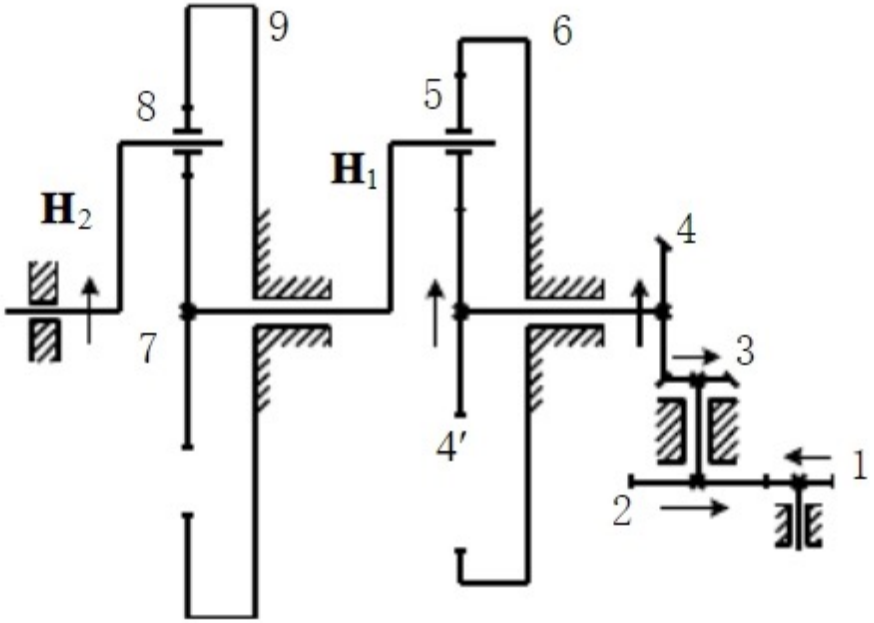
HW04

第03章 齿轮传动设计（下）作业参考答案

南方科技大学

HW 04.1

- 下图所示的轮系中，已知N_1=36, N_2=60, N_3=23, N_4=49, $N_{4'}$=69, N_5=31, N_6=131, N_7=94, N_8=36, N_9=167,ω_1=3549 rev/min，请计算得出 ω_{H2} 。
- For the gear train in the figure below, given N_1=36, N_2=60, N_3=23, N_4=49, $N_{4'}$=69, N_5=31, N_6=131, N_7=94, N_8=36, N_9=167,ω_1=3549 rev/min, please find ω_{H2}.



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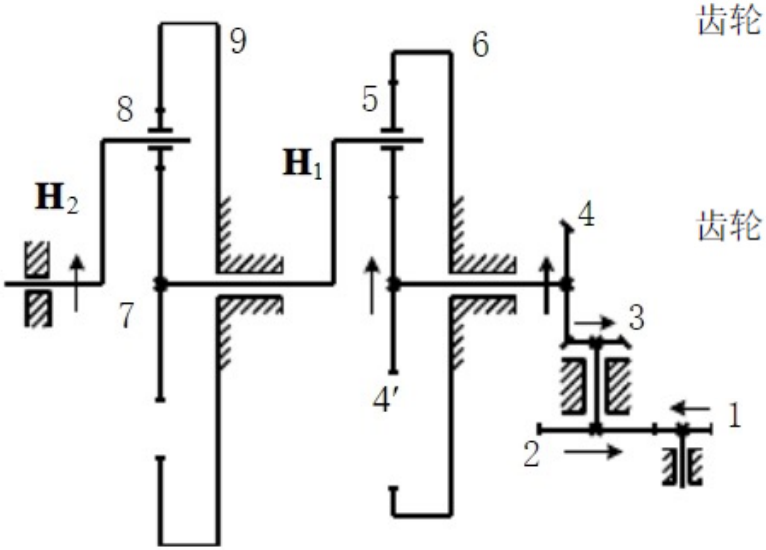
如例 5-4 图所示，此轮系由三部分组成，齿轮 1、2、3、4 组成定轴轮系，齿轮 4′、5、6 及系杆 H_1 组成行星轮系，齿轮 7、8、9 及系杆 H_2 组成行星轮系，三者之间属串联关系。齿轮 4 和齿轮 4′ 属同一构件，系杆 H_1 和齿轮 7 属同一构件。

解：对定轴轮系 1，2，3，4 有：

$$i_{14}=\frac{n_1}{n_4}=\frac{z_2\ z_4}{z_1\ z_3} \qquad (1)$$

(4 pts)



齿轮 4′、5、6 及系杆 H_1 组成行星轮系：

$$i_{4'H_1}=\frac{n_{4'}}{n_{H_1}}=1-i_{4'6}^{H_1}=1+\frac{z_6}{z_{4'}} \qquad (2)$$

(4 pts)

齿轮 7、8、9 及系杆 H_2 组成行星轮系：

$$i_{7H_2}=\frac{n_7}{n_{H_2}}=1-i_{79}^{H_2}=1+\frac{z_9}{z_7} \qquad (3)$$

(4 pts)

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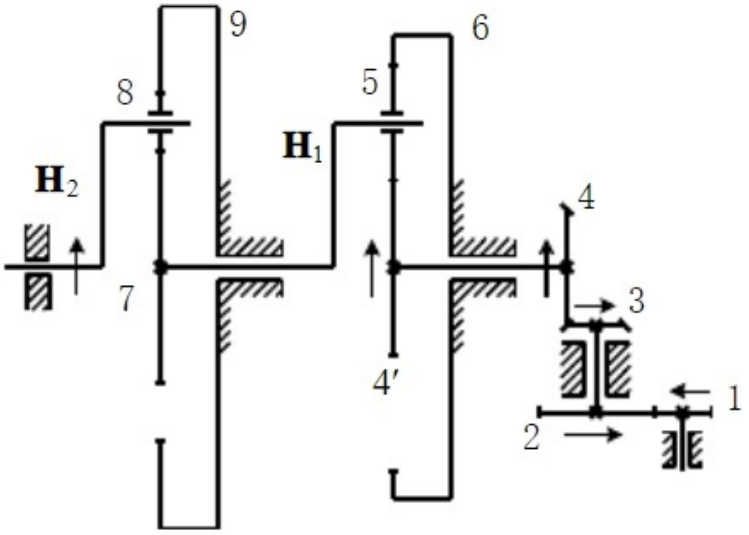

由式(1)、式(2)及式(3)，并考虑到 $n_4 = n_{4'}$，$n_{H_1} = n_7$ 得：

$$i_{1H_2} = \frac{n_1}{n_{H_2}} = \frac{z_2 z_4}{z_1 z_3}\left(1+\frac{z_6}{z_{4'}}\right)\left(1+\frac{z_9}{z_7}\right) \quad \text{(4 pts)} \quad (4)$$

将各轮齿数代入式(4)得：

$$i_{1H_2} = \frac{n_1}{n_{H_2}} = \frac{60\times 49}{36\times 23}\left(1+\frac{131}{69}\right)\left(1+\frac{167}{94}\right) = 28.58$$

则：$n_{H_2} = \frac{n_1}{i_{1H_2}} = \frac{3549}{28.58} = 124.19 \text{ r/min}$ (4 pts)

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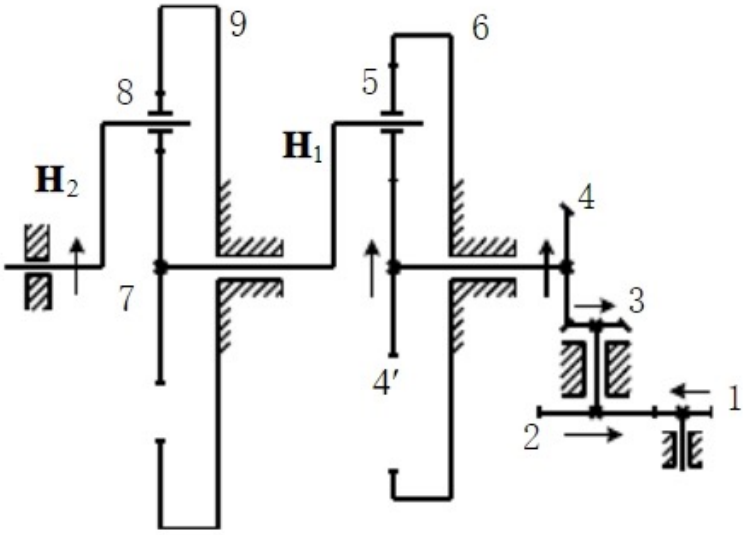
This compound gear train consists of a gear train with fixed axes (1,2,3,4) and 2 epicyclic gear trains (4',5,6,H_1 & 7,8,9,H_2) .
For the gear train with fixed axis,

$$i_{14} = \frac{n_1}{n_4} = \frac{z_2\ z_4}{z_1\ z_3} \qquad (1)$$



And for the epicyclic gear train 4', 5, 6, and H_1,

$$\boldsymbol{i}_{4'H_1} = \frac{\boldsymbol{n}_{4'}}{\boldsymbol{n}_{H_1}} = 1 - \boldsymbol{i}_{4'6}^{H_1} = 1 + \frac{\boldsymbol{z}_6}{\boldsymbol{z}_{4'}} \qquad (2)$$

For the epicyclic gear train 7, 8, 9, and H_2,

$$i_{7H_2} = \frac{n_7}{n_{H_2}} = 1 - i_{79}^{H_2} = 1 + \frac{z_9}{z_7} \qquad (3)$$

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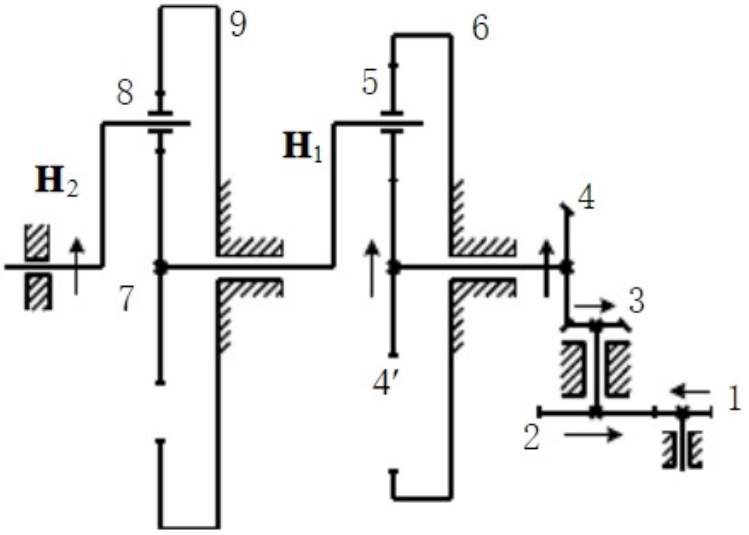
Since $n_4=n_{4'}$, $n_{H1}=n_7$, according to Eq.(1), (2) and (3),

$$i_{1H_2}=\frac{n_1}{n_{H_2}}=\frac{z_2\ z_4}{z_1\ z_3}(1+\frac{z_6}{z_{4'}})(1+\frac{z_9}{z_7}) \qquad (4)$$

Therefore,



$$i_{1H_2}=\frac{n_1}{n_{H_2}}=\frac{60\times 49}{36\times 23}(1+\frac{131}{69})(1+\frac{167}{94})=28.58$$

$$n_{H_2}=\frac{n_1}{i_{1H_2}}=\frac{3549}{28.58}=124.19\ \text{r/min}$$

HW 04.2

- 设有一对标准直齿圆柱齿轮，已知
  - 齿轮的模数为 $m = 5\ \text{mm}$,
  - 小、大齿轮的参数分别为:
    - 应力修正系数 $Y_{Sa1} = 1.56$，$Y_{Sa2} = 1.76$;
    - 齿形系数 $Y_{Fa1} = 2.8$，$Y_{Fa2} = 2.28$;
    - 许用应力 $\sigma_{\text{FP1}} = 314\ \text{MPa}$，$\sigma_{\text{FP2}} = 286\ \text{MPa}$,
  - 并算得小齿轮的齿根弯曲应力 $\sigma_{\text{F1}} = 306\ \text{MPa}$ 。
- 试问:
  - (1) 哪一个齿轮的弯曲疲劳强度较大?
  - (2) 两齿轮的弯曲疲劳强度是否均满足要求?

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- （1）计算得

$$\frac{\sigma_{FP1}}{Y_{Fa1}Y_{Sa1}}=\frac{314}{2.8\times1.56}=71.886$$

$$\frac{\sigma_{FP2}}{Y_{Fa2}Y_{Sa2}}=\frac{286}{2.28\times1.76}=71.272$$

故小齿轮的弯曲疲劳强度大。

- （2）

$$\sigma_{F1}=306\text{MPa}<\sigma_{FP1}=314\text{MPa}$$

故小齿轮的弯曲疲劳强度满足要求。

$$\sigma_{F2}=\sigma_{F1}\frac{Y_{Fa2}Y_{Sa2}}{Y_{Fa1}Y_{Sa1}}=281.1\text{MPa}<\sigma_{FP2}=286\text{MPa}$$

故大齿轮的弯曲疲劳强度也满足要求。

Deadline of this homework: Nov 07 @ **23:30**

Link to submission:
https://ancorasir.com/?page_id=3987

All homework MUST be hand-written.
No late submission is allowed!

Please refer to the above link for further details on how to make the submission and the detailed deadline for submission.

谢谢~

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