 and 4 in unison. The slidable taps 9 and 10 may be carried by control switch 20 so that after selection of the appropriate potentiometer, further adjustment of the switch mobile element varies taps 10 and 9. Thus, when the control switch is actuated to adjust arms 3 and 4 to the *a* points, then the audio source will be coupled to the grid of tube 16 through solely potentiometer 1—9. In the *b* position of the arms 3—4, the potentiometer

2—10 will solely couple the audio input source to the tube 16.

The arm 10 is pre-set so that the input level to the push-pull stage is sufficient for linear operation. It is intended that either (*a*) potentiometer 2 operate over a limited range, i. e., its upper range, so that push-pull amplifier 11—12 operation is always along the linear portion of the characteristics, or (*b*) a fixed series resistance be inserted at X for the same purpose, permitting full scale operation of potentiometer 2. The resistance of potentiometer 2 could then be reduced accordingly. With the arms 3 and 4 on contacts *a* the amplifier operation is entirely normal. The input level volume controls 1 and 2' may be combined into one unit. The arms 3 and 4 may be the arms of a multiple contact switch which are mounted on a single shaft for simultaneous operation. Those skilled in the art are fully aware of the manner of constructing volume control potentiometers which have initial "on-off" positions. It is obvious that if, when using potentiometer 2—10, the audio input level is increased so that the operation may be over a less curved portion of the amplifier (11—12) characteristic, then the power supplied to the reproducer will have to be reduced to a suitable low value.

Hence, an attenuation pad, as for instance 21—22—23, is utilized between the secondary winding of transformer 13 and the reproducer R. The arms 6 and 7 are arranged selectively to connect the attenuation pad into the circuit. Thus, the left end of resistor 21 terminates in contact 6*b*, while the right end of resistor 22 terminates in an arm 7 cooperating with contact 7*b* connected to the upper end of the reproducer input terminals. Contact 6*a* is directly connected to contact 7*b*, while a free contact point 7*a* is provided adjacent contact 7*b*. It will now be seen that when arms 6 and 7 are in the *b* positions the attenuator pad is in circuit. Further, the attenuator is in circuit when the arms 3 and 4 are in the *b* position. Arms 6 and 7 are preferably mounted on the single shaft (20) which carries arms 3 and 4. Hence, when switch 20 is adjusted to actuate arms 3—4—6—7 into *a* position, then the "low level" control is out of circuit and the attenuation pad is also out of circuit. In such case the output of amplifier 11—12 feeds directly into the reproducer. The attenuator is constructed and designed to reduce the audio power supplied to the speaker to a suitable level. This permits the more linear operation of push-pull stage 11—12 for low signal level thereby reducing distortion, while restoring the required low volume level between the push-pull stage and the reproducer.

Potentiometers 1 and 2 may be a single unit, and reset manually or mechanically for each switching operation. The potentiometer 1 may be in the form of a fixed, or a semi-fixed resistor. The attenuator pad 21—22—23 may be continuously variable; or it may be variable in a few large steps. The attenuator may have any convenient configuration, such as for example T, Pi, L, H or any other which will provide a satisfactory impedance match between the push-pull stage 11—12 and reproducer R at all settings of the pad. In case an attenuation pad is employed other than the T pad shown, then the attenuator switching circuit will require appropriate modification.

While I have indicated and described a system for carrying my invention into effect, it will be apparent to one skilled in the art that my invention is by no means limited to the particular organization shown and described, but that many modifications may be made without departing from the scope of my invention, as set forth in the appended claims.

What I claim is:

1. In combination with an audio amplifier whose input voltage-output characteristic has an appreciable curvilinear portion at low input level, an audio input source, an audio utilization means, an audio volume level control device adapted to control the transfer of audio energy from said source to said amplifier over a range of relatively low input values, a second volume level control device adapted to control said transfer over a range of relatively higher input values such as normally to operate said amplifier over the linear portion of its characteristic, said first control device being constructed to operate said amplifier at the less curved part of said curvilinear portion, means adapted to reduce the audio volume level of the amplifier output to an extent sufficient to compensate for increase in audio level at said first control device, and means for selectively connecting said first control device and audio volume reducing means into their respective control circuits and disconnecting said second volume control device.

2. In combination with an audio amplifier whose input voltage-output characteristic has an appreciable curvilinear portion at low input level, an audio input source, an audio utilization means, an audio volume level control device adapted to control the transfer of audio energy from said source to said amplifier over a range of relatively low input values, a second volume level control device adapted to control said transfer over a range of relatively higher input values such as normally to operate said amplifier over the linear portion of its characteristic, said first control device being constructed to operate said amplifier at the less curved part of said curvilinear portion, means adapted to reduce the audio volume level of the amplifier output to an extent sufficient to compensate for increase in audio level at said first control device, and a common mechanical means for simultaneously and selectively connecting said first control device and audio volume reducing means into their respective control circuits in one position thereof and for replacing said first control device by said second volume control device and disconnecting said audio volume reducing means in a second position of the common means.

3. In combination with an audio amplifier whose input voltage-output characteristic has an appreciable curvilinear portion at low input level, an audio input source, an audio utilization means, an audio volume level control device adapted to control the transfer of audio energy from said source to said amplifier over a range of relatively low input values, a second volume level control device adapted to control said transfer over a range of relatively higher input values such as normally to operate said amplifier over the linear portion of its characteristic, said first control device being constructed to operate said amplifier at the less curved part of said curvilinear portion, means adapted to reduce the audio volume level of the amplifier output to an extent sufficient to compensate for increase in audio level at said first control device, and means for selectively connecting said first control device

and audio volume reducing means into their respective control circuits, said last means being constructed and arranged simultaneously to disconnect said second control device from the control circuit between said source and amplifier.

4. In combination with an audio amplifier whose input voltage-output characteristic has an appreciable curvilinear portion at low input level, an audio input source, an audio utilization means, an audio volume level control device adapted to control the transfer of audio energy from said source to said amplifier over a range of relatively low input values, a second volume level control device adapted to control said transfer over a range of relatively higher input values such as normally to operate said amplifier over the linear portion of its characteristic, said first control device being constructed to operate said amplifier at the less curved part of said curvilinear portion, means adapted to reduce the audio volume level of the amplifier output to an extent sufficient to compensate for increase in audio level at said first control device, and a common mechanical means for simultaneously and selectively connecting said first control device and audio volume reducing means into their respective control circuits, said last means being constructed and arranged simultaneously to disconnect said second control device from the control circuit between said source and amplifier.

5. In combination with an audio amplifier whose input voltage-output characteristic has an appreciable curvilinear portion at low input level, an audio input source, an audio utilization means, an audio volume level control device adapted to control the transfer of audio energy from said source to said amplifier over a range of relatively low input values, a second volume level control device adapted to control said transfer over a range of relatively higher input values such as normally to operate said amplifier over the linear portion of its characteristic, said first control device being constructed to operate said amplifier at the less curved part of said curvilinear portion, means adapted to reduce the audio volume level of the amplifier output to an extent sufficient to compensate for increase in audio level at said first control device, and means for selectively connecting said first control device and audio volume reducing means into their respective control circuits, said audio level reducing means being an attenuator, and said last selective connecting means being constructed and arranged to disconnect the first control device and attenuator from the control circuit and concurrently connect said second control device into control circuit between the said source and amplifier.

6. In an amplifier system of the type utilizing a class B amplifier, a signal input source, a pair of independent signal control potentiometers arranged separately to couple said source to the amplifier input electrodes, one of the potentiometers being constructed to adjust the transfer of signal energy over a normal level range, the second potentiometer being constructed to adjust the transfer over a relatively lower level range but at a deliberately increased level to insure operation over the least curved portion of the amplifier characteristic, a signal utilization device, an attenuation device, and means for simultaneously connecting said second potentiometer in transfer the control circuit, disconnecting said one potentiometer from the control circuit and connecting said attenuation device between said amplifier and utilization device.

7. In an amplifier system of the type utilizing a class B amplifier, a signal input source, a pair of independent signal control potentiometers arranged separately to couple said source to the amplifier input electrodes, one of the potentiometers being constructed to adjust the transfer of signal energy over a normal level range, the second potentiometer being constructed to adjust the transfer over a relatively lower level range but at a deliberately increased level to insure operation over the least curved portion of the amplifier characteristic, a signal utilization device, an attenuation device, and means for simultaneously connecting said second potentiometer in transfer the control circuit, disconnecting said one potentiometer from the control circuit and connecting said attenuation device between said amplifier and utilization device, said attenuation device being constructed to compensate for said deliberately increased level.

8. In an amplifier system of the type utilizing a class B amplifier, a signal input source, a pair of independent signal control potentiometers arranged separately to couple said source to the amplifier input electrodes, one of the potentiometers being constructed to adjust the transfer of signal energy over a normal level range, the second potentiometer being constructed to adjust the transfer over a relatively lower level range but at a deliberately increased level to insure operation over the least curved portion of the amplifier characteristic, a signal utilization device, an attenuation device, and means for simultaneously connecting said second potentiometer in transfer the control circuit, disconnecting said one potentiometer from the control circuit and connecting said attenuation device between said amplifier and utilization device, said amplifier consisting of a pair of tubes in push-pull relation, and a driver tube coupling said push-pull tubes to the connected potentiometer.

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