May 1979 – Oral Exam

One procedure for joining shaft sections is friction welding. An application of the method is depicted below. A flywheel is attached to one shaft, which is placed in a suitable fixture and accelerated to an angular velocity $\omega$ at which it is allowed to rotate freely. The second shaft is constrained against rotation always and at a certain instant is forced against the rotating shaft while maintaining an axial load $F$. Discuss the appropriate variables of the problem, (both given and otherwise) needed to determine the time $\tau$ required for relative sliding at the shaft interface to stop. Note any assumptions which you make. What relationships must the parameters of the problem satisfy such that inelastic deformation does not occur in regions far from the (to-be-welded) interface? What do you think about possible buckling of the shafts?

\[ t = 0^- \quad \text{Bearing} \quad \omega \quad \text{Bearing} \quad \text{Flywheel} \quad \text{Plane to be welded.} \]

\[ t = 0^+ \quad \text{Rotation} = 0 \quad F \]