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PHYSICAL ASPECTS OF SELF-ACTING HYDRODYNAMIC SYSTEMS

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Introduction

In science, like in life, bright periods of inspiration, elation, success and victory are invariably followed by dark spells of paradoxes, stagnation, crisis, totalitarianism and reaction. The above goes well with the words of R. Feinman saying, "If you sink your teeth deeper into almost any of our physical theories you will eventually get into some troublesome situation".

When at the very dawn of aviation Samuel Langley was asked, "Why do aviators fail?" the Professor answered, "Maybe, because the man started from the end and tried to build flying machines before he knew the laws on which all flying is based".

Something like that happened in science: pseudo-scientific theories based on erroneous interpretation of theoretical phenomena were forced into science by totalitarian methods and dominated in it, whereas other concepts running counter to them were banished, treated as false, reactionary, etc. Just remember the notorious directive of 1938 concerning works of Prof. N. Kasterin (1869-1947) or heated discussions on inertia forces held in 1936-1937 and later on psychology, genetics, cybernetics, etc. The Inertia Vortex Hydromechanics authored by Professor Alexander Milovich (1874-1958) [1] had the same bad luck.

Having failed to get an insight into natural mechanisms of basic physical phenomena, with any dissidence suppressed, fundamental science of that time hampered development of new technologies. New inventions were given development not thanks to existing theoretical knowledge but often contrary to them, by fighting with dogmatic concepts and institutions [2].

All the above-mentioned refers in the first place to the nature of vortex formation and application of vortex motion energy. The knowledge of real fundamentals of these processes helps better understand the torus [3] and other technologies as well as physical aspects of multiple seemingly mysterious natural phenomena.

1. Vortex Motion Energy

The issue of how great the resistance of a fluid medium to solid substances moving therein may be is one of the oldest hydrodynamics problems.

Nevertheless, for a long time all attempts to find its general theoretical solution failed.

Historically, two theories were proposed.

According to Newton's theory of inertia (or "impact theory"), the fluid medium resistance to solid bodies moving within may be caused by the inertia of fluid particles as they run onto the body, hence the resistance force should be proportional to the momentum of the fluid mass running onto the body. However, all attempts to estimate the value of this force were not successful since every time a calculated force turned out to be half the actual value.

Supporters of the "friction" theory attribute the *fluid medium resistance* primarily to *friction* of the body surface against the fluid flowing about it and express such friction by purely experimental formulas.

Yet, when introducing the "force of friction" term, nobody provided a clear definition of the nature of this force and its mechanical meaning. Meanwhile, the above force was already known to differ fundamentally from the friction force of solids since the former proved to be unaffected by pressure.

Beginning with Helmholtz, it was found that the contact surface between a fluid flow and a static wall is always a vortex surface. *The fluid viscosity was thought to be the source of vortex generation.*

The above provided the basis for development of an interface layer theory.

Having applied his interface layer theory to an aircraft wing, Prandtl saw that theoretically the force of resistance was dramatically less than the one obtained from experiments and could not explain appearance of the body profile resistance force or wing lift force.

Both theories had nothing to do with the reality.

As the aviation matured, times came when engineers mocked all attempts of mechanical people to create analytical theories in support of practice.

The first half of the 20^{th} century was marked by painstaking efforts of scientists to reconcile the classical hydrodynamics theory with achievements of engineering practice in the aviation field, which resulted in revision of basic principles of the fluid mechanics.

As a result, the revised mechanics *ruled out the necessity of dealing with ideal fluid* as well as with inertia of its particles. It was generally agreed that *physical properties of a fluid* (primarily, viscosity) *determine the basic motion pattern* that can be assessed only in the course of experiments [4].

The fluid mechanics turned into a tool for mathematical processing of experimental data and issuing recommendations on how to optimize needed experimental research having lost the *predictive capability* of a physical theory.

Since the nature of the force that resisted the motion of a body in liquid or gas was not cleared out, mechanics was mislead by a wrong notion that viscosity of liquid was the only source to produce vortices. With such theoretical assumptions dominating in current technologies, no wonder nobody tried to make use of the vortex motion energy.

From the above point of view, ideal fluid devoid of viscosity cannot be a source of vortex generation, therefore such fluid cannot interact with bodies it flows about, i.e. does not resist to their motion in it.

But in that case it is hardly possible to understand disappearance of the momentum force of fluid mass running onto the body, which Newton thought to be the main cause of fluid medium resistance because particles of even the most ideal fluid still remain material bodies.

It is obvious that the passive force of viscosity always directed at destroying any relative motion of fluid particles cannot be the main source of vortices, being, on the contrary, the only reason for their attenuation.

As for the vortex generation effect, i.e. conversion of forward motion of fluid particles to their axial rotation, which actually stops longitudinal movement of this part of the fluid, such an effect is made possible only if *there is an obstacle to rectilinear movement of particles by inertia.*

The Obstacle Theory developed by Professor Milovich which is based on operation of a system of sources or force tubes activated in a body by a fluid flow running onto it, or on alternative vortex layers invariably covering the side surface of any body flown about by fluid irrespective of viscosity, provides answers to all questions related to dynamic body and fluid interaction. Moreover, the theory can correctly account for the fluid viscosity effect since a viscous fluid moving along force tubes requires a greater pressure difference at their ends, as compared to ideal

fluid, given the same fluid flow rate, i.e. *viscosity increases the resistance strength of a fluid medium.*

"To complete the analysis of the new fluid medium resistance theory fundamentals," Prof. Milovich wrote, "we have to clear them of the viscosity effect, show that they also hold true *for ideal fluid*. The more so that the interface vortex layer theory based on the viscosity effect in the sheerest fluid layer enveloping the whole body surface is still adhered to. Obviously, the most objective solution would be experimenting directly with ideal fluid.

According to the Institute of Physical Problems, such a fluid is liquid helium possessing superfluidity. But operating on liquid helium is not easy and can be done only at the Institute of Physical Problems. Hopefully, they will be able to carry out such an experiment for the sake of science.

In the meantime we may only provide proof *ex adverso* (by contradiction).

If, based on the interface layer theory, we assume the zero factor of fluid viscosity, then the interface layer effect will cease to exist. According to this theory, vortices will not occur on the surface of a body flown about. Flowing about will become potential and there will be no interaction force generated between the body and the fluid. However, should the fluid have no viscosity as an ideal fluid, its particles at any rate will still have a mass and force of inertia. *The momentum of such fluid will remain a certain force* regardless of viscosity, and this force will not disappear together with viscosity, as was shown by nobody else but Newton; therefore, if a body is flown about even by most ideal fluid, we will invariably have their interaction force, i.e. vortex generation and development." [5].

The above assumptions were set forth by Professor Milovich in 1930-1940*ies*.

In the last century sixties, American scientists carried out experiments that showed appearance of vortex rings in liquid helium at super-low temperatures, in a fluid almost fully devoid of viscosity and friction [6].

"Undoubtedly", A. Milovich wrote, "further development of this theory will change the current views on phenomena occurring in a liquid (or air) medium with solid bodies, such as aircraft, ships, etc., moving through, which is sure to promote progress in respective fields of engineering while the theory fundamentals will give rise to further development of the science of fluid mechanics." [5].

The theories of sources, the dipole, dynamic interaction of solids and fluid developed by Professor Milovich [5] disclose causes of vortex generation, the nature

and properties of resistance forces making it possible to trace relations between them and other natural forces known to us as well as to predict their effect under unknown conditions. Notwithstanding the above, all Professor Milovich's attempts to find understanding and recognition of his scientific ideas were not successful until his last days. And after his death there was nobody to fight against pseudo-scientific views in hydrodynamics.

Thus, the science that opened prospects of using vortex energy was rejected along with a potential of using accumulated knowledge for the benefit of people.

2. Dipole as an Energy Carrier

What indeed has science lost by rejecting inertia approaches to resistance forces and vortex generation processes?

It has long been known from classical hydrodynamics that an isolated infinite straightforward vortex, like a finite closed vortex, drives fluid to non-vortex motion having a speed potential.

This property of vortices though not properly checked was also tacitly superimposed onto finite-length open vortices lying with their ends on fluid boundaries [7].

From V. Thompson's theorem it follows that if the fluid motion had a non-vortex nature at its initial moment it should remain as such all the time; and on the contrary, vortex motion never changes its vortex nature.

To put it in another way, *conservative forces of nature are not able to change the initial behavior of fluid motion*.

The above approach disregarded processes of additional energy generation in these systems.

This inference, however, is not applicable to forces that have no potential such as forces of interaction between a fluid and solid bodies flown about by it that are of purely vortical nature [8].

A. Milovich corrected this error in his works:

"*Wherever a fluid medium contains sources or finite open vortices* the full energy resource of the fluid medium will vary in different points, and in the vicinity of such energy dissipators the constant Bernoulli Equation will be a variable or there will be no Bernoulli integral at all.

… A system of source points … has both kinematic and dynamic meanings. As such, the system can introduce into a fluid medium a certain new energy resource to

be dissipated by sources present in this medium. Therefore, we should treat the vortex source points of any open vortex ends as source points of dissipation in the fluid of the vortex energy additional to the fluid medium. Open finite vortices like the system of source points act as extra energy dissipators". [7].

We have already got used to and do not notice or pay attention to the fact that our environment is filled with continuous media such as air, light, electromagnetic fields, ether, etc. Therefore we hardly ever think of what in fact characterizes existence and interaction of bodies in a continuous medium. Given the continuity of a large space confined by a medium, any objects (obstacles, bodies whose properties are different from those of the medium) will be nothing but points, i.e. incommensurably small items as compared to the space occupied by the medium (compare a water drop and a pool, or the Sun and the Galaxy). And due to the material nature of this medium and its continuity (uniformly filled space) any exchange processes, processes of interaction between bodies and the medium or between bodies themselves cannot be of a local autonomous nature, in other words, *in continuous medium space there cannot be any isolated bodies that do not interact with the medium*. Due to the law of continuousness, *bodies moving in a continuum are always surrounded by ambient flows radially directed towards them and acting as sources or sinks* depending on medium and object properties. Such a body may be, for instance, a rain-drop falling into a pool or an inflated balloon rising in the air or a fish moving in water, etc. Ambient flows initiated by these movements exert a dynamic pressure in the direction of body motion. *The dynamic pressure force generated by the flow in the direction of its movement is equal to the second momentum of the flow in that direction*. Therefore, the theory that describes interaction of flows with obstacles (bodies) or other flows is at the same time a theory of force interaction (interaction forces) and may *help understand the nature of forces*.

A point in a continuous medium that ejects or sucks in this medium will be referred to as the source point.

A source point ejecting the medium from itself into the outer space will be referred to as a positive source point. On the contrary, a negative source point will be the one sucking the medium inside.

For planar movement towards the source point, the surface of the equal potential of velocities $\varphi=const$ is a circumference ($r=const$).

The flow rate of a planar source $\boldsymbol{q}$ having a unit width is defined as flow rate through the lateral area of a right circular cylinder of a unit height:

$$q = 2\pi r \frac{Q}{r} = 2\pi Q \qquad (1)$$

where $Q = \dfrac{q}{2\pi}$ is the flow rate of the medium through the lateral area which constitutes the flow rate of the source $\boldsymbol{q}$.

This flow rate $\boldsymbol{Q}$ through the lateral area is referred to as the source intensity.

The sign of the intensity determines the source sign.

If the medium has multiple sources grouped into a system, then *the whole system of sources will have the matter flow rate* equal to the algebraic sum of all source flow rates, such as:

$$q = 2\pi(Q + Q_1 + Q_2 + \cdots) \qquad (2)$$

Though formally meeting hydrodynamic equations, the source point theory set forth here cannot yet reflect real natural phenomena since *it tacitly accepts a physically impossible effect - full extermination or creation of matter from nothing in source points,* since it is clear that *the source point might suck all the matter from the environment into itself only in case all the matter in it could disappear as a result of conversion to nothing. Or on the contrary, the source point might continuously eject the matter from itself, provided this matter could be continually generated in it from nothing*. In both cases we would invariably come to having the whole matter volume increased or decreased in space, i.e. to its variability. Such change in the initial volume of the medium is expressed by equation (2).

And since initial volumes of real media should remain constant during their motion, to recover the reality of the source theory an additional condition, besides the continuity equation, should be met that expresses *a non-variability or constancy condition of the initial volume of the medium substance*.

According to equation (2) this condition may be represented by a below equation:

$$q = 2\pi(Q + Q_1 + Q_2 + \cdots) = 0 \qquad (3)$$

The algebraic sum of the multiple source intensities should be zero:

$$(Q + Q_1 + Q_2 + \cdots) = 0 \qquad (4)$$

and thereby the equation shows that in reality there exists a system of at least two source points with intensities equal in value but opposite in sign rather than one isolated source point system. *A point of continuous medium space that is a coincident point of two source points with equal intensities but opposite signs is referred to as a source pair or a dipole* [5].

A vortex or a dipole is a dynamic material structure integrating two extremes (polarities)- radiant and sink - continuous ejection and suction of matter, which ensures circulation inside the structure. It means that if from any point of a system filled with medium, some amount of medium is *extracted* with a flow rate $\boldsymbol{q}$, the system *responds* by accepting an extra quantity of medium equal to the one extracted in any other point. That is, any external interaction (with $\boldsymbol{q}$ flow rate) does not leave the system unaffected but *generates a responsive counteraction* (with $-\boldsymbol{q}$ flow rate) to compensate for the *changed density inside the system*. On the contrary, to extract a fraction of medium with a flow rate $\boldsymbol{q}$ from a closed system, a pressure drop is needed, i.e. it is necessary to apply a force, perform work against the system response. Accordingly, if the *medium is partially extracted* from a closed system under external forces, then *the inside pressure is lowered,* and should an open collector be additionally connected at any point of the system, the external medium will rush into the system, i.e. the collector will have a sucking capability providing a *suction mode*. In the teaching of the ancient Consecrated this condition corresponds to the "inhale", passive state, darkness, In or female energy. On the contrary, when medium is *fed into* the system from outside, a higher pressure is generated inside, and if there is an additional collector installed the excess medium will rush out through the collector creating *a pressure mode*, corresponding to "exhale", active state, brightness, Yan or male energy.

Generally speaking, such a system is self-oscillating. This property of the dipole generates and maintains the process of permanent motion in nature.

Normally, a dipole, or vortex, is a dynamic structure, a kinematic pattern of a fluid flow, as shown in Fig.1 [7]. This is a system of two sources having equivalent intensities ($\boldsymbol{Q}$) and opposite signs (radiant and sink), or of two oppositely directed vortices. Due to this circumstance one side of the dipole (vortex) ejects fluid (from

side ***m***) while the other side sucks it in (from side ***n***) thereby providing a pressure drop that develops a driving power (***P***) of the dipole (vortex, soliton or structures alike). The pressure force ***P*** onto the ambient fluid is directed from point n to point m increasing the pressure. The fluid medium in turn exerts pressure onto the dipole with the equivalent force but in the opposite direction. And if the dipole can move freely in the fluid, then the fluid medium pressure will move it towards the ***XX*** axis from point ***m*** to point ***n*** to decrease the pressure, The dipole will be somewhat "sucked by fluid medium" like any body flown about by fluid.

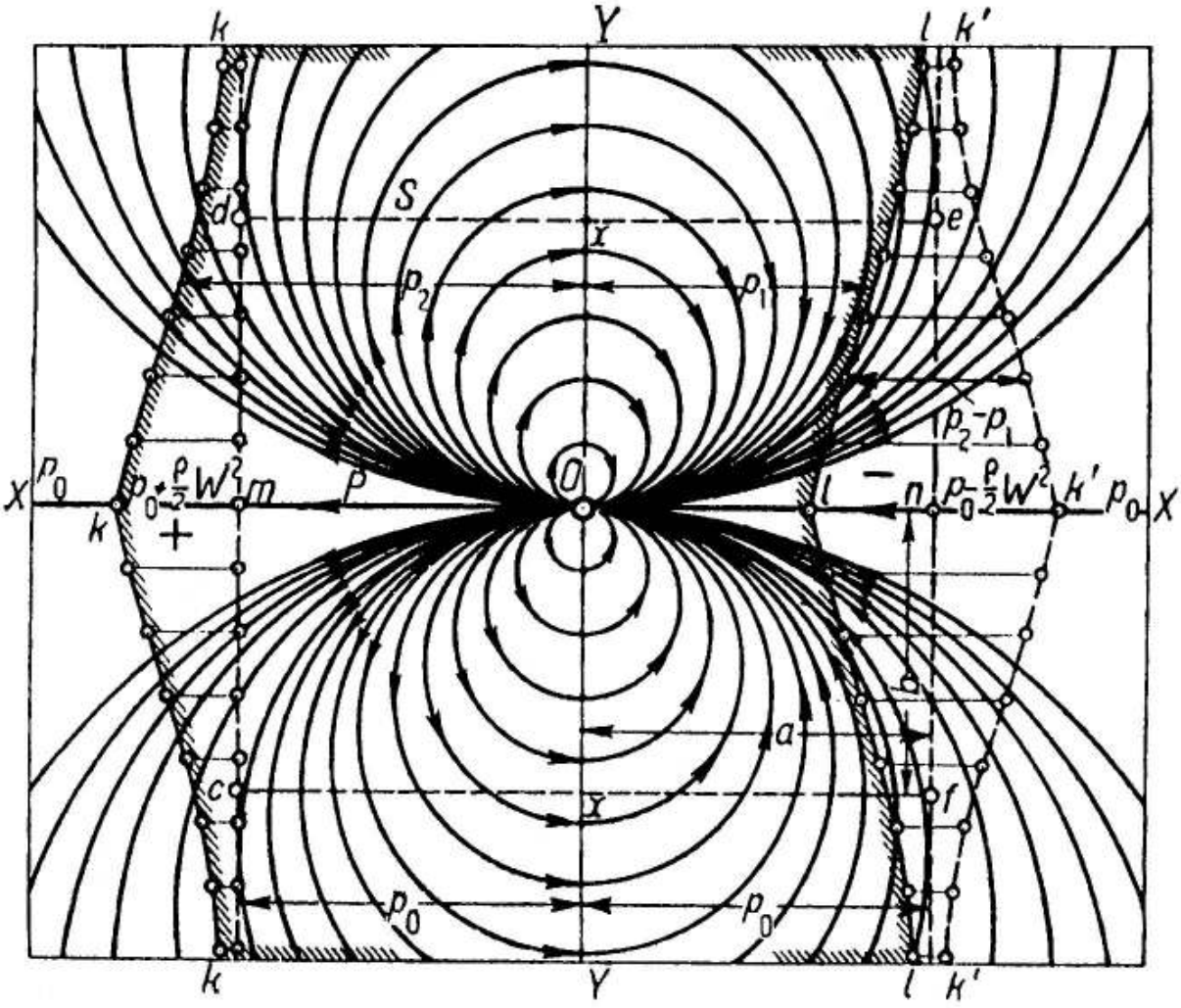

Fig. 1 [7]

To ensure reality of interaction processes in a continuous medium, it is indispensable to have both a positive source ejecting the medium (the radiant) and a negative source sucking the ambient medium (the sink). Whereas the positive source (radiant) in the medium is implemented easily by the flow reflection from the obstacle (body), the negative source (sink) can hardly be implemented without

special techniques. One of the solutions may be found in nature. To meet condition (3), we have to stop propagation of the medium (q=0) towards the center of the source by directing the lateral area flow Q transversely to the source radius, i.e. at a tangent to the circumference converting it to a flow rotating around the source axis *thereby producing a vortex.*

Professor Milovich proved the similarity between the vortex theory and the theory of sources – the similarity between vortex source intensities and source point intensities, and expanded the dipole nature: *the dipole is nothing else but a system of two infinitely close parallel counter rotating vortices, or of two source points having intensities equal in value but different in sign.*

The dipole imparts a definite and finite momentum to the medium along the axis of motion generated by the dipole. Therefore, the dipole is a force or the center of energy radiated by it into the ambient medium. Professor Milovich used to say that the latter idea turned out to be so difficult for comprehension that even experts in hydrodynamics were reluctant to trust it.

To eliminate all doubts in the full reality of the dipole, a device was fabricated to simulate its activity [5].

To implement the key property of the dipole, that is simultaneous suction and ejection of the same amount of fluid with equal velocities, Professor Milovich made a loop-like channel ***ABC*** (Fig.2[5]) with a square cross-section.

The sucking and ejecting ends ***A*** and ***C*** of this channel have a similar cross-sectional area f and are located inversely against each other in the same horizontal plane in such a way as if their extension shown by dot lines formed something like a straight-forward tube ***AC***.

To activate an air flow in this channel, a propeller ***K*** rotating round axis ***00*** is installed in its upper wider part ***B***. The whole channel is suspended on a horizontal axis going through point ***0'*** and normal to the drawing plane. The channel ***ABC*** may freely rotate round this axis under the effect of a force developed at the channel ends ***A*** and ***C*** during the propeller operation, while the design eliminates the influence of the propeller pulling force on this rotation. The force ***P*** is measured by a weight ***G*** placed on a scale ***E***. The scale ***E*** is suspended at the end of channel ***C*** by means of a thin wire running about a movable block ***D***.

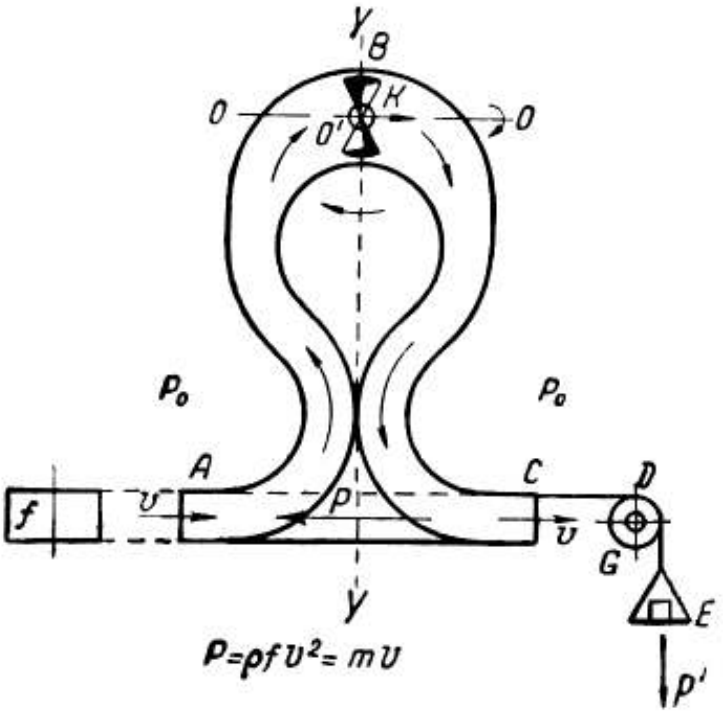

Fig. 2 [5]

The key issue to be resolved by an experiment was whether the force ***P*** would appear that affected the ends of the channel ***ABC*** during the propeller operation with the air flow moving along the channel since according to a common judgment based on a wrong application of the Bernoulli's equation, the pressure value at the channel ends ***A*** and ***C***, where the velocity of the inlet and outlet flows is identical and equal to ***v***, should be also identical and equal to

$$H_a = p_0 - \rho\frac{v^2}{2} \quad \text{and} \quad H_c = p_0 - \rho\frac{v^2}{2} \qquad \text{(a)}$$

where $\boldsymbol{p_o}$ is the pressure of the fluid onto a surrounding container. From the above expressions (a) it follows that $\boldsymbol{H_a = H_c}$, therefore $\boldsymbol{P}=0$.

It may be inferred from the above judgment that the propeller work moving the air flow along the channel completely disappears and does not impart any additional energy to this flow. In other words, according to this judgment the energy conservation law may be cancelled and the energy converted to nothing. On the contrary, knowing that the energy imparted to the fluid by the propeller work never disappears completely we have to regard the pressure values at the channel ends

$$H_a = p_0 - \rho\frac{v^2}{2}$$

$\boldsymbol{H_a}$ and $\boldsymbol{H_c}$ to be equal to (since the fluid at this channel end is sucked into by the channel, which is possible only if the pressure inside it lower than the pressure of the ambient fluid medium) and, respectively, to $H_c = p_0 + \rho\frac{v^2}{2}$, i.e. greater that the external pressure affecting the flow strength because otherwise the fluid cannot flow out of the end ***C***. But then the pressure difference

$$H_c - H_a = p_0 + \rho\frac{v^2}{2} - (p_0 - \rho\frac{v^2}{2}) = 2\rho\frac{v^2}{2} = \rho v^2$$

will be equal not to zero but to a double flow strength, or $\boldsymbol{\rho v^2}$. Therefore, the sought-for *force **P** exerted on the **ABC** channel ends will be also not equal to zero but to*

$$P = \rho f v^2 = mv \quad (5)$$

i.e. *to the second momentum of the fluid flowing along the channel.*

According to Professor Milovich, an experiment carried out using the above-described apparatus fully confirmed all abstract theorems [5].

The fundamentals of inertia concepts of vortex formation and dynamic interaction proposed by A. Milovich and rejected by modern science show that:

- inflow/outflow of additional energy into/from the medium in the presence of the system of sources or finite open vortices, the dipole, is a real and fully legitimate phenomenon;

- concepts of hydrodynamics and related branches that were predominant in the past and are prevailing now are based on erroneous interpretation of facts, which is a pseudo-scientific approach;

- unprejudiced analysis and review of the theoretical concepts of fluid mechanics will help science to overcome the crisis.

3. Body inertia

If we try to separate all nature directly perceived by us into its constituent parts, we will identify two most general properties mutually inherent to each other: matter and motion.

The core of classical physics is the law of matter and energy conservation. Matter/energy can neither appear from nothing nor disappear to nowhere without any reason. But the tendency to simplification and unification in science left *the issue of the natural mechanism of the common conservation law unresolved. The natural mechanism of perpetual motion of matter remained unrevealed* due to the same reason. Science has not progressed beyond the statement that "matter keeps perpetual motion", treating it as an axiom without trying to understand the nature of the matter perpetual motion.

Aristotle and his followers considered force to be the reason for motion. They believed a body will stop movement as soon as it is no longer affected by force. *Force is necessary for keeping motion.*

Newton understood that it was beyond his power to give a direct answer to the principal philosophic question about the mechanism of perpetual circulation, transformation and motion of matter, so for the beginning he restricted his activity by only external manifestations of matter motion and interaction. Newton enclosed the internal nature of matter motion into a "black box" named "inherent force of matter" and characterized all processes inside the "box" as inertia, an attribute of the mass or matter confined to a body. The causes of an external phenomenon of the impact on the body motion were summarized by Newton in the form of "applied forces" that became dominating in the classical mechanics.

According to the first Newton's law *any body, until it remains insulated, saves its state of rest or rectilinear motion*. Such a body is characterized as *free* and its motion is referred to as *free motion* or *inertial motion* [9]. Newton attributed the free motion to the *inherent force* intrinsic in the matter *that provided the state of rest or rectilinear motion of a body*, not disclosing the nature of this force.

Newton's followers entirely discarded forces needed to maintain free motion and interpreted the first Newton's law such that no forces were needed to maintain the state of rest or uniform motion. Force was thought to be the cause of momentum change only. But since this change is produced by other bodies, the following definition of force was accepted: force is a measure of bodies interaction intensity

manifested by their momentum change. That is, only "applied forces" remained in the basics of mechanics. Using the approach that negated free motion forces in nature a conclusion was made that, "strictly speaking, free bodies do not exist. They are nothing else but physical abstractions" [9].

Finally, classical mechanics got rid of free motion forces taking for granted a reference system wherein all free bodies move in a rectilinear manner. This system is called an inertia reference system. Such interpretation deprives the inertia law of its original meaning reducing it to an assertion that instead of a real force providing free motion of matter there is at least one inertial reference system, i.e. its physico-mathematical abstraction.

The above approach cut off from reality had the following consequences: in the long run, the reality of an interim medium was sacrificed to eliminate contradictions and the concept of "interaction by touch", or of a contact to transfer a stimulus to a remote distance, was rejected.

With applied forces predominant in physics, the latter deals mainly with interactions that result in relocation of the mass center, i.e. with situations wherein the mass center is relocated under the effect of a force pulse.

But no less interesting is a case when the mass center of a body is fixed and the process pertains to Newton's first law of inertia.

There are two states of fluid equilibrium or quiescence to be distinguished: absolute and relative.

The fluid quiescent or equilibrium state is described by the equilibrium equation $dP = \rho(Xdx + Ydy + Zdz)$ referred to as the principal hydrostatic equation.

The above equation is used to solve all issues related to research into the equilibrium of a fluid affected only by the gravity force.

The mechanical interpretation of the principal equilibrium equation in hydrostatics shows that any *pressure increment* when a fluid particle moves from one point in space to another is possible only if *a certain amount of work of external forces is performed. This work may be both positive and negative, i.e. either external forces can be active or the fluid itself can output work. The fluid turns out to be capable of work, possessing a certain energy amount* [10].

However, not any system of external forces is capable of maintaining fluid equilibrium. Given equal temperatures in all points of the fluid, the fluid equilibrium

may be maintained only by forces that have a potential. That is, *keeping a quiescent state is possible only in the presence of a conservative force field.*

These provisions laid the basis for laws of thermodynamics.

If a fluid is held in a container that moves in space, then its particles besides being affected by the gravity force acceleration will be also affected by the acceleration of fluid particles movement together with the container. Under the effect of all these forces the fluid will acquire a certain form of equilibrium differing from the one when the container is motionless. Such a form of fluid equilibrium is called *relative equilibrium*.

Professor Milovich attached special importance to systems in the relative equilibrium state:

"Motion of a fluid particle like any material body may be always separated into two principal components:

a) motion followed by relocation of the particle's center of gravity in space;

b) rotation of a particle as a solid body round its gravity center remaining motionless in space (vortex motion).

Modern engineering can deal with and utilize the energy of only the first type (a) of fluid motion

The energy of the second type fluid motion (b), or *the vortex motion energy is fully wasted energy*.

The latter shows how important it is for engineers to study this type of movements and their impact on the mode of its (fluid) whole mass motion [6]".

In other words, science treats open vortices as energy dissipating structures only believing that additional energy of closed vortices or flows is unlikely to be transferred to the external environment without opening a vortex since it is generally agreed that work of conservative field forces in a closed path is equal to zero. The work of fields is fully compensated and there will be no energy advantage.

Is the issue of using vortex motion energy indeed so hopeless?

4. Physics of Relative Equilibrium

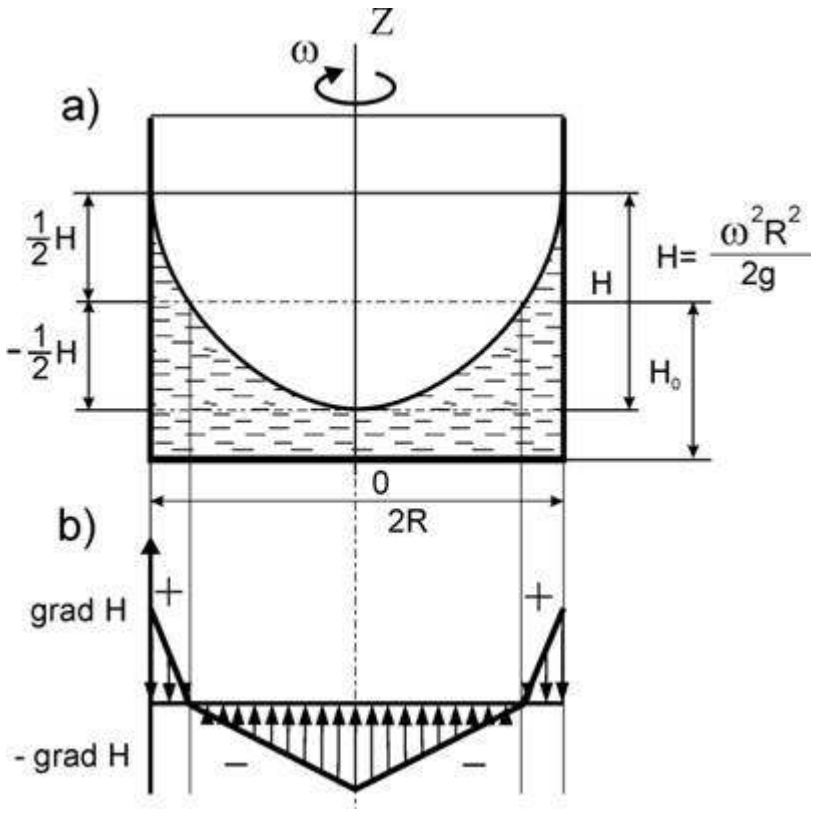

Fig. 3

Let us consider a case when the mass of fluid uniformly rotating round its vertical axis is in equilibrium. Let a cylindrical container ("Newton's bucket") (fig.3a) holding heavy fluid with ρ density rotate uniformly at a constant angular velocity ω round a fixed vertical up-directed axis ***0Z.*** In this case the fluid particles rotate round the axis at the same angular velocity. Their circumferential velocities are proportional to the distance to the axis.

For the fluid mass to keep equilibrium under such conditions, *acceleration of the centrifugal force trying to remove fluid particles away from the rotation axis should be neutralized by equal pressures* eventually followed by pressure distribution over the paraboloid of rotation round the axis ***0Z*** [10].

A body rotating round the axis passing through its mass center, is in relative equilibrium regardless of whether the rotation velocity changes or not. Such a body is called free and its motion is referred to as free motion or inertia motion.

If the body rotates round the axis passing through the mass center, then any line passing through the rotation axis has a pair of forces - two parallel oppositely directed and modulo equal momentum forces, impulses of tangential velocity of fluid

particles. The pair of the forces does not have a resultant force. In other words, there is no force affecting the mass center of the rotating body, so it should stay at rest, be motionless. Since the body does not have the resultant force, the mass center does not move, therefore the work equals zero, the kinetic energy of the body particles is not consumed. The process of rotation round the axis passing through the mass center is *idle*. The body rotating in this way can neither oppose to outside impulses of applied kinetic energy nor consume this energy, it can only increase the kinetic rotation energy of its particles by a value of external action energy (the axis friction force is neglected). This is *a process of transformation of an unbalanced applied force into kinetic energy of the body substance*. Having no obstruction to its motion the force impulse increases the living or inherent force of the body substance, i.e. the body inertia. An ability of such a system to accumulate rotation energy is used in a flywheel.

On the other hand, the potential of a fluid on the free surface of the rotation paraboloid is a sum of works to overcome the gravitation and the centrifugal force for the mass transfer during rotation. As we noted, this is an idle process, so the work should be zero. How can it go on under conditions of constant energy inflow?

When affected by the centrifugal inertia forces the fluid particles move towards the wall away from the rotation axis. On the wall (fig.3) backflow occurs, hence the initial fluid level $\boldsymbol{H_o}$ and pressure in the container rise by $dH = \frac{1}{2} \cdot \frac{\omega^2 R^2}{2g}$. Under the backflow influence *compression stresses* occur in the fluid in that place. It is positive work.

On the contrary, the fluid particles moving under their own momentum away from the rotation axis reduce the pressure and their free surface near the axis, but the external atmosphere pressure $\boldsymbol{Po}$ tends to increase it. As a result the level at the axis drops against the initial fluid level $\boldsymbol{H_o}$ by $dH = \frac{1}{2} \cdot \frac{\omega^2 R^2}{2g}$ and *tensile stresses* occur near the rotation axis. It is negative work. Figure 1b shows a diagram of fluid pressure change in a rotating container.

These pressure types are used in classical thermodynamics and hydrostatics as a key parameter of an equilibrium system.

In the area between the wall and the axis a *standing wave* is present.

A similar pressure distribution picture will also take place when fluid is rotating in a lidded cylindrical container or in separate radial pipes filled to the top with fluid. But the pressure is balanced by the container walls rather than by the atmosphere pressure; besides, it is not followed by the level change and displayed in the form of stresses in the fluid.

5. A Self-Acting Hydraulic Turbine

The revealed stress distributions during rotation of a body round the axis traversing its mass center make the flywheel break, thus adversely affecting the body. But is it possible to use all these facts to advantage?

The answer is 'yes' - by using the dipole as a force carrier.

The classic thermodynamics deals only with equilibrium systems all portions of which have identical values of thermodynamic parameters. Body rotation round the axis traversing the mass center is characteristic of a non-equilibrium isochoric system having a constant fluid volume. Under the effect of the centrifugal force in the gravity field the volume is re-distributed in space followed by pressure re-distribution. As a result, the system includes two areas identified earlier that have opposite pressure change values. A higher, excessive pressure exists near the container wall and it would be safe to say that a *hot source is at work* here because any pressure rise is always followed by heating. On the contrary, under effect of centrifugal forces a lower pressure, or sucking in, is maintained at the rotation axis, at this place *a cold source is active* resulting in cooling down. The area between the axis and the container wall contains two active interrelated sources located in series and having different polarities. These are the ends of a finite open vortex (the dipole) that make up a "free running" thermal engine that can be started up by reverse circulation from the hot source towards the cold source. Similar temperature stratifications during rotational circulation of gas and liquid were observed by J. Ranque [11] and Viktor Schauberger (1885-1958) [12], and later by R. Hilsch, Yu. Potapov [11], et al.

A temperature change in a system affected by pressure changes is caused by respective phase transformations (condensation, evaporation) in liquid.

Any physical structure has a high-density core surrounded by a less dense atmospheric layer made of the same substance the core is composed of [2]. A layer of saturating vapor over liquid may be taken as an example. But like any atmosphere that penetrates into denser porous, crystalline or other structures (bodies), including

liquid, *vapor is* also *present inside the liquid rather than over its surface only*. Voids (pores) in the liquid structure are filled with its vapor whose molecules are coupled with liquid molecules. This process of physical adsorption is similar to the condensation process, and *physical adsorption heat is similar to condensation heat by its value*. The physical adsorption heat is about ten times less than the chemical adsorption heat.

The density and pressure of the saturating vapor at constant temperatures are non-variable values that are different for different liquids. *Vapor always tends to maintain a constant pressure and hence a constant vapor density*. If the vapor density changes under the influence of external factors (carrying away or bringing vapor particles, for instance, by wind), then its pressure also changes [13]. The liquid coupled with vapor responds by trying to recover the vapor density, ensure its constant pressure. Thus lowering the pressure leads to evaporation followed by heat absorption, i.e. cooling down, while pressure buildup is followed by condensation with heat (energy) release, i.e. by heating. This re-confirms the well-known statement that energy (heat) is matter and vice versa as well as the inverse preposition – *any thermal changes in vapor or liquid lead to a change in vapor density (pressure) followed by appropriate phase transformations in liquid.*

A fluid is a two-component two-phase medium (liquid + vapor) and phase transformations therein provide the main mechanism of energy exchange in physical processes.

The second thermodynamics law means that *heat passes of itself from a hotter body to a colder body (in a mechanical system a body falls down in the gravity field) without additional energy application.* Thermal engines operate based on such free heat transition from a hot body to a cold one. On the contrary, heat cannot pass of itself from a colder body to a hotter body; energy should be spent for heat transfer (like for raising a body upwards). Usually, for overcoming resistance between the sources in this direction a power device (a pump) is used that needs additional energy.

The centrifugal force of inertia developed during the body rotation round the axis is the force that provides formation of two interrelated sources of the thermal engine with opposite polarities as well as the fluid motion from the colder source to the hotter source to meet the Second law of thermodynamics. The need for an additional power device is hereby eliminated. The system being in a relatively

equilibrium state is an idle system that maintains conditions for the thermal engine operation inside itself without applied energy consumption; such a system is a self-sustained or self-acting oscillation system.

The only thing left to do is to switch our thermal engine from the idle state to the operation state.

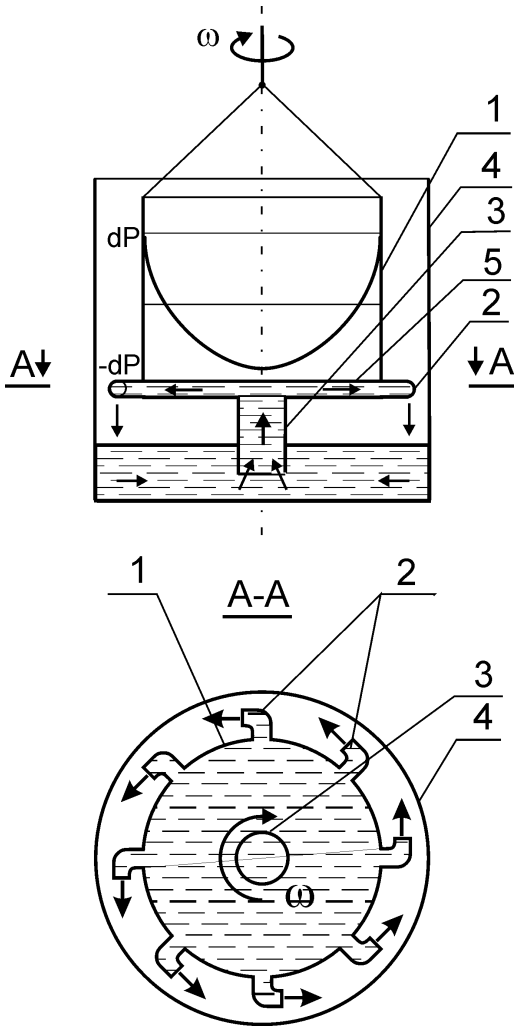

Fig. 4

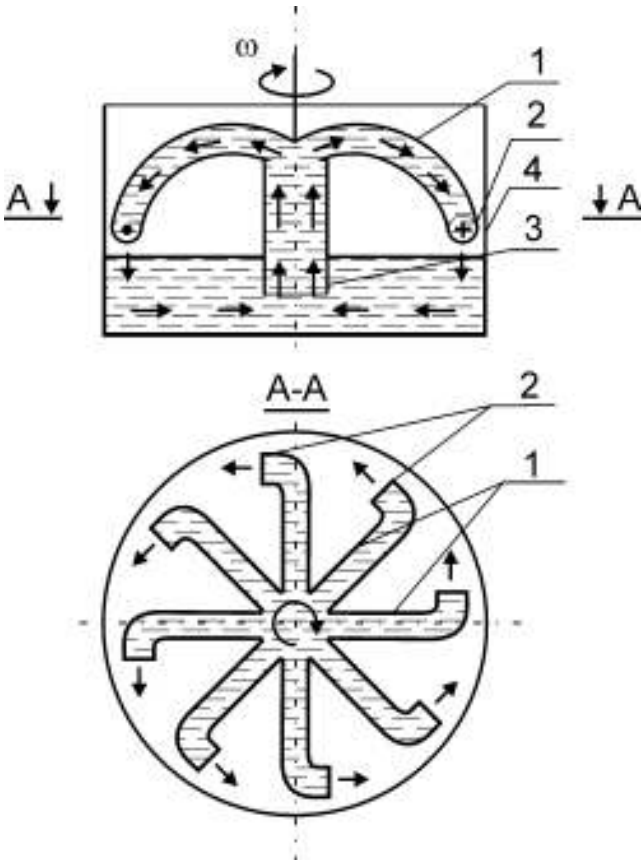

Fig. 5

To start up the thermal engine, i.e. to ensure motion from the hotter source to the colder one (Fig.4), pairwise located holes are made in the side wall near the bottom of a closed (with a lid (5)) container (1) filled with liquid. Bent tubes with nozzles (2) directed towards the side opposite to the rotation direction are connected to the holes. A tube (3) is connected to a hole in the container bottom, which hole is located on the axis aligned with the tube. This rotating container is placed in a pot with liquid such that the tube (3) is dipped into the liquid. The liquid from the lower container will be sucked into the rotating container through the hole in the tube (3) on the axis and the same amount will be ejected into the wall holes through the bent tubes having nozzles

(2). The liquid will start circulation. The mass of the liquid rotating in the upper container will still remain in the relative equilibrium. A device with similar properties that simultaneously sucks and ejects the same amount of liquid is referred to, as we know, *a dipole*.

An example of dipole implementation is an ordinary siphon, a bent (∩-shaped) tube filled with water. In one segment of the siphon tube liquid is sucked in and rises upwards, and if its level in the second segment is lower (due to the higher pressure) than in the sucking segment the falling liquid is ejected.

Instead of a rotating container filled with liquid a turbine (Fig. 5) may be used made of siphon tubes (1) located pairwise in symmetry with the axis. The ejecting segment of the siphon is bent (2) at the end in the direction opposite to the rotation direction and may or may not be provided with a nozzle. All sucking segments are placed at the rotation axis or combined into a common tube (3) concentric with the rotation axis. The pressure difference (hydraulic drop) existing between the siphon ends, $H = \frac{\omega^2 R^2}{2g}$, caused by the centrifugal force makes the siphon work.

One of the advantages of such engines is their continuous operation cycle.

Additional kinetic energy of liquid circulation is utilized through the flow reaction force (***R*** *horizont.*) at the bent parts of the turbine walls.

The reaction force that reflects the effect of a flowing jet on the walls is equal to [14]:

$$R_{гориз} = \frac{\gamma}{g} Fww = 2\gamma F \frac{w^2}{2g} = 2\gamma FH$$

where γ is volume weight;

F is output hole cross-section;

w is horizontal speed of outflow from the hole;

H is liquid pressure (head).

In case of liquid rotation: $H = \frac{\omega^2 R^2}{2g}$.

The reaction force is used for creation of an additional torque that enhances the existing system torque. Maintaining a positive feedback ensures growth of liquid

rotation rate (energy), which in turn increases the circulation energy. The constant energy (torque) growth obtained may be used, for instance, for rotation of the generator or other operational units.

By a similar method Viktor Schauberger employed the energy of additional liquid circulation in his water-driven implosion machine as early as in the thirtieth last century for home illumination and heating [12]. Fig.6 [12] shows an early drawing of the implosion machine, and Fig.7 [12] is a photograph of Viktor Schauberger near the last operating model of his home implosion power generator in 1955.

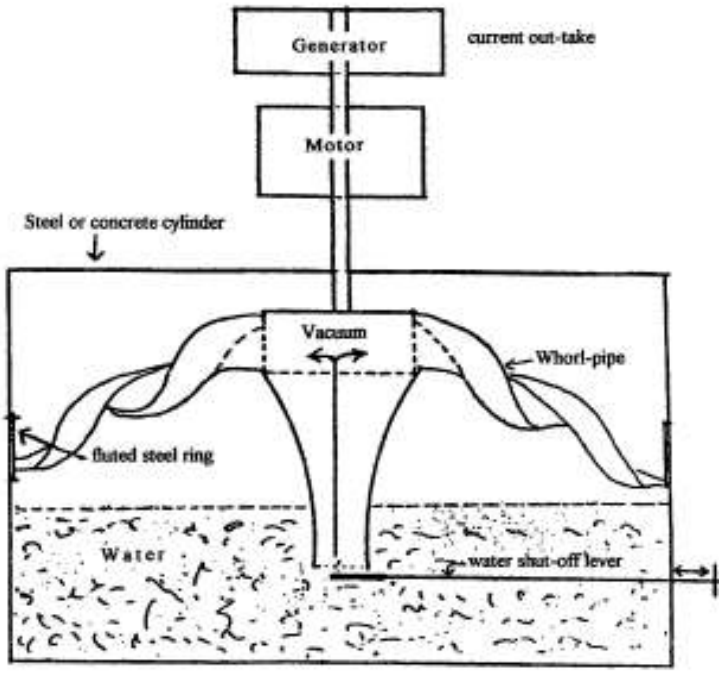

Fig. 6 [12]

Fig. 7 [12]

The described principles of using additional circulation energy of the dipole within the idle process may be employed in creation of similar electromagnetic and other self-acting devices.

Examples of successful technical implementation and application of a dipole are provided by rapidly progressing, multi-application and promising torus technologies making use of devices with eversible tore shells [15,16].

There is a great number of natural processes exhibiting additional circulation energy, e.g. transverse circulation processes at river bends, processes of cyclone, whirlwind or typhoon generation, etc.

Conclusion

Inflow of additional energy into the ambient or outflow from the ambient in the presence of dipoles, a system of sources or finite open vortices is a real and fully legitimate phenomenon.

There are no principal difficulties in resolving the issue of low-cost power supplies. The problem is solved by making use of additional circulation energy within idle processes occurring in interactive conservative fields of different nature.

Development and application of self-acting self-oscillation processes is hampered by predominant pseudo-scientific views and notions.

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