the inputs to both amplifiers. Because $|\overline{v_0^2}|$ and $|\overline{v_2^2}|$ are functions of the equivalent noise resistance of the amplifiers, R_n, it is desirable to make R_n as small as possible. R_n for each amplifier was approximately 770 ohms at 300° K over a band width of 3 to 7 kc/s. This was derived by measuringthe recorder deflection (or the squared r.m.s. voltage at the inputs to the multiplier) for $|\overline{v_0^2}|$ and $|\overline{v_2^2}|$ for various input resistances to the amplifiers at room temperature. For a band width of 3 to 12 kc/s the equivalent noise resistance of the amplifiers was 650 ohms. If one assumes that the flicker noise is proportional to $1/f$, then the equivalent noise resistance of the amplifiers at high frequencies is approximately 340 ohms. Therefore, flicker noise was the main contribution to R_n between 3 and 7 kc/s.

4. Errors Due to Mismatch of the Time Constants in the π Network

Equations (4) and (5) were derived under the condition that $(\omega\tau_i)^2 \ll 1$ or that all the τ's are equal. If this does not hold, then equation (4) for $T_0 = T_2$ is modified and one gets:

$$(4a)\quad \frac{T_0(R_0+R_2)}{T_1-2T_0} = R_1 \frac{1+(\omega^2\tau_0\tau_2)/(T_1-2T_0)\ \{T_1-T_0\tau_1[(1/\tau_0)+(1/\tau_2)]\}}{1+(\omega\tau_1)^2}.$$

If

$$T_1 \gg T_0 \quad \text{and} \quad T_1 \gg T_0\tau_1\left(\frac{1}{\tau_0}+\frac{1}{\tau_2}\right),$$

one obtains:

$$(4b)\quad \frac{T_0(R_0+R_2)}{T_1-2T_0} \simeq R_1 \frac{1+(\omega\tau_1)^2(\tau_0\tau_2/\tau_1^2)}{1+(\omega\tau_1)^2} = R_1 f(\omega, \tau_i).$$

At helium temperatures it is then sufficient to make $\tau_0\tau_2 \simeq \tau_1^2$. The deviation of $f(\omega, \tau_i)$ from unity will increase with increasing frequency. If both τ_0 and τ_2 are 10% larger than τ_1, then the error at the upper half power frequency is less than 1%. The average error is smaller, because for lower frequencies the error decreases and τ_1 was always adjusted between τ_0 and τ_2. For a systematic error in adjusting τ_1 the fractional error in the noise temperature is almost a constant in the liquid helium range.

5. A-c. Resistance of Thermometer Elements

The deviation of the resistance of R_0, R_1, and R_2 in the audio-frequency range from their d-c. value was estimated to be approximately 0.1% (see above).

6. Response of the Integrator

In the case of a narrow square noise band of width B and uniform spectral intensity a RC integrator of integration time τ will measure with a relative error of a single measurement, β, (Burgess 1951):

$$(8)\quad \beta = \frac{[\overline{(A-\bar{A})^2}]^{\frac{1}{2}}}{\bar{A}} = (2B\tau)^{-\frac{1}{2}},$$

where $\bar{A}$ is the deflection of the recorder due to the d-c. component of the signal and $\overline{(A-\bar{A})^2}$ the mean-square deviation of the recorder due to the signal.