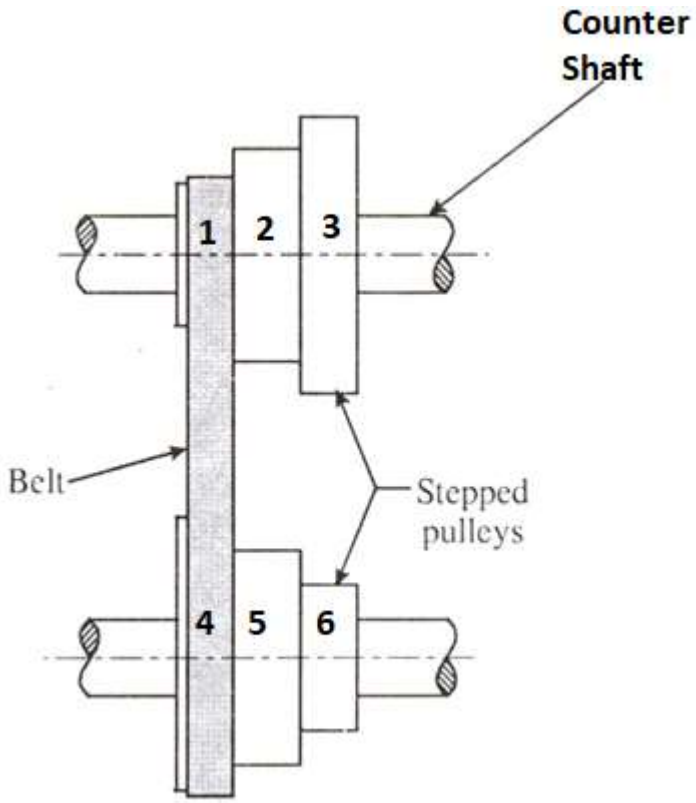
7. Design a set of stepped cone pulleys for driving a machine by a belt drive from a counter shaft running at 850 rpm. The machine is to run at 350, 450 and 550 rpm and the smallest step on the countershaft is 300 mm in diameter. The distance between the centers of the two shafts is 3 meters. Sketch the arrangement.



$D_1 + D_4 = D_2 + D_5 = D_3 + D_6$

$N_1 = N_2 = N_3 = 850$ rpm

$N_4 = 350$ rpm, $N_5 = 450$ rpm, $N_6 = 550$rpm

$D_1 = 300$mm

<u>First Step</u>

$N_4/N_1 = D_1/ D_4$

$350/850 = 300/D_4$

$D_4 = 728.57$mm

<u>Second Step</u>

$N_5/N_2 = D_2/ D_5$

$450/850 = D_2/D_5$

$D_2 = 9* D_5/17$

We have $D_1 + D_4 = D_2 + D_5$

$300 + 728.57 = 9* D_5/17 + D_5$, $D_5= 672.53$mm

$D_2 = 9* D_5/17$, $D_2 = 9* 672.53/17 = 356.05$mm.

Third Step

$N_6/N_3 = D_3/ D_6$

$550/850 = D_3/D_6$

$D_3 = 11* D_6/17$

We have $D_1 + D_4 = D_3 + D_6$

$300 + 728.57 = 11* D_6/17 + D_6$, $D_6= 624.5$mm

$D_3 = 11* D_6/17$, $D_2 = 11* 624.5/17 = 404.08$mm.

8. A belt drive transmitting power between two pulleys which are 2 meters apart with a speed reduction ratio of 4 has an angle of contact of 3.91 radians. The diameter of the larger pulley is 120 cm and the driver pulley runs at 1600 rpm. The initial tension in the belt is 0.95KN and coefficient of friction is 0.28 Calculate the length of the belt, power transmitted and width of the belt if the permissible tension per meter of the belt is 10 KN.

X= 2m; speed reduction ratio = 4; θ= 3.91 rad; D_2=120 cm; N_1=1600 rpm; T_0=950 N.

L=? P=?

Velocity ratio = 1 / (speed reduction ratio) = 1 / 4 = 0.25;

$N_2/N_1 = 1/ 4$ ==>$N_2 = 1600/4$ or $N_2= 400$ rpm

$D_1/D_2 = 1/4$ ==> $D_1/120 = 1/4$ ==> $D_1 = 30$ cm or 0.3m.

$T_0 = (T_1 + T_2) / 2$ ==> $950 = (T_1 + T_2) / 2$;

$T_1 / T_2 = e^{\mu\theta} = e^{0.28x3.91} = 2.99$ or $T_1= 2.99\ T_2$;

950 $= (2.99\ T_2 + T_2) / 2$; ==> $T_2 = 476.19$ N;

$T_1 = 2.99\ T_2$ ==> T1 = 2.99 x 476.19 = 1423.81N.

P = (T1-T2) V / 60000

P = (1423.81 – 476.19) π x 0.3 x 1600 / 60000 = 23.82 kw.

Permissible tension/ meter = 10kN = 10000N

10000 x b =T1

10000 x b = 1423.81 ==> b = 0.14238 m or 14.238 cm.

Length of the belt : since θ = 3.91 which is > 3.14, the belt drive is a cross belt drive

$L_{cross} = \pi (r_1 + r_2) + [(r_1 + r_2)^2 / X]+ 2X$

$= \pi (0.15 + 0.6) + [(0.15 + 0.6)^2 / 2]+ (2x2)$

= 6.637 m.