Problem: A dense air machine operates between the pressures of 65 pounds per square inch and 230 pounds per square inch absolute. The compressor receives air at a temperature of 10° F., and it is discharged from the water cooler at 95°F. The value of n for the compression line is 1.3 and for the expansion line, 1.4. See fig. 196

Find (a) the weight of air per minute per ton of refrigeration; (b) bet work per minute per ton of refrigeration; (c) weight of cooling water per minute per ton of refrigeration; (d) horsepower per ton of refrigeration; (e) ~~displacement-clearance; (f) displacement-per-minute per-ton-of-re-~~ displacement per minute per ton of refrigeration for the compressor, assuming 2 percent clearance; (f) displacement per minute per ton of refrigeration for the cooling coils or expander, assuming 2 percent clearance; (g) coefficient of performance.

Assuming the friction loss to be 15 percent, and also assume the initial temperature of the cooling water to be 65°F. and the final temperature 75°F.

solution

(a) $\frac{T_2}{T_1} = \left(\frac{P_2}{P_1}\right)^{\frac{n-1}{n}}$, $T_2 = 470\left(\frac{230}{65}\right)^{.231} = 630^\circ F.\ Abs.\ or\ 170^\circ F.$

$T_4 = 555\left(\frac{65}{230}\right)^{.286} = 387^\circ F.\ Abs\ or\ -73^\circ F.$

Weight of air per minute per ton of refrigeration

$= \frac{200}{.24(10-(-73))} = 10.0$ pounds.

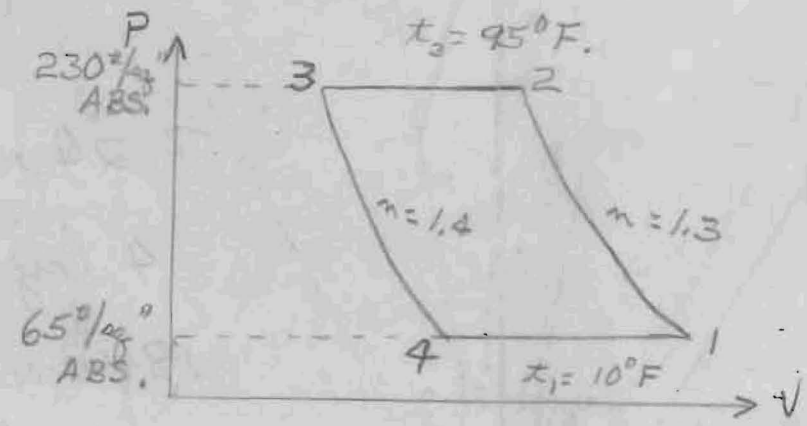


Fig 196

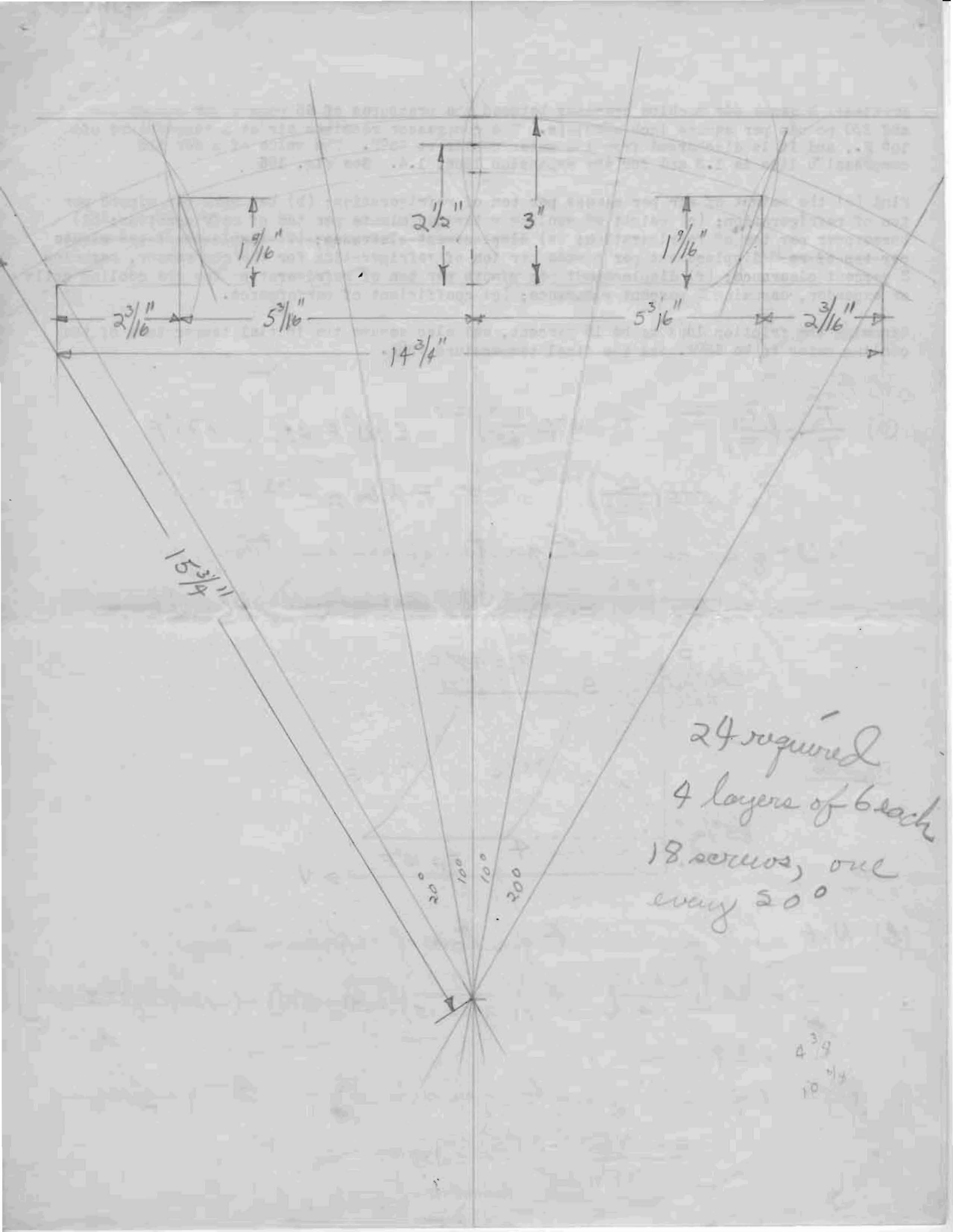
(b) Net work per minute per ton of refrigeration.

$= 10 \times .24\left[\left(\frac{1.4-1}{1.4}\right)\left(\frac{1.3}{1.3-1}\right)\left(\frac{1}{1.00-.15}\right)(630-470) - (1.00-.15)(555-387)\right]$

$= 216$ BTU/min,

(c) Weight of cooling water per minute per ton of refrig.

$= \frac{.24 \times 10(630-555)}{75-65} = 18$ pounds,



24 required
4 layers of 6 each
18 servos, one
every 20°