Alfred Evert 20.12.2007

07.02. Meander-Wheel

Starting Aspects

Solution for stationary power-supply was offered by ´Cellar-Windmill´ of previous chapter. Windmills can produce usable energies only by large constructional volumes, even that machine fits into any cellar. Smaller and more effective engines are only possible when using working-medium more dense, e.g. water weighting 800 times more than air, or also any oil.

When air rotates, centrifugal forces practically can be neglected. Opposite, rotating fluids show strong centrifugal forces and one must pay attention when organizing movement processes.

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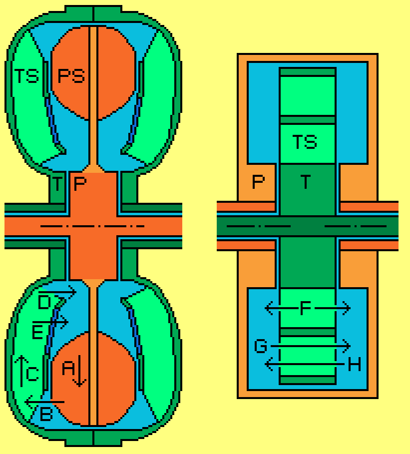


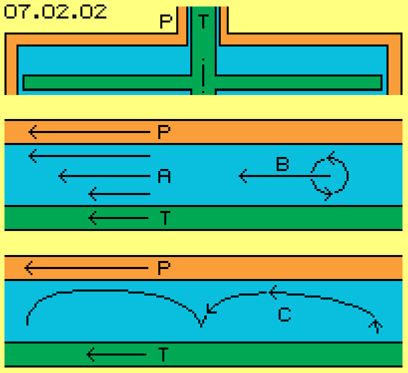
Objectives of that chapter now is conception of effective engine by small constructional volume and drive by water. Performance is generated only by suction effects, so based on kinetic energy of normal molecular movements, similar to previous ´Cellar-Windmill´. Principle of movements of that machine are shown once more at pictures 07.02.01 left side.

Pump P (red) moves air outward (A), air enters inlet (B) of turbine, flows inward (C), quite inside air moves into inlet (D) of pump respective some earlier through slots (E) alongside turbine suction-sides.

That circuit is not possible when using water as working medium, because fast rotating water can not be sucked inward contrary to its centrifugal forces. Right side of picture schematic is sketched possible solution avoiding that negative effect of centrifugal forces. Here (at first) pump P (red) is drawn as outer constructional element, within which turbine T (green) is installed.

In principle, water within turbine-blades TS (light green) must keep likely radius all times. Water there may move only from left to right side and vice versa, like marked by double-arrow F. That movement to and fro also can be organized as circuit, however only at radius nearby, like marked by arrows G and H. Possibly that movement process can be installed also at different areas.

07.02.02



Drag-Effect

This engine is based only at application of suction, so pump may not have any blades affecting pressure. At picture 07.02.02 upside most simple principle schematic and partial is sketched: pump P (red) is build only by rotating plane disk, water (blue) is dragged by friction at surface and indirectly also turbine T (green) becomes turning.

This construction represents most simple hydro-static clutch. When starting system, power is demanded until all masses are accelerated to wanted revolutions. Finally also turbine will turn nearby as fast as pump. Also at running mode, power input is necessary to overcome friction losses.

When turbine is braked down to less revolutions, also pump turns slower and drive of pump demands more power input, practically like power is drawn off system by turbine. So at first, that system of pump and turbine won´t produce additional energy (and thus only represents simple hydro-static clutch). That conception here only is used for producing speed differences within water between pump and turbine. This is done by few power input for compensation of friction (some hundred watts, while further input for pump-drive is available at turbine-output nearby hundred percent).

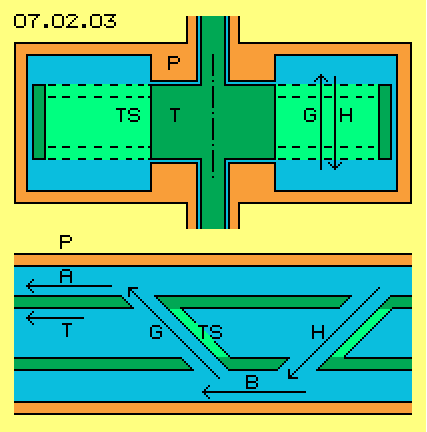
At middle of picture, view from outside onto disk of pump P (red) and turbine T (green) is shown. Both disks are turning from right to left side, by different speeds. Water between disks shows different flow-layers A of different speed gradients.

Movement however is not steady and layers are not stable. Circling movement B will come up where centre of circle wanders ahead by average speed. Within space thus movement pattern comes up like sketched at C at downside part of picture. Water is rolling-over forward, turning within itself, just like drops glide down at pane of glass.

That movement pattern e.g. is also comparable with tracked-vehicle: at frontside chain-links are put onto ground (here turbine-surface) and backside chain-links again are lifted off ground. These both movement components, at the one hand towards turbine and at the other hand off turbine-surface, are important for that Meander-Turbine-Wheel.

Meander-Movement

Picture 07.02.03 upside once more shows principle construction. Pump P (red) includes turbine T (green) and turbine-shaft is turning within hollow-shaft of pump. Turbine is no disk closed all around but disk has openings, through which water (blue) can move from one side of turbine to the other and also back again (see arrows G and H).



At this picture 07.02.03 downside, part of cross-sectional view through machine is shown (view at circumference at area of arrows G and H). Upside and downside are both pump-disks and alongside these surfaces water move nearby as fast as pump is turning around (see arrows A and B). Turbine turns slower, e.g. only by half speed (see arrow T).

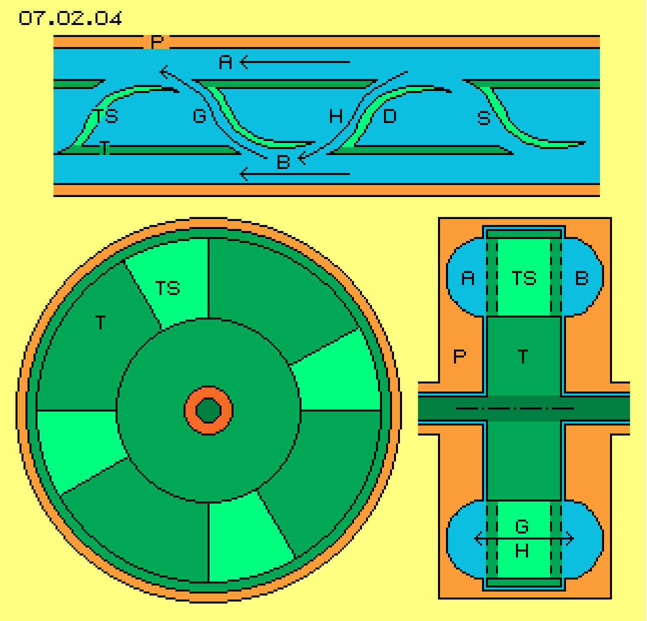
Between pump-disks, turbine is installed which in principle is build also by two disks (dark green), interrupted by slots. These slots are shifted and connected by diagonal wall, reaching from each backside (in turning sense) edge of one side cross to the other side. These diagonal walls represent turbine-blades TS (light green).

So diagonal passage-ways downside-up G and upside-down H exist. Both ´canals´ reach from inlet to outlet diagonal-forward in turning sense. Both canals are bordered by wall only at their backsides (in turning sense). From that diagonal-wall towards backward reach these side-walls of turbine-disks, each until next opening ahead of next diagonal-wall.

All around, several of these ´turbine-blades with attached side-surfaces´ are arranged, each time showing into opposite diagonal direction. Water is sucked through these canals by faster flows A and B alongside pump-surfaces. Water wanders meander-like ahead within turbine, alternating at tracks G and H.

Pressure- and Suction-Wall

At picture 07.02.04 upside, previous cross-section is shown once more. Turbine-blades TS (light green) now are drawn some more fluid-conform. At each outer edge is attached side-wall of turbine T (dark green). Openings ahead of each curved turbine-blade practically build nozzles for inlet and outlet of diagonal canals.



Pump P (red) turns faster than turbine and correspondingly also flow A between pump and turbine moves faster than turbine. Like at water-jet-pumps thus water is ´dragged-off´ sideward openings. Any faster flow affects like suction onto slower flows aside. Water of flow G follows flow A without resistance, by ´own drive´. Flow A is not slowed down, but enlarged mass-throughput results without corresponding input of power - like well known by any water-jet-pump (resp. see details at previous chapters).

That suction affects back within canals to inlet at other side of turbine. There, fast flow B sucks water off passage-way H out of turbine, practically as supply for previous flow G. Like mentioned upside, movement-pattern of flows A and B show movement-component off turbine-side-wall (corresponding to suction-effect of water-jet-pump) and at the other hand show movement-component towards turbine-side-wall (corresponding to flow into inlets of diagonal canals).

Each common turbine-blade has a pressure-side and a suction-side resp. both building canals between. Openings of side-walls of that turbine are each installed ahead (in turning sense) of turbine-blades, i.e. flows G and H run along suction-sides S (in turning sense front-side surface of turbine-blade). Corresponding pressure-side D is represented by backside surface of turbine-blade, which is installed ahead of (in turning sense).

That pressure-side is far away from corresponding suction-side and aside is protected by backward-showing blade and at the other side by backward-reaching side-wall of turbine. Practically no flow exists at that pressure-side, water turns around system axis like turbine, i.e. at pressure-surfaces affects normal static pressure (resp. water-particles hit onto that wall permanently by given vehemence and frequency, details see previous chapter and many earlier chapters).

Alongside suction-surfaces S water flows and thus water-particles hit onto that wall with correspondingly reduced frequency and by angles more acute. Thus at suction-surfaces weights less static pressure. Surplus turning momentum of that turbine exclusively is based on that difference of static pressures onto blade´s both surfaces. Flows are not decelerated at all.

At picture 07.02.04 downside-left, cross-section is sketched with view from aside at turbine-wall T (dark green) and visible parts of turbine-blades TS (light green) between. Downside-right at this picture is sketched corresponding schematic longitudinal cross-sectional view.

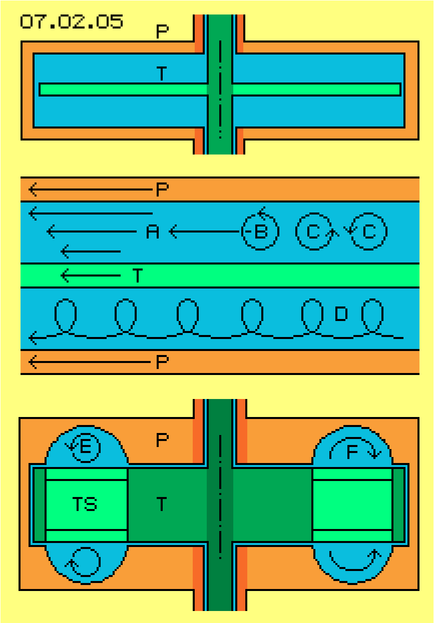
Hidden Pressure-Surfaces

Similar movement processes are described at chapter 05.09. ´Dam-Pressure-Motor´, based on phenomenal ability of trout. Within their grills corresponding cross-flows exist, however with outlets at both sides of fish. Relative fast flows exist alongside plane suction-sides of grill while flows are hindered at pressure-sides by brush-like structures. Difference of static pressures allows trout motionless keeping stationary within strong flows. At this Meander-Wheel, that principle is used extremely as pressure-sides are protected completely against flows.

Also one year ago, that conception by ´wing-profiles with hidden pressure-sides´ was described at chapter 05.06. ´Suction-Wind-Mill´. At common wing flow exists also at downside surface, nevertheless wings generate lift-forces ten times stronger than demanded drive-forces. ´Wing-profiles´ used here show practically no flow at downside resp. pressure-surface and thus are more effective. Mentioned Suction-Wind-Mill is not only easy to construct, but will work even by smaller size much more effective than described at that early chapter.

At common turbine-blades, flows at pressure-surfaces have priority, because by redirection and deceleration mechanical turning momentum is achieved. Kinetic energy of flow thereby becomes transferred into mechanical movement energy. So there only one shape of energy is transferred into an other shape. Opposite, here at these turbine-blades kinetic energy of flow is not changed, but flow is used only indirectly by side-effect of its reduced (static) side-pressure. That´s exclusive base for any benefit-surplus by fluid-machines.

Vortices-Garland



Movements of water between pump and turbine is shown more detailed by picture 07.02.05. Upside of picture, simple model is sketched once more with disk-like surfaces of pump P (red) at both sides of turbine T (green), which here also is simply shaped disk-like.

As mentioned upside, water will move at different layers A with different speeds and circled movements B come up, wandering ahead in turning sense of system. All around that movement pattern exists and thus these circle-movements C will meet and hinder each other. Transmission of different speeds becomes damaged and effect of ´sticking-suction´ comes up. At least by phases exist unstructured turbulences with also negative ´friction-losses´.

Well structured flows and continuous transmission between flows of different speeds is only possible by garland-like movement pattern. Turning movement between surfaces (like here at cross-sectional view marked B) is overlaid by turning motion at radial level, like sketched at longitudinal cross-sectional view and marked E.

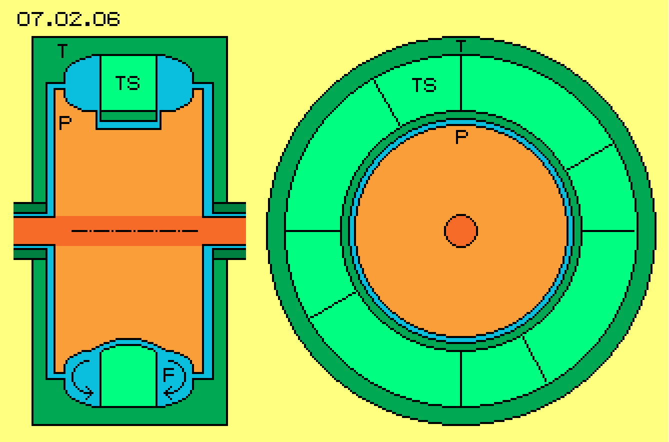
Combined turnings represent friction-less ´roller-bearing´ as water-cylinder is turning between surfaces and same time is wandering ahead in turning sense of system, all around synchronously. That movement pattern exists by flows which continuously move into diagonal directions. If that shape of movement is combined with diagonal running flows within turbine-canals, optimum circulation F within whole system is achieved.

Circulation by Centrifugal-Forces

By that circulation F now at large radius exists prevailing movement towards turbine resp. into turbine, while outlet of turbine occurs further inside. Movements from left to right and vice versa no longer occur at likely radius and thus different centrifugal forces come up and must be considered. Picture 07.02.06 shows, now an other arrangement of pump and turbine must be used, opposite to previous pictures.

Slow turning turbine T (green) now must be positioned outside, so slower turning water shows corresponding less centrifugal forces. Like mentioned upside, masses push and ´stick´ at surfaces of most long radius. If now pump P (red) is installed inside, water becomes accelerated at pump-surfaces and by stronger centrifugal forces pushes outward.

At the one hand, water outside is pressed into turbine, at the other hand that faster flow drags water off slower turning turbine-canals inward-aside. Circulation within total system thus is enforced by these different centrifugal forces at surfaces of fast pump and slow turbine. Pump should reach outward only to middle of turbine-blade, while outside surfaces completely are build by turbine.



Turbine practically is cylinder-shaped with disks at both sides, including pump. From that turbine-cylinder, turbine-blades reach inward. At longitudinal cross-sectional view downside is sketched, inner surface of turbine-blades could even show round contours and pump there could be shaped correspondingly.

That inner side of turbine could even have slots, however only one slot ahead of each suction-surface and only at their outlet-side. Pump not only will drag off water aside but now already further inside at outlet of turbine-canals. That additional suction-effect would increase pulling-inward of water within turbine.

At longitudinal and cross-sectional view of that picture, turbine-blades are drawn by relative small height. Cross-flows thus run still at relative likely radius, so differences of centrifugal forces within turbine are relative small. Centrifugal forces of faster flows alongside pump-surfaces however are much stronger and thus wanted mix-up is achieved, now however in shape of well structured turn-around.

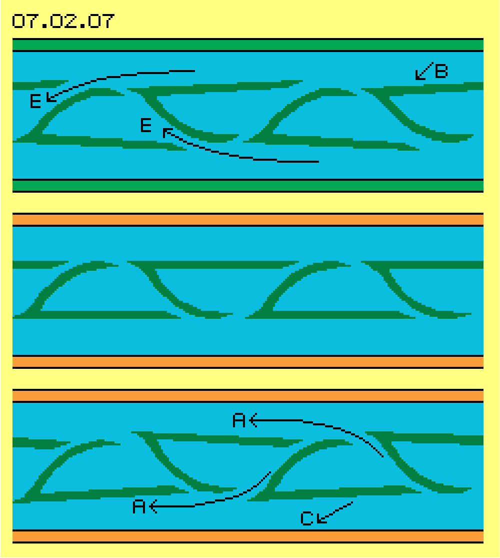
Pump accelerates water by friction at its surfaces and opposite water is decelerated by friction at surfaces of slower turning turbine. Acceleration demands power-input for drive of pump. Deceleration by turbine results turning momentum nearby same size, so power-input and -output is balanced. Average of speeds of all flows in total is constant and thus kinetic movements energies of system in total is nearby constant.

Twisted Walls

Now turbine-blades must be adjusted to that circuit with prevailing inlet at large radius and prevailing outlet further inside. In principle, inlet could be arranged only outside and outlet only inside, so canals would be diagonal also at radial level. In principle however fluid should be allowed to flow as free as possible. At picture 07.02.07 therefore is sketched a gradual solution.

At middle of picture, turbine-blades are shown by normal position with straight arrangement of side-walls. Upside is shown cross-sectional view at larger radius and downside at smaller radius. All turbine-blades here are drawn same size, however in reality blades at large radius are some longer stretched and inside are some shorter.

Upside at picture, cross-section at large radius is sketched, where prevailingly flow towards inlet E of turbine-canals occurs. Each whole turbine-blade inclusive its attached side-wall is twisted by three degrees, so inlet opens some more towards left resp. right side.



Water became accelerated by pump and also here outside water moves faster than turbine, at this picture from right to left side along turbine-side-walls. Water ´disappears´ into each inlet E. Flow B towards turbine can go on also behind each inlet, because next turbine-side-wall is shifted some diagonal. So rolling circulation at this area can steady wander ahead.

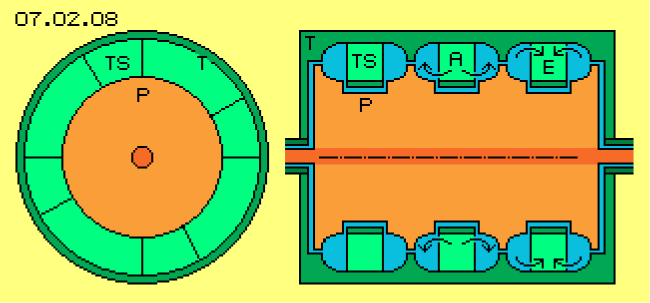
Downside at this picture, cross-section at smaller radius is shown, where prevailingly water is sucked off outlet A of turbine-canals. Rolling flow C there is moving off turbine. At the one hand, thus water is ´dragged´ off outlets, at the other hand that diagonal flow can go on between openings, as side-walls of turbine are shifted some outward-ahead (in turning sense).

Basic structure of turbine-blades thus exists only at middle radius, while further outside and further inside total blades resp. at least its side-walls are twisted by e.g. three degrees. Outside that twist opens inlets some more to left and right side, inside that opposite twist turns outlets further towards left resp. right side.

At inner radius that outlet opens wide. Like mentioned upside, that opening could even start already at inner side of turbine-blades. These blades show rather complex shape, at the other hand these constructional elements could be shaped much better, e.g. concerning these round contours. Here however only principle of that most effective movement process is presented and usable shapes in general are discussed.

Three-Cylinder-Engine

This engine could be build corresponding to previous picture 07.02.06. Turbine-blades should not be very high and also not too wide, so machine is most compact, e.g. by outer diameter of maximum 50 cm, at the other hand total length well could be 100 cm. Engine with several ´cylinders´ could be practical, like schematic shown at picture 07.02.08. That engine is build by three turbine-wheels, e.g. also three time double-wheels or any other useful combination could be installed at one common system shaft.



Here at this picture for example, turbine-blades are installed between radius 13 cm and 19 cm, so are only 6 cm high and also about 6 cm wide. Common cylinder of turbine has diameter of about 40 cm and length of about 60 cm. Each eight blades of previous profile are arranged at one cylinder. Effective surface thus is 6 * 6 * 8 * 3 = 864 cm^2 resp. 0.0864 m^2. Length of effective lever-arm is assumed by average radius of 16 cm resp. 0.16 m.

If pump now is started up to e.g. 1200 rpm, short time later also turbine will rotate by likely revolutions. Also at idle-mode exist friction-losses and drive of pump might demand e.g. 1 kW. If turbine must take load, turbine will slow down and also pump will turn some slower. At e.g. 600 rpm turbine might produce 2 kW, at the other hand drive of pump demands additional 2.5 kW for keeping original revolutions. So machine needs 1 to 3 kW for itself resp. produces general loss of about that size.

Net-performance of that engine is based exclusively on difference of static pressures at suction- and pressure-surfaces of turbine-blades. Slots aside of suction-surfaces represent nozzles and thus relative high speeds might come up there. So alongside suction-surfaces affects reduced static pressure. Naturally that fast flow will also ´suck-off´ water from pressure-surfaces. These however are far away and at the other hand, water from inlets is pressed into that ´dead-end street´. So practically no flow will exist at pressure-surfaces (and by sure if e.g. porous material is installed at pressure-sides).

Performance

At average radius of 16 cm, circumference is about 100 cm. If turbine turns by previous 600 rpm, so 10 revolutions are done each second, water at area of turbine moves by 10 m/s within space. If pump turns previous 1200 rpm, water nearby pump-surfaces moves by 20 m/s within space. Relative speed between both areas of water thus is 10 m/s.

Now based on previous circulation and cross-flows it´s realistic to assume, water moves alongside suction-surfaces by 5 m/s (while at pressure-surfaces no flow exists), however based on nozzle-effect well could move faster. Dynamic pressure of flow is P = 0.5 times density times speed by square. Density of water is 1000 kg/m^3. So here results flow-pressure of P = 0.5 * 1000 * 5^2 = 12500 kg/ms^2. Corresponding to that flow-pressure, (static) pressure-aside onto suction-surfaces is reduced (details see previous chapters).

That pressure-difference weights onto effective surface of all blades by 0.0864 m^2. Force thus is F = 12500 * 0.0864 = 1080 N. That force affects at lever-arm of average radius of 0.16 m length. Turning moment thus is M = 1080 * 0.16 = 172.8 Nm. As turbine turns by previous revolutions of 600 rpm, resulting theoretic performance P = 172.8 * 600 / 9550 = 10.8 kW. At following table these numbers are listed at fourth column.

Revolutions - Pump / Turbine	rpm	720 / 360	1200 / 600	1200 / 600	3600 / 1800
V - Pump / Turbine	m/s	12 / 6	20 / 10	20 / 10	60 / 30
V - Suction-Sides	m/s	3	5	7.5	15
P - Flow-Pressure	kg/ms^2	4500	12500	28125	112500
Force F = P * 0.0864 m^2	N	389	1080	2430	9720
Momentum M = F * 0.16 m	Nm	62	173	389	1555
Performance theoretic	kW	2.3	10.8	24.4	293.1

Based on nozzle-effect relative speeds alongside suction-surfaces well could be stronger. If these flows e.g. move by 7.5 m/s, performance practically is double by about 24.4 kW (see column 5). If machine would drive revolutions comparable with common combustion-engines, for example 3600 resp. 1800 rpm of pump resp. turbine and relative speed at suction-surfaces is assumed by 15 m/s, theoretic performance of 293.1 kW results (see column 6). Idle-revolutions probably will be some 720 / 360 rpm, where performance achieves about 2.3 kW, so previous ´needs-for-itself´ resp. general losses of about 1 to 3 kW are compensated.

Universal Engine

Previous calculations of theoretic performance naturally can show only general scales and real performance naturally will differ. Without any doubts however that engine will produce more output of power than demanding drive-forces. By variation of radius and effective surface, revolution and flow-speed alongside suction-surface, any performance is generated.

Design of turbine-blades and other surfaces will be decisive factor. It might be hard for ´hobby-handcrafts´ to build that machine. Producers of pumps and turbines however have sufficient facilities for optimizing and producing that engine.

In comparison to combustion-engines that machine has minimum number of constructional elements and weight/performance-relation is most best. This motor works with null consumption of conventional sources of energy and completely emission-free, so less side-units are demanded. It will be practical to transfer mechanic turning momentum via generator into electric current, which is usable for many demands most effective. That engine is usable for stationary power-supply, however there are also other solutions of Free Energy (e.g. ´Cellar-Wind-Mill´ or simple ´Suction-Wind-Mill´ of previous chapters). For drive of cars however no really usable alternatives for common combustion-engines are available, so that Meander-Wheel-Engine by priority will be best for that application.

No new technology must be developed, well known techniques for production of pumps resp. turbines only must consequently be shifted onto usage of suction. Latent given kinetic energy of normal molecular movements is available for free and unlimited usage. First engines based on that principle of Meander-Wheel could be available at market within one year.

07. Fluid-Machines