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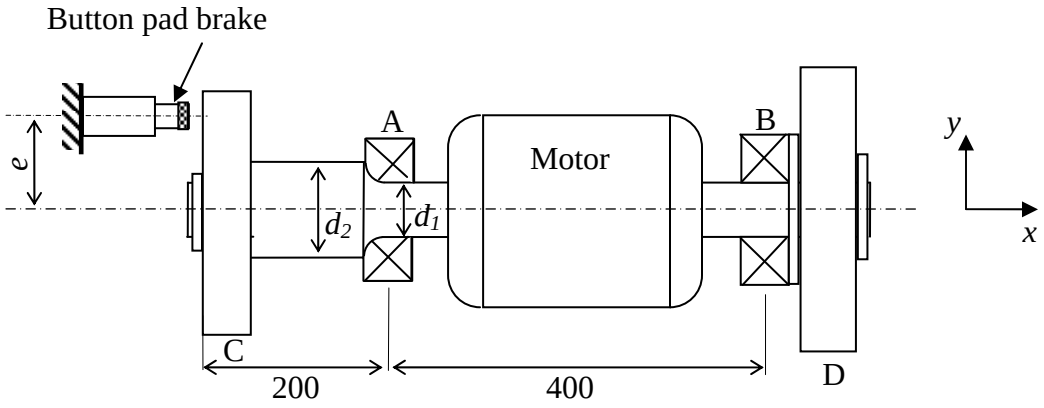
ME-351A
Design Tutorial 02

1.0 The grinding machine shown in the figure has two grinding wheels mounted on a shaft at the ends C and D. The shaft is an extension of the motor axle (the armature of the motor is also wound on the same shaft). The bearing at A can resist thrust loads. You can assume simply supported condition at the bearings A and B. The shaft has a shoulder (change in diameter) at the bearing A which is filleted. The diameter d_2 should be at least 20% larger than the diameter d_1.

A button pad brake operated by hydraulics is provided at the left grinding wheel for stopping the rotation on emergency. The motor power will be cut off automatically once this brake is applied. On applying the brake, the hydraulic pressure in the cylinder presses the brake pad against the side of the grinding wheel C with a force F. The maximum force exerted is 500 N. Assume that the force of 500 N is applied without delay and hence can be treated as a constant force during the duration of braking. The coefficient of friction, μ is 0.25 and the breaking torque, T, is calculated by the equation, $T = 0.97\mu Fe$, where e is 120 mm. You should have a factor of safety of around 2 against both yielding and fatigue failure. Use (**will be announced in lab**) steel and assume machined condition for the surface of the shaft and ambient operating conditions.



All dimensions in mm

a) Determine the diameters d_1 and d_2 so that, the shaft will not yield (use von-Mises)

b) The shaft should not fail by fatigue for at least 4000 emergency braking incidents. The shaft will complete 20 rotations before coming to stop each time the brake is applied.

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