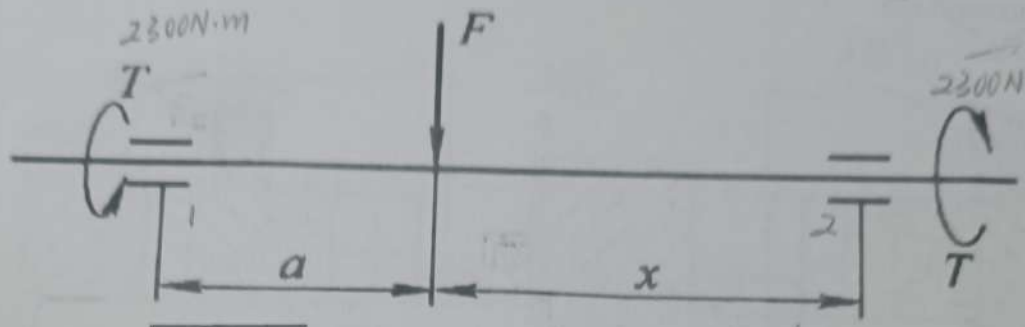
Q1.

A rotation shaft is shown in the figure. Please calculate the maximum value of x if:

$d = 60\ mm, T = 2300\ N \cdot m, F = 9000\ N, a = 300\ mm, [\sigma_{-1b}] = 160\ MPa.$



不考虑 F_t

解:

$$d \geq \sqrt[3]{\frac{Me}{0.1[\sigma_{-1b}]}} \Rightarrow Me \leq 0.1\,[\sigma_{-1b}]\,d^3 = 3456\ N\cdot m$$

$$Me = \sqrt{Ma^2 + (\alpha T)^2}$$

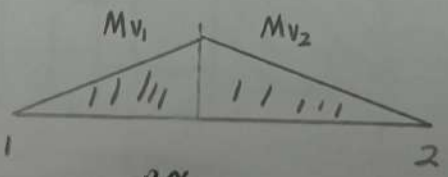
$$\Rightarrow Ma = \sqrt{Me^2 - (\alpha T)^2}$$

将力F分解并求解弯矩.

$$F_{V1} + F_{V2} = F$$

$$\text{对}M_1 = -Fa = -F_{V2}(x+a) \Rightarrow F_{V2} = \frac{a}{x+a}F$$

$$F_{V1} = \frac{x}{x+a}F$$



$$M_{V1} = M_{V2} = \frac{ax}{x+a}F$$

$$Ma = \frac{ax}{x+a}F$$

$$\Rightarrow \frac{ax}{x+a}F = \sqrt{Me^2 - (\alpha T)^2} \quad \text{where } Me = 3456\ N\cdot m$$

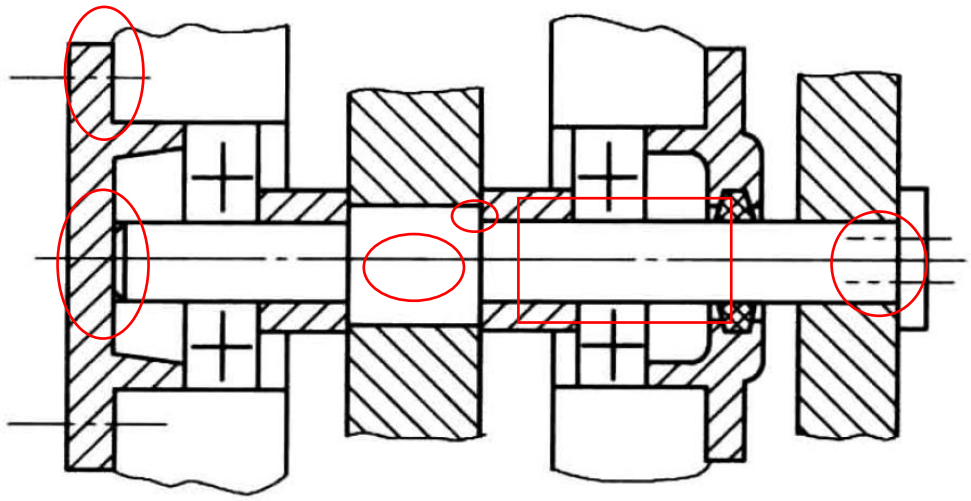
转矩不变, $\alpha = 0.3 \Rightarrow x = -1.48\,m$ (舍)

转矩脉动变化规律不明, $\alpha = 0.6 \Rightarrow x = -2.03\,m$ (舍)

频繁正反转的轴, $\alpha = 1 \Rightarrow x = 6.42\,m$ ANS

Q2.

Only Considering the structural design of the shaft (without considering issues such as bearing lubrication and shaft fillet transition), please point out the errors in the diagram and correct them.



Errors:

1) 端盖与箱体之间缺少垫片 ⟶ 增加垫片

2) 轴端与端盖接触 ⟶ 缩短轴端长度

3) 传动件缺少键连接 ⟶ 增加键连接

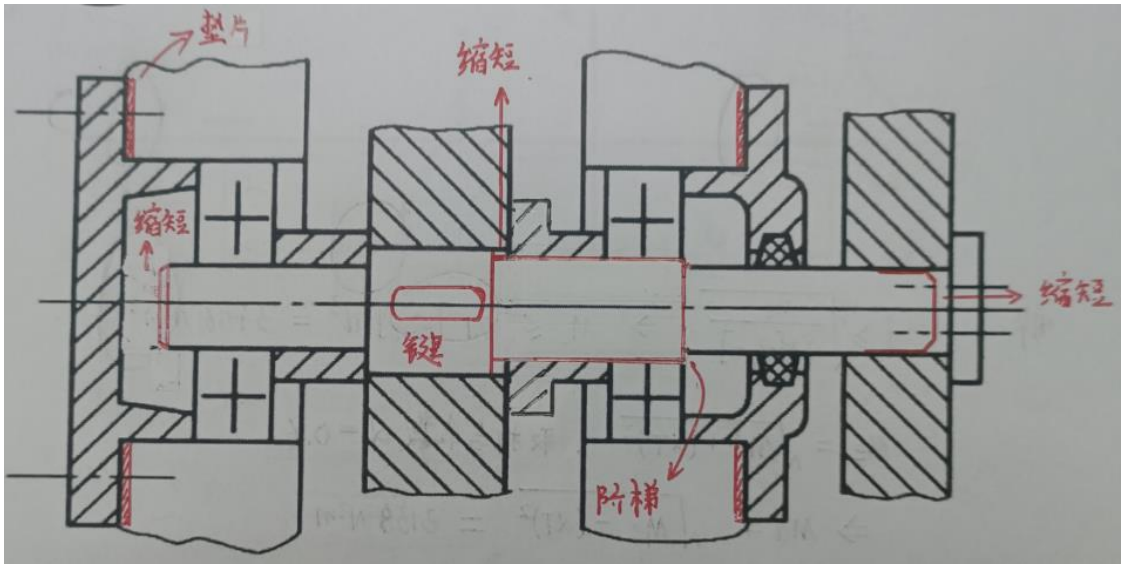
4) 与传动件配合段轴颈长度未小于传动件轮毂长 ⟶ 缩短此处轴颈长度

5) 传动件一侧应由轴肩固定 ⟶ 改变轴截面尺寸，形成轴肩

6) 轴承安装距离过长，但轴未制成阶梯状 ⟶ 制成阶梯状轴

7) 轴端挡圈与轴端接触 ⟶ 缩短轴端距离

修改后见下图：



OR