We generalize two studies of rigid $G$-connections on $\mathbb{P}^1$ which have an irregular singularity at origin and a regular singularity at infinity with unipotent monodromy: one is the work of Kamgarpour-Sage which classifies rigid homogeneous Coxeter $G$-connections with slope $\frac{r}{h}$, where $h$ is the Coxeter number of $G$, and the other is the work of Chen, which proves the existence of rigid homogeneous elliptic regular $G$-connections with slope $\frac{1}{m}$, where $m$ is an elliptic number for $G$. In our work, similar to Chen, we look for rigid homogeneous elliptic regular $G$-connections, but we allow the slope to have a numerator greater than 1. However, for the present purpose, we essentially restrict to the case where $G$ is either $\text{Sp}_{2n}$ or $\text{SO}_{2n+1}$. For $\text{Sp}_{2n}$, we show that Kamgarpour-Sage connections and Chen connections exhaust all the rigid homogeneous elliptic regular connections. For $\text{SO}_{2n+1}$-connections, having introduced the notion of ”generalized Chen connections,” we classify all rigid connections of this type. We conjecture that any rigid homogeneous elliptic regular $\text{SO}_{2n+1}$-connection is in this form. (Received September 21, 2021)