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# 07.01. Cellar-Windmill

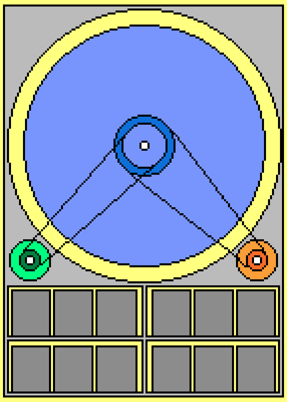
## Objectives

Mechanical turning momentum is achieved when fluid-flow are redirected and decelerated at blades of turbine. Air-flows however achieve only small turning momentum by that technique, because that light medium has only small mass respective density. Much stronger forces however are usable indirectly: normal atmospheric pressure at wing-profiles as used at any airplane, sail or windmill.

Objectives of that chapter now are conceptions of machine, where autonomous generated wind is organized in order to achieve most different speeds at front- and backside of wing-profiles, thus to achieve different static pressures, for drive of machine by itself and surplus for external use.

My ´dream´ still is to use some space at cellar for simple wind-mill, about dozen car-batteries, starter and generator for charging batteries (like coarse sketched at picture 07.01.01). Electric control should be rather simple and energy-supply would be done if only some few kW are available continuously.

07.01.01



I also would like to assemble that machine by myself, e.g. by light plastic parts. At the following I describe approach of conception - and Christmas 2008 I would like to find construction kit at front door. Many other guys even would like to pay some years energy-accounts for that construction set.

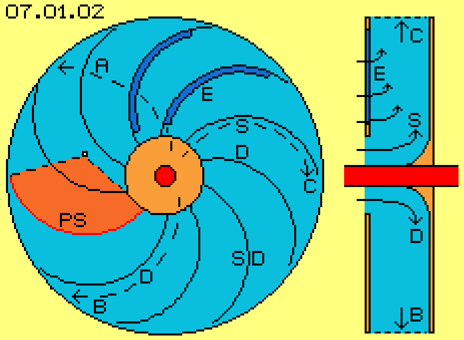
## Basis Spiral-Canal

At earlier chapter 05.11. was described a ´Spiral-Canal-Motor´ and that conception here will be used as pump. Picture 07.01.02 left side shows cross-sectional view and right side longitudinal cross-section through that constructional element.

Like at common radial pumps, air from a central inlet is guided outward at spiral track (see dotted curve A). Blades of that pump PS can be shaped like circle bow (see red marked circle segment). Here for example ten of these blades are drawn. Air is pressed outward alongside pressure-side D (front side in turning sense of system) of blade (see dotted curve B). Same time air increasingly is accelerated in turning sense of system (so previous track A results).

Each pump-blade has a pressure-side D (in turning sense in front) and a suction-side S (in turning sense back). Each one canal is build between a pressure- and a suction-side, and bordered into axial direction by two disks. At normal radial pumps, cross-sectional surfaces are adapted to radius and speed of air flow. Sideward borders become more narrow towards outside as these disks are arranged diagonal or hyperbolic bended.

07.01.02



Like longitudinal view shows, at this Spiral-Canal-Pump however these side-walls show parallel from inside towards outside. Air enters at centre and towards outward thus has much too wide space. Especially alongside suction-sides continuously exists relative void, i.e. much more air could move there (see dotted curve C).

So that ´miss-construction´ generates relative vacuum, usable for additional mass-throughput. Direct behind suction-side (in turning sense of system) are openings D within left side-wall. Through these openings additional air is sucked into canal. That ´wrong-air´ follows suction-side ´by own drive´, without any problem, up to soundspeed.

At cross-sectional view, openings E are marked by dark blue colour at two blades. At schematic longitudinal view upside, situation along suction-side S is sketched, inclusive sidewise additional flow through slots E. At schematic longitudinal view downside, situation along pressure-side D is sketched, where both sides are closed by disks. There may not be any opening, because there air is dammed up and would escape through openings.

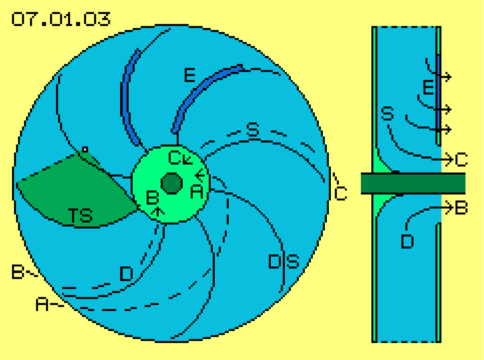
This pump thus demands input of power only for transport and acceleration of air direct at pressure-sides, while main part of air-throughput is done by suction resp. without demanding input of power. Here at this example, radius at outlet is 2.5 times wider than at inlet, and also air is accelerated by factor 2.5 while moving outward. Cross-sectional surface of canals at normal radial pump thus towards outside should be more narrow, at least five times. Opposite, here four fifth of mass-throughput are done without corresponding mechanical input of power.

At begin of this year I published that claim by chapter 05.11. ´Spiral-Canal-Motor´, as logical conclusion respective decidedly designed construction. Probably that solution already is used by any application, nevertheless it´s astonishing, that usage of suction is not common techniques. However I am very glad, my claims now are confirmed by diverse experiments and without any doubts: by minimum input of power most strong and well ordered flows are generated when using suction effects and that conception of ´spiral-canals with wrong-air´ is most suitable construction principle for.

**Basis Wing-Profile**

When thinking about technical applications, we mostly ´think-by-pressure´: pumps transport fluids by pressure and opposite, turbines transfer flow-pressure into mechanical turning momentum. Free Energy however becomes usable only by application of suction resp. by side-effects. Just that ´phenomenon´ of lift at wings illustrates that difference: airplane with huge power is to press upward by wide angles of attack. ´Natural´ lift however uses no pressure but suction is generated with autonomous acceleration of flow and as side-effect lift forces come up nearby without costs (see details at previous chapters).

By that view it´s most important for that windmill, not to use flow-pressure at turbine-blades by its best, but to organize flows at both sides of blades with most different speeds. Real pressure for production of mechanical turning momentum is not directly delivered by flow but by atmospheric pressure, which is reduced at suction-side by faster flow.



Analogue to previous picture now at picture 07.01.03 conception of that turbine schematic is shown. Again, contours of turbine-blades TS can be shaped as circle-bow (see circle-section marked dark blue). Outside, blades start by relative acute angle to tangential direction and inside end into radial direction.

Along pressure-side D of turbine-blade (backside surface in turning sense), air is guided inward (see dotted curve B). As same time blades move ahead, air within space moves at spiral-inward bended track (see dotted curve A).

Opposite to pump, here suction-side S is frontside (in turning sense) surface of turbine-blade. Also alongside that surface air flows from outside inward (see dotted curve C). This flow is without importance by that meaning, this redirection occurs without pressure onto turbine-blade, so no mechanical turning momentum is produced.

Also here canals are build between one suction- and one pressure-side. Right at longitudinal cross-sectional view, side-walls again are drawn parallel, so cross-sectional surfaces towards inward become smaller. Air there becomes narrowed, so pressure could come up even towards suction-side, reverse to turning sense of system.

Previous flow C along suction-side, only indirectly can contribute for generating turning momentum, by most high speed. That bended surface corresponds to wing´s upper surface, i.e. there comes up relative void, into which air-particles fall by high speed. That void becomes increased, if direct in front of turbine-blade openings E are arranged within side-wall and air is drawn off through these openings. Air-particles thus fly even faster along suction-side of that blade.

Mechanical turning momentum results by difference of static pressures at both surfaces of blade: relative slow flow at pressure-side (with corresponding high static pressure) and much faster flow along suction-side (with corresponding low static pressure).

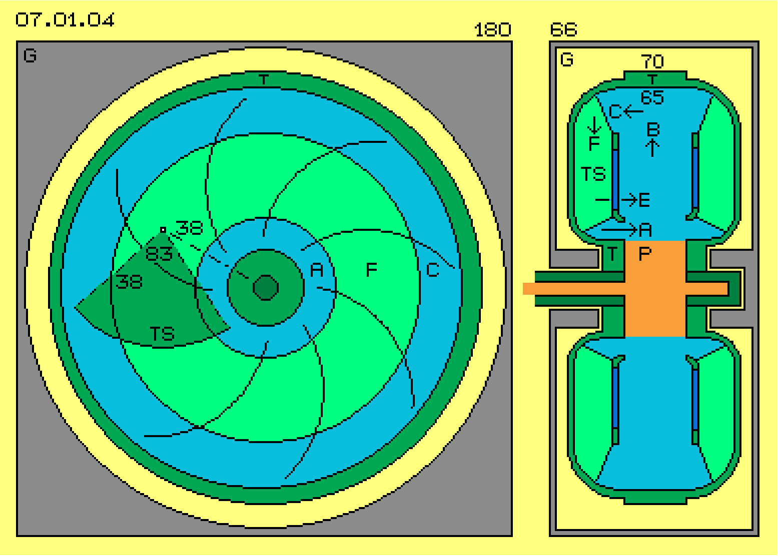
At this picture again two of these openings E are marked dark blue at cross-sectional view, each direct ahead of blades. Schematic longitudinal view again shows no cut straight radial, but upside shows situation along bended suction-side S, where air can flow off that surface towards aside (see arrows E). Downside at longitudinal view, situation at pressure-side D is sketched. Here no early flow-aside is possible, but air can leave that surface only at inner outlet-area (see arrow B).

So flows alongside both surfaces of blade are most different, distance between blades should not be too short. At previous pump e.g. ten blades were arranged, while here at turbine (at first) only eight blades are installed.

Previous pump and this turbine are analogue designs, each showing constant width from inside outward, both are bordered by one closed side-wall and one partial open side-wall. If both components are installed direct nearby each other, they complete and enforce mutually their movements processes.

## Basic Conception of Turbine

At previous chapter was detected, symmetric arrangements achieve most effective processes by most favourable constructional design. If one component includes the other in total, fluid can move only within closed system. However when using air as working-medium, system must not be closed hermetically, but actual atmospheric pressure should exist within machine.



Picture 07.01.04 now at first shows basic conception of

turbine, while pump is only marked by parts. Picture also shows only part of housing G (grey) containing windmill (thus not part of housing for gear, motor, generator, batteries, control-units etc.). This housing for example is 180 cm high and wide and some 66 cm deep. Also air between housing and windmill will move around. So inner side of housing should be round, so no disturbing vortices come up.

Within housing, turnably is beard turbine T (green), which encloses pump P (red, here drawn only central parts of). Shaft of pump runs within hollow-shaft of turbine, both shafts reach outside for drive of pump and output-thrust of turbine. Turbine as a whole is ring-shaped, at this example about 57 cm wide with an outer radius of about 70 cm (so sufficient space towards housing exists for previous mentioned outer air-movements).

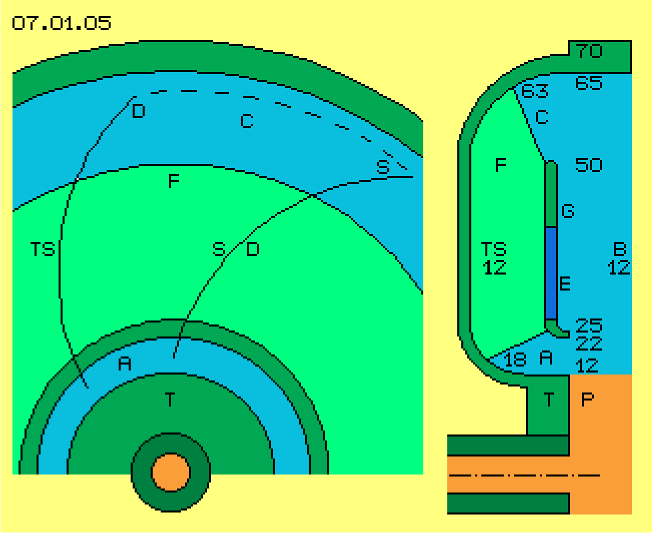
Inner space reaches outward to radius 65 cm und is about 53 cm wide. That inner space is bordered aside, inside and outside by plane surfaces with each edges rounded. Turbine-blades TS (light green) reach from side-surfaces to middle-wall with its openings E (dark-green respective dark-blue).

At cross-sectional view left side are drawn eight turbine-blades TS. Their contours are build as circle-bows with radius 38 cm and centre of circle is positioned also 38 cm from system axis. Circle-segment (marked dark green) is about 83 degrees. Blades start outside by acute angle to tangential direction and reach out some distance into outer rounding. Blades end inside by radial direction and reach some distance into inner rounding.

Air F flows between blades from outside inward, by parts through openings E to right side, remaining air flows off inner outlet A. At area B of pump, air flows outward again and back to inlet C of turbine. This circuit occurs at long stretched spiral tracks in shape of ring-vortices.

## Dimension of Turbine

At picture 07.01.05 turbine partly is shown by larger scale and some data of that example are integrated. Turbine T (dark green) has outer radius of about 70 cm. Inner ´air-space´ reaches from outer radius 65 cm towards inside radius of 12 cm. Middle-wall G reaches from radius 50 cm to 25 cm, inclusive inside rounding also to radius of about 22 cm. Blades TS (light green) are arranged between side-wall and that middle-wall and blades reach from radius about 63 cm to 18 cm. Turbine-blades are 12 cm wide and also area B of pump is 12 cm wide.



Circumference at radius 63 cm is about 4 m and at radius 50 cm still about 3 m long. By width of 12 cm total inlet area of turbine-blades thus is nearby 0.4 m^2. Circumference downside at radius 25 cm is only 1.5 m long and by 12 cm width less than 0.2 m^2. Direct at area of outlet A between radius 22 cm and 12 cm cross-sectional surface is some larger than 0.1 m^2.

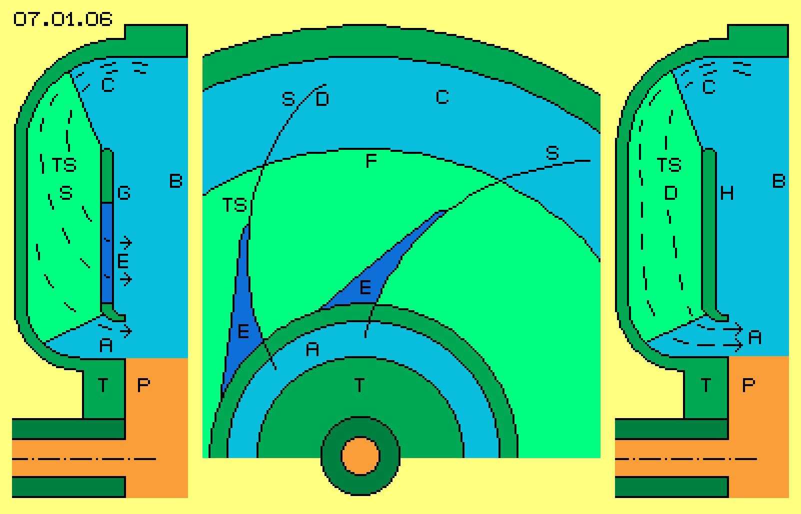
So outside at turbine-inlet F air can enter by wide space, while inside at turbine-outlet A only one quarter of cross-sectional surface exists. Side-openings E thus should be as wide as nearby three quarter of inlet-cross-section or air just has to move much faster through that bottle-neck.

## Flow-Speeds

Mass-throughput (e.g. through pipe) is totally different when using pressure or suction. The more pressure is applied, the more resistance comes up and thus relative throughput is diminished (like known at most fluid transports through pipes). If however fluid is drawn off pipe-end, stronger suction affects reduced resistance and maximum throughput is achieved (up to sound-speed).

Application of suction achieves unexpected high speeds even through openings ´too narrow´. At these movement processed in shape of ring-vortices, maximum speed of flow doesn´t exist at most large radius but at area of flow into inner core of vortex. That statement is not only based on logic conclusion however also approved by simple experiments, without any doubts, e.g. also by any tornado which is most wide ring-vortex and shows its most fast flows into downside core of rotating system.

In comparison with common radial turbines, these narrow cross-sections towards inside are real ´miss-constructions´. Here however side-openings E sufficiently allow air to flow off turbine. As air is sucked off these openings, smaller cross-sectional surfaces result corresponding stronger flows. Just by openings ´too narrow´ thus air alongside turbine suction-surfaces will flow essentially faster.


07.01.06

At middle of picture 07.01.06 previous part of cross-sectional view is shown once more, where now openings E (dark blue) are marked. These openings start outside very small and become wider towards inside. At radius 25 cm opening will take half of distance to next blade (alternative arrangement later).

Left side at picture, corresponding longitudinal view is shown and tracks of air along turbine suction-side S is marked by dotted lines. Most part of air outside will move alongside turbine inner border C, afterwards flowing off towards right through opening E. That flow from outside inward will not be decelerated but accelerated. Only rest of air along suction-side flows off inner outlet A.

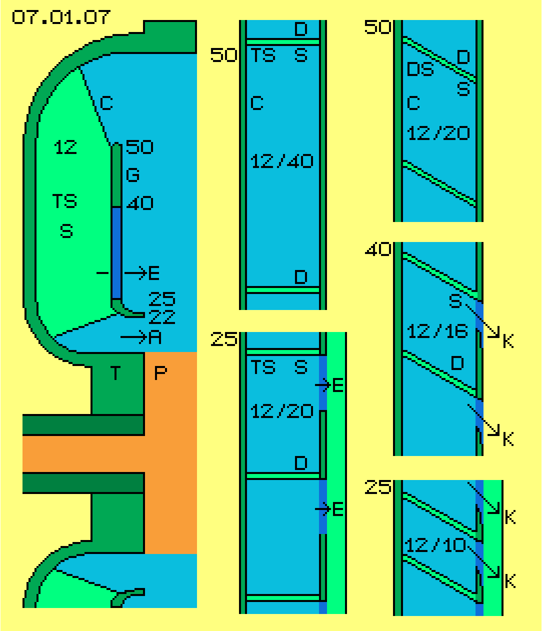
Right side at picture, situation near pressure-side D of turbine-blade is sketched and again typical track of air is marked by dotted lines. Also here most part of air masses flow along turbine outmost wall. Also along these pressure-sides air mostly moves left side along side-wall. Middle-wall H here is closed, so that air has to leave turbine through inner outlet A. That outlet is relative narrow, so air is dammed up somehow. Flows alongside pressure-sides thus are relative slow, i.e. corresponding stronger static pressure weights onto pressure-sides than at suction-sides of turbine-blades.

## Diagonal Blades

At picture 07.01.07 left side once more part of turbine T (dark green) and suction-side S of turbine-blade TS (light green) is shown with some data of that example. At middle and right columns of picture are drawn some cross-sectional surfaces.

At previous descriptions only eight turbine-blades were suggested, so between blades exists wide distance in order to organize flows most different at both surfaces. At radius 50 cm circumference is about 314 cm, so between these eight blades exists distance of nearby 40 cm. At width of 12 cm at inlet C of turbine, thus wide surface is available for air intake (see middle column upside).

Further inside at radius 25 cm canal is only half as long with some 20 cm. Opening E (dark blue) there is about 10 cm long. Via that opening air moves off suction-side, while air alongside pressure-side finally can exit turbine at inner outlet A. So there exists even more clearance than necessary for different flows.



Disadvantageous at that solution is, these openings E are far away from each other (see middle column downside). Air exits by separated jets, so no closed flow all around exists. At that inner space thus would come up separated vortices and turbulences with most negative effects. Desirable would be continuous flow all around from canals of turbine into area of pump. Column right side at this picture shows essentially better solution for organizing optimum flow.

Width of canals is unchanged with its 12 cm, however number of turbine-blades is double with now sixteen blades. Cross-section surface at radius 50 cm thus is 12 cm wide and about 20 cm long (see right column upside). In addition now blades TS (light green) no longer show right angles to side-wall and middle-wall (dark green) but are arranged by angle of about 30 degrees. Cross-section between blades thus are shaped like parallelogram.

At radius 40 cm cross-sectional surface is about 12/16 cm wide (see right column at the middle). There openings K (dark blue) start, direct at suction-side S, about 4 cm wide. By arrow is marked, air now can move alongside suction-surfaces diagonal outward towards right side.

At radius 25 cm cross-sectional surface still is 12 cm wide, however only 10 cm long (see right column downside). Half of that length takes opening K. If frontside edge (in turning sense) of that opening is rounded or even little bit bended towards left, nearby continuous flow diagonal-ahead from turbine into area of pump exists.

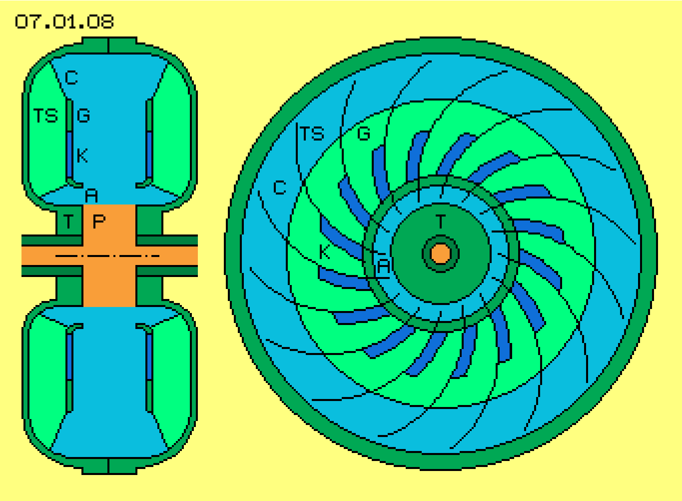
Middle-wall G (dark green) thus is closed disk from radius 50 cm to 40 cm, between radius 40 cm and 25 cm that disk partly is interrupted by openings K (dark blue). Between radius 25 cm and 22 cm middle-wall again has closed surface, however bended and reaching towards right resp. pump-area by about 3 cm. Downside of that rounded ring is area of inner outlet A.

**Advantageous Diagonal-Flow**

Upside at picture 07.01.06 at C was mentioned, air prevailingly moves alongside wall of turbine. When now that flow enters diagonal arranged blades, air will move further to middle of canal (here at picture thus towards right side), so pressure onto blade surfaces will become more equal spread.

Just into that direction diagonal-inward resp. -forward in turning sense, air will be drawn off turbine-canals by faster turning pump. Without change of direction, air moves diagonal over suction-sides and through opening K at diagonal track, spiral bended within space. Because these openings actually are ´too narrow´ highly accelerated flow comes up there. At suction-sides of turbine-blades thus static pressure is reduced considerably.

These openings give chance for early exit-aside only for air nearby suction-sides. Alongside pressure-sides, air also spreads diagonal, however that air becomes wedged into corner between pressure-side and closed part of middle-wall. That air can move only slow through relative narrow inner outlet A. At pressure-sides of turbine-blades thus weights much stronger static pressure than at suction-sides.


07.01.08

Sixteen turbine-blades naturally have surfaces double large than previous eight blades. So pressure-differences can affect at wider surface. In addition double openings K exist. If their frontside edges are rounded or little bit bended into turbine-canals, practically continuous diagonal flow all around moves towards pump.

At picture 07.01.08 now complete turbine is drawn with previous discussed elements, by some smaller scale, left by longitudinal and right by cross-sectional view. Via wide inlet C air flows into these sixteen canals between sixteen turbine-blades, air passes closed ring G of middle-wall, is sucked off through openings K, however only alongside suction-sides. These openings now are positioned nearby each other and diagonal exit of air results all around equal turning flow. Remaining air near pressure-sides finally exit via inner outlet A.

Within that turbine thus occurs mass throughput at most flow-conform tracks, because all surfaces show round shapes and flow processes are organized accordingly. Nevertheless, design of all surfaces is as clear, turbine could well be constructed by metal sheets. However plastic will be predestine material for these round forms, resulting light construction by sufficient stability.

**Optimum Windmill**
Common windmills with long wings cover huge surface, however can take wind-energy only by three small wing-profiles. At their suction-sides, flow becomes accelerated and at their pressure-sides flow becomes little bit decelerated, so backside of come up accelerated turning vortices. These wander further back by wind speed, however also air in front of wings is drawn into circling turbulent flows. Next wing may enter that area finally when ´vortex-pigtails´ moved backward off.

If behind windmill an airflow is generated by suction, these disturbing vortices are sucked off and thus more wings could be installed. Flow by suction is produced low-cost and thus suction-windmills would be very effective and to drive independent of natural wind.

I searched for solutions since years, however could not really solve problem: if air is sucked off suction-side of any blade it´s merely to avoid, air is drawn off also alongside next pressure-side. Finally that diagonal arrangement of profiles, combined with sideward sucking-off air along suction-sides and separated outlet of air at pressure-sides, represents real solution.

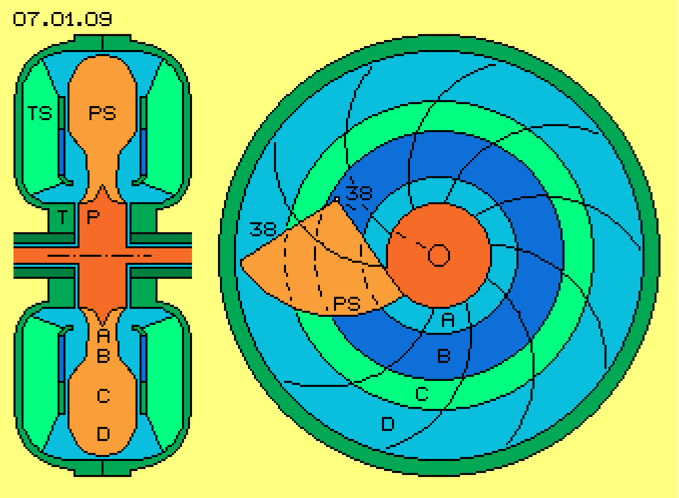
Profiles could even be stronger bended than drawn here. As flows move diagonal over surfaces, bending appears more flat. In addition there is no interruption of laminar flows when using suction. At any case however, all flows along pressure-sides should be wedged into that corner and therefore dammed up and slowed down little bit. Pressure-differences between suction- and pressure-sides thus are much stronger than at any free turning common windmill.

Optimum relation of cross-sectional surfaces of inlet-area, sideward openings and outlet-areas however is only to find by experiments. That relation in addition depends on revolutions of pump and turbine and also on conception of pump, which at the following is discussed.

**Basic Conception of pump**

Upside at picture 07.01.02 Spiral-Canal-Pump was described, where cross-sectional surfaces towards outward were much too wide in relation to relative narrow inner inlet-area. Essential characteristic of that pump thus is additional input of ´wrong air´ from aside. Without additional power-input, much stronger mass-throughput is achieved because that air follows back-stepping suction-sides ´by own drive´.

Here now that side-flow occurs via openings at middle-wall between turbine and pump. Pump by itself needs no partly open side-wall resp. side-borders at pressure-sides of pump exist only rudimentary. At picture 07.01.09 basic conception of that pump schematic is sketched, left side by longitudinal- and right side by cross-sectional view.



Shaft of pump P (dark red) is beard left and right within hollow-shaft of turbine T (dark green). At space between both turbine-wheels TS (light green) are positioned pump-blades PS (light red) with their ´spoon-shaped´ contours.

These blades are bended as circle-bows, again with radius 38 cm (see light-red circle-segment) and centre of circle again is 38 cm from system axis. Ten of these blades are drawn here. That pump transports air prevailingly by suction and suction spreads also back into flows without resistance. These ten blades offer sufficient space for movements and that number of blades is sufficient for that purpose.

Areas from A to D are marked where pump-blades serve for different functions. At area A, air of inner turbine-outlet is grasped and accelerated in turning sense of system (because pump in general is turning faster than turbine). At area B, blades at first are rather small, so offering sufficient space for air flow through side-openings of turbine. However also here that air is accelerated, at least indirectly by faster turning surfaces of pump.

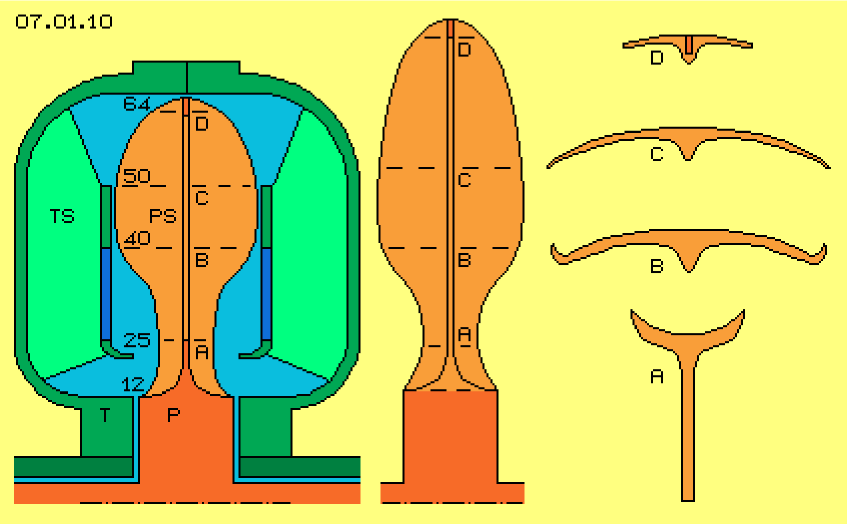
Further outward, pump-blades become wider and finally take whole width between closed parts of middle-walls. At this area C now air prevailingly by suction-sides is pulled outward-ahead. At area D, that suction-effect goes on, at the other hand now air is pressed against turbine-wall out there, so air flows aside to left and right inlet of turbine-wheels.

## Suction-Spoon

At picture 07.01.10 previous longitudinal cross-sectional view is drawn once more by larger scale, also previous areas A to D and some radius are marked. Pump-blades are as wide as both turbine-wheels, so about 24 cm or inclusive middle-bar about 25 cm. As turbine at radius 22 cm shows towards middle by 3 cm each side, pump inside is about 18 to 19 cm wide.

Pump-blades reach from radius 12 cm nearby to outer wall of turbine, about radius 64 cm, so are about 52 cm long into radial direction. Length of circle-bow surface of pump-blades is about 60 cm and that ´flat´ view onto blades here is drawn at middle of picture, where contours appear some stretched. Right side of picture are sketched some cross-sections of pump-blades at each position marked, by some larger scale.

Through inner outlet of turbine, maximum one quarter of air-volume flows. Pump is rounded from radius 12 cm, so air is guided outward alongside that ´bulge´. Pump-blades are based on that ´blade-foot´ (or hub) which may reach outward to radius 25 cm. Blades there are rather small, for example only 8 cm wide. At picture downside-right cross-section A of that position is drawn.



Edges of pressure-sides (frontside in turning sense) show ahead and build a channel. Backside that blade builds a bar (respective fin or rib), reaching back to following blade (that´s previous blade-foot up to radius 25 cm). Blades grasp part of air at frontside channel. Distance between blades however is already nearby 15 cm, so most part of air is dragged only indirect into turning sense of system by backside parts of pump-blades. Pump in general must not accelerate ´resting´ air, but also that air of inner area comes from turbine already moving diagonal-ahead.

Up to radius 40 cm width of blades increases, from these 8 cm to 24 cm, so becomes three times as wide (if middle-bar is ignored). Same time circumference becomes longer, from these 1.5 m to now some 2.5 m. Layer of air grasped inside by blade-channel now at that radius 40 cm is much more thin. Like shown right side at cross-section B, small border-edges showing ahead are sufficient to keep that volume of air at pressure-side of blade.

At radius 25 cm blade practically builds ´spoon-handle´. Up to radius 40 cm previous channel becomes ´turned-upside-down´, so now round side of spoon shows ahead in turning sense of system. That pump is not designed for affecting pressure but prevailingly that hollow suction-side shall drag air behind (and air will follow that back-stepping wall up to sound-speed without any resistance).

## Permanent turning Ring-Vortex

Between radius 25 cm and 40 cm blade reaches further into air-flow by its increasing width. Corresponding to larger radius, blades towards outside move faster within space. However even out there, blade must merely affect pressure for acceleration of air. It´s most probably, most high speed of flows within whole system exists at area of side-openings within turbine-middle-wall - just based on ´nozzle-effect´ of these rather small openings.

Pump-blades at first give sufficient space for that air coming from turbine, afterward blades fit into that flow and draw air by suction-sides forward-outward. That drag goes on also at area between radius 40 cm and 50 cm, there alongside closed part of middle-walls. Like sketched right side at cross-section C, curvature of blade-profile keeps constant, however finally at radius 50 cm no more borders of blade-edges exist.

Further outward, bending becomes more flat, like cross-section D at radius about 62 cm shows. Blades become increasingly smaller and allow air to flow off into direction to inlets of left and right turbine-wheel. Most dense and fast flow will run around turbine inner-wall as flat layer, also pushed some aside by blade´s ´spoon-tips´. However that push demands only few power because contrary-pressure affects inward by mostly radial directions.

Everyone knows experiments of ´smoke-rings´ wandering far through rooms and their turning movements stop only when hitting onto barrier. Air within that system here moves like these smoke-ring-vortices, however by additional rotation around system axis. Opposite to common ´pressure-thinking´, pump here must not work for acceleration of masses, but pump functions more as ´moderator´ of that movement-process.

Air within that system is decelerated only within corners of turbine-pressure-sides. As soon as that air exits turbine through inner outlet, that dense air now can expand, i.e. flies ahead accelerated by its own. At turbine-suction-sides air becomes accelerated like at any upside surface of wings or any convex bended surface. These openings ´too narrow´ at middle-walls hinder air movements, however only that part along pressure-sides and not air at suction-sides. Air flows especially fast through these nozzles.

Pump prevailingly has function to redirect given flows forward-outward again and to guide air back to turbine-inlets. Thereby mechanical acceleration by power input is demanded only by small part, as main flows of air are based on internal kinetic energy in shape of normal molecular movement. Air-particles follow each back-stepping suction-side without resistance by their own - and must not be pressed ahead by pressure-side of following blade.

For jobs of common radial-pumps that ´spiral-channel-spoon-suction-pump´ is real miss-construction. However that pump keeps up continuous movement circuit of air within that system by minimum input of power (which is demanded mostly for friction losses). Some hundred watts for drive will do and keep up rotation of that pump with its wide diameter of 130 cm.

### Light Construction

This pump must not affect strong pressure forces onto air, however must take its own centrifugal forces. Constructional elements must be build solid and at the other hand most light. These blades could be build by metal sheets, all forms are shaped into three dimensions same time, so even thin sheets become stable. In principle however plastic is predominated material for these round shapes.

That ´spoon-handle´ of blades is most weighted at area between radius 12 cm up to about 40 cm. Further outward, blades are bended backward in turning sense, so centrifugal forces affect by lever arms. Total pump could be build by central disk and at both sides each half blades are installed. At cross-sections that solid disk of ´blade-foot´ however is drawn only up to radius 25 cm. Further outward that disk exists only rudimentary as rib at backside of blades (however that bar could also be arranged at frontside or frontside and backside of blade).

At cross-sections at radius 62 cm to 64 cm centrifugal forces could be hold by ring running all around circumference (here marked as rectangle dark-red). So stabile disk must not cover total surface, but material is necessary only for ring quite inside and quite outside plus ribs alongside blades. If for example quite outside steal-band is installed all around, that pump-wheel will be stable and light constructed as well. Pump and turbine should weight only some few kilograms and even with diameters up to 140 cm should drive relative high revolutions.

**Pressure Differences**
Actual these processes are well known, however one must consider on and on which huge differences exist between application of pressure or suction. At picture 07.01.11 these facts schematic are sketched.

At A principle of transmission of flow-pressure into mechanic momentum is visualized, like done e.g. by ´free-jet-turbines´ nearby hundred percent. Jet becomes redirected at round surface of turbine-blade (dark green). Half of its speed, jet needs for keeping up speed of blade, other half of its speed is reduced to just that turbine-speed. Water afterward falls down of turbine by gravity, by direction down-forward (dotted arrow).

So maximum one half of kinetic energy of water-jet is transferable into turning momentum. If outlet is not completely free of resistance (like practically at all other applications) even less energy is usable. In addition, air brings too less mass onto blades, so no satisfactory performance is achieved.

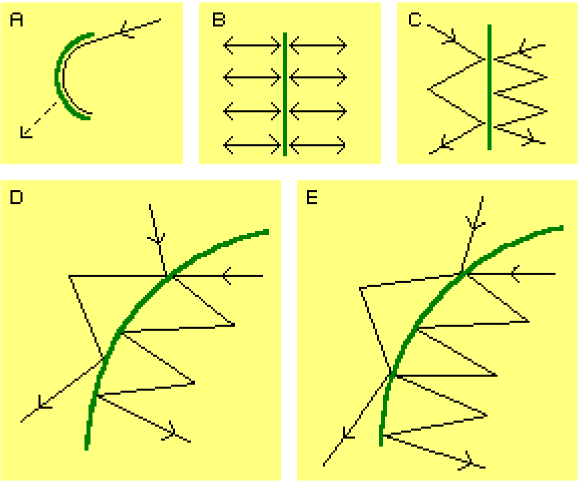
Even air has few mass resp. density, air-flows can be used most effective, however by quite other process. Flow-pressure is not transferred directly into turning momentum and flow is not delayed, but basic ´power´ is just normal atmospheric air pressure. That ´force´ does not result by weight of some kilometre-high air-column above, but that force is expression of normal molecular movement of air-particles (details see chapter 05.13. ´Explosion / Implosion´).

At B are sketched eight ´trembling´ particles, which are pushed to and fro between wall (dark green) and neighbouring particles (left and right of, here not drawn). Intensity of hits onto wall depends on speed of molecular movement, thus on heat of air. Frequency of hits depends on density of air - and only indirectly thus gravity contributes to atmospheric pressure.

At this picture at C, air flows upside down along that wall. Particles still are trembling, however collision with wall each time is some shifted downward. Right side, flow is slow, its ´static pressure´ from aside onto wall is little bit diminished, correspondingly that air pushes some harder into direction of flow. Left side faster flow is sketched, i.e. these particles have less chance for hitting onto wall, however affect more pressure forward directed.

By each trembling-act, particles can either hit onto wall or fly ahead into flow-direction (resp. can affect pressure corresponding to movement-components). Difference of pressure into flow-direction (dynamic- or flow- or dam-up-pressure) of fast flow opposite to slow flow thus exactly corresponds to difference of their (static) pressure aside onto wall.

07.01.11



Speed differences autonomous come up if air flows towards bended surface, e.g. air at D moves from upside-right towards that bow-like wall. Lee-side (left) is protected by wall, there comes up relative void, into which particles can fall longer distances until next collision. Resulting effect is an accelerated flow. Particles there move not faster at all (like if air is heated up). Particles get into that area only little bit less hindered and if many particles fly similar direction, they hinder each other less by that coming-ahead movements. They rarely hit aside onto wall and in general by more acute angles.

Opposite at luff-side (right) space becomes some more narrow for particles, i.e. they hit at wall more frequently and more frontal. These particles finally can flow off only downside and that redirection affects some sideward push onto wall.

This movement process occurs e.g. at sails and it´s told, ´wind-pressure´ at luff contributes one third of drive, two third are done by suction at lee-side. That´s wrong because suction by itself does not affect any forces, relative void at lee only allows air to move faster with corresponding reduced static pressure. Real drive forces thus result exclusive by hits of molecular movements which are more frequent at luff-side.

´Suction´ means area of less density, into which particles of neighbouring areas hit onto less collision-partners. Within a flow, movements prevailingly are directed more forward and also there following particles find less resistance, so fast flow works like suction towards areas backward (and aside). Flow has not only affect towards forward (by dynamic pressure) but also far back spreads reduced resistance. Flow sketched at D thus ´drags´ particles faster from its original area into flows direction. At E that effect of accelerated flow is marked by ´trembling-movements´ more flat.

Turbine of that Spiral-Canal-Windmill uses bended blades and alongside suction-sides appears previous autonomous acceleration. This effect is enforced as air is sucked off openings aside. Both facts affect acceleration back into inlet-area of turbine. Diagonal arrangement of blades allows sideward flow along suction-sides going straight on into area of pump. Opposite, between pressure-sides and closed part of middle-wall (in turning sense ahead of openings) are corners, into which air is ´narrowed´, flow is decelerated and difference of static pressures increasing once more.

That delay at luff-side is balanced by acceleration at lee-side, i.e. flow becomes only more different however not slowed down in total. Usable pressure-difference thus is not achieved by breaking-down flows, but is only side-effect of differing flows characteristics. Benefits exclusively result by manipulation of normal molecular movements - where fluid´s kinetic energy is not changed nor ´consumed´.

Mechanic turning momentum thus at the one hand is achieved via redirection and delay of flows like sketched upside at A. If e.g. flow of 20 m/s is reduced to 10 m/s, reduction of speed appears as factor by square, so by $10^2 = 100$. If alongside a wall flow of 20 m/s exists and at the opposite side of wall flow of 10 m/s, pressure-difference appears as factor $20^2 - 10^2 = 300$. That´s why modern ´fast-mode´ windmills achieve three times better performance than oldfashioned ´slow-mode´ windmills. Question now is performance of that ´Spiral-Canal-Windmill´ as closed system with its autonomous produced wind.

### Surfaces and Lever-arms

Experimental data approved functions of separated components, however combination of that pump and turbine is not available at this very moment. Following examples of calculations thus can only show expected scales. Relative certain however is basis of effective surfaces and lever arms.

Turbine-blades are about 60 cm long, effective length however is only radial distance between radius 25 cm and 50 cm, so 25 cm. Blades are arranged diagonal, effective surface however is only right-angled width of 12 cm. Projected surface of blade thus is 25 * 12 = 300 cm^2. Each sixteen blades of both turbine-halves in total show 2 * 16 * 300 = 9600 cm^2, so total-surface of nearby one square-metre.

Blades show into radial direction only at inside part, at radius 50 cm however e.g. by angle of 45 degrees. Force weighting onto that slope surface out there affects only by factor 0.7 in turning sense of system. As an average here is calculated with factor 0.85, which is equal to surface of 0.8 m^2 completely showing radial.

Forces affect at radius from 25 cm to 50 cm, most strong forces however inside. As weighted average here is calculated by radius 33 cm, so 0.33 m is assumed as length of effective lever-arm.

**Pressure-differences and Turning-momentum**

Dynamic pressure resp. flow-pressure is calculated by formula P = 0.5 * density * speed by square. Density of air here is assumed by 1.2 kg/m^3. Flow with speed e.g. of 20 m/s thus shows flow-pressure P = 0.5 * 1.2 * 20^2 = 240 kg/ms^2. Speed of 30 m/s results 540 kg/ms^2 flow-pressure. If flows of both speeds flow along both sides of wall, difference of both dynamic pressures is equal to difference of both static pressures, so here 540 - 240 = 300 kg/ms^2. That pressure affects onto previous effective surface of 0.8 m^2 by force F = 300 * 0.8 = 240 N. This force affects at previous lever-arm of 0.33 m, so turning momentum M = 240 * 0.33 = 80 Nm results.

As speed by square is part of these calculations, turning-momentum increases progressive by faster flows and speeds more different. Speed of e.g. 45 m/s results P = 0.5 * 1.2 * 2025 = 1215 kg/ms^2, so 675 kg/ms^2 more than speed of previous 30 m/s, affecting onto effective blade-surfaces by F = 675 * 0.8 = 540 N and at effective lever-arm results turning momentum M = 270 * 0.33 = 180 Nm (in comparison with previous 80 Nm).

**Flow, Revolutions, Performance**

Final resulting performance of machine strongly depends on revolutions of pump and turbine and also on given relative speed-differences. Insight in causal connections might show following example.

If pump turns by 1500 rpm, each second occur 25 revolutions. Circumference at radius 65 cm is about 4 m, so pump produces flow of about 100 m/s. If turbine turns by 900 rpm, each second occur 15 revolutions. At radius 50 cm circumference is about 3 m, so inlet-area of turbine turns by 45 m/s within space. Air from pump enters turbine-canals thus by 100 - 45 = 55 m/s as relative speed within canal resp. alongside surfaces of turbine.

Air at pressure-sides of turbine-blades is little bit decelerated by relative narrow inner outlet, so air flows along pressure-sides for example by average speed of 55 - 10 = 45 m/s. Opposite, flow at suction-sides with relative narrow side-openings is strongly accelerated by that nozzle-effect. If pump moves air by 100 m/s outside at wide circumference, air within narrow inner space is sucked outward by much faster speed. This might seem strange, however air flies behind back-stepping wall without resistance up to sound-speed and as mentioned upside once more, that suction affects far back within flow.

So within ´nozzles´ will exist speed at least of 100 m/s (by cautious calculation). Relative to turbine-blade thus air enters at outer inlet by 55 m/s and leaves by 100 m/s though openings aside. As an average on total effective surface about 75 m/s can be assumed cautiously. So at pressure-sides air flows by 45 m/s and at suction-sides by 75 m/s.

As upside already calculated, 45 m/s result dynamic pressure of 1215 kg/ms^2. At speed of 75 m/s results P = 0.5 * 1.2 * 5625 = 3375 kg/ms^2, so difference is 3375 - 1215 = 2160 kg/ms^2, affecting at surface of 0.8 m^2 by force F = 2160 * 0.8 = 1728 N and at lever-arm of 0.33 m affecting as turning momentum M = 1728 * 0.33 = 576 Nm.

Performance is calculated by formula P = turning-momentum * revolutions / 9550. At previous turbine-revolutions of 900 rpm results theoretic performance P = 576 * 900 / 9550 = 54.3 kW. Drive of pump will demand only some few hundred watts, while mechanic friction and internal vortices might reduce performance by one third respective to about 36 kW. If only half performance would remain as continuous output, these 27 kW would be more than sufficient for energy-supply of residential building.

At following table previous calculations with revolutions of 1500 / 900 rpm of pump / turbine are listed (column 3), where drive and other losses are assumed by one third of theoretic performance. Next column shows corresponding numbers of 1200 / 720 rpm of pump / turbine, where some 20 kW are available (column 4). Even slow revolutions of 900 / 540 rpm might result net-performance of about 7 kW (column 5). Minimum for autonomous mode might be about 600 / 360 rpm (column 6).

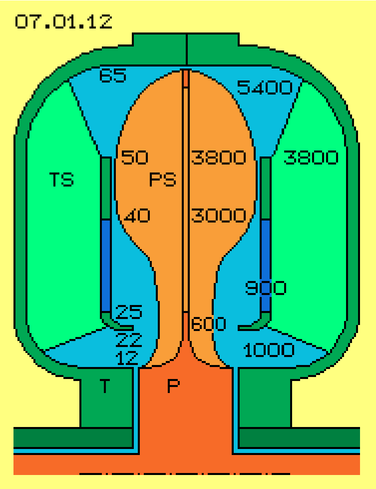
These calculations are based on cautious estimates, however can show only scale of performance in general. Only one result might be sure: that Spiral-Canal-Windmill achieves sufficient performance already by moderate revolutions, e.g. for energy-supply of houses - while high revolutions and / or larger constructional volumes could produce increasing performance.

Optimum relation of revolutions of pump and turbine are only to find by practical tests, however optimum could strongly differ within different ranges of revolutions. If turbine turns relative slow, air enters blades relative fast and pressure-differences increase, at the other hand turning momentum is small at slow revolutions. Here was used relation 5 : 3 as probably suitable average for pump- resp. turbine-revolutions.

| Revolutions - Pump/Turbine | rpm | 1500 / 900 | 1200 / 720 | 900 / 540 | 600 / 360 |
|---|---|---|---|---|---|
| V - Pump / Turbine / Inlet | m/s | 100 / 45 / 55 | 80 / 36 / 44 | 60 / 27 / 33 | 40 / 18 / 22 |
| V - Pressure- / Suction-Side | m/s | 45 / 75 | 36 / 62 | 30 / 45 | 20 / 30 |
| P - Pressure- / Suction-Side | kg/ms^2 | 1215 / 3375 | 778 / 2306 | 540 / 1215 | 240 / 540 |
| P - Difference stat. Pressure | kg/ms^2 | 2160 | 1528 | 675 | 300 |
| Pressure F = P * 0.8 m^2 | N | 1728 | 1222 | 540 | 240 |
| Momentum M = F * 0.33 m | Nm | 576 | 407 | 180 | 80 |
| Performance theoretic | kW | 54.3 | 30.7 | 10.2 | 3.0 |
| Drive and Losses | kW | 18.3 | 10.7 | 3.2 | 2.0 |
| Net-Performance about | kW | 36.0 | 20.0 | 7.0 | 1.0 |

### Mysterious Acceleration

Some might wonder about ´wondrous acceleration´ of flow speed at suction-side. Nobody is surprised about turning-momentum-constant: solid body rotating around an axis naturally moves by faster angles-speed when guided to shorter radius. Also here air within turbine is guided from outside inward, however that´s not real cause of acceleration. Air does not show inertia like solid bodies, but each single air-particle flies inertia-conform straight on into its momentary direction. Particle comes more forward in space if collisions are more rare, so particle wanders all times into direction of less density or towards neighbouring faster flow. Air occasionally thus even runs ´around corners´.



Decisive for movement direction of air thus is density of neighbouring areas. At that machine areas of different density come up by different cross-sectional surfaces and naturally also by movement of pump suction-sides. At picture 07.01.12 cross-sectional view through machine once more is shown and right side are marked some order of cross-sectional surfaces, by square-centimetre, for one half of machine.

Between radius 65 cm and radius 50 cm air crosses from area of pump into area of turbine. Cross-sectional surface is most wide by about 5400 cm^2 (and because air by majority moves alongside outer wall, middle-wall even could reach some further outward). At radius 50 cm and width of 12 cm real inlet to turbine is about 3800 cm^2 wide.

Air along pressure-sides leaves turbine finally through inner outlet between radius 12 cm and 22 cm. That cross-sectional surface is about 1000 cm^2, i.e. maximum one quarter of all air will cross from turbine to pump quite down there. At radius 25 cm circumference is about 1.5 m, blades of pump there are only some 4 cm wide, so blades take cross-sectional surface of maximum 600 cm^2. This corresponds to previous 1000 cm^2, because pump runs faster about 1.6 times.

Further outward, pump-blades become wider and at radius 40 cm reach full width of 12 cm. Blades there grasped air by cross-sectional surface of about 3000 cm^2. Maximum 1000 cm^2 come from inner outlet, so air for about 2000 cm^2 must come through side-openings of middle-wall. Each opening is about 15 cm long and 4 cm wide, so has surface of about 60 cm^2 and total surface of sixteen openings is only 900 cm^2. Pump there offers not only double surface (previous 3000 - 1000 = 2000 cm^2), but in addition turns 1.6 times faster alongside these openings of only 900 cm^2 - and into that void at backside suction-surfaces of pump-blades air-particle fly. That´s why also at suction-sides of turbine-blades at least these speeds of previous calculations exist.

Towards outside cross-sectional surfaces of pump become wider again, up to 3800 cm^2, so suction goes on also further out, until finally air by pump-revolution-speed moves along turbine-wall, again faster than turbine by itself moves within space. Air won´t stick at outer radius, but suction within nozzles of opening is strong enough reaching through turbine-canals back into outer turbine-inlet.

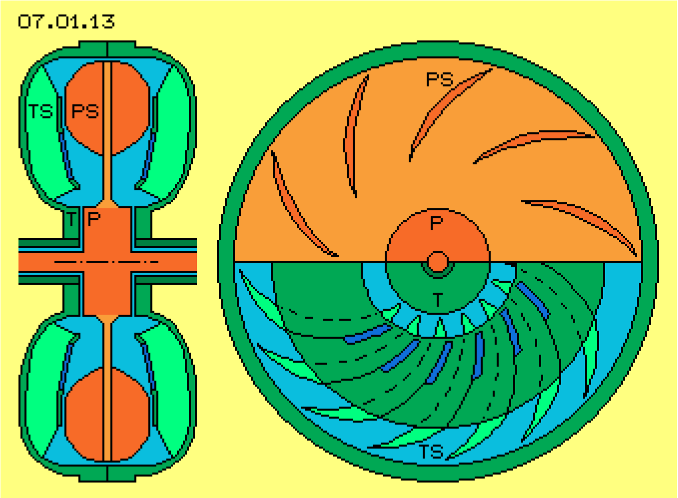
This convection-flow at the one hand is achieved as pump-pressure-sides push some part of air outward-ahead. At the other hand, slower turning turbine-pressure-sides push air inward. Prior part of that circuit however is achieved by suction-sides of pump and turbine as well - and only as pure side-effect come up drive-forces at turbine-blades, usable for external benefits.

## Optimum for Xmas

Principles of design discussed here, naturally are to realize by most different techniques. As an example little bit different design is shown at picture 07.01.13, left side by cross-sectional view and right side by longitudinal view, upside part of pump-area, downside part of turbine-area.

At pump ´less could be more´, e.g. if inner area is mostly free and pump-blades start further outside. Like mentioned upside, disk could be installed throughout inner to outer radius and at both sides are attached each halves of pump-blades. Previous ´spoon-handle´ and complex shape of edges no longer are necessary. Blades are continuously bended like spoon-surfaces, with arch showing into turning sense.

Like also mentioned upside and now drawn at cross-sectional view, middle-walls of turbine reach some further outside and there are shifted aside little bit. Wall now is arranged some diagonal and thus corresponds some better to diagonal flows within turbine-canals. At longitudinal view, diagonal-position of turbine-blades (light green) is marked (see partly dotted lines). Within middle-walls (dark green) again are marked side-openings (dark blue). From these openings (and from inner turbine-outlet) now air at first moves into free inner area of pump, afterwards back-affecting suction of pump-blades drag that air into direction outward-forward again.



For many years I tried to design autonomous working windmill. Since years I did know, usage of Free Energy is only question of organisation of suitable movement processes. Energy of system may not be consumed or drawn off, but only side-effects may be ´miss-used´ for external purposes.

Now in my opinion, this conception of ´Spiral-Canal-Windmill´ is well satisfactory and thus my job is done. Other people now must invest time and knowledge for further improvement and production of that ´Windmill at Cellar´. Xmas 2007 is just around the corner and as mentioned upside, I would welcome Xmas 2008 constructional set at the door.

07. Fluid-Machines