Alfred Evert 18.03.2008

07.06. Windtower - Generator

Objectives

Previous chapters constitute the basis for Free Energy Engines of diverse conceptions, using air or liquids as working medium. Based on clear effects these machines produce more benefits than demanding power input. However, these constructions are not quite simple so prototypes are not easy to build. Nevertheless many of my theoretic claims already are confirmed by different experiments. For example, strong and well ordered flows are generated by minimum input of power if suction-effects are implied.

Objective of that chapter now is description of a real simple design for local power supply, so even handcrafts could build such machines for use in the home. Most simple source of power is wind, so normal air will do - and naturally machine by itself should produce demanded wind.

Using Windpower

Picture 07.06.01 shows four examples of usage of wind: an old windjammer and modern high-tech sailing yachts using wind for drive, an old windmill and high-tech wind power plant, where wind is transferred into mechanical rotation and finally into electric currency. Vast differences appear between these old and new constructions e.g. concerning material and technology, nevertheless real difference is just based on movement process used.


07.06.01

Merely no air movement exists at sails of these yard-sailors. Dam-up-pressure of wind presses towards rear-end side of sails and pushes ship forward. Courses are possible only into direction of wind or at small angels aside. Opposite, modern sailing yachts achieve maximum speed at courses with steep angles towards wind. Vectors of wind-speed and drive-speed add, so much stronger wind seemingly exists at sails. However flow along sail-surface at lee is much faster than at luff. Difference of static pressures result, prevailingly effecting cross to and only partly into direction of course. Nevertheless that usage of normal air-pressure - respective it´s partial ´protection´ by fast flows - is much more effective than using only dam-up pressure of original wind.

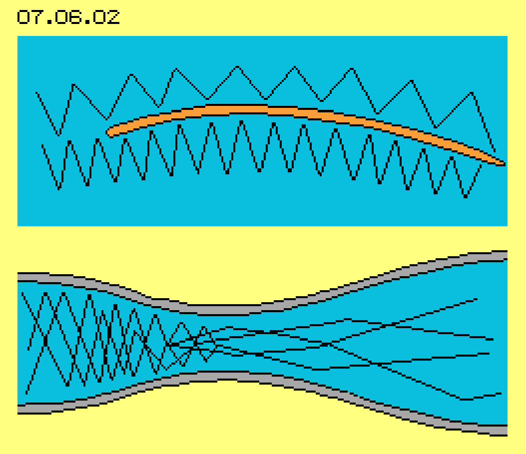
Analogue, old windmills did use practically only wind-pressure, weighting onto ´sloped plane´ and thus resulting turning momentum, however at most moderate revolutions of these ´slow-runners´. Modern wind power plants are ´fast-runners´ and use original wind only as trigger in order to generate speed-differences at ´upper and lower surface´ of these wing-profiles. Difference of static pressures act at large lever arm and relative fast revolutions.

Lift-Effect

At top of picture 07.06.02 schematic is shown a wing-profile (red) respective only decisive curved surface (e.g. of a sail). Continuously comes up an area of relative void along convex curved upper-surface, into which particles fall by own drive. As they move relative fast along that surface, they hit relative rarely and only by flat angles onto that surface, so effect relative less pressure (here simplistic marked by a long-stretched zigzag track upside of the profile).

Opposite comes up relative dam-up respective slow flow at concave curve underside of profile, so air particles hit relative often and by steep angles onto that surface (here simplistic marked by a narrow zigzag track downside of the profile).

Flows of different speeds show difference of dynamic (dam-up) pressures. Exactly corresponding to that, exists difference of static (from aside) pressure onto suction- and pressure-surfaces, resulting lift-forces at wings respective at corresponding curved profiles. Based on common factors for resistance and lift (Cw and Ca of common formula) results quite clear, benefit by lifting-force is about ten times stronger than power-input demanded for overcoming resistance.



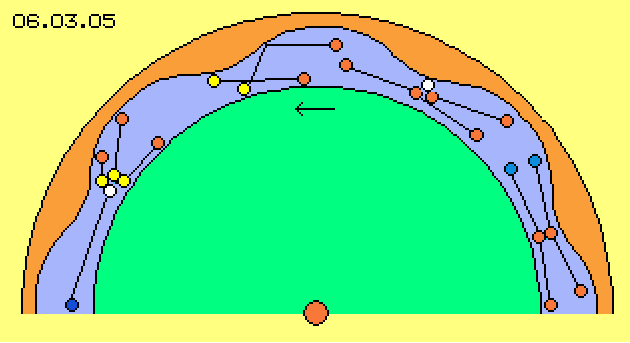
These facts are describe in extension by chapters ´05.04. Lift at Wings´ and ´05.12. A380 and Lift´ respective also at ´05.13. Explosion and Implosion´ (so please study details there). Suitable usage of that effect is discussed at many other chapters. That simple and reliable principle works also by ´artificial´ wind for generating surplus benefit. So that lift-effect is a decisive factor for generating turning momentum also at present conception of that ´windtower´.

Nozzle-Effect

Below at previous picture 07.06.02 an other usable effect schematic is sketched: acceleration of flows via Laval-nozzles. At previous lift-effect, molecular movement is manipulated by generating suction-areas, so at suction-surfaces come up accelerated and ordered flows. Now by these nozzles, molecular movement in addition is manipulated that kind, spreading of molecular speed becomes wider, so air-particles are accelerated up to ultra-sound speeds.

Average speed of air particles is about 500 m/s. Even within strong winds or if particles move through pipe by 50 m/s, theses particles fly ten times longer distances at chaotic tracks than moving ahead. At cross-sectional view through a pipe (grey), left side that movement is roughly sketched by zigzag lines. As particles come into section of decreasing cross-sectional surface, they are rejected from walls in shorter intervals and particles collide mutually after shorter distances. So at first comes up an area of dammed up air and diagonal showing walls are pushed ahead (here towards right).

Air becomes more dense and thus probability strongly increases, more than two particles meet same time. At these multiple-collisions e.g. two particles transfer their forward directed movement-component onto third particle. Such ´cross-strokers´ afterward become ´stationars´ while ´racers´ fly off outlet by much faster speed. These particles move into likely directions and thus come along within space relative wide distance, like sketched by line right side within that pipe. So narrowing of cross-sectional surface does not reduce throughput, but flow becomes accelerated. There won´t come up resistance losses, however thrust onto wall in front of bottleneck. Behind bottleneck, accelerated flow shows stronger kinetic energy - without external input of additional energy.

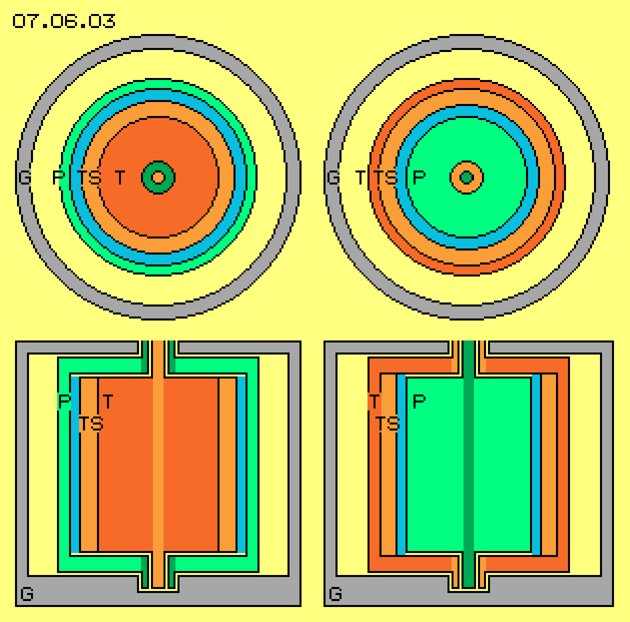

06.03.05

Effect of such ´Laval-nozzles´ is discussed in great length at chapter ´06.03. Ultra-Sound-Engine´, e.g. by that picture 06.03.05. So please study details of that ´phenomenon self-acceleration´ at mentioned chapter (there however these nozzles are build between cone-shaped housing and rotor, while here simply between cylinder surfaces). Nozzle-effect is well known and often used technology, special effect of Laval-nozzles is used at most different applications with astonishing results. That reliable effect is usable also for generating turning momentum by suitable shape of curved surfaces.

One cubic metre air has total mass of about 1.2 kg and its particles move within space by about 500 m/s. So latent existing kinetic energy of that cubic metre air is E = 0.5 * 1.2 * 500^2 = 150000 Nm. If particles will no more run into any direction but are organized in ordered flows, part of that huge energy is free available for external usages.

Wind-Tower

Objective of that ´Windtower-Generator´ now is integration of previous lift- and nozzle-effects in most simple construction. Principle of design schematic is shown at picture 07.06.03 by cross-sectional and longitudinal view, left hand and right hand an alternative variation.


07.06.03

Within cylinder-shaped housing G (grey) is installed a round hollow cylinder and within that is installed a round solid cylinder. Via hollow-shaft and solid shaft both elements can rotate within housing. One of these cylinders represents a pump P (green), the other cylinder represents a turbine T (red). Surface of pump is completely round and smooth. Opposite, surface of turbine can show different structures and this area here is named turbine-blades TS (light red). Space between surfaces of pump and turbine is filled up with normal air (blue) as working medium.

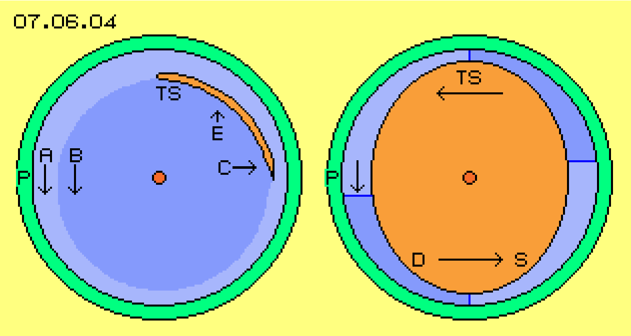
In principle there are two general variations: at the one hand, the pump is represented by surrounding hollow-cylinder and central cylinder represents turbine (inclusive its turbine-blades). That variation is sketched at picture left hand. Alternative, outer hollow-cylinder works as turbine and central cylinder functions as pump, like here sketched right hand. At the following these elements of alternative arrangement are called outer-pump and inner-turbine (at picture left hand) respective outer-turbine and inner-pump (right hand of picture).

The pump and the turbine are rotating, however turbine some slower. So also air outside of hollow-cylinder will be turning. In order to reduce friction losses, sufficient distance should exist between housing and hollow-cylinder. So also inner side of housing should be round and all surfaces most smooth.

At longitudinal view, that ´tower´ is drawn rather low, however real towers could be really high. Drive of system is done via shaft of pump by electric motor (here not drawn). Surplus power is drawn off system via shaft of turbine, e.g. for drive of electric generator (here also not drawn). In order to form really simple design, there is no external inlet or outlet and air within machine does not move into axial direction but air is only turning around system axis within closed circuit.

Simple Wing

In general, surface of pump is round face, so usage of previous lift- and nozzle-effects is only achieved by suitable structure of turbine. Picture 07.06.04 at first shows two extreme possibilities. Pump P (green) here is build by outer hollow-cylinder. Rotation here all times is assumed left-turning, thus also working medium air in general is turning counter clock-wise.



At this picture left hand, turbine is drawn only as curved surface TS (red) with a sector of about 90 degree and frontside (in turning sense) is bent some inward. Air becomes redirected inward by that surface, so causes pressure onto concave side of that ´wing´. At convex side however, increasing cross-sectional surface is available. So there comes up suction-area, into which air flows with increased speed.

Practically two areas of air result: within that suction-area and along pump the air A (light-blue) moves relative fast, while inside of ´turbine-blade´ comes up central air vortex B (dark blue). These overlaying circle movements (of a vortex which by itself wanders around system axis) is very fluid-conform and a self-stable motion pattern. Nevertheless that single ´wing´ won´t achieve good efficiency, because force-component C of lift shows rather radial and thus only relative small component E works as turning momentum. In order to achieve ´turbine-blades´ more efficient, pressure- and suction-faces should be arranged other kind.

Elliptical Turbine

At this picture 07.06.04 right hand an other extreme shape of turbine T (red) is sketched. Cross-section of that inner-turbine represents an ellipse. By its long axis two bottlenecks towards outer-pump P (green) are build, so nozzle effect is achieved.

In front (in turning sense of system) of each bottleneck, increasing wider surface is available, into which accelerated air flows. At this area (light blue) the static pressure onto suction-surface S is relative weak. Opposite, behind (in turning sense) of each bottleneck, the air is dammed-up into these narrowing funnels (dark blue). Based on hindered throughput and increased density, the static pressure onto both pressure-surfaces D is relative strong.

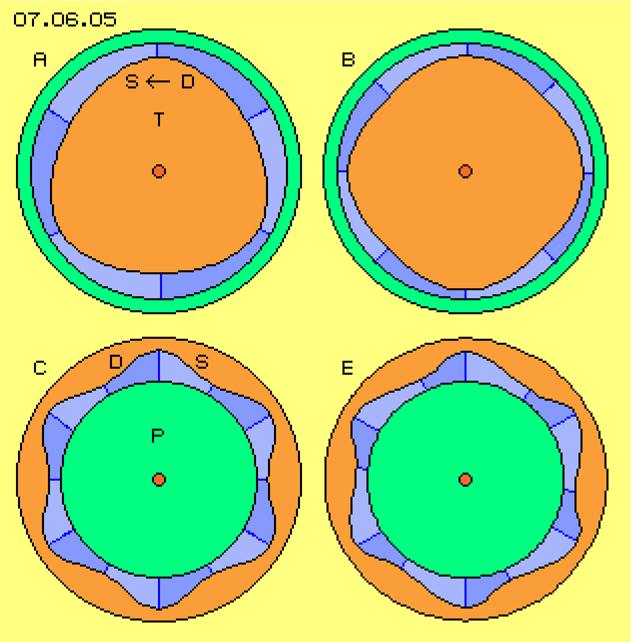
So suction- and pressure-surfaces of both ´turbine-blades´ here are very separated, however pressure-differences act most advantageous in turning sense of system (see arrow D - S). That extreme design thus could be most effective machine, however optimum dimensions and relation of rotation naturally must be found by experiments. For example, optimum angle of outlet of Laval-nozzles is told to be about 10 degree, which here must be transferred onto round structures.

Multi-Edge Inner-Turbine

At picture 07.06.05 the inner-turbine T (red) is shaped analogue, however above-left at A its contours show three bottlenecks towards outer-pump P (green). Nozzle-effect with its acceleration of flows thus is used three times and also turning momentum is generated by pressure-differences at each three suction-sides S (light blue) and three pressure-sides D (dark blue).

At this picture above-right at B the inner-turbine T (red) is drawn as ´round square´, so nozzle-effect works four times, however turning momentum won´t be really increased. Effective surfaces are too flat (like at previous wing left hand of picture 07.06.04), thus forces prevailing act radial towards system axis. So simple shaped turbines with only two or three ´noses´ might be more effective, at least when turbines are build by central cylinder.

Multi-Edge Outer-Turbine



Picture 07.06.05 below shows alternatives, where central round cylinder now represents the inner-pump P (green), outside the hollow-cylinder however functions as outer-turbine (red). At C and E the turbines e.g. are ´hexagonal´, i.e. showing six bottlenecks towards pump and between each six extensions towards outside. These contours are analogue to previous picture 06.03.05, by which movement processes of Laval-nozzle were discussed at the mentioned chapter.

At each outlet of nozzles (in turning sense in front of bottleneck) air can fly fast into wider space (light blue), so along suction-side S of turbine. At the following, air again is dammed up and pressed into the funnel (dark blue) of bottleneck, so at pressure-side D density is increased and forward-flow is reduced. At this alternative with outer-turbine now ´multi-edges´ are advantageous, because pressure-sides show some more into radial direction. Pressure-forces thus contribute by relative strong component to turning momentum of machine.

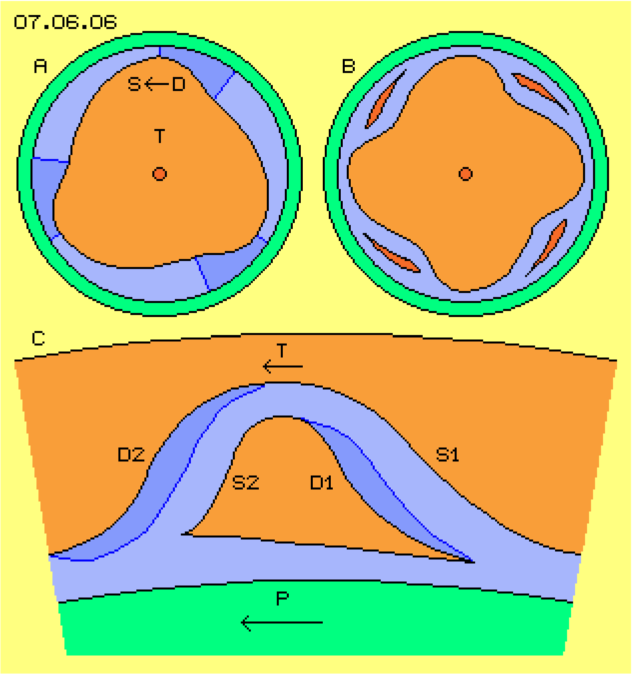
Asymmetrical Elements

At picture 07.06.05 below-right at E is sketched, bottlenecks and extensions must not be symmetrical. Here, suction-sides are arranged some more flat and thus fast forward-motion (light blue) is stretched longer, while pressure-sides are arranged more steep (showing more into radial direction) and thus dam-up (dark blue) pushes more into turning sense of system.

So if turbines are build by outer hollow-cylinder, nozzle-effect can multiple be used by many bottlenecks. At the other hand, lift-effect is used more efficient if suction- and pressure-sides are arranged by different inclination towards radial directions.

Naturally that asymmetry is usable also at an inner-turbine, like following picture 07.06.06 above-left at A demonstrates. There again is drawn previous ´triangle inner-turbine´ T (red, analogue to previous picture above-left at A), now however with flat suction-side S respective long stretched suction-area (light blue). Corresponding, pressure-side D is arranged steeper, i.e. showing more towards radial direction and dam-up (dark blue) can work into turning sense more efficient.

Additional Wing



The longer suction-side is stretched, the longer pressure-side can be arranged in radial direction. At the other hand exists danger of turbulent flows along suction-side (analogue to wings with too wide angles of attack), if cross-sectional surface within suction-area is extended too far. However, additional-wings could fill up that too wide area, for example like drawn at picture 07.06.06 above-right at B.

That inner-turbine has ´square´ shape, i.e. four bottlenecks are build towards pump. Contours of that turbine are strongly asymmetrical with long stretched suction-side and corresponding pressure-sides are arranged steep. Air is guided inward by additional wings and at the following, air again is guided outward along pressure-side. So at inlet of nozzle the static pressure is increased.

These additional wings naturally can be installed also at alternative version of outer-turbines. By some larger scale (and little bit over-drawn) that arrangement is sketched at below part of picture at C. The pump P (green) here is drawn only as part of central cylinder and outside of is drawn corresponding part of hollow-cylinder, so of the turbine T (red).

Inner wall of turbine has a deepening with a suction- and a pressure-side. Into that deepening an additional element is installed (red, analogue previous additional wing). At its pressure-side D1, the air is guided outward through a canal, which at the other hand is bordered by a suction-side S1. At both surfaces exists difference of static pressures and thus turning momentum is generated. At the following, the air is guided towards pump along pressure-side D2, where that canal is also bordered by opposite suction-side S2. Air thus is redirected at two pressure-sides (where these dam-up areas here are marked dark blue) respective lift-effect is used twice.

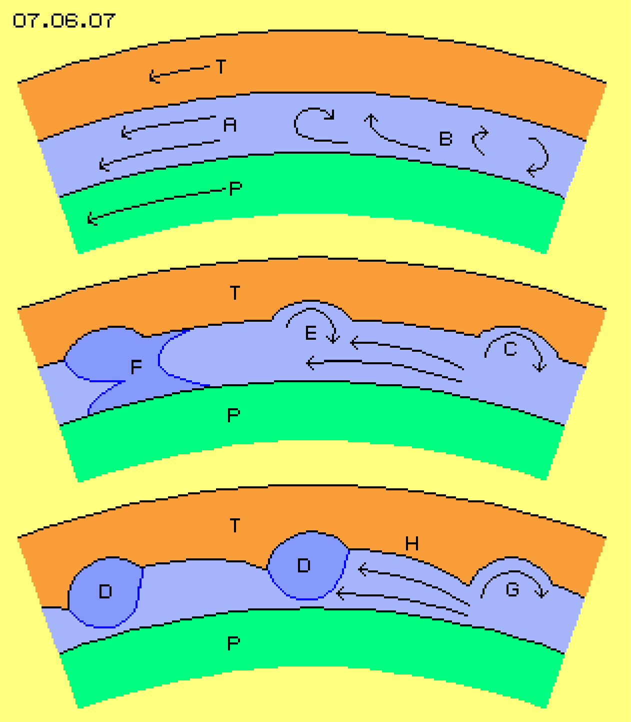
So there are diverse arrangements suitable for usage of nozzle-effect and for generating turning momentum by differences of static pressures at suction- and pressure-sides. However, these last possibilities with additional wings respective guiding fins do not fit to objective of most simple construction. Enormous forces come up within areas of nozzles and thus constructional elements should show most stabile shape, no matter inner- or outer-turbines are used. An important aspect for this concern is discussed at the following.

Chaotic Rolling

At picture 07.06.07 three times one below the other, a sector of outer-turbine T (red) and corresponding section of inner-pump P (green) schematic are drawn. Like before, surface of pump is round and smooth, while surface or turbine is structured. In principle, pump turns faster than turbine (see arrows P and T).

At first is assumed, also turbine shows round and smooth surface. Between surfaces of pump and turbine will come up different flow layers with speeds decreasing from inside towards outside (see arrows A). However these layers won´t shift and glide along each other without ´friction´, but turbulent flows will come up (see curved arrows B) with most differing and varying movement pattern. At some phases these surfaces will ´stick´ together by strong suction, temporary chaotic vortices will ´run untrue´, interrupted by smooth running like most best ball-bearings.

So ´friction-losses´ come up continuously with chancing resistance and only at certain ration of revolutions that arrangement might really ´run round´. These chaotic changes should be replaced by ordered movement structures. Suitable measurements are sketched at middle part of picture.



Fixed Vortices

Round deepenings C could be installed at surface of turbine, here e.g. as deep as one third of circle-diameter. Within that hollow will come up back-turning vortex, depending on revolutions faster or slower turning or even pressed some flat. At any case however, now a location is fixed for that vortex and afterward air can move free until next vortex within next deepening E. There now that general forward moving flow is hit aside by vortex-flow coming out of its hollow.

That meeting of flows practically works like a bottleneck respective results an area of dam-up F (dark blue). Pressure of dam-up is transferred via vortex onto pressure side of deepening (its front side in turning sense of system) and thus indirectly generates turning momentum. At the other hand, within that area of relative high density will come up increased number of multiple-collisions, i.e. with wide spreading of speeds of involved particles. At front side of that bottleneck thus particles are catapulted off with ´surplus-speed´ (like at real Laval-nozzles).

Ultrasound-Drive

Upside already was pointed to chapter ´06.03. Ultra-Sound-Engine´, so here some important facts are remembered only in brief. Normal speed of air-particles is about 500 m/s. As an average, sound-impulses wander at zigzag tracks forward by about 330 m/s. If directions of two particles meet by right angle and they meet same time a third (resting) particle, that third will fly off by about 700 m/s (see ´free-flyers, cross-strokers, stationary and racers´ of mentioned chapter). Out off (Laval-) nozzle, particles can be launched up to double soundspeed and throughput in average well might occur by soundspeed.

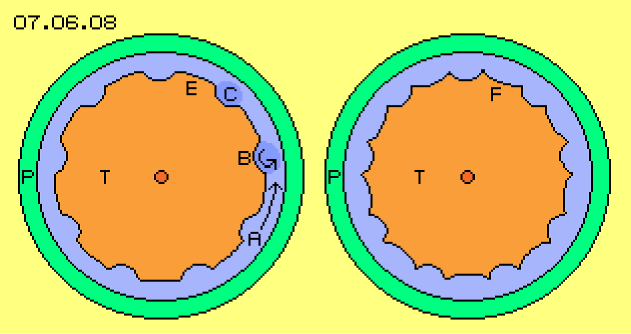
If surfaces of turbine and pump move within space by 20 or 40 or 80 m/s, they move multiple slower than particles move by normal like increased speeds. These super-fast particles collide with surfaces by flat angle and thus effect thrust, onto turbine like onto pump. These super-fast particles finally meet next vortex and ´heat´ it up. These super-fast particles are redirected inward, however all times their fast speed keeps forward direction. So never any particle flies backward (in turning sense of system) with likely strong kinetic energy.

Optimum contours of deepenings and distance between deepenings and distance between surfaces will be found only by experiments, where also ratio of revolutions might be important. At downside part of previous picture 07.06.07 possible variation is sketched. Deepening G is some shifted, as turbine-surface H between deepenings is no circle-bow concentric to system axis, but arranged some diagonal. Cross-sectional surface for previous super-fast particles becomes some wider until next vortex.

Essential characteristic of that variation thus is, bottlenecks no longer are build by ´noses´ of solid material, but areas of vortices within deepenings (D, dark blue at previous picture) build ´soft´ bottlenecks, however same time flows between bottlenecks become better structure.

Previous mentioned turbulent flows, especially at long stretched suction-surface or wide suction areas thus are eliminated. Flow-pressures are transferred onto pressure-surfaces of deepenings via ´elastic´ vortices. Important however is, flow speeds are generated much faster than turbine and pump are moving within space. That machine will not only run like at ball-bearings - but at certain scales of revolutions will become self-accelerating.

Likely Rotation Sense
At picture 07.06.08 previous considerations now are transferred to alternative solution with outer-pump P (green) and inner-turbine T (red). The air A between surfaces in general is moving ahead in turning sense of system, so here air is left-turning. The deepenings B are installed at slower turning turbine-surface and within these hollows now vortices are also left-turning (while at previous picture 07.06.07. these vortices were right-turning).

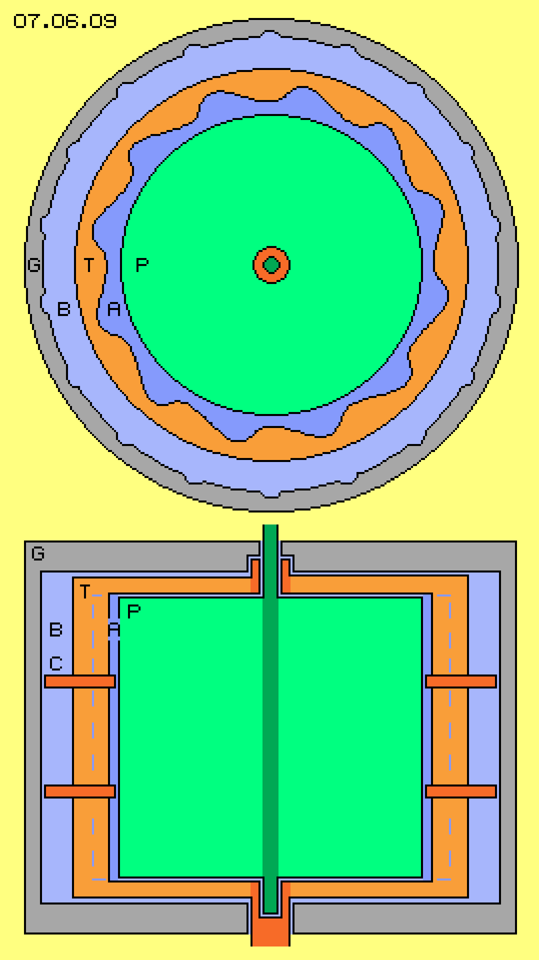

07.06.08

Apart from that, these vortices C respective ´soft bottlenecks´ work like described upside. Like there, also here optimum contours etc. must be found by experiments. Here for example are indicated only two alternative solutions for surfaces between deepenings: left-hand at E these parts of turbine-surface are circle-bows showing outward. Right-hand at F these contours are curved some inward, so building small suction- and pressure-sides also between deepenings. At first, air thus has increasing space to move and afterward is guided some more tangential towards next vortex.

Essential difference to previous version however is, turning around system axis and turning of vortices within deepenings show likely direction. Like mentioned upside, these overlaying likely turning circle movements are most fluid-conform motion-pattern - and above this especially ether-conform, because that type of motion is general shape of movements of basic substance behind all appearance, which I call ether. So well could come up resonance-phenomena, what´s e.g. called ´coupling-in space-energy´ (however that subject must be discussed by many other chapters, e.g. inclusive general question why air particles are moving at all and go on moving all times).

Construction
Picture 07.06.09 shows an example of general conception by cross-sectional and longitudinal view, however only schematic and not true to scale. Here is drawn an inner-pump P (green) and an outer-turbine T (red) with diverse asymmetrical deepenings. Air A (dark blue) as working medium is filled up between both constructional elements.

As mentioned upside, between hollow-cylinder and housing G (grey) must exist sufficient space, so air B (light blue) can circulate with most less resistance. Friction-losses once more are reduced, if inner face of housing would be designed like turbine-surfaces. For example, deepenings could be installed (like sketched here), so stationary vortex-structures come up. Alternative, hillocks could be installed at housing-surface, building bottlenecks. So via Laval-nozzle-effect also that air B is accelerated and thus thrust acts at outer turbine-surface.



Problematic are front sides of housing, turbine and pump, because there plane surfaces of different speeds glide along each other. If distances between are not wide enough, danger of ´sticking by suction´ comes up. Also here, e.g. small notches into radial directions will help to install stable vortex structures.

Inevitably at these turning disks, air is transported outward, i.e. through central holes or even through ball-bearings additional air is sucked in. However air can not flow off outward, so inside of machine the air pressure is some increased. That´s advantageous, because higher density results stronger performance.

At bottlenecks come up extreme strong ´suction-forces´, i.e. based on fast flows the static pressure is rather low. Corresponding experiments demonstrated, constructional elements did ´implode´ several times, parts were bent inward even stabile material was used. That hollow-cylinder thus should be strengthened e.g. by ring-shaped disks D (dark red) respective all surfaces must be build solid.

The drive motor and the electric generator (here not drawn) should be flanged direct at shafts, each at opposite sides of housing. Alternative could be used gear-wheels, however belt-gears are not safe enough and thus dangerous.

Operating Mode

The system is started by turning the pump. The air sticks at pump-surface and is pulled in turning sense. At first, turbine is not weighted with load and thus by air-friction becomes also turning. Some later, turbine will rotate nearby as fast as pump. Finally when turbine is decelerated by load, wanted differences of speeds come up. At the one hand, now the air is dammed-up at inlet of nozzles, so increased static pressure acts at pressure-sides of ´turbine-blades´ (no matter which of previous versions is used). At the other hand, at outlet of nozzles flow becomes accelerated decisively. These particles fly very fast along suction-sides and thus produce reduction of static pressure onto these surfaces. At the following, these particles with their high kinetic energies hit onto pressure-sides respective are pressing into funnel of dam-up area.

So finally by difference of rotation speeds of pump and turbine, wanted nozzle-effects come up. Opposite to most other conceptions, that system is not strict controllable via revolutions of pump. If pump is accelerated, no immediate increasing performance is achieved. The air is only pushed some faster through bottleneck and part of that additional energy acts as additional pressure at next dam-up area. Additional input of force thus at its best achieves corresponding stronger turning momentum, however no surplus energy is generated. Surplus exclusively is achieved by acceleration of particles within Laval-nozzles.

If opposite, pump is decelerated, throughput at bottleneck is some reduced, i.e. at inlet of nozzles exists some stronger dam-up-pressure onto pressure-sides of turbine. Higher density within that area increases probability of multiple-collisions and thus more particles with surplus-speed are launched off in front of bottleneck-area. These super-fast particles increase dam-up-pressure of next (front-side in turning sense) bottleneck-area. Reduction of pump-revolutions thus does not reduce turning momentum correspondingly.

Even pump speed is completely stopped down, nozzle-effect goes on working, i.e. thrust onto pressure-sides of dam-up-area still exists and still super-fast particles are catapulted ahead of bottleneck. That turbine practically carries its own ´drive-engine´, which however acts quite contrary e.g. to common jet-engines: that ´jet´ here is directed forward, as particles fly off and forward (in turning sense of system) by excessive speed. Wanted thrust however acts by dam-up-pressure at nozzle-inlet (so at rear end of bottleneck, by view in turning sense of system).

That system does not work by ´re-pulsive-principle´ (rather hard to understand, because quite different e.g. to common jet-engines): also within dam-up-area, general directions of molecular movements show forward. Only if at least two particle with their forward-motion-component hit same time a third particle, kinetic energy of both is transferred onto that third. That ´racer´ flies off by excessive speed into relative empty space ahead (and finally into next dam-up-area). Both energy-delivering particles stay behind with relative few kinetic energy respective few motion (called ´stationaries´ at mentioned chapter) and thus show less resistance for next collision. High kinetic energy of fast flow off nozzle, thus comes up in the debit of slow movements of particles direct within area of bottleneck - and not on debit of backward directed rejection at any solid part of machine (details please study at mentioned chapter).

So no additional energy is ´produced´, but only local and intermediate spreading of average speeds of molecular movements and their directions become more different. In total, naturally all kinetic energies are constant. Temporary acceleration in front of nozzle is based on temporary deceleration of particles within bottleneck and thus results dam-up acting in turning sense of system. Accelerated particles transfer their kinetic energies onto pressure-sides or just into previous dam-up. So as a whole, that manipulation of molecular movements is simply temporary (however continuous) and only as a side-effect wanted turning momentum results ´by-the-way´.

Warning and Exclusion of Liability

Performance of system thus is hardly controlled by revolutions of pump, so that engine prevailingly is usable for generating relative constant performance. Already when starting system, turbine-shaft should take load. As soon as movement process within nozzles is started, it will go on autonomously. So system well can achieve state of self-acceleration. Even stop of pump won´t end function of nozzles. That machine thus may not operate without mechanical brake at turbine-shaft, sufficiently strong and working by guarantee.

I point out these dangerous situations. I only describe movement principles in general and why which constructional elements could be designed which kind. However, I refuse any responsibility and liability for the actual construction or use of any such machines. The complete responsibility for all risks, rests solely with whoever decides to actually construct or operate any such machines.

Example-Data

It´s merely possible to calculate performance of that machine, e.g. because relative speeds of air between pump and turbine will behave totally different depending on range of revolutions. So following data of an example may only be coarse clue.

The housing could show outer radius of about 50 cm and an inner radius of 47 cm. Assuming distance of about 4 cm, turbine could be installed at radius of 43 cm to 39 cm. At circumference of about 250 cm could be installed 20 ´turbine-blades´ of each 12.5 cm length and 2.5 cm depth. For example, height of turbine could be 200 cm. Effective surface thus would be A = 20 * 2.5 * 200 = 10000 cm^2 respective about 1 m^2.

If the bottleneck between turbine and pump is assumed by 2 cm, pump would show outer radius of 37 cm and thus a circumference of about 230 cm. If that pump e.g. runs 1200 rpm, so 20 revolutions each second, the pump-surface will move about 46 m/s within space.

If turbine rotates half as fast, so 600 rpm respective 10 revolutions each second, the turbine-surface will move (in average) about 25 m/s. Difference of speeds of pump (previous 46 m/s) and turbine (25 m/s) thus is about 20 m/s. One can assume, the air will move along pressure-sides towards bottleneck by that relative speed. The air leaves bottleneck much faster. By conservative estimate one may assume, the air flies at least with 50 m/s along suction-sides of turbine.

If density of air is calculated with 1.2 kg/m^3, dam-up-pressures of flows at the one hand is P = 0.5 * 1.2 * 20^2 = 240 kg/ms^2 and at the other hand is P = 0.5 + 1.2 * 50^2 = 1500 kg/ms^2. That difference D = 1500 - 240 = 1260 kg/ms^2 corresponds to difference of static pressures at suction- and pressure-sides. Effective surface is about 1 m^2, so at that surface weights force F = 1260 * 1 = 1260 kgm/s^2 = 1260 N. That force acts at lever-arm of about 0.4 m, so turning momentum M = 1260 * 0.4 = about 500 Nm exists. That torque is delivered by turbine rotating 600 rpm, so theoretic performance results with P = 500 * 600 / 9550 = about 30 kW.

That number is only rough estimate and may only be a clue for possible scale of gross performance of that machine. Opposite to that number drive of pump demands energy input, however that will be maximum one tenth (because fast flows produce thrust not only on turbine- but also at pump-surfaces). This performance is further reduced by friction-losses, e.g. by air-movements between housing and turbine and between surfaces at both ends of cylinders. Naturally come up mechanical friction losses at diverse bearings. Also electric motor like generator won´t work without losses, up to losses of intermediate storage of electric energy at batteries.

So net-performance of total system will be much less than previous theoretic gross-performance. Nevertheless, even only half of generated energy finally might be available, units like these well could produce power-supply for houses.

Control by Density

These values indicate to note previous warning. One has to be aware when starting pump, performance won´t increase correspondingly. Normally, at the beginning will exist just no performance and finally at certain range of revolutions, nozzle will ´start-up´ and performance increases. At the other hand, at faster revolutions the performance even can decrease, if no constant optimum vortices-pattern exists. However all times one must be aware, these Laval-nozzles at optimum conditions can generate ultrasound fast flows ´out of nothing´.

In general, performance of fluid-machines increases by square of speed, so in general also here faster revolutions achieve stronger performance (however hollow-cylinders can not drive any speed). Stronger performance is also achieved when using wider effective surfaces, so by larger volume of construction (where ´module-building´ will be suitable, e.g. long (hollow-) shafts have several bearings within housing). Opposite to common windmills, such ´towers´ can be build subterranean - and their performance is available all times.

Stronger performance by unchanged constructional volume and speeds is also achieved when using compressed air instead of air with normal atmospheric pressure as working medium. Effective mass of previous example is about 0.2 m^3 air, so only about 0.25 kg. At two or five bar, pressure of 0.5 kg or 1 kg mass is available. So if inner space of machine is put under pressure, the performance will increase correspondingly - and spontaneous. Even revolutions stay constant, that machine can deliver stronger turning momentum via variable air-pressure.

That control by internal operating-pressures is valuable also by an other aspect: the performance decreases immediately if air is sucked-off machine (respective air is allowed to flow into tank with previous rather low pressure). By that measurement, uncontrolled self-acceleration of machine is under control. Opposite to control-mechanism of other fluid-machines of other chapters, control of performance of that windtower is well done by more or less density of working medium.

Test-Mode

The performance of the machine results of turning momentum times revolutions of turbine. Turning momentum here results of relative speeds of flows along suction- and pressure-sides of turbine. Jobs for optimising surface-structures and dimensions, e.g. of distance between turbine and pump etc., thus can be done also if turbine is not turning (but only pump is turning).

For these tests thus turbine should not be allowed to turn in turning sense of system, e.g. as a rod is fix connected with turbine-shaft and rod is hindered to move in turning sense. At the other hand the momentum in turning sense can be measured by spring-scales. Turning momentum demanded for drive of pump is known. So surplus of turning-momentum becomes measurable for different ranges of revolutions of pump. Comparing results of different surface-structures and dimensions will allow to find optimum conditions. Result of resting turbine can be transferred onto running turbine, if relative speed to (now faster turning) pump is likely.

Outlook

The efficiency of that general principle will become obvious soon - respective analogue experiments did already show analogue effects quite clear. However it will take time and many tests are necessary to find optimum shapes, dimensions and scales of revolutions by differing experiments. At any case however, now latent kinetic energy of air will become usable, first time by most simple conception, by most clear and reliable effects: force of lift at curved surfaces and acceleration of flows within nozzles.

07. Fluid-Machines