Improvement in Mechanical Efficiency in Tesla Turbine by the Employment of Carbon Fiber Disc

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Abstract— This paper enlightens about the use of Carbon Fibers as a improvement material in the Tesla Turbine instead of conventionally used blade materials. The main convolution behind this paper reveals about the Mechanical efficiency to be improved. In the case of the conventional turbines the mechanical efficiency was low upto the great extent because of poor aerodynamic design for the blades as well as low quality blade material. The improvement can be laid upon by enhancing the blades which can sustain upto higher temperatures. The main purpose behind the use of Carbon Fibre dics is to improve the strength of disc since the material has good advantages over the conventional blade material. The material has high stiffness, high tensile strength and other radiant properties. Here the experimental investigation is laid upon and the analysis is employed to compare the properties with the conventional blade material.

Key words: Carbon Fiber Disc, Tesla Turbine, Mechanical Efficiency, High Tensile Strength, Prony Brake Dynamometer, Experimental Procurement

I. INTRODUCTION

Number of turbine have been developed which work efficiently with steam like:

1) De Laval turbine: Impulse turbine which is less expensive and not pressure proof.

2) Pressure compound turbine: Auguste Rateau developed a pressure compounded impulse turbine using the de Laval principle as early as 1900. Today highly efficient and various size of steam hydraulic turbine available. But there are different design different capacity and different types of blades for hydraulic, wind, steam turbine. In 1910 Nikola tesla has invented a ROTARY DISC TURBINE which can use to develop power from air, water, steam, or mixture of it. The Croatian born inventor and engineer Nikola Tesla is probably best known for his invention of the coil and the induction motor. However, in 1910, a dual patent was filed, under British Patent 24001, for a Rotary Disk type air compressor and turbine engine.

These machines were similar in principle, and comprise a series of thin discs, set close together but separated by spacing washers, mounted on a shaft to form a rotor. This rotor is mounted in a housing, or stator, in the form of a tube, and provided with end plates, which contain the bearings. The compressor differs from the engine in that the stator takes the form of a spiral volute, whereas that of the engine is circular in profile. The direction of flow of the media, air or gas also differs. The patent also identified other applications of the principal, with a motor unit and as a pump for liquids.

Working fluid	Steam
Horse power	100 HP
Rotor diameter	18 “

Table 1: Conventional Results

II. DISC TYPE TESLA TURBINE

It is intended that compressed air be used as the medium for this example, and suitable connections and an inlet nozzle are incorporated into the stator. Lubrication is from a reservoir by a drip feed on an absolute loss system, as the machine is not intended as a continuously running unit, but as a development item for a larger scale evaluation of the operating principles. The compressed air is at 80 p.s.i., and the performance is expected to be in excess of 100 h.p. Provision is made in the design to operate the machine using gas generated by a combustion system, but it is only intended to be run for very short periods when operating with this medium. Air for the combustion system is provided by an external air source, either an independent air compressor, or from a works air network. The air should be free from excess condensate, and from oil contamination. The air connection is shown on the drawing, and should incorporate a shut-off valve, preferably of the ball type. Fuel is supplied through the union on the adaptor in the stator as shown on the drawing, and delivers the fuel through the needle valve shown. It then mixes with the air from the compressor in the combustor tube, where it is ignited, using the igniter, which is either an electric glow plug or similar device. After the initial combustion, the process becomes self-sustaining. The heated gas follows the same path as that previously described, namely a spiral circuit round the disc face, and exhausts through the ports as illustrated. The air pressure should be at 50 to 60 p.s.i. (3.4 to 4.0 bar), and the fuel supply, which should be either kerosene or propane, at 100 to 150 p.s.i. (7.0 to 10.0 bar).Here different type of medium used like compressed air, gas and steam, this also effect performance and space between discs. The machine described above aimed to develop power 100hp but it was claimed that it develop 3 times power than aimed i.e. 330 hp.

III. DESIGN AND MANUFACTURING OF PARTS

Take rod of Aluminum having diameter 13 mm. As shown in figure turns all cross section by turning on lathe. Threading done by special threading tool. Transparent acrylic material selected as stator cover and support. 0.511 inch dia. hole drilled on each plate to provide support to bearing.

As shown in figure we design rectangular cross section nozzle to cover all discs. 10mm diameter hole drilled in nozzle and internally threaded on both side for pipe connection. By using milling machine extra material on lower portion removed and converging cross section created as shown above. Thick x-ray sheet used as a spacer between two discs. Internal hole cut by using punch and external diameter created

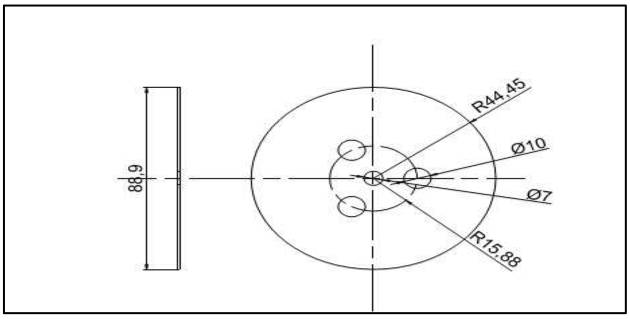


Fig. 1: Fiber Disc

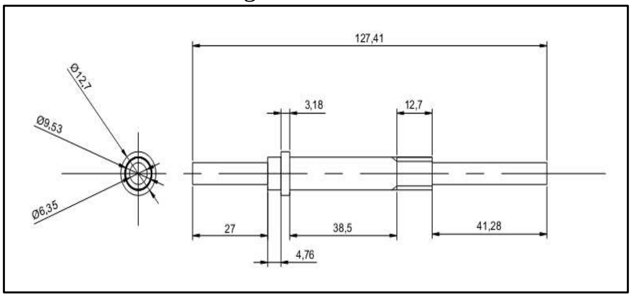


Fig. 2: Aluminium Shaft

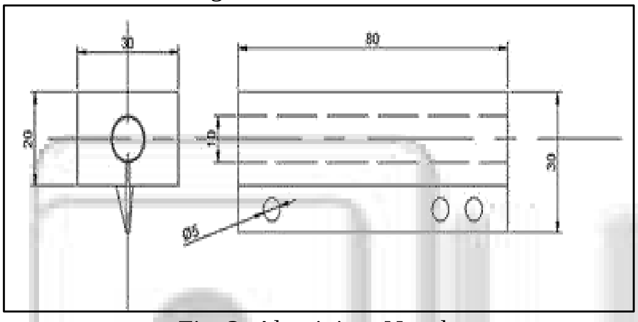


Fig. 3: Aluminium Nozzle

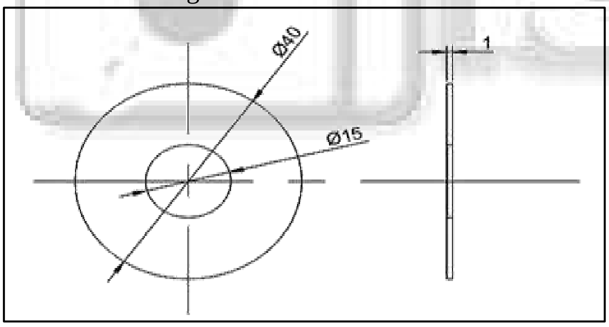


Fig. 4: Washer

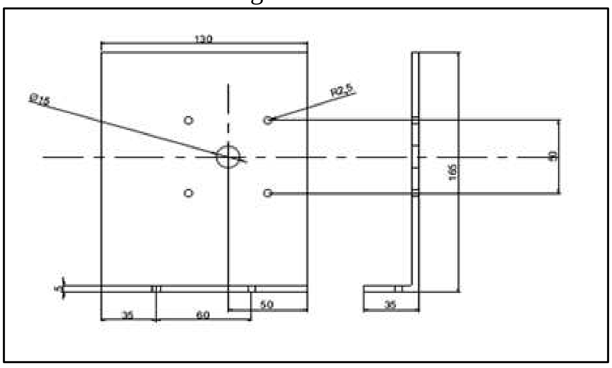


Fig. 5: Acrylic Stator Cover

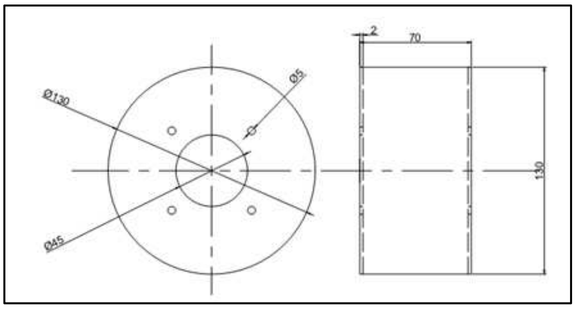


Fig. 6: Plastic Stator.

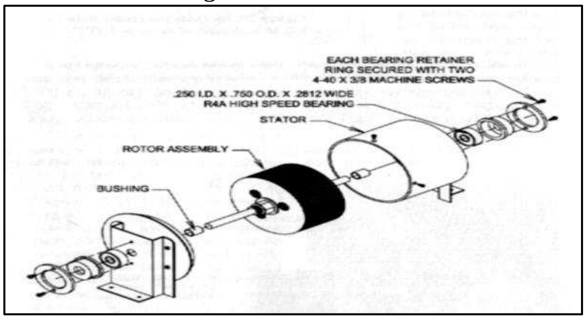


Fig. 7: Assembly of all the parts

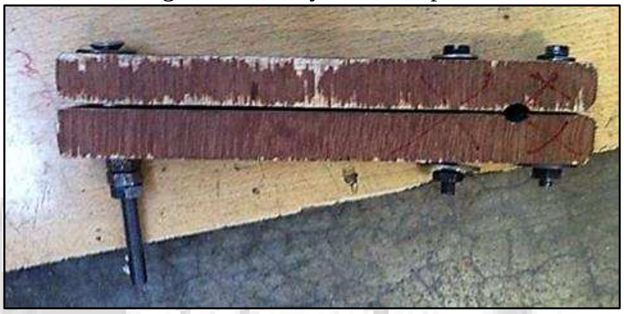


Fig. 8: Prony Brake Dynamometer

Part	Material	Size
Stator	Plastic	3.8”dia;2”width
Stator cover	Acrylic	5.2”*6.4”;0.0478”width
Nozzle	Aluminum	1.5”length bar
Washer	X-ray paper	0.872”OD 0.405 ID
Disc	Fiber	3.5” dia;0.036”width
Shaft	Al	0.5”dia;5”length rod

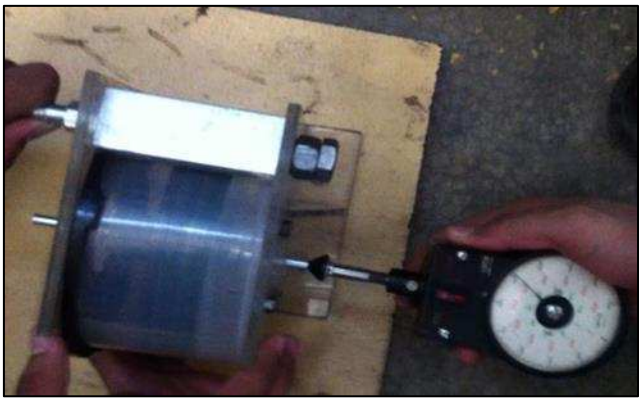
Table 2

IV. METHOD FOR ASSEMBLY

Take shaft as shown above. Insert spacer and disc one by one and tight it by nut. Cover assembly by stator. Mount bearing on shaft. Connect stator cover with stator by using bolt and fix bearing in stator cover. Mount nozzle at top of stator cover. Connect whole assembly with base.

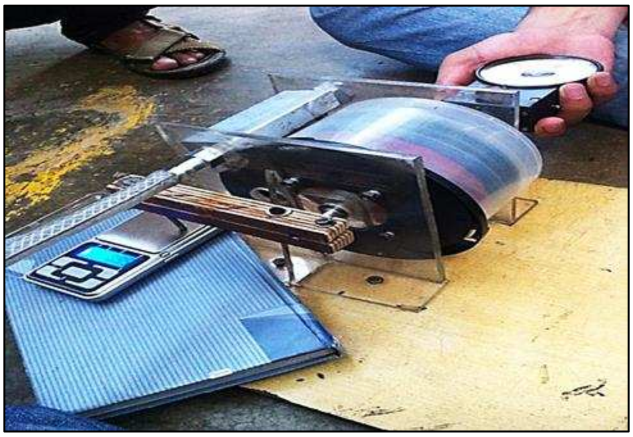
V. EXPERIMENTAL TESTING OF TURBINE

A. *Experimental Setups At No Load Condition:*



1) Connect setup with compressor outlet.
2) Set pressure 4 kg/cm2.
3) Decrease pressure continuously at 3, 2.5, 2, 1.5,1 kg/cm2.
4) Measure RPM by using Tachometer at Each pressure.

B. *On Load Condition:*



1) Connect setup with outlet.
2) Set pressure 4 kg/cm2.
3) Connect Prony Break Dynamometer with shaft.
4) Decrease pressure continuously at 3, 2.5, 2, 1.5,1 kg/cm2.
5) Measure RPM in Tachometer and load by using Dynamometer and weight scale.
6) Table1, 2, 3 shows reading for on load condition.

VI. RESULT TABLES-1, 2, 3

pressure (bar)	rpm	Weight (gm)	Distance (cm)	Torque (gm cm)	Torque (Nm)	Power (W)
0.98	0	25	10	250	0.024525	0
1.47	0	35	10	350	0.034335	0
1.96	400	35	10	350	0.034335	1.44207
2.45	2500	45	10	450	0.044145	11.5880625
2.94	4500	46	10	460	0.045126	21.322035

Table 3

pressure (bar)	Rpm	Weight (gm)	Distance (cm)	Torque (gm cm)	Torque (Nm)	Power (W)
0.98	0	27	10	270	0.026487	0
1.47	2500	23	10	230	0.022563	5.9227875
1.96	4200	28	10	280	0.027468	12.113388
2.45	4800	30	10	300	0.02943	14.83272
2.94	5600	33	10	330	0.032373	19.035324

Table 4

Pressure (bar)	Rpm	Weight (gm)	Distance (cm)	Torque (gm cm)	Torque (Nm)	Power (W)
0.98	0	18	10	180	0.017658	0
1.47	2100	13	10	130	0.012753	2.8120365
1.96	4000	16	10	160	0.015696	6.59232
2.45	5000	24	10	240	0.023544	12.3606
2.94	5400	24	10	240	0.023544	13.349448

Table 5

A. *Result Table: Free Rotation Of Turbine (Without Load):*

pressure (bar)	rpm	Weight (gm)	Distance (cm)	Torque (gm cm)	Torque (Nm)	Power (W)
0.98	5000	0	10	0	0	0

1.47	6200	0	10	0	0	0
1.96	6800	0	10	0	0	0
2.45	7000	0	10	0	0	0
2.94	8500	0	10	0	0	0

Table 6

B. Graphical Representation:

1) Torque-RPM:

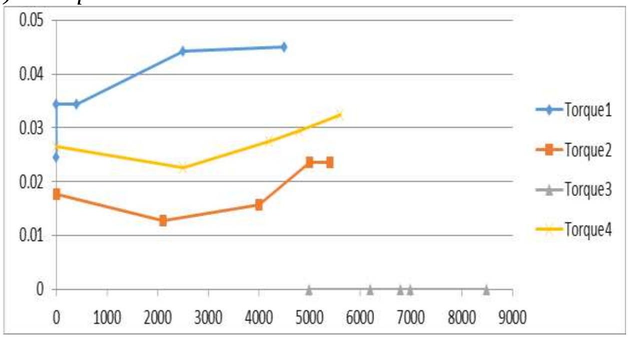


Fig. 11: Torque-RPM

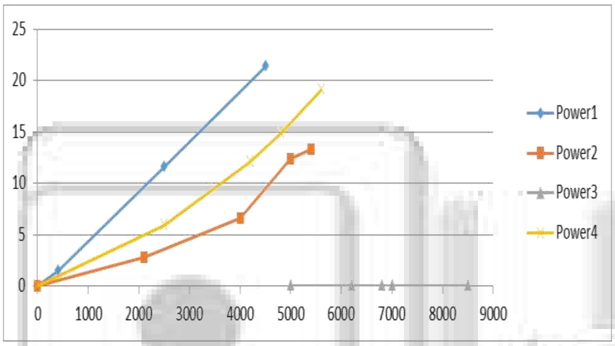


Fig. 12: Power-RPM

VII. Conclusion

The concept of Tesla turbine was verified by physically constructing it within available resources. From engineering point of view it was attempted to understand the phenomena and characteristics. It is felt that the turbine made here can be refined further with optimized parameters and can be placed for study in turbo lab. Experimental reading shows that in tesla turbine with increase in inlet pressure rotation of shaft, torque and output power increase. At lower pressure because of low velocity of fluid, rotation of turbine is zero but torque increase due to zero velocity of shaft. High rotational speed can be obtained by using this machine at lower pressure compare to reciprocating machine. In case of our turbine we got 8500 RPM at only 3 kg/cm2 pressure, but because of higher rotational speed of disc it may cause damage the disc at its center because of yielding and elasticity of material this problem can solved by using higher tensile strength material like steel. Graph of power-speed shows that power varies linearly with speed.

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