Practical No. 3: Determine mechanical advantage and velocity ratio of worm and worm wheel for different load and effort.

I. Practical Significance

There is often a need to lift loads and different lifting machines are used depending on the type of load, intensity of the load and other site conditions. Worm and worm wheel machines are used for lifting heavy loads in confined spaces. After carrying out this experiment, a qualified engineer can assess the suitability of worms and worm wheels depending on the given lifting situation.

II. Industry/Employer Expected Outcomes

Apply the principles of engineering mechanics to analyze, design and automation the prototypes and equipment's of various industries

III. Course Level Learning Outcome(s)

CO1-Select the suitable machine under given loading condition.

IV. Laboratory Learning Outcome(s)

Verify law of machine under the given condition.

V. Relevant Affective Domain related Outcome(s)

a. Follow safety practices and precautions.
b. Demonstrate working as a leader/a team member.
c. Maintain tools and equipment.

VI. Relevant Theoretical Background

Worm and Worm Wheel: A worm is square-threaded screw and worm wheel is a toothed wheel. In this machine, a worm and worm wheel are geared together maintaining their axes at right angles to each other. An effort wheel or pulley is attached tothe worm coaxially so that effort can be applied through a rope wound over the pulley. A load is securely mounted coaxially on worm wheel and load is connected with a separate rope wound around the load drum. For single rotation of effort wheel, effort traverses a distance= πD. For an n- threaded worm, worm pushes the worm wheel through one tooth during single rotation of effort wheel. If the total number of teeth in a worm wheel is T push of one tooth means the load drum traverses through (n/T) rotations.
Thus, when the radius of load drum is r, distance moved by the load= $2 \pi r X (n/T)$.
Therefore, the velocity ratio,

$$\text{Velocity Ratio (V.R.)} = \frac{\text{Distance Travalled by Effort}}{\text{Distance Travalled by Load}}$$

$$= \frac{\pi D}{2\pi r \left(\frac{n}{T}\right)}$$

$$= \frac{DT}{2nr}$$

Where,

D = Diameter of effort wheel

Observations and Calculations

$$V.R. = \frac{DT}{2nr} \quad \frac{108.28 \times 122}{2 \times 6 \times 70.06} = 15.712$$

1. D = 108.28 ..... mm
2. R = 70.06 ..... mm
3. T = 122 ..... No.
4. n = 6 ..... No.

XI. Observations Table

Sr. No.	Load W (N)	Effort P (N)	M.A.	Velocity Ratio	Efficiency η (%)	Ideal Effort Pi(N)	Effort Lost in Friction Pf (N)
1	100 gm	20	5	15.71	31.82	6.36	13.64
2	150	30	5	15.71	31.82	9.54	20.46
3	200	40	5	15.71	31.82	12.73	27.27
4	250	50	5	15.71	31.82	15.91	34.09
5	300	60	5	15.71	31.82	19.09	40.91

Sample Calculations

$$M.A. = \frac{\text{Load}}{\text{Effort}} = \frac{W}{P} = \frac{100}{20} = 5$$

$$\text{Efficiency } (\eta) = \frac{M.A.}{V.R.} \times 100\% = 31.82$$

$$P_i = \frac{W}{V.R.} = \frac{100}{15.71} = 6.365$$

$$P_f = P - P_i = 13.635$$

Law of Machine is $P = mW + C$

Where,

$$M = \text{Slope} = \frac{P2-P1}{W2-W1} = 0.2$$

C = Y intercept (i.e. Machine Friction) = 0 N

XII. Results

1. The law of machine is P = (0.2.....) W + (...0.....) N
2. The average efficiency of machine is = 31.82 %

XIII. Interpretation of results

Machine is .Irriversible

Friction loss is (i.e. Y – intercept = ...) reduced by ..... the machine.
The graph between load and effort is a straight line which indicates.....
The graph between load and efficiency is a curve which indicates.....
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XIV. Conclusions and Recommendations

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XV. Practical Related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO. Write answers of minimum three questions.

1. Write four field application of worm and worm wheel.
2. Can this machine be used to lift heavy loads?
3. State the given machine is reversible or not, give reason.

Space for answers

Q.1 ⟶ ?

Ans:- ① Its Used as high Redution Ration
② As a Turning mechisium for many musical Instruments.
③ To its the heavy load
④ To transmit The power

Q.2 ⟶ ?

Ans:- Yes this machine can lift heavy load

Q.3 ⟶ ?

Ans:- Machine is non-Reversible because efficiency is less than 50%.