the socket, etc.), and part of the load of the first stage which is reflected into the input due to the grid-to-plate capacity. In this experiment a cascode input was used which has the advantage that the grounded grid stage reduces the capacitive feedback from output to input without introducing partition noise. However, due to the finite feedback shot noise of the grounded grid stage contributes also to this error.

The errors in (*a*) and (*b*) can be represented by noise-current sources in shunt with the π network. The noise temperature which must be ascribed to this input conductance cannot be determined by calculation because its components and their noisiness are not readily estimated. If one assumes that the real part of the input impedance to the amplifiers is R_g and its effective temperature is $T_g = \alpha T_1$ where α is a constant and T_1 room temperature, and if one also assumes that both amplifiers have the same input characteristics and that $R_g \gg R_0$ and $R_0 \simeq R_2$, then the error in the absolute temperature due to shunt current sources is:

$$(7) \qquad \epsilon = \frac{\Delta T}{T} \simeq \frac{R_0}{2kT}\left[e(I_1+I_2+I_3)+2k\frac{\alpha T_1}{R_g}\right] = \frac{A}{T},$$

where A is a constant for one particular thermometer.

2. Errors Due to Current Flow in the Resistors

Nyquist's law is based upon the assumption that the circuit is a passive network. This requires that no currents are flowing through the resistors R_0, R_1, and R_2. To minimize thermoelectric effects dissimilar materials between the amplifiers and resistors in the network were avoided and the voltage due to this effect was measured to be smaller than 3 μv at the inputs of the amplifiers when R_0 and R_2 were at helium temperatures. The grid current $I_1-(I_2+I_3)$ was approximately 2.6×10^{-9} amperes. Because thin metal layer resistors (R_0 and R_2) consist of a large number of very small conducting particles in loose contact, contact noise may be generated if a current is passed through the resistors. Christenson and Pearson (1936) did not find any contact noise in thin solid carbon filaments when large currents were passed through the specimen. Also Bittel and Scheidhauer (1956) found no noise in addition to the thermal noise when a current was passed through metallic conductors between 45 c.p.s. and 11.5 kc/s. Therefore thin solid metal layer resistors should be free of any noise in excess of thermal noise and Nyquist's law should hold accurately for the above small currents.

3. Non-linearities and Amplifier Noise

Non-linearities in the amplifiers, the multiplier, and the integrator are another source of error. Due to non-linearities the recorder deflection will be increased by an increment proportional to $(|\overline{v_0^2}|\overline{v_2^2}|)^{\frac{1}{2}}$. Because for $Z_1 = \infty$ as well as for balance (see equation 5) the correlation coefficient should be zero for no distortion of the signal, the variance should be the same for both cases. Because both amplifiers were built on different chassis and shielded from each other, the coupling capacity between the amplifiers must have been very small. The zero for balance of the recorder was then determined by grounding