Rotational spectra of several isotopomers of the Ne-H$_{2}$S van der Waals dimer were measured in the frequency range from 4 to 22 GHz, using a pulsed molecular beam Fourier transform microwave spectrometer. Two $K=0$ progressions were recorded for the symmetrical isotopomers (with H$_{2}$S/D$_{2}$S). This doubling is attributed to an internal rotation motion of the H$_{2}$S moiety within the complex. The two states can be correlated to the 0$_{00}$ and 1$_{01}$ internal rotor states of free H$_{2}$S and D$_{2}$S. Only one $K=0$ progression was measured for Ne-DSH. The excited internal rotor state is no longer metastable since the symmetry constraints no longer apply. An anomalous isotope effect observed in Ar-H$_{2}$S, where the substitution of hydrogen by deuterium causes an increase in the ground state $B$ rotational constant,$^{a}$ was not observed here, in agreement with the ab initio study by Dykstra and co-workers.$^{b}$ Nuclear quadrupole hyperfine structure was resolved or partially resolved for isotopomers containing $^{35}$S and D, respectively, and the corresponding quadrupole coupling constants were determined. These were used to derive information about the intermolecular dynamics. The results are compared with those of Ar-H$_{2}$S and Ar-H$_{2}$O.