VERIFICATION OF IMPULSE MOMENTUM

PRINCIPLE USING FLAT AND CURVED VANES.

Name of the student:

Roll No:

Date of Performance :

Date of Submission

Marks Scored:

Signature of Staff

Experiment No : 01

1. **Title :** Verification of impulse momentum principle using flat & curved vanes.
2. **Aim :** To conduct an experiment on the Jet on Vane apparatus and determine the vane efficiency.

3. Equipment : Impact of Jet Appratus.

Theory:

The study of impact of a jet of water is essential to understand the principle of an impulse turbine such as Pelton Wheel Turbine. When high pressure water from a source such as a dam flows through a nozzle in the form of a jet, the entire pressure energy of the water is converted into kinetic energy at the nozzle. When this jet of water hits a vane positioned in front of it, the vane deflects the jet and due to the change in the momentum of the water jet, a force is imparted to the vane by the water.

Experimental Setup:

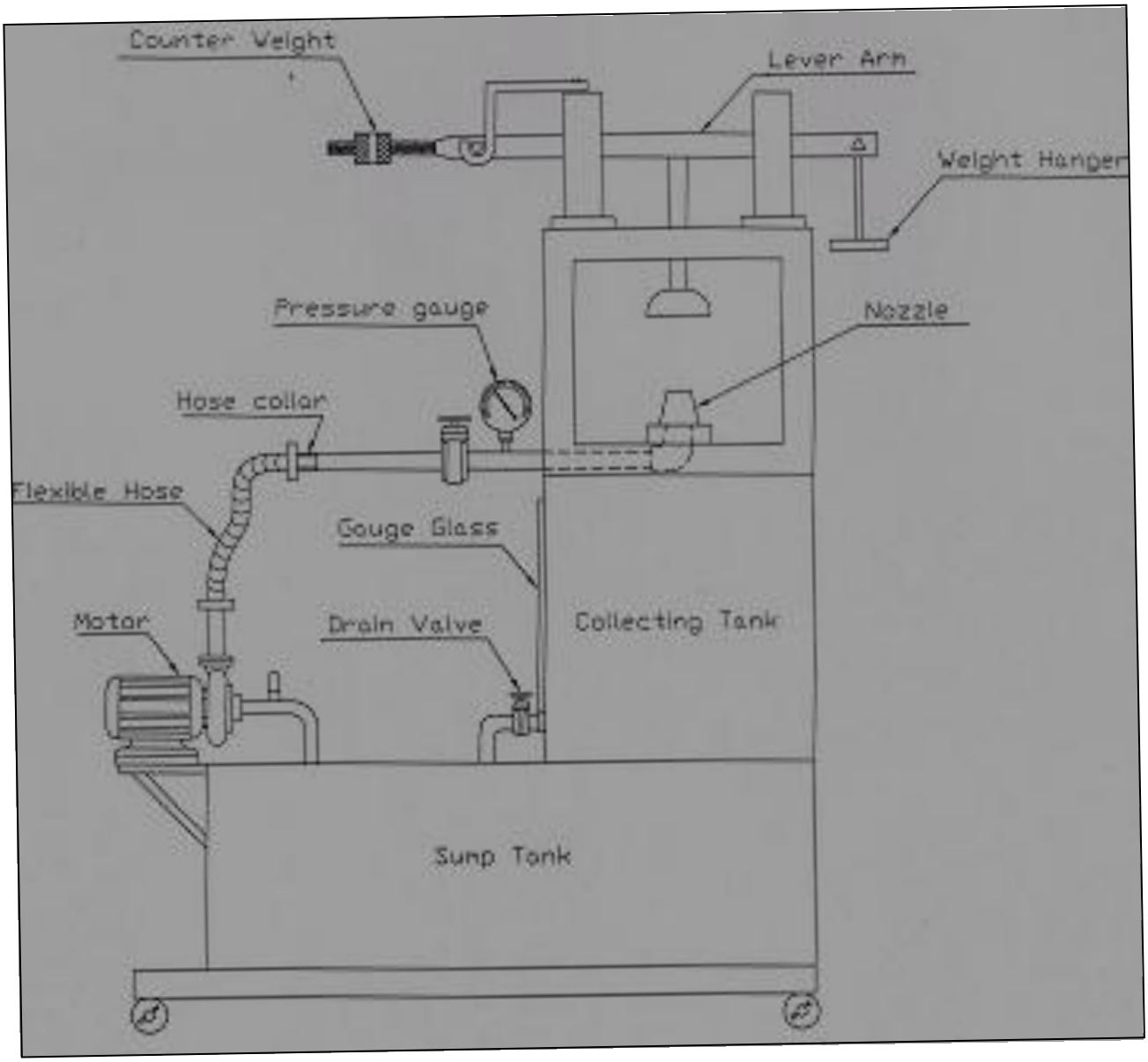
The equipment consists of a high efficiency gun metal nozzle fitted to a 25mm. diameter pipe supply line with a gate valve. Vertically above the nozzle, a gun metal vane is fitted to a bracket of a differential lever which balances the upward force of the jet from the nozzle, The lever is provided with an adjustable no load screw mechanism. The force due to the jet on the lever is counter balanced by metric weights placed on a hanger. Different types of vanes can be fitted to the bracket.

The complete assembly is enclosed is a framed structure housing with a transparent window for visual observation. The water deflected by the vane is collected in the collecting tank.

For experimental purposes, a brass nozzles with 6 mm nozzle diameter and two Gun metal vanes of the following shape are provided

i) Semi-circular vane (180 deg. angle of deflection)

ii) Horizontal flat vane (90 deg. angle of deflection)



Experimental Setup

4. Experimental Procedure:

i) Fit the required vane on the lever.

ii) Measure the differential lever arms and calculate ratio of lever arms(2.2 in this case).

iii) Balance the lever systems by means of counter weight for no load.

iv) Place a weight on the hanger.

v) Open the gate valve and adjust the jet, so that the weight arm is balanced.

vi) Collect water in the collecting tank.

vii) Note : (a) The pressure gauge reading - P.

(b) The weight placed - W.

(c) Time for 10cm. rise in the collecting tank -t.

viii) Calculate the discharge by weight.

ix) Calculate the vertical force.

5. Specification:

1.	Area of collecting tank	A	=	0.3 x 0.3 sq.m	
2.	Rise in water level	R	=	0.1 m (say)	
3.	Time taken		=	t seconds	
4.	Actual flow rate	Q	=	AR/t	cu.m/sec
			=	0.009/t	cu.m/sec
5.	Actual mass flow rate	M	=	1000 Q	kg/sec
6	Nozzle diameter	d	=	0.006 m	
7	Nozzle area	a	=	$3.14 \times d^2/4$	sq.m
			=	2.83×10^{-5}	sq.m
8	Jet velocity	V	=	Q/ a	m/sec
9	Angle of deflection of the vane to the jet		=	$T_1 - T_2$	deg
10.	Mass flow rate of water		=	M	kg/sec

11 The lifting force (F) = Change in momentum per second in vertical direction.

$$F = M \times V \times (\sin T_1 - \sin T_2)/g$$

For Horizontal flat vane, $T_1 = 90$ deg and $T_2 = 0$ deg.

$$F = (M \times V)/ g$$

For Semi-circular vane, $T_1 = 90$ deg and $T_2 = -90$ deg.

$$\mathbf{F} = (2 \times M \times V)/g$$

12 Actual lifting force measured **(Fact)** = W x lever arm ratio kg

13 The efficiency of the Jet = Fact / F

6. Observation Table:

Vane type	Inlet Pressure P Kg/sq.cm	Time for R cm rise t seconds	Flow rate Q x 10^{-3} cu.m/sec	Mass flow rate M Kg/ sec	Jet Velocity V m/sec	Input force F Kg	Counter Load W Kg	Fact Kg	Vane efficiency Fact/F %
Cup									
Cup									
Flat									
Flat									

7. Conclusions:

Signature of Staff
(Prof. A.B VERMA)