Volume Expanders
by Kent King

During the 1930's, considerable development went into volume range expander circuits. The need for a "volume expander" is due to the wide variations in level that a normal musical piece will deliver. A full orchestra commonly has a range of 70 decibels or more between the loudest and softest passages. This represents a ratio of 10 million to one, if we express the output in watts. Typical transmitters of the 1930's could deliver 45 to 50 decibels of volume range, far short of the 70 plus that would be required for full reproduction. So a volume "expander" within the radio seemed to be the answer.

The volume expander circuit could almost be called a "reverse AVC" system. With the AVC circuit, we want to lower the amplification of very strong local signals, and favor weak, distant signals. With the volume expander, we want to amplify loud passages even more, while leaving quiet passages unaffected. Figure 1 shows a typical volume expander circuit, provided by RCA to promote the use of the (then) new 6L7 tube.

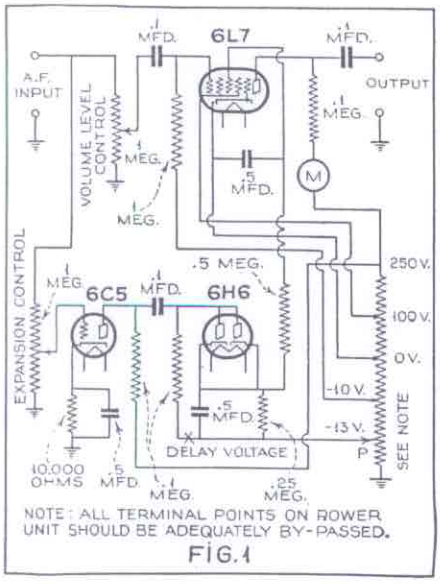

FIG. 1

The input signal is applied to both the 6L7 and to a 6C5 amplifier simultaneously. The output of the 6C5 is rectified in the 6H6, providing a *positive* voltage with respect to the reference on the voltage divider. This bias signal is applied to the other input grid of the 6L7, where it produces an initial large negative bias. Under normal sound, the amplification factor of the 6L7 is low, but with louder passages, the gain is increased in proportion to the signal strength. Thus, quiet passages are unaffected, while louder passages are "expanded." The amount of expansion can be controlled by the expansion control. It is also possible to set a threshold signal level, this is done by biasing the rectifier tube to the desired level. There is a required time constant for the control voltage on the 6L7 as well. Typically, the RCA data recommends a time factor of between 250 and 500 ms. If the time constant is too short, speech sounds unnatural. Too long a time negates the desired effect of the circuit.

Scott used two different volume expander circuits. Both of Scott's expander circuits resemble the basic RCA diagram, except that both are built in a push-pull configuration. The earliest version is an add-on "outboard" expander sold with the Allwave 23 High-Fidelity. The Quaranta series, including the unusual "Baby Quaranta" or Allwave 27, has the outboard expander circuit built onto its receiver chassis, being the first Scott to have an integral volume expander. The Allwave expander uses 6A7s in place of the yet undeveloped 6L7. The expander driver is a 6C6, and is rectified by a type 76 triode tied as a diode..

The Philharmonic expander circuit is very similar to the basic RCA design, using two 6L7s in push-pull. The driver is a 6J5, and the rectifier is a 6H6. Scott also tied in a 6E5 "eye" tube to show relative expansion, in place of the meter in the RCA circuit. The Philharmonic is the only other Scott besides the Quaranta to have an integral volume expander. The AM-FM Philharmonic does not have the expander circuit, in order to make room on the chassis for the FM circuits.

The effectiveness of an expander circuit is debatable. The circuit is very sensitive, making it a source of unwanted noise in the amplifier. Leaky capacitors will often affect the time constants, creating speech distortion or making the circuit appear dead, as described above. It is certainly wise in a contemporary restoration to replace all the bypass capacitors in the expansion circuit.