Tesla Engine Builders Association
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Debunking the Debunker

Don Lancaster Again Puts His Foot In

At 11:29 AM 9/5/98 PDT, Bernard Clay wrote:

>Seeing the squabble over friction or adhesion when explaining the Tesla turbine, I wonder if the Coanda effect, or some variant of it, figures in the behavior of the steam or compressed air as it does its work on the turbine runners.

>Very briefly, the Coanda effect describes the tendency of a jet of fluid to attach itself or "stick" to a surface, curved or flat. In the latter case, if the jet is introduced at an angle to the flat surface, it will bend down and cling to that surface. The jet will be very resistant to separation, especially if ambient air is prevented from freely reinvading the surface. The surface itself will be below atmospheric pressure. Is the adhesion spoken of quite often in connection with the Tesla turbine in fact the Coanda effect?

Tesla Engine Builders Association Inc. 9/10/98 wrote:

While not using this term in 1911, the effect is exactly what Tesla was explaining.

Tesla's description of this discovery is contained in an article appearing in the September 18, 1911 periodical "Motor World": "Dr. Tesla Talks Of Gas Turbines." Also reproduced in our 1994 text: "Tesla's Engine - A New Dimension For Power," pages 97-100.

Quoting Tesla:

"I have been working at this a long time. Many years ago I invented a pump for pumping mercury. Just a plain disk, like this, and it would work very well. 'All right,' I said, 'that is friction.' But one day I thought it out, and I thought, 'No, that is not friction, it is something else. The particles are not always sliding by the disks, but some of them at least are carried along with it. Therefore it cannot be friction. It must be adhesion.' And that, you see, was the real beginning.

"For if you can imagine a wheel rotating in a medium, whether the fluid is receiving or imparting energy, and moving at nearly the same velocity as the fluid, then you have a minimum of friction, you get little or no 'slip.' Then you are getting something very different from friction; you are making use of adhesion alone. It's all so simple, so very simple. This is the greatest of my inventions...."

Recently we received a letter from the Tesla Coil Builders Association (TCBA) President, Harry Goldman, relating to this misunderstanding.

Included was a copy of "Tech Musing" by Don Lancaster, appearing in "Electronics Now," Oct. 1998 issue. In this piece Don includes a listing of 10 Tesla turbine references he describes as "Real Science" as well as listing his three opinions as to why the Tesla turbine/pump can't possibly operate efficiently.

Mr. Goldman included a note attached to the copy of Don's column stating:

"Don Lancaster has never been able to say a good thing about Tesla. He's been pretty quiet since my letter to the editor a while back. Now he's attacking Tesla via the Turbine. I feel you are best qualified to comment on this."

Following are Don's erroneous assertions and our response;

(A) "Thermodynamic Reversibility Violations"

This opinion is based on Don's mistaken belief that the turbine operates by friction, thereby giving up the majority of energy as unrecoverable waste heat. This is, of course, not true.

The majority of the "Real Science" references offered by Don involved the work of Professor Warren Rice. The most recent of Prof. Rice's papers listed by Don is dated 1970. Don is apparently not aware of the more recent work on the subject which includes Professor Rice's final work, published close to his retirement, in the early 1990's, entitled: "Tesla Turbomachinery."

In this 1991 paper Prof. Rice states; "With proper use of the analytical results, the rotor efficiency using laminar flow can be very high, even above 95%." Tesla claimed 98%. So just how does a 95%+ efficient runner give up the majority of its energy to waste heat as has been claimed by Don? The fact of the matter is that the Tesla turbine IS thermodynamically reversible to a similar extent to that possible with best bladed type turbines but without the disadvantages introduced by lifting surfaces.

(B) "The turbulent flow or otherwise lousy fluid dynamics at the inputs and outputs."

The input and outputs of a Tesla pump housing are very similar to those encountered in many centrifugal types. Prof. Rice expresses the opinion, in his 1991 paper, that pumping efficiency would, although not strictly tested, probably be limited to approximately 65% due to losses at the inlet and outlet. This is not unlike other bladed type pumps.

Prof. Rice was only able to offer his opinion in this regard, however, as he did not do testing of a pump built in strict accordance to the Tesla design. His experimentation instead involved "co-rotating disks" which did not employ the central pumping geometry as described by Tesla. Tesla explained this geometry as necessary to pre-rotate the incoming fluid, for the purpose of reducing inlet loss.

Commercially available Tesla type pumps have revolutionized the pumping of difficult fluids and have been documented to achieve higher pumping efficiencies than conventional bladed type pumps when operated using high viscosity fluids. This, despite the fact that efficiency has been severely compromised in these Tesla type pumps via a drastic increase in disk spacing and elimination of the central pumping geometry, thereby allowing the passage of large solids. Texaco documented in 1986, after the Tesla type pumps had finally became commercially available, a savings of $68,000 per year, per pump, in comparison to the conventional bladed type they had replaced.

Prof. Rice also built several experimental turbine models and achieved ever increasing efficiency as he improved upon his originally crude models. Prof. Rice's turbine nozzle construction was not, however, built to the Tesla spec. Even so, Prof. Rice's final *single stage* version of the Tesla turbine was documented, using air as the working fluid, of achieving upwards of 36% efficiency. If the nozzle geometry as employed by Tesla had been used, efficiencies could have matched the 55% achieved by Tesla.

Prof. Rice was also not aware of, and did not use, the numerous disk support bolts and spacers employed by Tesla. This hardware is power producing and is absolutely essential for starting torque and vital for disk stability, without which adhesion can be broken, allowing friction to manifest.

The bottom line for efficiency is available power in versus available power out. As such, properly constructed Tesla turbines have been documented to have a lower steam consumption than comparable bladed turbines operating in the same class. This is what matters, not theory.

Higher efficiency is achieved in bladed turbines of similar size only by resorting to *multiple-stage* configurations.

Conclusions contained in Prof. Rice's final "Tesla Turbomachinery" paper are quite positive. It is also acknowledged in this final 1991 paper that experimentation with turbines, strictly constructed to the original Tesla design had not been done by him. He also expressed dismay that much of the work being done by others was being kept secret and was unavailable.

Prof. Rice's final conclusions include; "Tesla-type Turbomachinery should be considered in applications in which conventional machines are inadequate. This includes applications for small shaft power, or the use of very viscous fluid or of non-Newtonian fluids. There is some reason to believe that multiple-disk turbomachines can operate with abrasive two-phase flow mixtures with less erosion of material from the rotor. For that reason they should be further investigated for applications to produce power from geothermal steam and particle laden industrial gas flows. There may also be unique applications possible using ceramic disks. There is considerable evidence that multiple disk turbomachinery can be quieter in operation than is conventional machinery and that the noise produced is more nearly 'white' noise without a prevailing sound signature. Multiple-disk pumps are well-known to resist cavitation."

It should be noted that one of Tesla's main promotions for his turbine was geothermal heat conversion, which he described as; "Our Future Motive Power."

(C) "All those experimenters who deify Tesla while not knowing enough math or having the faintest clue how to properly do decent research."

Recent success with the Tesla turbine has established that respect for Tesla and his original work is the key.

The real benefit for the experimenter, and why the Tesla Engine Builders Association (TEBA) has been possible, is literally Professor Rice's final word on the subject in his final 1991 presentation;

"It is the ***ONLY*** type of turbomachinery that can be easily constructed in a relatively primitive machine shop."

Emphasis ours.

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Theoretical Analysis of a Disk Turbine

by William Tahil

Ed. The following article attempts to calculate the performance of a disk turbine given various assumptions. Although this was originally submitted as a theoretical analysis of a "Tesla Turbine," we have pointed out to William that his calculations are much more representative of the Thrupp type design, whereby the fluid enters and exits at the periphery of the disks. A Tesla type turbine utilizes the free inward spiraling action of the working fluid to extract power. This is not the case in the Thrupp design which operates primarily by friction, working fluid being sheared across the disks at high velocity, both entering and exiting the turbine at the periphery. William is continuing to refine his analysis, based on a new set of assumptions, to be published in a future addition of the Newsletter.

This is a simplified analysis which assumes steady linear flow of the fluid across the disk.

Consider One Disk of the Turbine, with a fluid acting in a straight line as shown in figure 1.

The Power of a Turbine is given by its Torque multiplied by its Angular Velocity: $P = T \bullet \omega$

Consider a small element of Area A on the disk at distance x from the centre of the disk and angle θ from a line parallel to the flow.

Now the Area A of the element is given by:

$$A = x \bullet \delta\theta \bullet \delta x$$