comes the dominant factor. Figure 4b indicates that the resolvers can produce satisfactory results even when the system is operating far off resonance.

Figure 5 shows the results obtained in measuring the yawing moment and side force due to roll velocity produced by the magnetic damper. Excellent agreement was obtained over a large range of yawing moment and side force due to roll velocity (Fig. 5a) and frequencies (Fig. 5b). The slight trend with frequency indicated in Fig. 5b is probably attributable to the uncertainty in obtaining the natural yaw frequency. These data indicate that the cross derivatives $C_{Y(p)}$ and $C_{n(p)}$ can be measured with this system; however, as shown in Sec. III-A and discussed in Sec. IV, model characteristics such as yaw natural frequency and products of inertia are very important in obtaining satisfactory data and must be considered in the model design.

The roll-damping characteristics obtained during the wind tunnel tests on the AGARD Model B are presented in Fig. 6. Only the $Re_{\infty,c} = 4 \times 10^6$ data are presented since no Reynolds number effects were found. The roll-damping coefficient, $C_{l(p)} + C_{l(\dot\beta)} \sin\alpha$, shows that the model is stable and that the data are symmetrical about $\alpha = 0$ for all Mach numbers, as would be expected. The magnitude of the damping decreases as $|\alpha|$ increases at $M_\infty = 2$ and 3, but the trend is reversed at $M_\infty = 4$. The magnitude of $C_{l(p)} + C_{l(\beta)} \sin\alpha$ at $\alpha = 0$ decreases as Mach number increases, and the data are in good agreement with theoretical estimates obtained from Ref. 5. The static stability parameter, $C_{l(\beta)} \sin\alpha$, is essentially zero at $\alpha = 0$, and the magnitude increases to produce more stability as $|\alpha|$ increases.

The static coefficients, C_N and C_m, are presented in Fig. 7 as a function of angle of attack, α. C_N increases linearly with α over the range tested, and the slope decreases as Mach number increases. C_m also increases with α, with the Mach 3 and 4 data being at practically the same level, whereas the Mach 2 data increase at a lesser rate. The data are in excellent agreement with data presented in Ref. 6.

VI. Conclusions

A forced-oscillation, dynamic-stability test mechanism was developed for measuring the moments and forces due to roll velocity on lifting configurations. Bench tests and wind tunnel tests on an AGARD Model B were conducted to evaluate the mechanism. Conclusions based on the results of these tests are as follows:

1) The results of the bench tests indicated that the rolling moment, yawing moments, and side force due to roll velocity could be precisely measured by the mechanism.

2) The results of the wind-tunnel tests indicated good agreement between the experimental and theoretical values of the roll-damping coefficient, $C_{l(p)} + C_{l(\dot\beta)} \sin\alpha$.

3) Yawing moment and side force due to roll velocity could not be obtained in these wind-tunnel tests because of an adverse coupling of the roll and yaw natural frequencies and the large product of inertia, I_{xz}, of this particular model. By careful model design, it will be possible to obtain accurate values of the cross derivatives $C_{Y(p)}$ and $C_{n(p)}$.

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