习题答案

1—1

$$K = -\frac{\Delta p}{\Delta V}V$$

$$\therefore \Delta p = -K \times \frac{\Delta V}{V} = 7000 \times 10^5 \times \frac{0.1}{50} = 1.4MPa$$

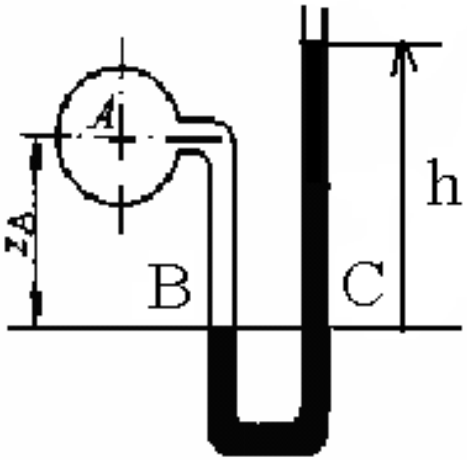
1—2

$$°E = \frac{t_1}{t_2} = \frac{153}{51} = 3$$

$$\gamma = (7.31°E - \frac{6.31}{°E}) \times 10^{-6} = 19.83 \times 10^{-6} m^2 / s$$

$$\mu = \rho\gamma = 850 \times 19.83 \times 10^{-6} = 1.69 \times 10^{-2} N \cdot s / m^2$$

1—3



- 以B—C为等压面，以相对压力计算：

$$p_B = p_A + \rho_A g z_A \qquad (1)$$

$$p_C = \rho_{hg} g h \qquad (2)$$

$$\because\ p_B = p_C$$

$$\therefore\ p_A = \rho_{hg} g h - \rho_A g z_A$$

$$= 13.6\times10^3 \times 9.8 \times 1 - 900 \times 9.8 \times 0.5$$

$$= 1.29\times10^5\, Pa$$

- 若以绝对压力计算：

$$p_A = 1.01\times10^5 + 1.29\times10^5 = 2.3\times10^5\, Pa$$

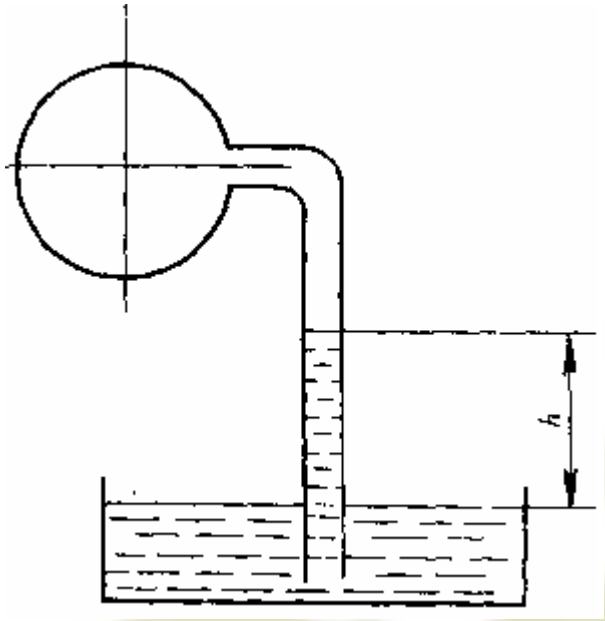
1—4

$$\because p_a = p + \rho g h$$

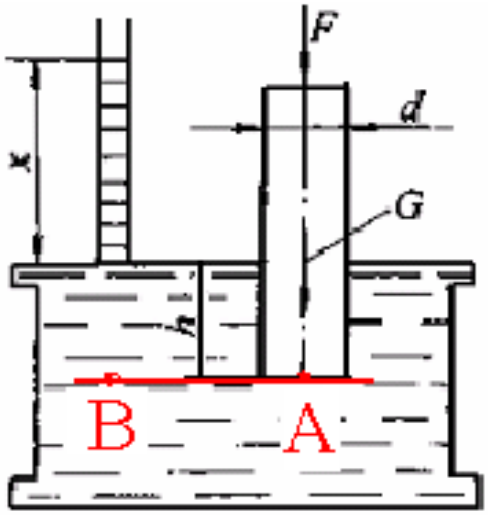
$$\therefore p_{真} = p_a - p = \rho g h$$

$$= 1000 \times 9.8 \times 0.5$$

$$= 4900 Pa$$



1—5



- 以柱塞底部接触液面为等压面，以相对压力求解：

$$p_A = \frac{F+mg}{A} = \frac{4(F+mg)}{\pi d^2}$$

$$p_B = \rho g(h+x)$$

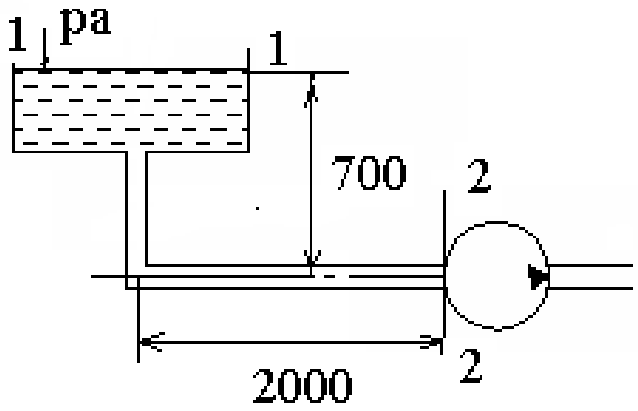
$$\because\ p_A = p_B$$

$$\therefore \frac{4(F+mg)}{\pi d^2} = \rho g(h+x)$$

$$x = \frac{4(F+mg)}{\rho g \pi d^2} - h$$

1—6

- 列1—1，2—2截面的伯努利方程，以2—2轴线为基准面：



$$\frac{p_1}{\rho_1}+z_1g+\frac{\alpha v_1^2}{2}=\frac{p_2}{\rho_2}+z_2g+\frac{\alpha v_2^2}{2}+h_wg$$

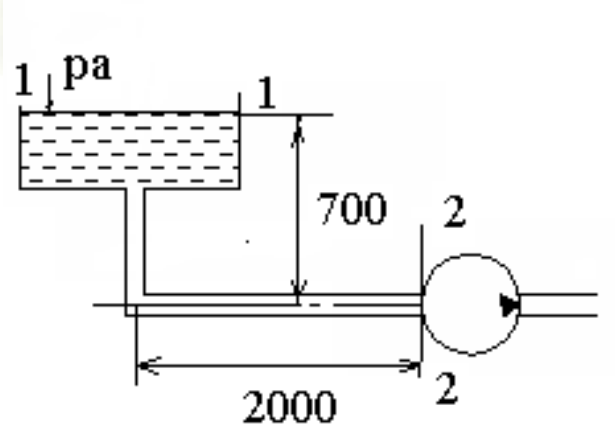
式中：$p_1=p_a, z_1=700, v_1=0, z_2=0,$

$$v_2=\frac{q}{A_2}=\frac{16\times10^{-3}\times4}{60\times\pi\times(20\times10^{-3})^2}=0.85m/s$$

$$\mathrm{Re}=\frac{vd}{\nu}=\frac{0.85\times0.02}{0.11\times10^{-4}}=1545<2320$$

$$\therefore \lambda=\frac{75}{\mathrm{Re}},\quad \alpha=2$$

1—6



$$\Delta p_\lambda = \rho g h_\lambda = \rho g \frac{75}{\mathrm{Re}} \frac{l}{d} \frac{v_2^2}{2g}$$

$$= 880 \times \frac{75}{1545} \times \frac{2000}{20} \times \frac{0.85^2}{2} = 1543.2 Pa$$

$$\Delta p_\xi = \rho g h_\xi = \rho g \times \xi \times \frac{v_2^2}{2g}$$

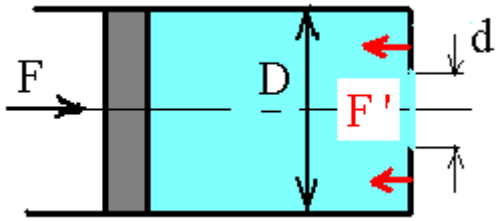
$$= 880 \times 0.2 \times \frac{0.85^2}{2} = 63.58 Pa$$

$$p_2 = p_a + \rho g z_1 - \frac{\alpha \rho v_2^2}{2} - (\Delta p_\lambda + \Delta p_\xi)$$

$$= 1.048 \times 10^5 \ pa$$

习题答案

1—9



- 以中间液体为对象，分别受到活塞作用力F和固体壁面对液体的作用力F‘，其合力满足动量方程：

$$\Sigma F = F - F' = \rho q(v - v_0)$$

$$p = \frac{F}{A} = \frac{3000 \times 4}{\pi \times 0.05^2} = 1.529 \times 10^6 Pa$$

$$q = C_d A \sqrt{\frac{2}{\rho}\Delta p} = 0.61 \times \frac{\pi \times 0.01^2}{4} \sqrt{\frac{2}{900} \times 1.529 \times 10^6} = 2.79 \times 10^{-3} m^3/s$$

$$v = \frac{q}{A_d} = \frac{2.79 \times 10^{-3}}{\pi \times 0.01^2/4} = 35.55 m/s$$

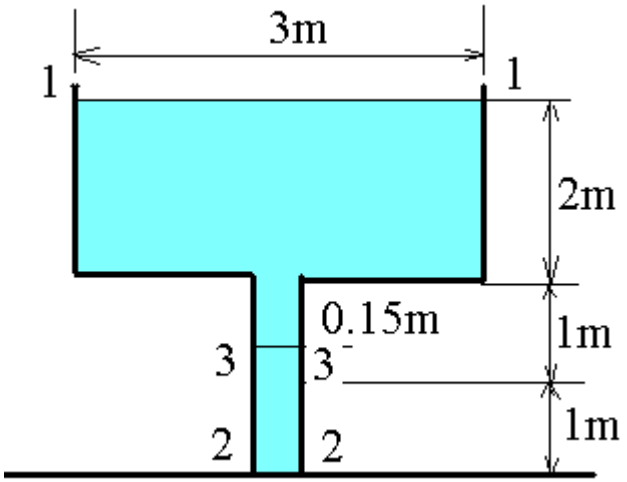
$$v_0 = \frac{q}{A_D} = \frac{2.79 \times 10^{-3}}{\pi \times 0.05^2/4} = 1.42 m/s$$

$$\therefore F' = F - \rho q(v - v_0) = 2914.3N$$

- 液体作用于固体壁面的力与F’大小相等，为2914. 3N，方向相反，为向右。

习题答案

1—11



- 列1—1，2—2面的伯努利方程，以2—2为基准面：

$$\frac{p_1}{\rho_1}+z_1g+\frac{v_1^2}{2}=\frac{p_2}{\rho_2}+z_2g+\frac{v_2^2}{2}$$

$$式中:p_1=0,z_1=4m,v_1=0,p_2=0,z_2=0,$$

$$v_2=\sqrt{2z_1g}=\sqrt{2\times4\times9.8}=8.85m/s$$

- **列1—1，3—3面的伯努利方程，以3—3为基准面：**

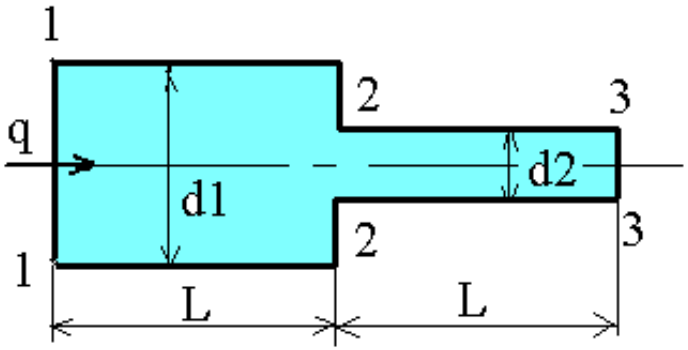
$$\frac{p_1}{\rho}+z_1g+\frac{v_1^2}{2}=\frac{p_3}{\rho}+z_3g+\frac{v_3^2}{2}$$

$$式中:p_1=0,z_1=3m,v_1=0,p_3=?,z_3=0,$$

$$\because A_3=A_{2,}\ \therefore v_3=v_2=8.85m/s$$

$$\therefore p_3=z_1\rho g-\frac{1}{2}\rho v_3^2=-9.76\times10^3Pa$$

1—14



$$v_1 = \frac{q}{A_1} = \frac{18\times10^{-3}\times4}{60\times\pi\times(10\times10^{-3})^2} = 3.82m/s$$

$$v_2 = \frac{q}{A_2} = \frac{18\times10^{-3}\times4}{60\times\pi\times(6\times10^{-3})^2} = 10.62m/s$$

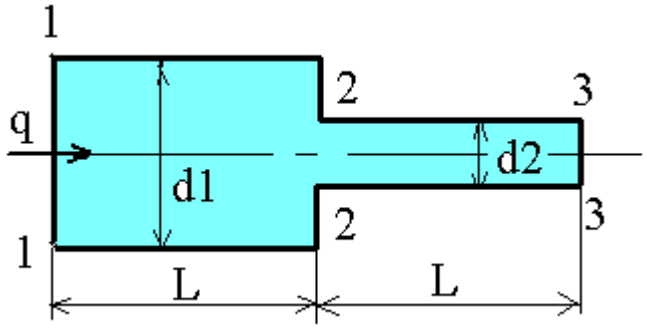
$$\mathrm{Re}_1 = \frac{v_1 d_1}{\nu} = \frac{3.82\times0.01}{20\times10^{-6}} = 1910.8 < 2320, \quad \therefore \text{层流}$$

$$\mathrm{Re}_2 = \frac{v_2 d_2}{\nu} = \frac{10.62\times0.006}{20\times10^{-6}} = 3184.7 > 2320, \therefore \text{紊流}$$

$$\Delta p_{\lambda 1} = \lambda_1 \frac{l}{d}\frac{\rho v_1^2}{2} = \frac{75}{\mathrm{Re}}\frac{l}{d}\frac{\rho v_1^2}{2}$$

$$= \frac{75}{1910.8}\times\frac{3}{0.01}\times\frac{900\times3.82^2}{2} = 77322.2Pa$$

1—14



$$\lambda_2 = 0.3164 \times \mathrm{Re}_2^{-0.25} = 0.3164 \times 3184.7^{-0.25} = 0.042$$

$$\Delta p_{\lambda 2} = \lambda_2 \frac{l}{d} \frac{\rho v_2^2}{2} = 1065812.58 Pa$$

$$\Delta p_{\xi} = \xi \times \frac{\rho v_2^2}{2} = 0.35 \times \frac{900 \times 10.62^2}{2} = 17763.543 Pa$$

$$\Sigma \Delta p = (\Delta p_{\lambda 1} + \Delta p_{\lambda 1} + \Delta p_{\xi}) = 1.16 MPa$$

列1—1,3—3伯努利方程：

$$\frac{p_1}{\rho} + z_1 g + \frac{\alpha_1 v_1^2}{2} = \frac{p_3}{\rho} + z_3 g + \frac{\alpha_3 v_3^2}{2} + h_w g$$

式中：$z_1 = z_3 = 0, v_1 = 3.82, v_3 = v_2 = 10.62,$

$\alpha_1 = 2, \alpha_3 = 1.1$

$$p_1 - p_2 = \frac{1}{2}\rho(v_2^2 - v_1^2) + \Delta p = 1.2 MPa$$

2-1(补充)

泵的额定流量为100L／min，额定压力为 2.5MPa，当转速为1450r／min，机械效率为ηm＝0.9。由实验测得，当泵出口压力为零时，流量q1＝106L／min。压力P为2.5MPa时，流量q2为100.7L／min。试求：

1)泵的容积效率ηv；

2)如泵的转速下降到600r／min. 在额定压力下 工作时，计算泵的流量为多少?

3)上述两种转速下泵的驱动功率。

- （1） $\eta_v = \frac{q_2}{q_1} = \frac{100.7}{106} = 0.95 = 95\%$

- （2）转速600r/min时 $q = 100.7 \times \frac{600}{1450} = 41.7 L/\min$

- （3）总效率：$\eta = \eta_m \times \eta_v = 0.855$

n=1450r/min时

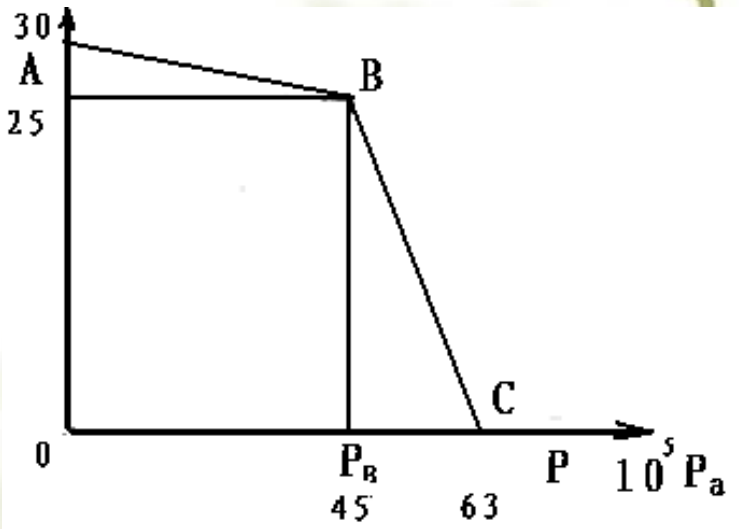
$$P_r = \frac{pq}{\eta} = \frac{2.5 \times (100.7/60)}{0.855} = 4.9KW$$

n=600r/min时

$$P_r = \frac{pq}{\eta} = \frac{2.5 \times (41.7/60)}{0.855} = 2.03KW$$

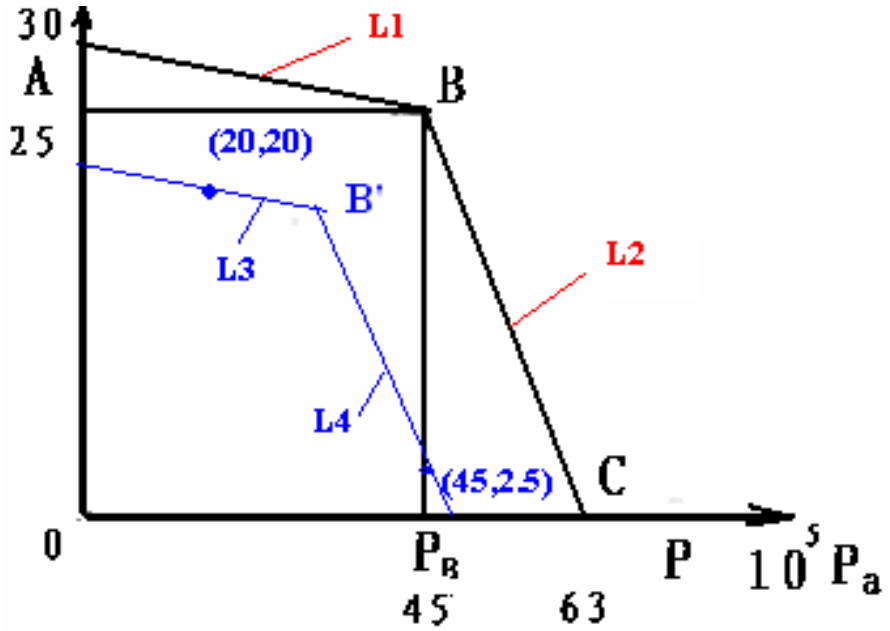
2—2（补充）

某机床液压系统采用限压式变量泵。泵的流量一压力特性曲线ABC如图所示。泵的总效率为0.7。如机床在工作进给时泵的压力P=4.5Mpa, 输出流量为q=2.5L/min, 在快速移动时，泵的压力和流量为2Mpa，20L／min，问限压式变量泵的流量一压力特性曲线应调成何种图形？泵所需的最大驱动功率为多少?



题3－3图

- 以（20，20）点做L1的平行线L3；
- 以（45，2.5）点做L2的平行线L4；
- 可计算出L3、L4的直线方程：
- L3：y=-0.11x+22.2
- L4：y=-1.39x+65.05
- 解得交点B’坐标为（33.5，18.5）



因此：最大驱动功率为：

$P=33.5\times10^5\times18.5\times10^{-3}/(60*0.7)=1.476kw$

3—1

$$(1) q_t = V_M n$$

$$q = \frac{q_t}{\eta_{Mv}} = \frac{12.5\times10^{-6}\times30/60}{0.9}$$

$$= 0.42L/\min = 6.94\times10^{-6} m^3/s$$

$$(2) \because T\omega/\eta_{Mm} = pq_t$$

$$\therefore p = \frac{T\omega}{q_t\eta_{Mm}} = \frac{T\times2\pi n}{V_M n\eta_{Mm}} = \frac{T\times2\pi}{V_M\eta_{Mm}} = 29.3MPa$$

3—2

$$(1)T_t = \frac{\Delta p \times V}{2\pi}$$

$$\therefore T = T_t \times \eta_{Mm} = \frac{\Delta p \times V}{2\pi} \times \eta_{Mm}$$

$$= \frac{(10 - 0.2) \times 10^6 \times 70 \times 10^{-6}}{2\pi} \times 0.94$$

$$= 102.6 Nm$$

$$(2)n = \frac{q_t}{V} = \frac{q \times \eta_{Mv}}{V} = 21.9 r/s = 1314 r/\min$$

3—3

$$(1) q_t = Vn$$

$$\eta_{Mv} = \frac{q_t}{q} = \frac{Vn}{q} = \frac{40\times10^{-6}\times1450}{63\times10^{-3}} = 0.92$$

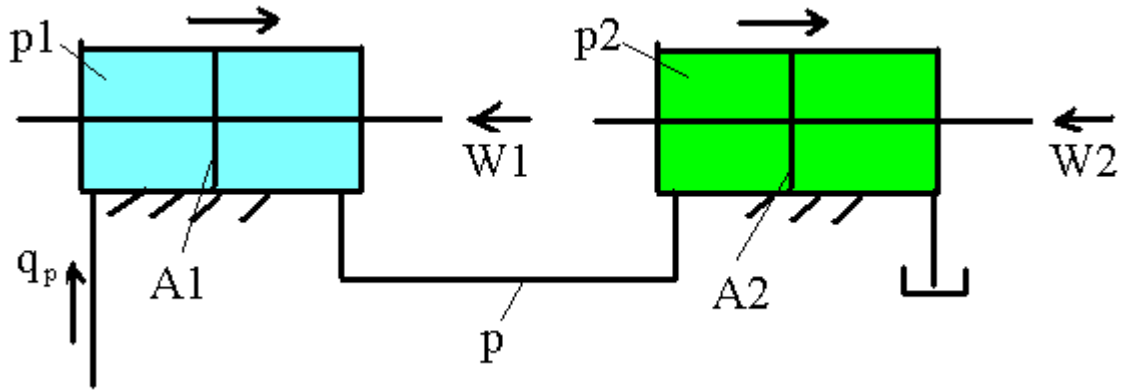
$$(2) T_t = \frac{\Delta pV}{2\pi} = \frac{6.3\times10^{6}\times40\times10^{-6}}{2\pi} = 40.11Nm$$

$$\eta_{Mm} = \frac{T}{T_t} = \frac{37.5}{40.11} = 0.935$$

$$(3) \eta_M = \eta_{Mv}\times\eta_{Mm} = 0.86$$

3—4

习题答案



$\because p_1A_1 = p_2A_1 + W_1$

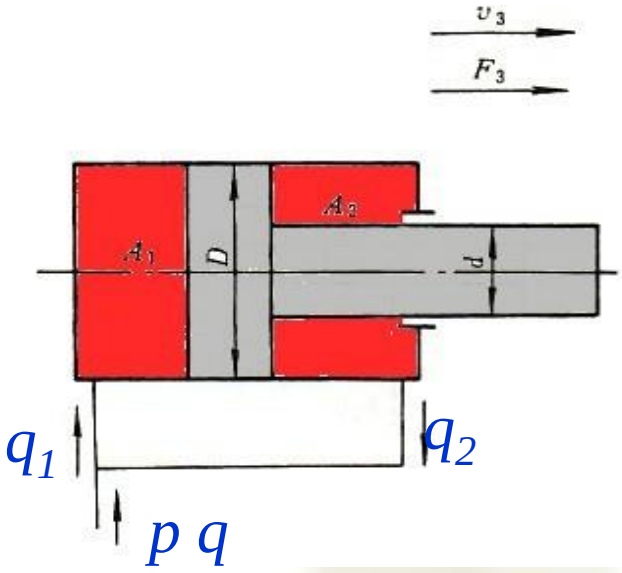
$$p_2 = \frac{W_2}{A_2} = \frac{4000}{20\times10^{-4}} = 2\times10^6 = 2MPa$$

$$p_1 = \frac{p_2A_1 + W_1}{A_1} = 2\times10^6 + \frac{5000}{50\times10^{-4}} = 3\times10^6 = 3MPa$$

$$v_1 = \frac{q_p}{A_1} = \frac{3\times10^{-3}}{50\times10^{-4}} = 0.6m/\min = 0.01m/s$$

$$v_2 = \frac{v_1A_1}{A_2} = \frac{0.01\times50\times10^{-4}}{20\times10^{-4}}0.025m/s$$

3—5

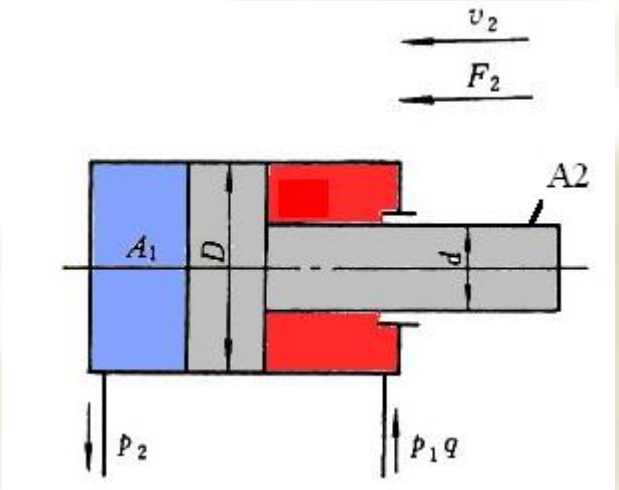


$$v_3 = \frac{q}{A_2}$$

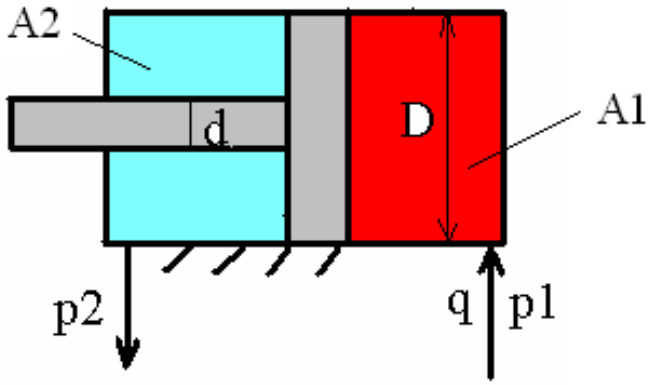
$$v_2 = \frac{q}{A_1 - A_2}$$

$$v_3 = 3v_2$$

$$\therefore \frac{q}{A_2} = 3\frac{q}{A_1 - A_2} \Rightarrow \frac{A_1}{A_2} = 4$$



3—6



(a)

$$v_a = \frac{q}{A_1} = \frac{4q}{\pi D^2} = \frac{4\times 25\times 10^{-3}/60}{\pi \times 0.1^2} = 5.3\times 10^{-2} m/s$$

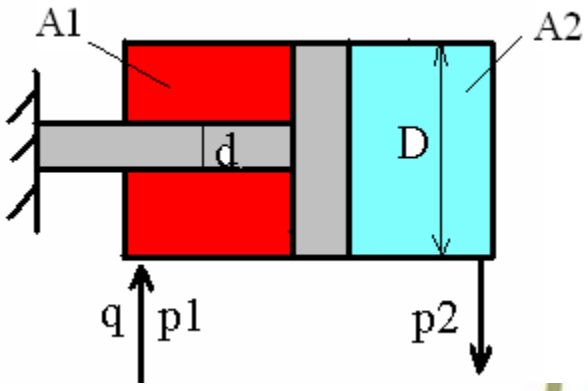
方向向左。

$$F = p_1 A_1 - p_2 A_2$$

$$= 20\times 10^5 \times \frac{\pi}{4} \times 0.1^2 - 2\times 10^5 \times \frac{\pi}{4} \times (0.1^2 - 0.07^2)$$

$$= 14906.9N$$

3—6



(b)

$$v_b = \frac{q}{A_1} = \frac{4q}{\pi(D^2 - d^2)} = \frac{4 \times 25 \times 10^{-3}/60}{\pi \times (0.1^2 - 0.07^2)} = 0.1 m/s$$

方向向左。

$$F = p_1 A_1 - p_2 A_2$$

$$= 20 \times 10^5 \times \frac{\pi}{4} \times (0.1^2 - 0.07^2) - 2 \times 10^5 \times \frac{\pi}{4} \times 0.1^2$$

$$= 6437 N$$

3—6

$(c)\qquad q_1 = q + q_2 \qquad \therefore v_c A_1 = q + v_c A_2$

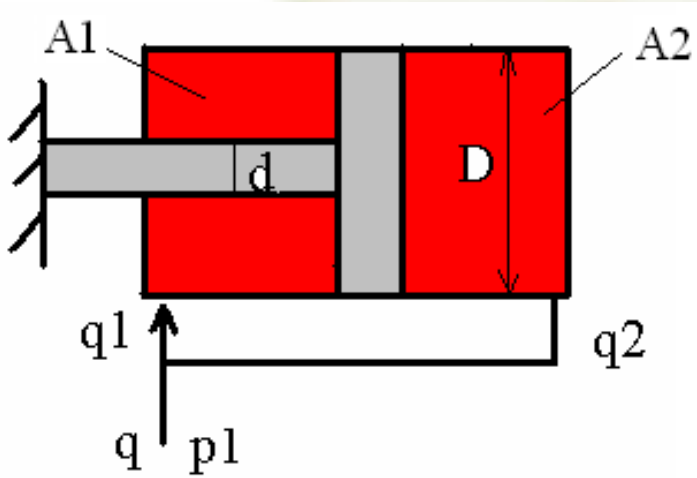
$$v_c = \frac{q}{A_1 - A_2} = -\frac{q}{A_{杆}} = -\frac{4q}{\pi d^2} = -\frac{4\times 25\times 10^{-3}/60}{\pi \times 0.07^2} = -0.108 m/s$$

方向向右。

$$F = p_1(A_1 - A_2) = -p_1 A_{杆}$$

$$= -20\times 10^5 \times \frac{\pi}{4} \times 0.07^2$$

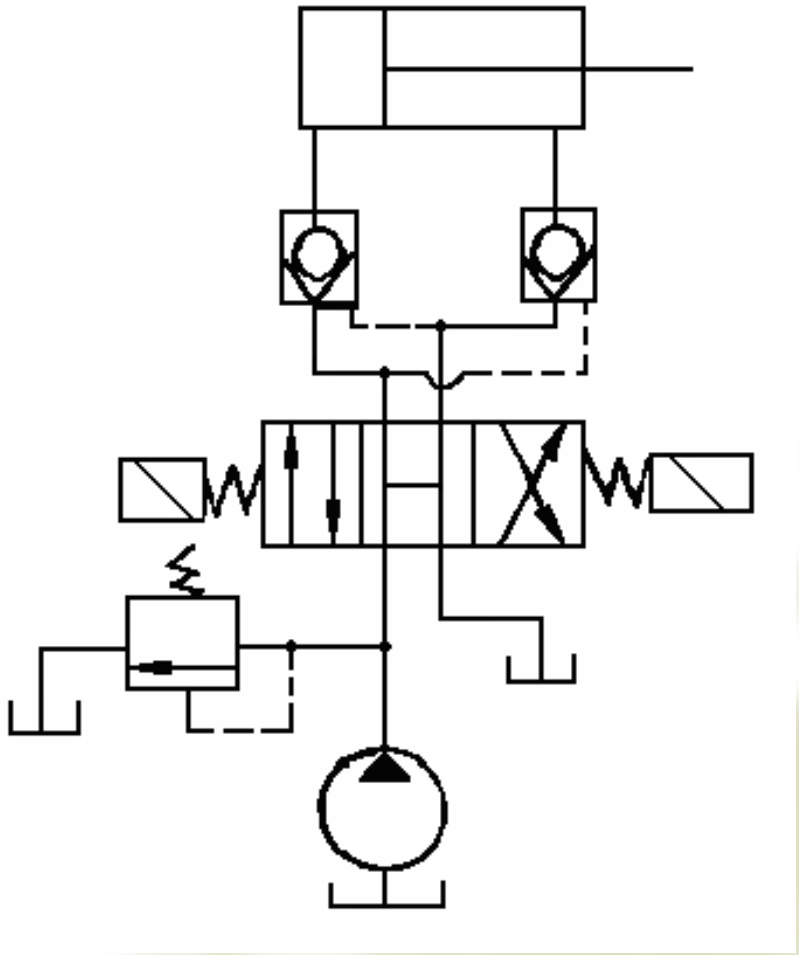
$$= -7696.9N$$



4-1习题

习题答案

1. 图示为采用液控单向阀双向锁紧的回路。简述液压缸是如何实现双向锁紧的。为什么换向阀的中位机能采用H型？换向阀的中位机能还可以采用什么型式？



Y型

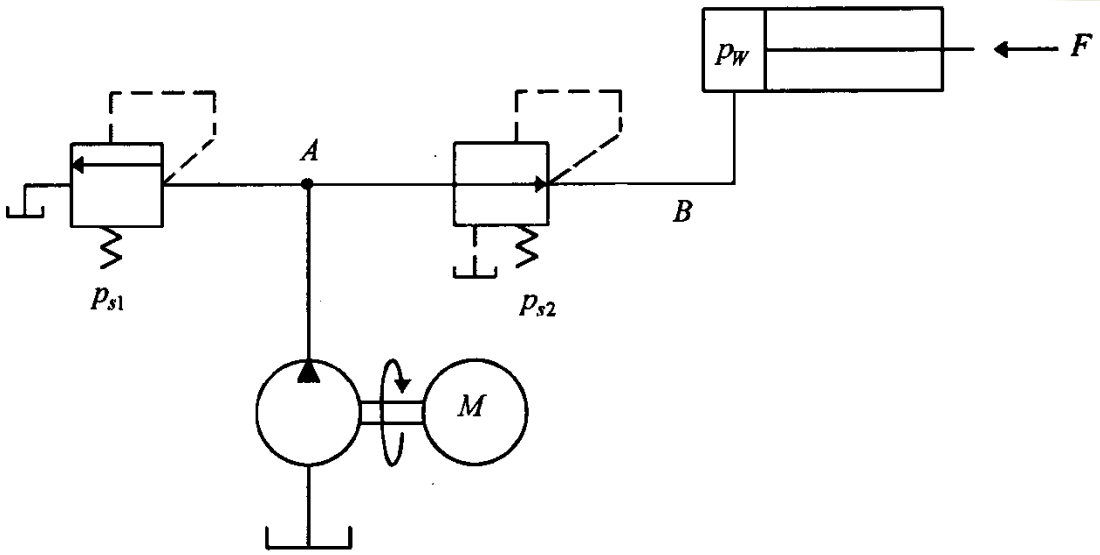
习题答案

4-2 作业题：

如图所示，溢流阀调定压力p_{s1}=4.5MPa，减压阀的调定压力p_{s2}=3MPa，活塞前进时，负荷F=1000N，活塞面积A=20 x $10^{-4}m^2$，减压阀全开时的压力损失及管路损失忽略不计，求：

(1) 活塞在运动时和到达尽头时，A、B两点的压力。

(2) 当负载F=7000N时，A、B两点的压力是多少？



(1)活塞运动时，负载压力$=\frac{1000}{20\times10^{-4}}=0.5\mathrm{MPa}<ps2$

∴减压阀阀口全开，溢流阀不开启，$p_A=p_B=0.5MPa$

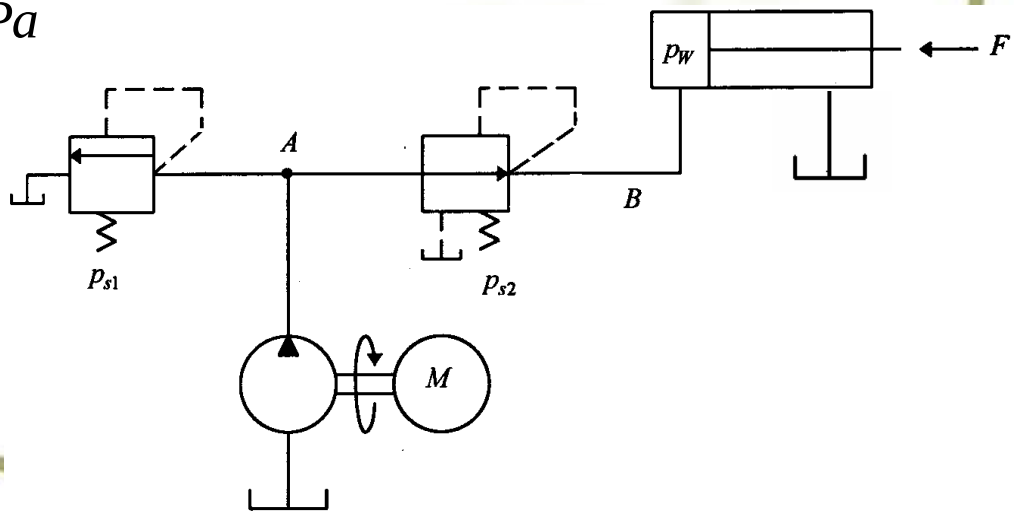
到达尽头时，油液无法流动，压力升高到开启溢流阀

∴ $p_A=ps1=4.5MPa, p_B=ps2=3MPa$

(2)负载等于7000N，负载压力$=\frac{7000}{20\times10^{-4}}=3.5\mathrm{MPa}>\mathrm{ps2}$

∴减压阀工作后始终无法推动负载，油液无法流动，压力升高到开启溢流阀

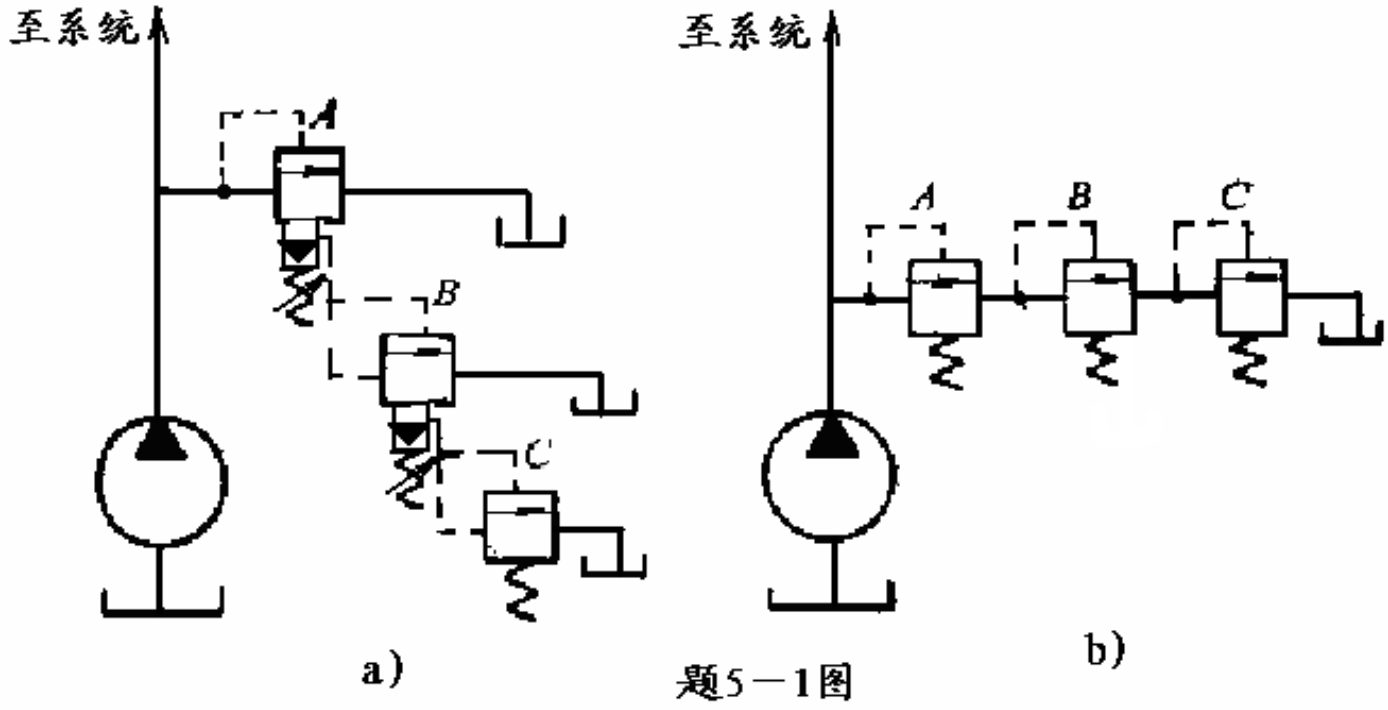
∴ $p_A=ps1=4.5MPa, p_B=ps2=3MPa$



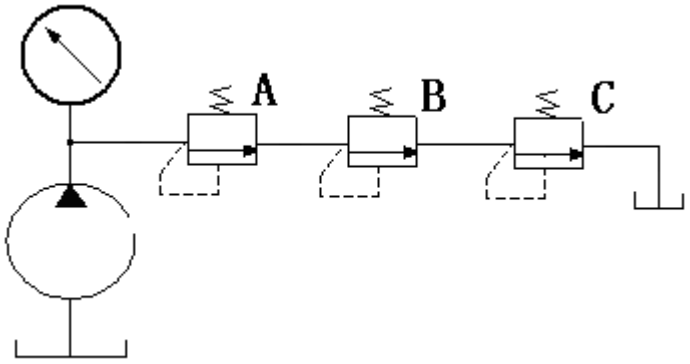
4-3 作业题：

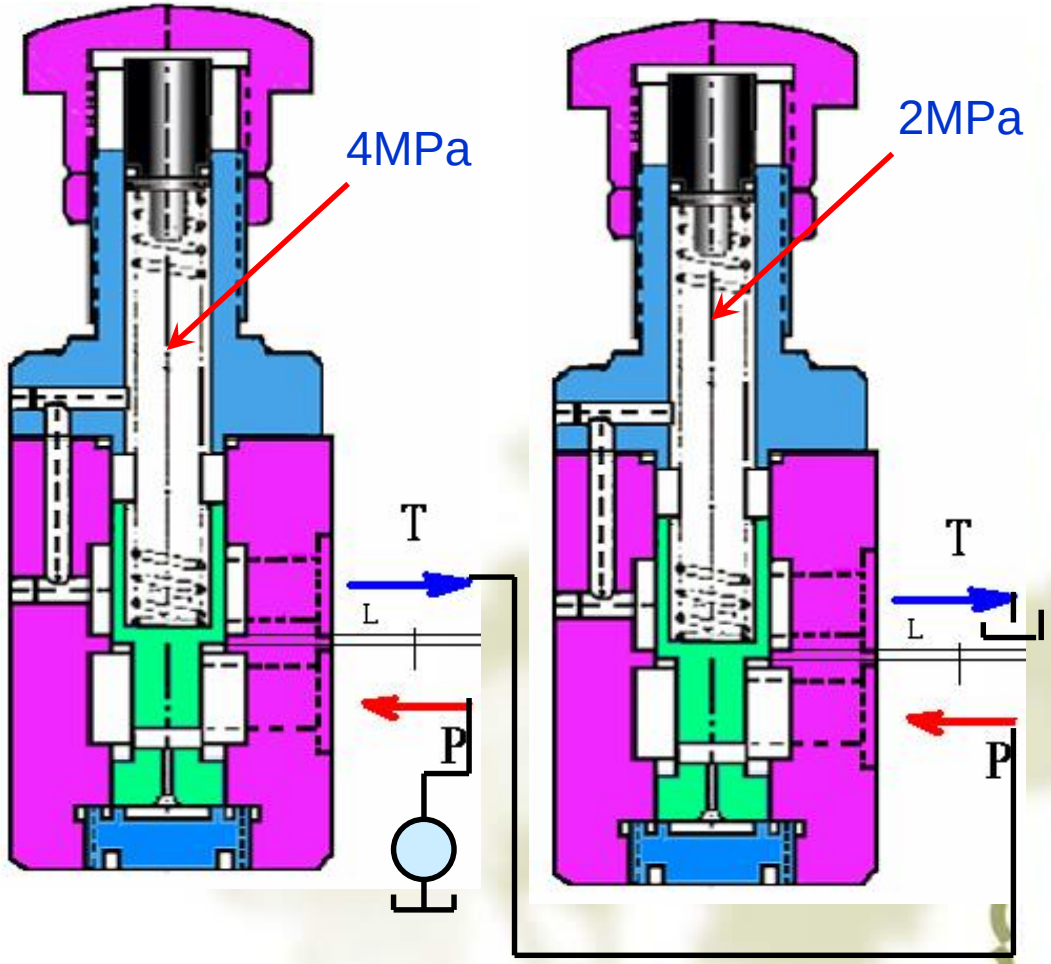
习题答案

图示的两个系统中，各溢流阀的调整压力分别为P_A=4Mpa，P_B=3Mpa，P_c=2Mpa，如系统的外负载趋于无限大，泵的工作压力各为多少？



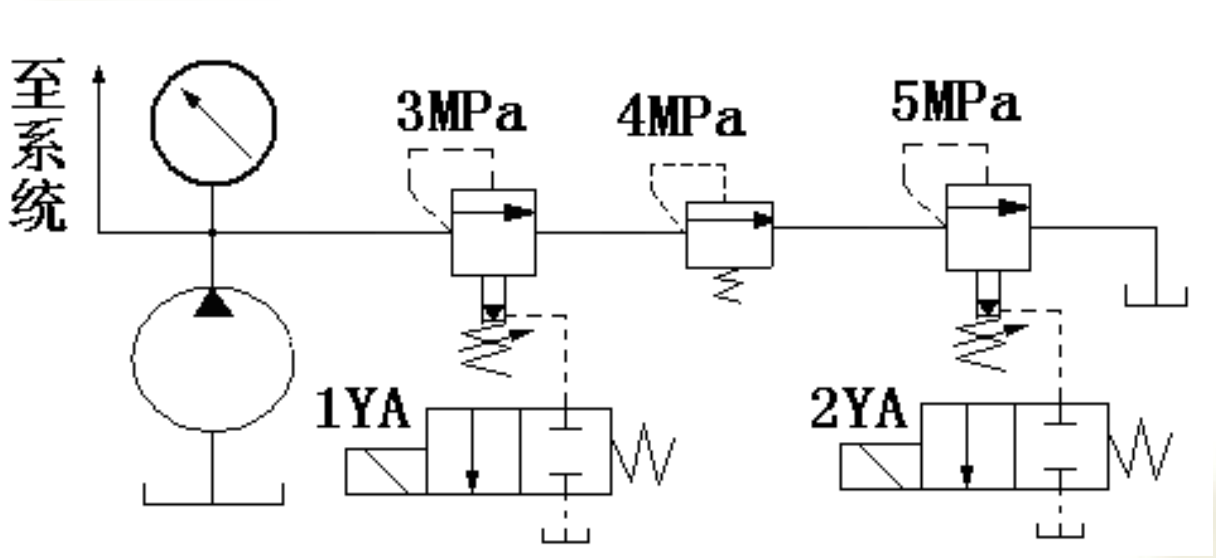
题5－1图





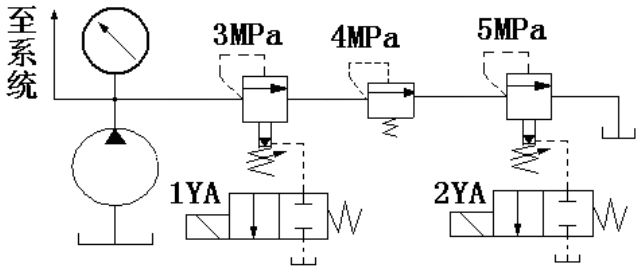
由于溢流阀有内卸油口回油箱，分析得串联溢流阀控制压力为“加法”。
所以压力计读数为9MPa.

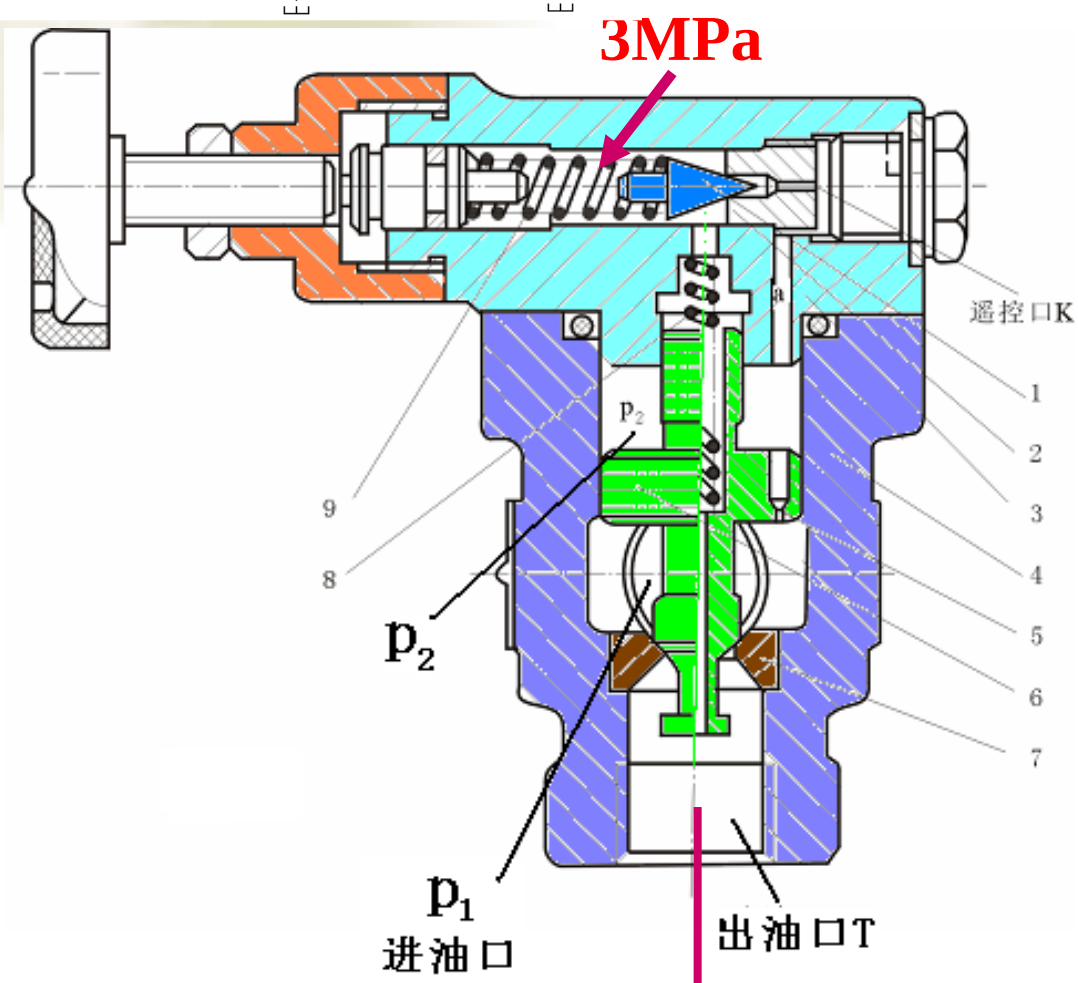
习题答案

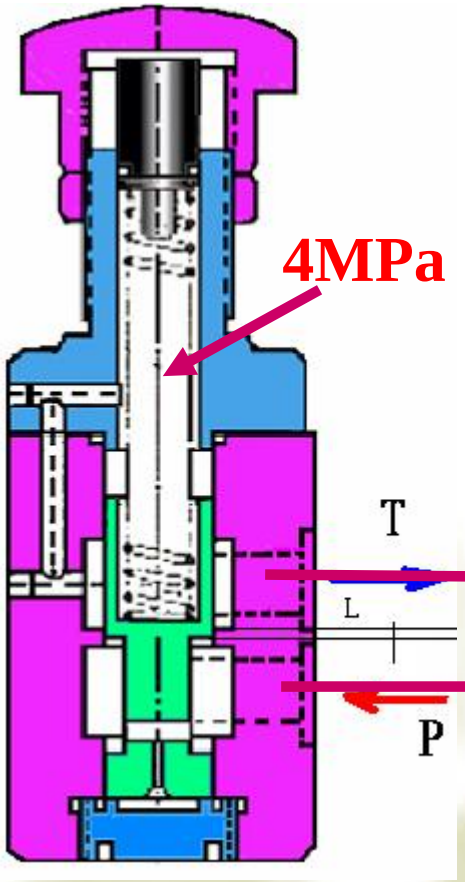


1YA	−	+	−	+
2YA	−	−	+	+
压力表读数	12	9	7	4

习题答案


至系统
3MPa
4MPa
5MPa
1YA
2YA

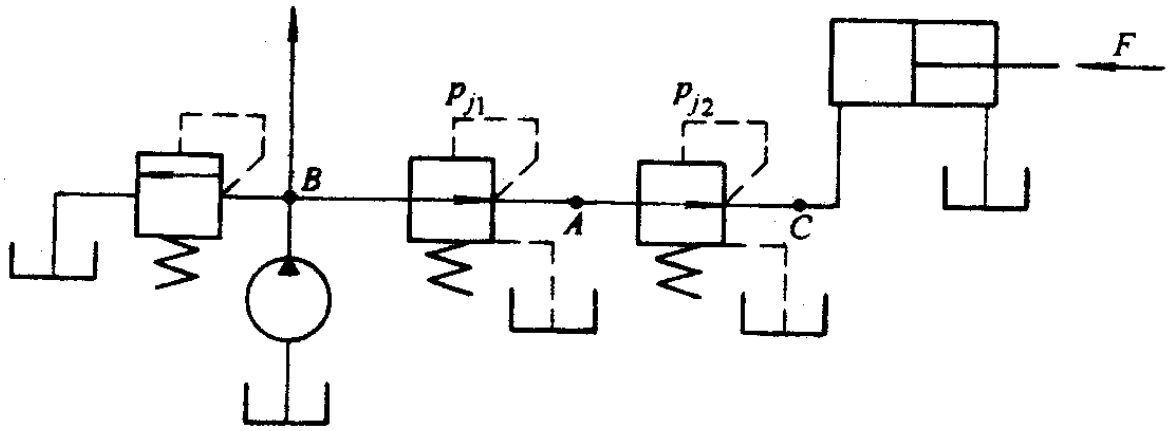

3MPa
遥控口K
1
2
3
4
5
6
7
8
9
p_2
p_1
进油口
出油口T


4MPa
T
L
P

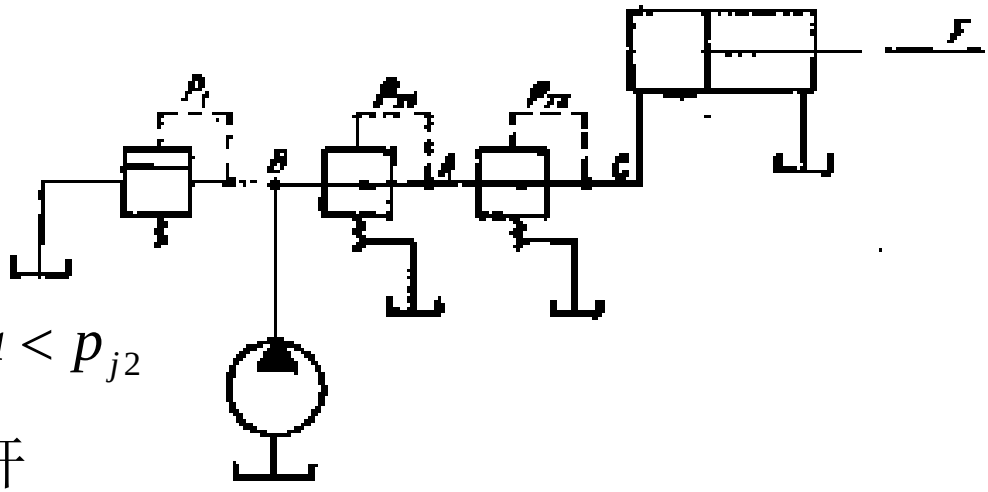
4-4 作业题：

习题答案

在题图所示回路中，已知活塞运动时的负载F＝1.2KN，活塞面积A=15×10⁻⁴m²，溢流阀调整值为p=4.5MPa，两个减压阀的调整值分别为P_{J1}＝3.5MPa和P_{J2}＝2Mpa，如油液流过减压阀及管路时的损失可略去不计，试确定活塞在运动时和停在终端位置处时，A、B、C三点的压力值。



题5—2 图



- **1） 活塞在运动时：**

$$p_c = \frac{1200}{15\times10^{-4}} = 8\times10^5\,Pa = 0.8MPa < p_{j2}$$

$\therefore$ 减压阀不起减压作用，阀口全开

$\therefore\ p_A = p_B = p_C = 0.8MPa$

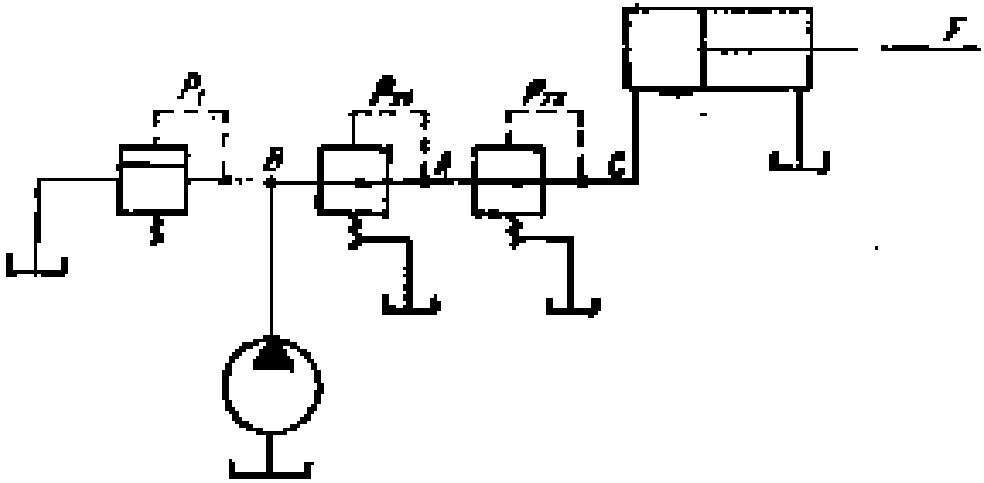
- **到达终端位置：**

$p_c = \infty$, 油液无法流动

$\therefore$ 系统达到溢流阀调定压力后稳定

$\therefore\ p_A = 3.5MPa$，$p_B = 4.5MPa$，$p_C = 2MPa$

2） 负载阻力增加到 F =4200 N，



$$p_c = \frac{4200}{15\times10^{-4}} = 28\times10^5\,Pa = 2.8MPa > p_{j2}$$

∴减压阀起减压作用后，出口压力降低为2MPa，无法推动负载

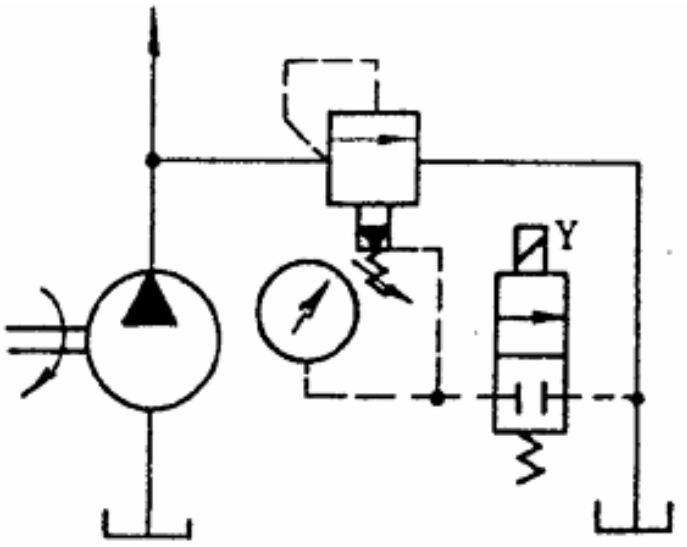
∴油液无法流出，系统压力升高到达到溢流阀调定压力后稳定

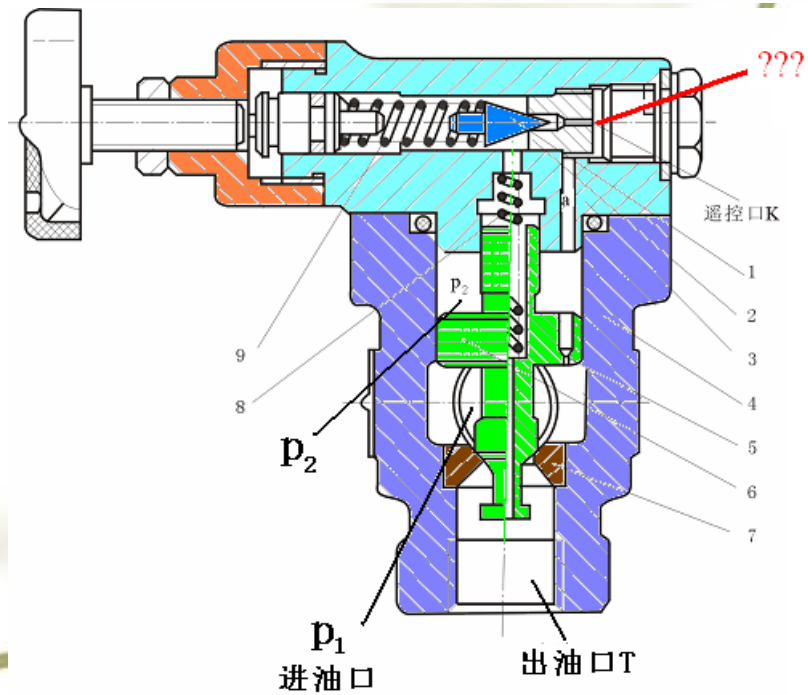
∴ $p_A = 3.5MPa$，$p_B = 4.5MPa$，$p_C = 2MPa$

习题答案

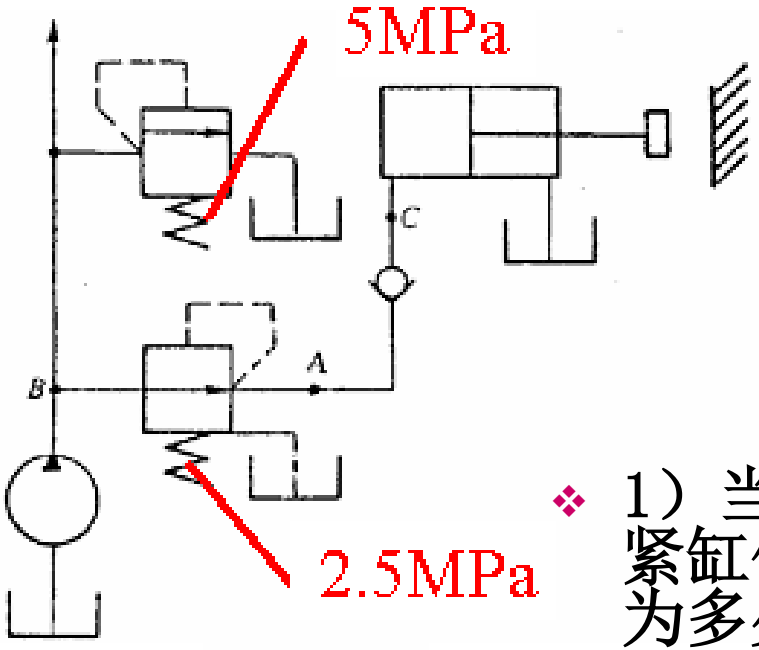
4—1（补）

1、 如图所示溢流阀的调定压力为4MPa，若阀芯阻尼小孔造成的损失不计，试判断下列情况下压力表读数各为多少？





- Y断电，负载为无限大时；4MPa
- Y断电，负载压力为2MPa时；2MPa
- Y通电，负载压力为2MPa时：0MPa。



习题答案

4—2（补）

- 1）当泵压力等于溢流阀调定压力时，夹紧缸使工件夹紧后，A、B、C点的压力各为多少？

2.5/5/2.5,开口减小，减压阀工作

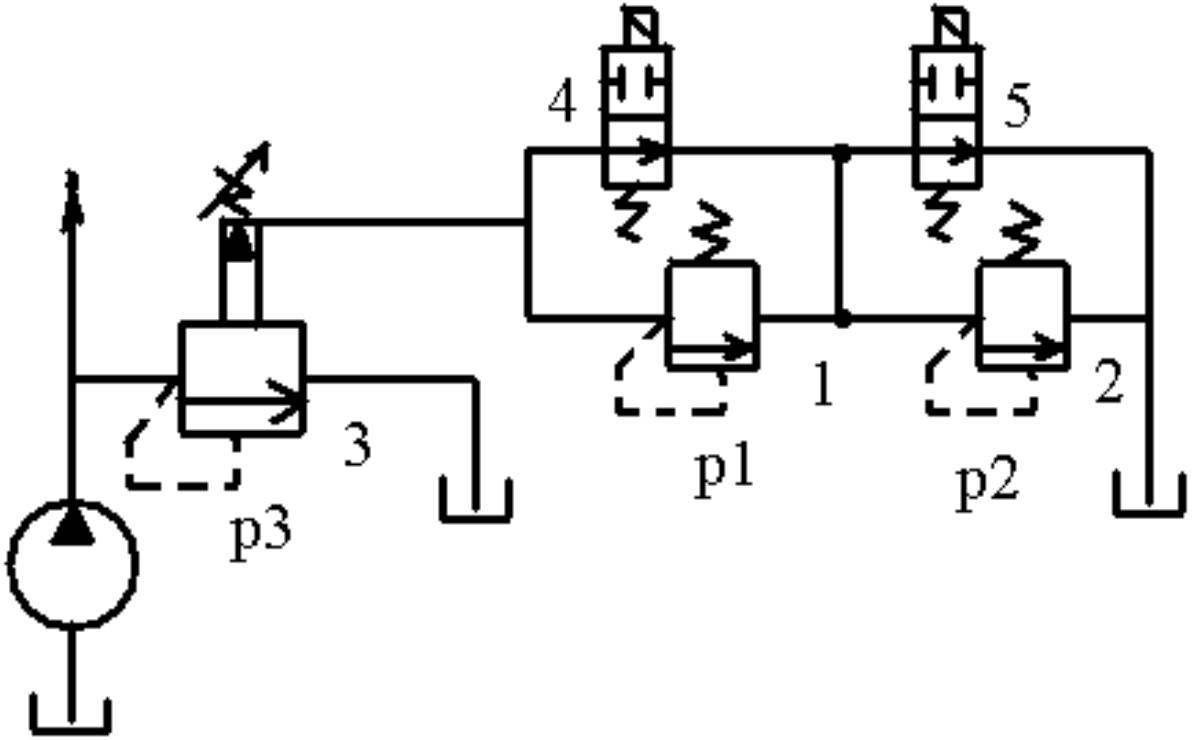
- 2）当泵压力由于工作缸快进压力降到1.5MPa时（工件原先处于夹紧状态）A、B、 C点的压力多少？

1.5/1.5/1.5,开口全开，减压阀不工作，

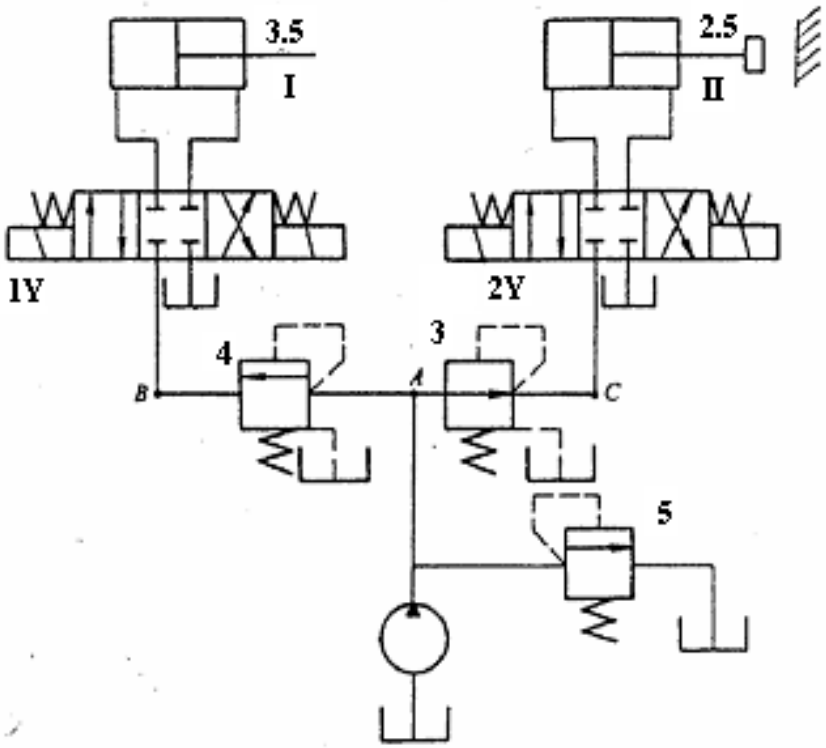
- 3）夹紧缸在夹紧工件前作空载运动时，A、B、C三点的压力各为多少？

0/0/0,开口全开，减压阀不工作

6—1



6—2



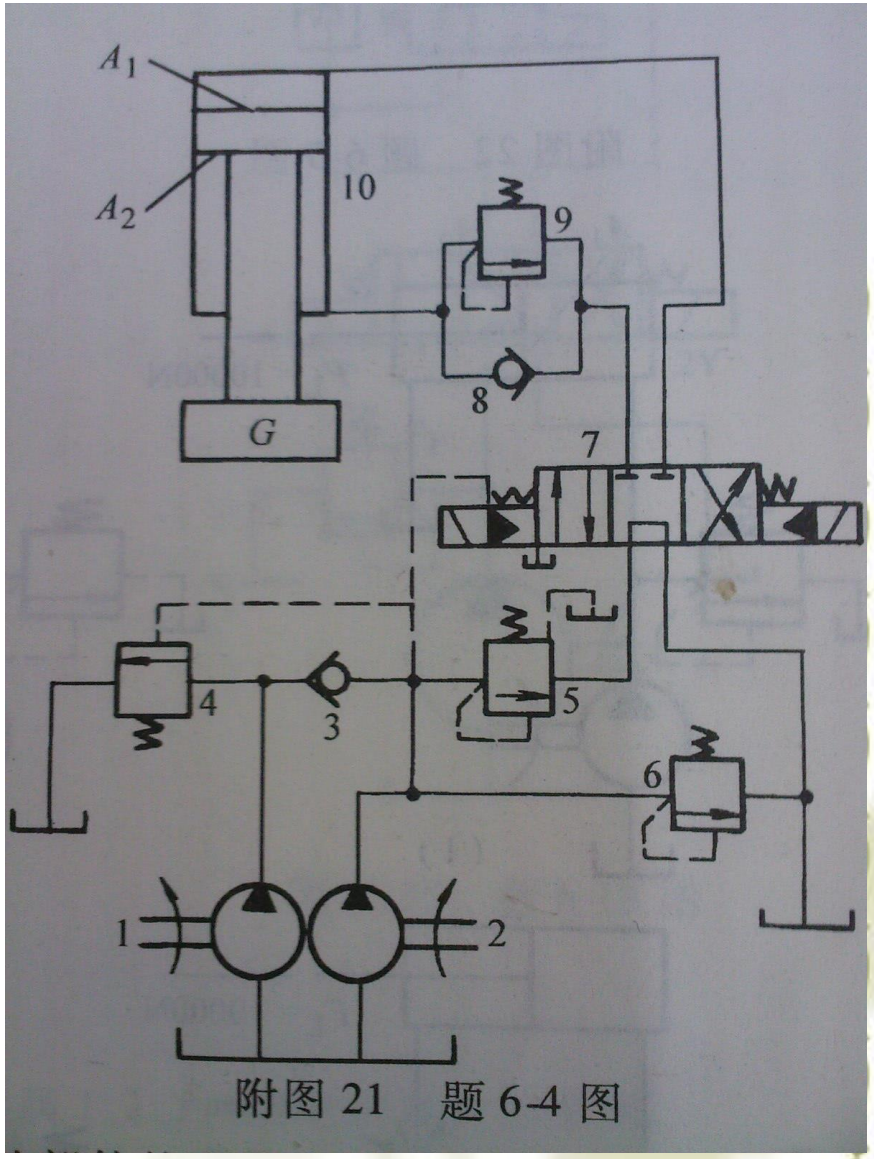
- 1）液压泵起动后，两换向阀处于中位；5, 5, 3
- 2）2Y通电，液压缸II活塞移动时:2. 5, ×， 2. 5

  活塞运动到终点时:5, 5, 3
- 3）2Y断电，1Y通电，液压缸I活塞运动时:4, 3. 5, 3

  到终点失去负载时:4, 0, 3。

6—4

- 4—外控内泄顺序阀：做泵1的卸荷阀
- 5—内控外泄顺序阀：为电液换向阀7的预控压力阀
- 6—溢流阀：调定系统最高压力
- 9—内控内泄顺序阀：平衡阀，平衡重力G，使重物不在外力作用下自行下落。



附图 21　题 6-4 图

6－4

- 阀4设定泵1的最高工作压力，p4＝p1，大于快进负载压力，小于工进负载压力；
- 阀5调定压力应保证电液换向阀的最低控制压力，p5=0.3-0.5MPa；
- 阀6设定泵2的最高工作压力，即工进时负载压力， p6＝p2；
- 阀9平衡重力G，p9略大于G/A2。

6—4

基本回路包括：

- 双泵供油快速回路—泵1，泵2，阀4，阀6，单向阀3；
- 换向回路—电液换向阀；
- 卸荷回路—
- 平衡回路—单向阀8，顺序阀9。

6—6

- 1）快进时，1Y断电，2Y得电，只克服摩擦负载：

$$p_1 = \frac{F_f}{A_1} = \frac{1000}{50\times10^{-4}} = 0.2MPa < p_Y$$

$$v_1 = \frac{q_1}{A_1} = \frac{q_p}{A_1} = \frac{30\times10^{-3}/60}{50\times10^{-4}} = 0.1m/s$$

$$\therefore p_p = p_1$$

$$\eta_1 = \frac{Fv}{p_p q_p} = \frac{Fv}{p_1 q_p} = \frac{1000\times0.1}{0.2\times10^6\times30\times10^{-3}/60} = 100\%$$

6—6

- 切削进给时，由调速阀调速，1Y得电，2Y得电：

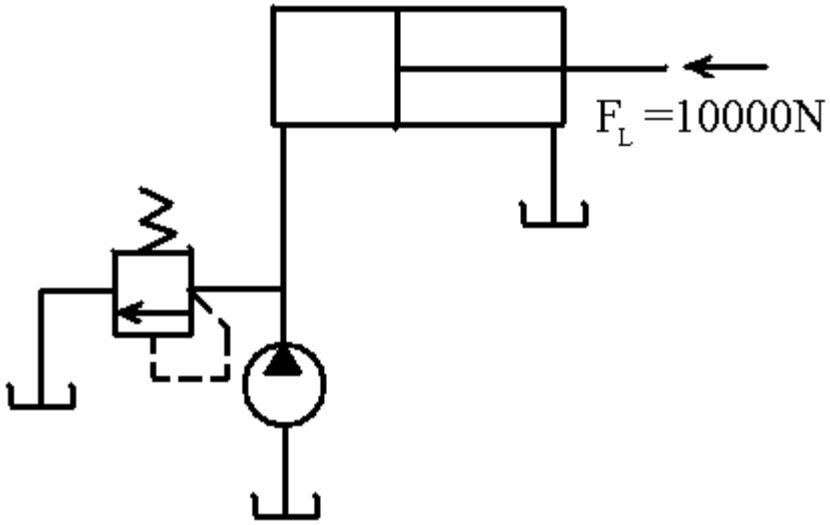
$$v_2 = \frac{q_i}{A_2} = \frac{1.2\times10^{-3}/60}{25\times10^{-4}} = 0.008m/s$$

$$q_1 = v_1A_1 = v_2A_1 = 0.008\times50\times10^{-4} = 2.4L/\min < q_p$$

$$\therefore p_p = p_Y = 2.4MPa$$

$$\eta_2 = \frac{Fv}{p_pq_p} = \frac{(F_f + F_L)v_2}{p_pq_p} = \frac{(1000+9000)\times0.008}{2.4\times10^6\times30\times10^{-3}/60} = 6.67\%$$

6—7



- （1）假设溢流阀不开启，液压泵流量全部进入液压缸

$$p_1 A_1 = F_L$$

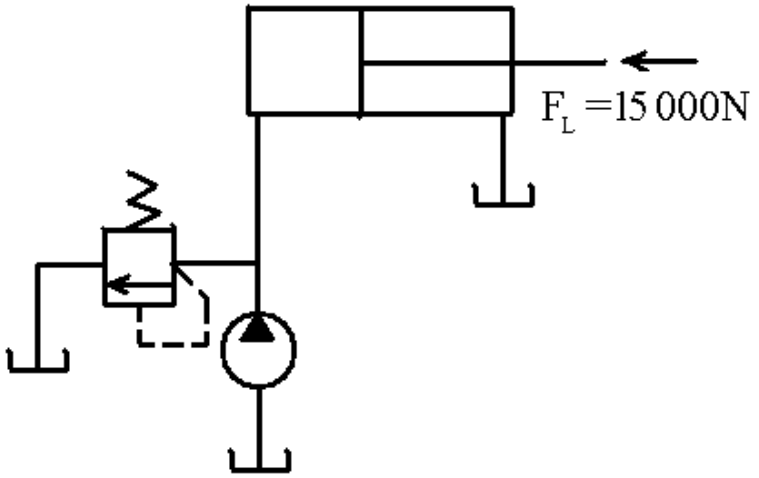
$$\therefore p_1 = \frac{F_L}{A_1} = \frac{10000}{50\times10^{-4}} = 2MPa < p_Y \therefore \text{正确}$$

$$\therefore p_p = p_1 = 2MPa$$

$$v = \frac{q_p}{A_1} = \frac{0.167\times10^{-3}}{50\times10^{-4}} = 0.0334m/s = 2m/\min$$

6—7

- （2）假设溢流阀不开启



$$p_1 A_1 = F_L$$

$$\therefore p_1 = \frac{F_L}{A_1} = \frac{15000}{50\times10^{-4}} = 3MPa > p_Y$$

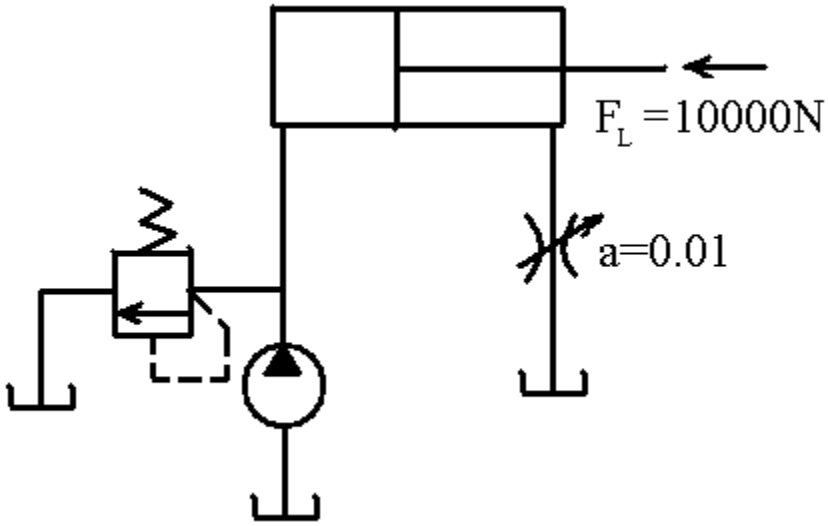
$\therefore$ 溢流。

$$\therefore p_p = p_Y = 2.4MPa$$

$$v = 0$$

- 溢流阀开启，泵工作压力小于负载力，推不动负载，**v=0**。

6—7



- （3）假设溢流阀开启，

$$p_1A_1 = p_2A_2 + F_L \qquad p_1 = p_Y = 2.4MPa$$

$$\therefore p_2 = \frac{p_1A_1 - F_L}{A_2} = \frac{2.4\times10^6\times50\times10^{-4} - 10000}{25\times10^{-4}} = 0.8MPa$$

$$\therefore q_2 = C_dA\sqrt{\frac{2}{\rho}\Delta p} = 0.62\times0.01\times10^{-4}\times\sqrt{\frac{2}{870}\times0.8\times10^6} = 2.66\times10^{-5}m^3/s$$

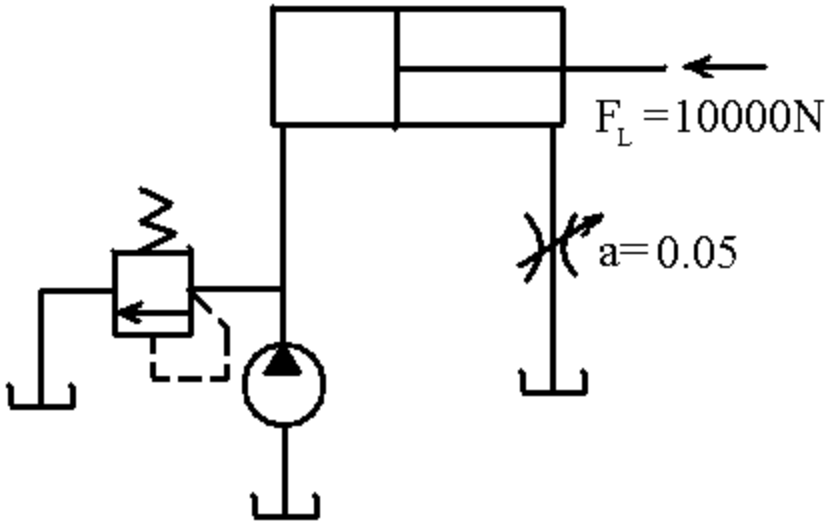
$$q_1 = \frac{q_2}{A_2}A_1 = \frac{2.66\times10^{-5}}{25}\times50 = 5.32\times10^{-5} < q_p = 0.167\times10^{-3}$$

$\therefore$ 成立

$$v = \frac{q_2}{A_2} = \frac{2.66\times10^{-5}}{25\times10^{-4}} = 0.01064m/s$$

$$p_p = p_Y = 2.4MPa$$

6—7



- （4）假设溢流阀开启，

$$p_1 A_1 = p_2 A_2 + F_L \qquad p_1 = p_Y = 2.4MPa$$

$$\therefore p_2 = \frac{p_1 A_1 - F_L}{A_2} = \frac{2.4\times10^6 \times 50\times10^{-4} - 10000}{25\times10^{-4}} = 0.8MPa$$

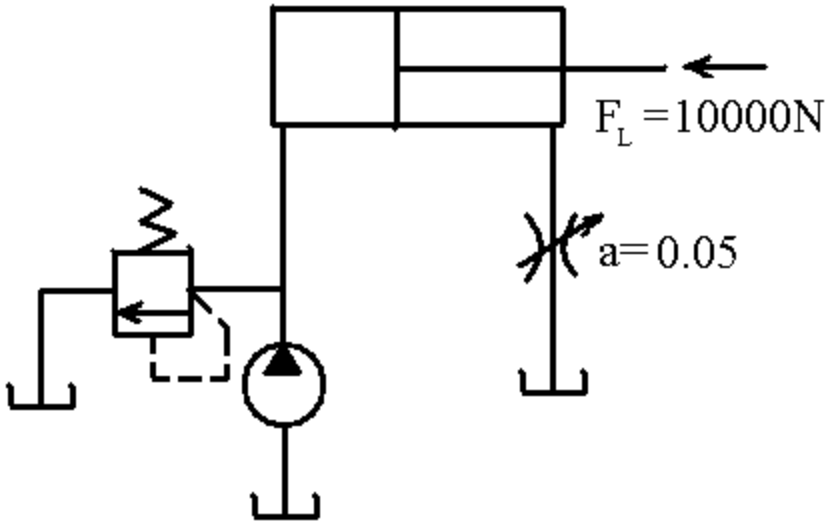
$$\therefore q_2 = C_d A\sqrt{\frac{2}{\rho}\Delta p} = 0.62\times0.05\times10^{-4}\times\sqrt{\frac{2}{870}\times0.8\times10^6} = 13.3\times10^{-5} m^3/s$$

$$q_1 = \frac{q_2}{A_2}A_1 = \frac{13.3\times10^{-5}}{25}\times50 = 2.66\times10^{-4} > q_p = 1.67\times10^{-4}$$

$\therefore$不成立

$$v = \frac{q_p}{A_1} = \frac{0.167\times10^{-3}}{50\times10^{-4}} = 0.0334m/s$$

6—7（4）

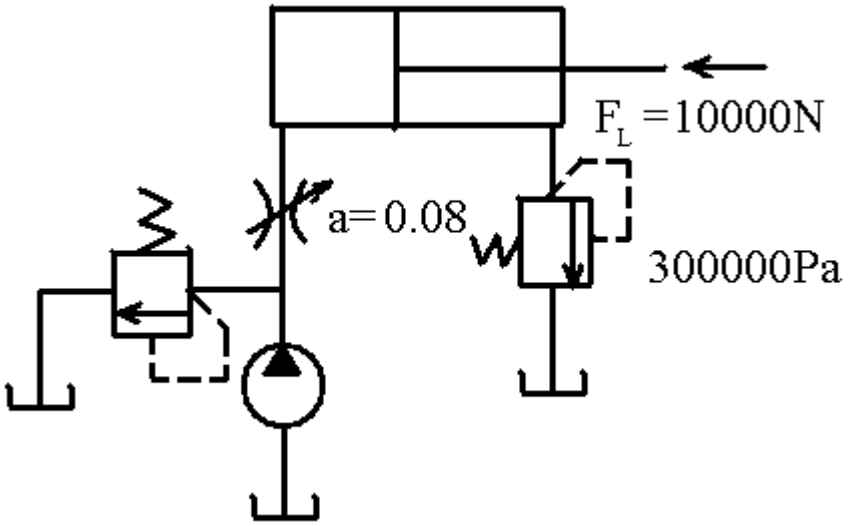


$$q_2 = vA_2 = 0.0334 \times 25 \times 10^{-4} = 0.835 \times 10^{-4} m^3/s = C_d A \sqrt{\frac{2}{\rho}\Delta p}$$

$$\therefore \Delta p = (\frac{q_2}{C_d A})^2 \frac{\rho}{2} = (\frac{0.835 \times 10^{-4}}{0.62 \times 0.05 \times 10^{-4}})^2 \frac{870}{2} = 3.156 \times 10^5 Pa$$

$$\therefore p_p = \frac{F_L + \Delta p A_2}{A_1} = \frac{10000 + 3.156 \times 10^5 \times 25 \times 10^{-4}}{50 \times 10^{-4}} = 2.1578 MPa$$

6—7



- （5）假设溢流阀开启

$$p_1 A_1 = p_2 A_2 + F_L$$

$$\therefore p_1 = \frac{p_2 A_2 + F_L}{A_1} = \frac{3\times10^5 \times 25\times10^{-4} + 10000}{50\times10^{-4}} = 2.15MPa$$

$$\therefore \Delta p = p_p - p_1 = 2.4 - 2.15 = 0.25MPa$$

$$\therefore q_1 = C_d A\sqrt{\frac{2}{\rho}\Delta p} = 0.62\times0.08\times10^{-4}\times\sqrt{\frac{2}{870}\times0.25\times10^6} = 1.189\times10^{-4} m^3/s$$

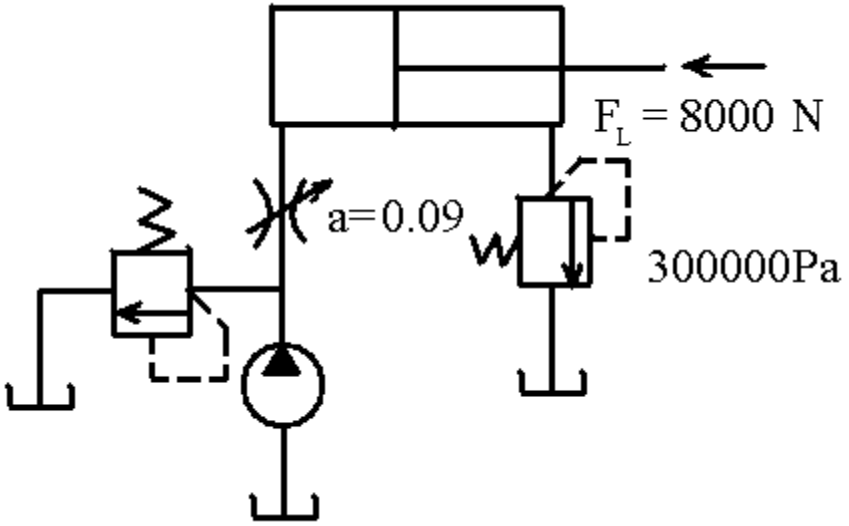
$$q_1 = 1.189\times10^{-4} < q_p = 1.67\times10^{-4}$$

$\therefore$ 成立

$$v = \frac{q_1}{A_1} = \frac{1.189\times10^{-3}}{50\times10^{-4}} = 0.2378m/s$$

$$p_p = p_Y = 2.4MPa$$

6—7



- （6）假设溢流阀开启

$$p_1 A_1 = p_2 A_2 + F_L$$

$$\therefore p_1 = \frac{p_2 A_2 + F_L}{A_1} = \frac{3\times10^5 \times 25\times10^{-4} + 8000}{50\times10^{-4}} = 1.75MPa$$

$$\therefore \Delta p = p_p - p_1 = 2.4 - 1.75 = 0.65MPa$$

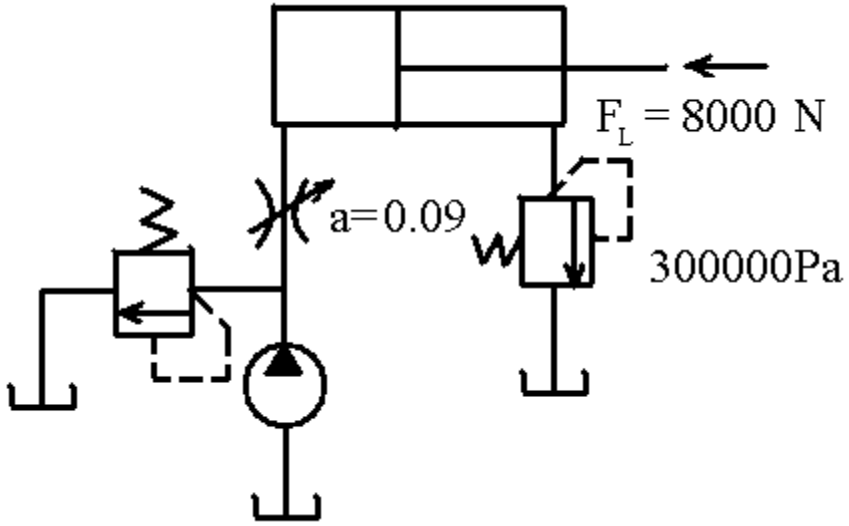
$$\therefore q_1 = C_d A\sqrt{\frac{2}{\rho}\Delta p} = 0.62\times0.09\times10^{-4}\times\sqrt{\frac{2}{870}\times0.65\times10^6} = 2.157\times10^{-4} m^3/s$$

$$q_1 = 2.157\times10^{-4} > q_p = 1.67\times10^{-4}$$

$\therefore$ 不成立

$$v = \frac{q_p}{A_1} = \frac{1.67\times10^{-4}}{50\times10^{-4}} = 0.0334m/s$$

6—7（6）

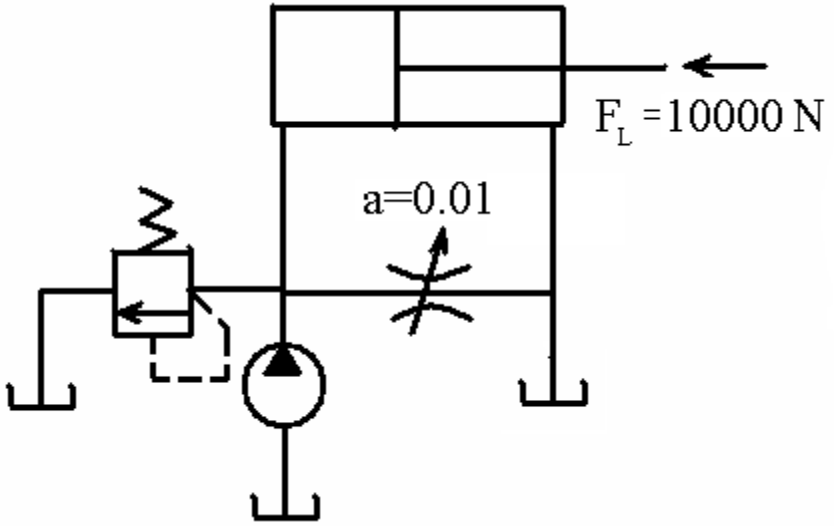


$$q_1 = vA_1 = q_p = 1.67\times10^{-4} m^3/s = C_d A\sqrt{\frac{2}{\rho}\Delta p}$$

$$\therefore \Delta p = (\frac{q_2}{C_d A})^2 \frac{\rho}{2} = (\frac{1.67\times10^{-4}}{0.62\times0.09\times10^{-4}})^2 \frac{870}{2} = 3.896\times10^5 Pa$$

$$\therefore p_p = p_1 + \Delta p = 1.75\times10^6 + 3.896\times10^5 = 2.1396 MPa$$

6—7



- （7）旁路节流调速回路，溢流阀为安全阀

$$p_1 A_1 = F_L$$

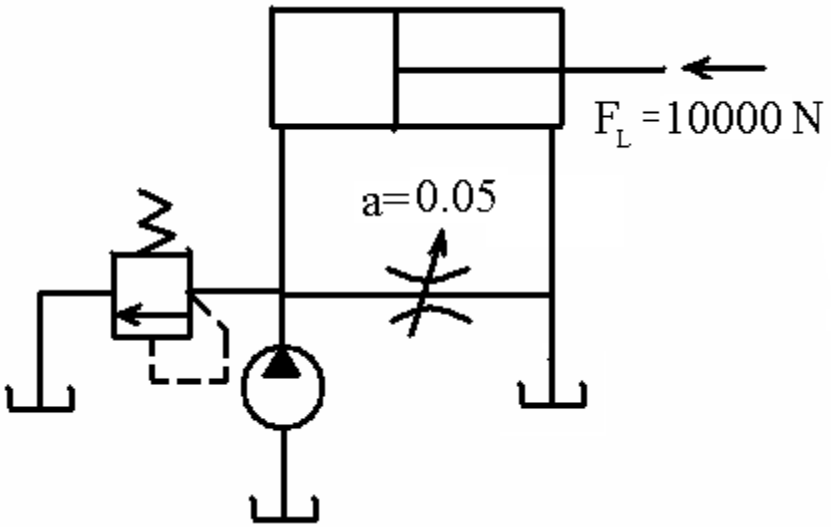
$$\therefore p_1 = \frac{F_L}{A_1} = \frac{10000}{50\times10^{-4}} = 2MPa$$

$$q = C_d A\sqrt{\frac{2}{\rho}\Delta p} = 0.62\times0.01\times10^{-4}\times\sqrt{\frac{2}{870}\times2\times10^{6}} = 0.42\times10^{-4}\,m^3/s$$

$$v = \frac{q_p - q}{A_1} = \frac{0.167\times10^{-3} - 0.42\times10^{-4}}{50\times10^{-4}} = 0.025m/s$$

$$p_p = p_1 = 2MPa$$

6—7



- （8）旁路节流调速回路，溢流阀为安全阀

$$p_1 A_1 = F_L$$

$$\therefore p_1 = \frac{F_L}{A_1} = \frac{10000}{50\times10^{-4}} = 2MPa$$

$$q = C_d A\sqrt{\frac{2}{\rho}\Delta p} = 0.62\times0.05\times10^{-4}\times\sqrt{\frac{2}{870}\times2\times10^{6}} = 2.1\times10^{-4}m^3/s$$

$$q > q_p = 1.67\times10^{-4}$$

$$\therefore v = 0$$

$$q_1 = vA_1 = q_p = 1.67\times10^{-4}m^3/s = C_d A\sqrt{\frac{2}{\rho}\Delta p}$$

$$\therefore \Delta p = (\frac{q_p}{C_d A})^2\frac{\rho}{2} = (\frac{1.67\times10^{-4}}{0.62\times0.05\times10^{-4}})^2\frac{870}{2} = 1.26MPa$$

$$\therefore p_p = \Delta p = 1.26MPa$$

6—8

- （1） $n_M = \dfrac{q_M \eta_{Mv}}{V_M} = \dfrac{q_p \eta_{Mv}}{V_M} = \dfrac{V_p n_p \eta_{pv} \eta_{Mv}}{V_M}$

$$\therefore V_p = \frac{V_M n_M}{n_p \eta_{pv} \eta_{Mv}} = \frac{1000 \times 10}{1500 \times 0.95 \times 0.95} = 7.39 ml/r$$

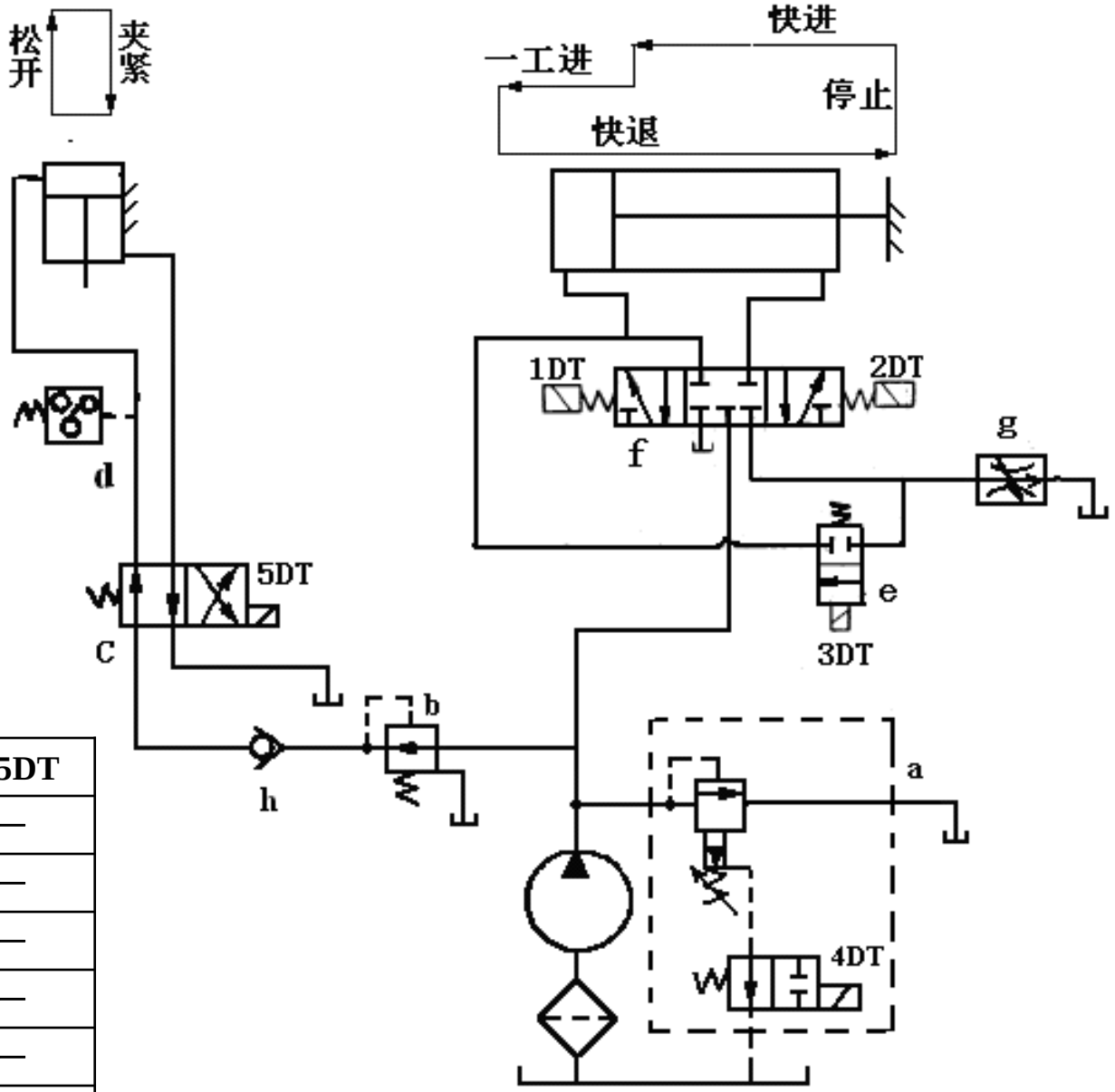
- （2） $T_M = \dfrac{1}{2\pi} \Delta p V_M \eta_{Mm}$

$$\therefore \Delta p = \frac{2\pi T_M}{V_M \eta_{Mm}} = \frac{2 \times \pi \times 8}{10 \times 10^{-6} \times 0.95} = 52.88 \times 10^5 Pa > p_Y = 40 \times 10^5 Pa$$

$$\therefore n_M = 0$$

- （3） $P_{p\max} = P_Y V_{p\max} n_p \eta_{pv} = 40 \times 10^5 \times 8 \times 10^{-6} \times 1500/60 \times 0.95 = 760w$

习题答案



动作	1DT	2DT	3DT	4DT	5DT
夹紧	—	—	—	+	—
快进	+	—	+	+	—
一工进	+	—	—	+	—
快退	—	+	—	+	—
停止	—	—	—	+	—
松开	—	—	—	+	+