High frequencies. At very high frequencies, the response is limited principally by the combined mass of the diaphragm and the voice coil M_{MD}. If the compliance C_{M1} of the front cavity were zero, the response would drop off at the rate of 6 dB per octave (see region *C* of Fig. 9.5). It is possible to choose C_{M1} to resonate with M_{MD} at a frequency that extends the response upward beyond where it would extend if it were limited by M_{MD} alone. We can understand this situation by deriving a circuit valid for the higher frequencies as shown in Fig. 9.7. It is seen that a damped anti-resonance occurs at a selected high frequency ω_U, which is given in terms of the Thiele–Small parameters of the drive unit by

$$\omega_U = \omega_S \sqrt{\frac{V_{AS}}{V_F}\left\{1 + \frac{S_T}{S_D}\left(1 + \frac{S_D c}{\omega_S Q_{ES} V_{AS}}\right)\right\}} \tag{9.21}$$

with a Q_U value of

$$Q_U = \omega_U \left\{\frac{S_T c}{V_F} + \omega_S\left(\frac{1}{Q_{ES}} + \frac{\omega_S V_{AS}}{S_D c}\right)\right\}^{-1} \tag{9.22}$$

where V_F is the volume of the front cavity. Above this resonance frequency, the response drops off 12 dB for each octave increase in frequency (see region *C* of Fig. 9.5).

Because the principal diaphragm resonance [Eq. (9.12)] is highly damped by the throat resistance of the horn, it is possible to extend the region of flat response of a drive unit over a range of four octaves by proper choice of C_{M1} at higher frequencies and by meeting the conditions of Eq. (9.18) at lower frequencies.

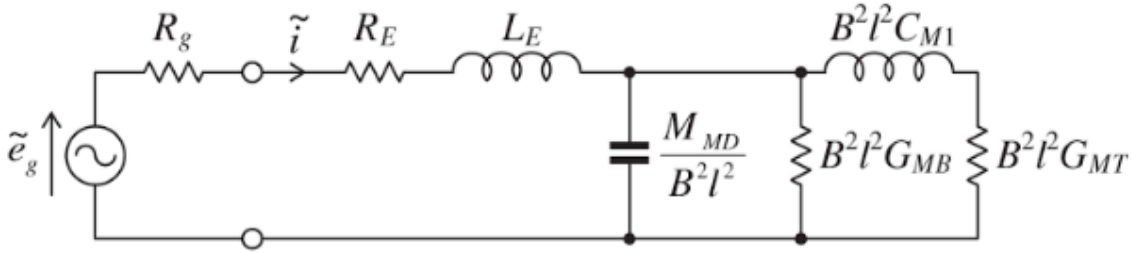

FIG. 9.7 Analogous circuit for a horn drive unit at high frequencies where the diaphragm mass reactance is much larger than its compliance reactance.