

Invention of Discrete Power Converter (DPC) As Paradigm Shift In The Converting Of Mechanical Energy Powered By Gravity

During thousands of years rotating waterwheel was used for converting of energy of moving water into mechanical energy of rotational motion. Thus, waterwheel (later – hydro turbine) represents the *prime mover* as *simple machine* - wheel and axle, which collides with water (as working medium) and gets the rotation of shaft for connection of useful mechanical load.

The rotating waterwheel may be defined as paradigm in the classical hydro-power discipline as *normal science* by Kohn [1], as well in the process of converting of mechanical energy.

Nevertheless, we may find the examples of alternative approach to a prevailing framework (paradigm). So, talented engineer, scientist and educator in Daniel W. Mead even in faraway 1915 wrote in his fundamental book [2]:

“... Mechanically, energy is exertion of force through space. As result this impressed force produces the motion of working medium in the space. If some mechanism being in contact (collides) with working medium is getting its own motion and is becoming the prime mover. In this way, the transformation of energy can be performed up to various useful mechanical loads. Obviously, in hydro power we are dealing with gravity force and water as working medium, however other flowing masses (as sand, gravel, slurry and grain, etc.) may be considered as working medium forced by gravity to input of new original prime movers. ...”

We can see that “other flowing masses ... as working medium ... forced by gravity” extends and modifies the phrase "hydro-power" significantly and are associated with "new original prime movers” which should be invented evidently. This looks like a prevision of fundamental change in this framework.

Finally, this new original prime mover was invented (and protected like IP product) as Discrete Power Converter (DPC). <http://dpc-renewable-energy.com/>

Thus, being based on Kahn’s work an implementation of DPC (as original machine - compound levers with cross-linked mechanical feedbacks) in the process of converting of energy (in hydropower particularly) can be considered as paradigm shift because of transition from traditional (continuous) principle of operating and construction to another – self oscillation mode [3].

DPC represents the fundamental changes in the basic concept and experimental practice of prime mover powered by gravity as follows:

1. The operation of power converter in the regime of mechanical relaxation oscillator (unlike continuous rotating of waterwheel) under acting of gravity as input force for mechanism.

Mechanically the relaxation oscillator generates a periodical sequence of short pulses (kinetic strokes) during which the useful work can be performed and some part of energy

will be dissipated as losses (in the form of heat as usual). Between pulses the mechanism is motionless and the losses do not exist (just potential energy is accumulated).

Because of fact that relaxation time is longer than short pulse the average losses are reduced in compare to continuous presence of losses in the continuous operating mode (like waterwheel).

By analogy this principle does work very well in switch mode power supply (SMPS in electronics) and human heart (as discrete pump of blood).

We can recognise here another paradigm regarding to relaxation oscillator as power converter associated with different areas of science - mechanics, electronics and biology.

2. Capability to provide simultaneously two kinds of mechanical motions in the orthogonal planes: reciprocate in vertical plane (as rocking levers), and reversible rotation (as main shaft) in horizontal plane.

This feature allows to extend broadly the functionality of machine because of different useful mechanical loads can be connected at the same time. For example, two piston pumps can be attached to left and right shoulders of rocking lever and some shaker (sieve) can be attached to main shaft. Thus, a lot of mechanical works can be done without electrical energy in simple way.

3. Possibility of using different flowing working medium (not only water) powered by gravity for generating of mechanical energy.

This is most valuable and useful feature for application of DPC in Renewable Energy. A lot of different free flowing working medium (both, natural and industrial origin) can be used for generating of mechanical energy (as "built-in" subsystems) in various branches of industry. It may be sand, gravel, ore, slurry, brine, saw dust, granulated materials and powders in industry and grain, seeds, nuts, tubers, husk, peelings in agriculture, etc. This possibility is important for modern demand to save energy by "green technologies".

4. Symmetrical clear and simple structure which allows to manufacture of machine easy and apply the mechanical loads in symmetrical manner.

DPC can be built easy from simple materials (even wood) in regular workshop, by local manpower. No special needs to bearing of the main shaft is required because of discrete regime of operation is provided. The group of DPC can be integrated in some local mechanical power system by cascade connection in series to the same flow of working medium.

5. Usage cross-type mechanical feedback for realisation of self-oscillating mechanism of symmetrical type.

The combination of two rocking levers (one as "feeder" with working medium, another as main rocking beam) which linked by mechanical feedback in "compound lever" allows to realise the self-oscillating mode of mechanism.

This is first in the world symmetrical self-oscillating machine as adequate mechanical model of well-known electronic device - *astable multivibrator* (AMV). This is clear evidence of similarity of acting of cross-type feedback for realisation of mode of relaxation oscillator in different symmetric structures - electronics and mechanics. Therefore, the concept can be used for development and design of innovative mechanisms and machines.

6. Capability to split input flow of working medium into two output equal parts.

This feature of DPC is not involved in power conversion but may be also considered as useful side effect. The principle of operation of machine allows to split the input flow of working medium on two equal output flows. Thus, DPC capable not only to generate the mechanical energy but also to divert symmetrically the input flow at the same time. So that power converter/hopper (loader) might be designed as compound machine.

7. Possibility to generate the sequence of equal periods of time.

Again, this feature of DPC is not involved in power conversion but is associated with possibility of self-oscillator to generate the sequence of time periods, as mechanical timer. This periodical action can be used for some signaling or for timing some technological operations, etc.

DPC project is being now in "seed stage" and corresponds to TRL6 (Technology Readiness Level by US DOE gradation - testing of small scale prototype). Implementation of DPC concepts in practice may produce the effects and potential impacts on the environment and society particularly for less developed countries.

On the base of pp 2, 3, 4, 6 many new simple mechanisms and machines can be designed (as water powered piston pumps, desalinators of lever's type, other mechanical drivers) for irrigation, agriculture, food processing under specific local conditions with lack of developed industrial and human resources. It could to reduce hard work for poor men and women in small households by getting the alternative sources of mechanical energy on cooperative base. Thanking to simplicity the manufacturing and maintenance of these machines can be organised also under local conditions which create additional employment and boost local economy.

Thus, development of DPC technology may be considered as Responsible Research and Innovation by main definitions [4].

References

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