The average signal detector produces an output proportional to the average of the peak values of the maximum channel. Depending on whether this signal is above or below a set-point level, the fine-resolution counter is caused to count down or up. The bits in this counter then cause a number of parallel resistance paths to be either closed or open, depending on whether the bit value is 1 or 0. The parallel sum of the closed resistance paths then varies the feedback in the variable-gain amplifier, thus changing the gain.

With 8 bits in the fine-resolution counter, each controlling a resistor, 256 resistance combinations are available. Gain is caused to vary, in 256 increments, over a 2:1 range (equivalent to 6 db) with a resolution of 0.2%.

When the fine-resolution counter reaches full count, a bit is carried over to (or borrowed from) the coarse-resolution counter. This count--in the form of 4 bits--is compared with the value in the exponent register, also containing 4 bits. When the two values are equal, the mantissa remains in the central positions in the mantissa register. When the exponent exceeds the coarse count, the mantissa is shifted to the right. When the exponent is less than the coarse count, the mantissa is shifted to the left.

By analogy, the exponent controls the position of the mantissa in the register, and the coarse count controls the position of the wiper on the constant-resistance points of the potentiometer. In the digital approach, the difference between these two counts is used solely to shift the mantissa. Thus, the use of a smaller digital register (15 bits, instead of 29) becomes feasible and, of course, the resistance ladder is reduced accordingly.

Again, by analogy, the fine-resolution count corresponds to the position of the wiper between constant-resistance points on the potentiometer. The 8-bit counter with 256 counts is, for practical purposes, the equivalent of the infinite resolution of a wiper.

The general effect of the smoothed-recovery unit may be understood by reference to Figure 10 where signal diagrams are shown in relation to the principal elements of the block diagram. The first diagram, at the input to the digital-to-analog converter, is a visualization of the envelope of the digital output of the system A/D converter. The envelope curves represent both the mantissa and the exponent for the maximum and minimum channels. The difference between channel amplitudes is limited to 30 db. The envelopes have been drawn to converge toward the end of the record, just as typical seismic signals do.

The envelope of the analog output of the D/A converter is shown in the second diagram. Since the average signal detector is averaging the peak, or envelope, values of the maximum channel, the playback envelope of this controlling channel remains approximately constant. This envelope is servo-controlled to a nominal level of 1/4 volt. This level is labeled "0 db" for the purpose of this diagram. The envelope of the minimum channel may be as much as 30 db below the maximum channel, at first. The minimum envelope gradually approaches the constant envelope as the maximum and minimum signals draw together toward the end of the record. The dashed line across the top of this diagram represents the +18-db burst-out capability, provided by the 3 left-hand bits of the digital input register of the D/A converter.

To bring the playback envelopes of all channels to the same constant level, AGC drivers in a feedback configuration (as diagrammed in Figure 8) are used with each output sample-and-hold amplifier. The third diagram shows the envelope of the maximum, or controlling, channel after output amplification to a nominal level of 1 volt. Since this channel already has a constant envelope, as a result of servo control in the D/A converter, AGC action need not be in operation on this channel. The gain diagram, therefore, shows no AGC action. Full scale of the output amplifiers is 10 volts, accommodating burst-outs of as much as 20 db above the average envelope level of 1 volt. A burst-out of a given db ratio has the same amplitude at any point along the time scale. Therefore, burst-outs are easy to see on the camera record.

On the minimum channel, illustrated in the fourth diagram (Figure 10), initial AGC action as high as 30 db