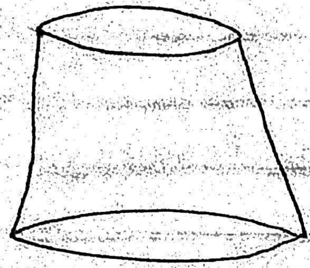
18/ENG08/080.

1)



$V_1 = 5m/s$

$V_2 = 2m/s.$

$P_1 = P_1/w = 2.5m$

$H_L = 0.35 \frac{(V_1 - V_2)^2}{2g}$

Using Bernoulli's equation $P_2/w = 2$

$P_1/w + V_1^2/2g + Z_1 = P_2/w + V_2^2/2g + Z_2 + H_L$

$P_2/w = P_1/w + \left[\frac{V_1^2 - V_2^2}{2g}\right] + [Z_1 - Z_2] - H_L$

$P_2/w = 2.5 + \left[\frac{5^2 - 2^2}{2 \times 9.81}\right] + 2 - \frac{0.35(5-2)^2}{2 \times 9.81}$

$P_2/w = 2.5 + 1.07 + 2 - 0.161$

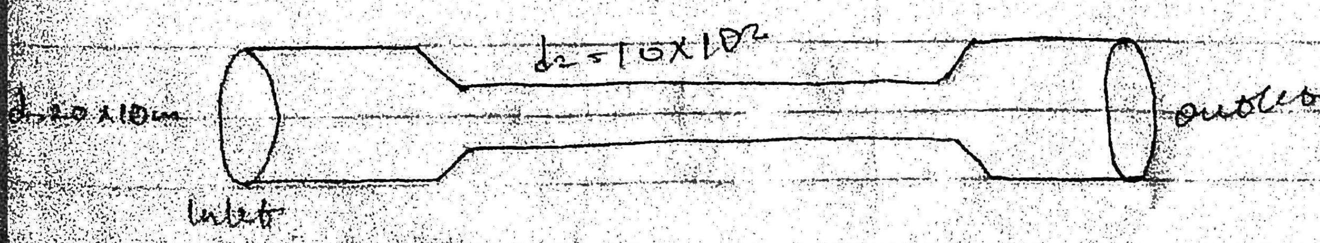
$P_2/w = 5.409m$

(2) $P_1 = 17.658\ N/cm^2$

$P_2 = 30cmHg$

$C_d = 0.98$

$Q = ?$



$A_1 = \frac{\pi \times (20\times10^{-2})^2}{4}$ $A_2 = \pi \times \frac{(10\times10^{-2})^2}{4}$

$0.03 m^2$ $A_2 = 7.85\times10^{-3} m^2$

$\frac{P_2}{w} = 0.3\times13.6 = 4.05 m Hg$

$\frac{P_2}{w} = -4.08$ (due to vaccuum pressure)

$P_1/w = \frac{17.056\times10^4}{9.81\times10^3} = 18$

$h = \frac{P_1}{w} - \frac{P_2}{w} = 18 - -4.08 = 22.08$

$Q = \frac{C_d A_1 A_2 \sqrt{2gh}}{\sqrt{A_1^2 - A_2^2}}$

$Q = \frac{0.98\times0.03\times(7.85\times10^{-5})\times(\sqrt{2\times9.81\times22.08})}{\sqrt{(0.03)^2-(7.85\times10^{-3})^2}}$

$Q = 0.1667 m^3/s$

(3) $d_0 = 15\times10^{-2} m$

$A_0 = \frac{\pi\times(15\times10^{-2})^2}{4} = 0.0177 m^2$

$d_1 = 30\times10^{-2} m$

$C_d = 0.64$

$y = 50\times10^{-2} m Hg$

Sg of oil = 0.9

$S_m = 13.6$

$S_o = 0.9$

$A_1 = \frac{\pi(30\times10^{-2})^2}{4} = 0.0707 m^2$

$H = 50\times10^{-2}\left[\frac{13.6}{0.9} - 1\right]$

$H = 7.055 m$

$Q = \frac{C_d A_0 A_1 \sqrt{2gh}}{\sqrt{A_1^2 - A_0^2}}$

$= \frac{0.64\times0.0177\times0.0707\times\sqrt{2\times9.81\times7.055}}{0.0707^2 - 0.0177^2}$

$Q = 0.187 m^3/s$

④ $y = 170mmhg = 170 \times 10^{-3}$ mhg
Sg of mercury = 13·6hg
Sg of seawater = 1·026

$V = \sqrt{2gH}$ $\qquad H = y \times \frac{Sh}{Sho} - 1$

$V = \sqrt{2 \times 9.81 \times 2.08}$

$V = 6.39 m/s$ $\qquad H = 170 \times 10^{-3} \times \left(\frac{13.6}{1.026} - 1\right)$

$H = 2.08m$

⑤ Actual flowrate $Q = 5dm^3/min = 8.33 \times 10^{-5} m^3/sec$
$P = 15 bar = 15 \times 10^5 N/m^2$
$V = 1700 w/min = 28.33 m/sec$
$T = 15N/m$ Normal displacement $= 100 cm^3$ / ~~~~ rev
$= 1.10^{-5} m^3$/rev

Volumetric efficiency

$\frac{\text{Actual flowrate}}{\text{Ideal flowrate}} \times 100\%$

Ideal flowrate = displacement × speed.

$V.E = \frac{8.33 \times 10^{-5}}{2.833 \times 10^{-4}} \times 100$

2

Fluid power $(Q \times \Delta P)$
$= 8.33 \times 10^{-5} \times 15 \times 10^5 = 124.95$ watts.

Shaft power $= T \times W$
$W = 2 \times \pi \times N \qquad 2 \times \pi \times 28.33 = 178$ rad/sec.
$= T \times W$

$W = 15 \times 178 = 2670$ watts.

The Overall efficiency

$\frac{\text{Fluid power}}{\text{Shaft power}} \times 100$

$= \frac{124.95}{2670} \times 100 =$ ~~4.68%~~ 4.68%