When $G_i'(\tau_i) = 0$, $a_i V_i'(\tau_i) = -\Pi_i'(\tau_i)$. Note also $\Pi_i'(\tau_i) = (\sigma - 1)\Pi_i(\tau_i)A(\tau_i)$ and $A'(\tau_i) = A(\tau_i)B(\tau_i)$.

$$\begin{aligned}
G_i''(\tau_i) =& a_i \left[P_i(\tau_i)^{-\alpha} r_i''(\tau_i) - \alpha r_i'(\tau_i) P_i(\tau_i)^{-\alpha} A(\tau_i) - \alpha V_i'(\tau_i) A(\tau_i) - \alpha V_i(\tau_i) A'(\tau_i) \right] + \\
& (\sigma - 1)\Pi_i'(\tau_i)A(\tau_i) + (\sigma - 1)\Pi_i(\tau_i)A'(\tau_i) \\
=& a_i \left[P_i(\tau_i)^{-\alpha} r_i''(\tau_i) - \alpha r_i'(\tau_i) P_i(\tau_i)^{-\alpha} A(\tau_i) - \alpha V_i'(\tau_i) A(\tau_i) - \alpha V_i(\tau_i) A'(\tau_i) \right] - \\
& (\sigma - 1) a_i V_i'(\tau_i) A(\tau_i) - a_i V_i'(\tau_i) B(\tau_i) \\
\propto& P_i(\tau_i)^{-\alpha} r_i''(\tau_i) - \alpha r_i'(\tau_i) P_i(\tau_i)^{-\alpha} A(\tau_i) - \alpha V_i'(\tau_i) A(\tau_i) - \alpha V_i(\tau_i) A'(\tau_i) - \\
& (\sigma - 1) V_i'(\tau_i) A(\tau_i) - V_i'(\tau_i) B(\tau_i)
\end{aligned}$$