THE VACUUM-PROPULSION TECHNOLOGY- CONCEPT AND APPLICATIONS

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Abstract: *most aircraft made in the XXth and XXIst Century are based on achieving the buoyancy on special surfaces ("bearing surfaces") and the physical principle applied (in connection with the Bernoulli's law regarding the flowing of fluids) correlates the bearing force with the profile and the active bearing surface, also with the fluid characteristics, including its velocity. The result was that the low pressure which can be obtained at the extrados of the bearing surface, gives the amount of the lift force. Therefore, the attention of researchers was directed toward the possibility of obtaining very low pressure on the extrados, possibly even the vacuum. Thus it came to vacuum propulsion technology presented in this paper*

Key words: *VTOL / UAV / Unconventional*

1. A BRIEF HISTORY

To make easy the flight and even to make the individual flying apparatus for humans, were ancient desires of the people, starting from the mythological Icarus, and reaching the works of Leonardo da Vinci, who studied the art of flight at birds and bats. Later in the XIXth Century, it reborn the interest in creating an aircraft and a number of inventors have tried to find the necessary technological solutions.

Between them, a few even managed to obtain very interesting results:

- *Karl Wilhelm Otto Lilienthal* (b. May 23, 1848 in Anklam, Germany - d. Aug. 10, 1896 Berlin, after an accident with one of his flying machines) was an aviation pioneer. It is believed, that he was the first man who built and flew an aircraft heavier than air, by launching it down the slope. His experiments helped to establish later some of the laws of aerodynamics. However, it is questionable the Lilienthal's position as the first aviator of the mankind, because there were similar attempts long before the era of Lilenthal. It is known for instance that in ancient China were built kites the size of a current hang glider today, that could easily carry a man. It is also known the case of George Cayley who in 1852 built and tested a flying apparatus by his own design. But there are other examples.

-*Traian Vuia* (b. Aug. 17, 1872, Bujoru, Caras-Severin County, in Austro-Hungary - d. September 3, 1950, Bucharest, Romania) was a romanian inventor and aviation pioneer. On 18 March 1906 he achieved the first self-propelled flight with a heavier than air apparatus, taking off from a flat surface. He started the construction of his flying machine in the fall of 1904, with the design and construction of the engine. Since 1904 it granted patents for his inventions. The mechanical works are completed since February 1905 but the aircraft wasn’t been ready until December, after being mounted its engine. It will become the "Vuia I" or "The Bat" because of the shape of its wings. It had a total weight of 250 kg, with a bearing surface of 14 m², equipped with a 20 HP engine. The experiments began in 1905, with the car version, the wings being folded. In the March 18, 1906 at Montesson, near Paris, the apparatus "Vuia I" was experienced in flight. After a runway of 50 meters, the flying machine rose into the air at a height of three feet and flew a distance of 12 m, at which the propeller blades were stopped and the plane landed.

-*Henri Marie Coanda* (b. Bucharest on June 7, 1886 - d. Bucharest on 25 november 1972) was a prolific romanian inventor best known for his pioneering work in aviation and the achievement of the lenticular aerodyne.

Thus, in 1910 he invented, built and experienced at Issy-les-Moulineaux field, near Paris, the first jet aircraft. In 1934 he obtained a patent in France for "*Method and device for deflecting a stream of fluid that penetrates another fluid*", which actually refered to the phenomenon known today as the "Coanda effect".

The applications of this phenomenon led him in particular to some important results in terms of aircraft hypersustentation. Thus he concluded that the aviation technology is fundamentally flawed and thus laid the foundation for other technologies, at which the principles was very different and the aerodynamic of aircraft differed substantially from the classical models, the new concept being able to obtain outstanding technical and flying performances, as was the case of the so-called "lenticular aerodyne."

From the perspective of this paper, our attention is focused on a very special application that Coanda gave to his “lenticular aerodyne”,- the so-called " Coanda flying epaulettes ", an advanced individual flying apparatus.

-*Viktor Schauberger* (b.30 June 1885 - d.25 September 1958) was an austrian inventor and visionary, forest ranger by profession. As a naturalist, he observed with great attention the natural phenomena and tried to explain and reproduce them artificially with the aid of the devices which he invented. Among his most important discoveries, it should be noted that it was the first to observe the wrong principle of operation of the classic propeller (which in general terms is the principle of the inclined plane) and made a new device ("the repulsin") for the replacement of the classic propellers.

For this new device he found applications both in energetics and propulsion. Later, he worked for the Nazi and there are some informations (unverified and unconfirmed officially) that he would designed and built a series of small experimental aircrafts, equipped with "repulsine".

-*Rudolf Liciar* is a german-romanian inventor who lived in Brasov in the interwar period. He was borned probably at the end of the XIXth Century in the Austro-Hungarian Empire, and he was been a long time fellow countryman with Viktor Schauberger.

In the present day, it is not known exactly in what context they met and how how Liciar had come to know a large part of the technological secrets held by Schauberger. It is known, however, that such technological informations, Liciar has obtained by entering in conntact with the austrian and german personnel of the numerous delegations which visited the industrial and agricultural regions of the eastern part of the Austro-Hungarian Empire. It is assumed that in this context, at some point, he could even met Viktor Schauberger himself.

The fact is that Liciar made the same observations as Schauberger about the wrong principle of operation for the propeller, except that, Liciar called the method as "*vacuum-propulsion*" and the device was called "*cyclonoid*". Also, Liciar worked several years for the Nazis and it was assumed he would have made some small aircrafts, which were later known under the generic name of "*foo-fighters*". The method of vacuum-propulsion can be applied in the field of energetics and propulsion, in the latter case, “*the cyclonoid*” (or “*the repulsin*”, according to Schauberger) could be achieved in two manners: sustentation (lift) cyclonoid and propulsive cyclonoid. The practical application to which we refer in this paper is mainly based on the technology invented by Rudolf Liciar.

-*Virgilius Justin Capra* (b. February 22, 1933 at Magureni, Prahova, Romania) is a romanian inventor. From the multitude of his inventions, innovations and experimental constructions, the most interesting from the perspective of this paper is the Capra's invention of 1956, when he made the first flying jetpack, an individual flying apparatus equipped with mini-rocket engines. Justin Capra has made over the years many models of small vehicles or motorcycles, trying to develop models for serial production, characterized by low fuel consumption and acceptable performance of maximum range, autonomy and reliability.

2. THE SPECIFIC PROBLEMS

The last two centuries have not some notable performances officially recorded, in achieving of a small individual aircraft which would be capable to enable the long flight in conditions of economicity and reliability.

With the development in the field of propulsion systems, these have increased their fuel consumption and become more and more complex and subject to risks of failure.

We mentioned that there were no such performances which be *officially* recorded, knowing that in a more discreet regime, if not secret, some inventors and/or builders apparently managed to obtain outstanding performances: it is the case of Henri Marie Coanda, Rudolf Liciar and similarly, Viktor Schauberger. Perhaps the invention attributed to Liciar, belongs to its origin, to Schauberger, but the detailed work of Schauberger is still unknown, and in that case we will rely on the known inventions of Rudolf Liciar.

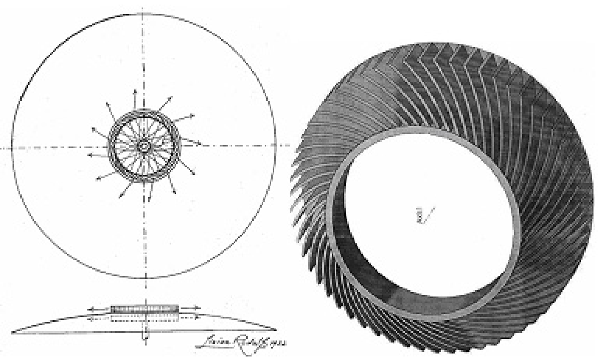

Fig.1 The Cyclonoid- its general configuration (right).

The *Cyclonoid* is actually a compressor machine with a completely and utterly special design, its configuration is such as to allow the achievement of vacuum in the space between the blades and the air exhaust after a trajectory that describes a cycloidal line; then the air jets can be taken by a stator device to steer them in a convenient way, virtually in order to use their energy, which is wasted at the classic propeller. The *cyclonoid* rotor (**left**) is disposed in the center of a (semi)lenticular aerodyne and the air jets expelled from the space between the *cyclonoid* blades, are used to blow the extrados of the semilenticular hypersustentation surface; the air jets exhausted from the *cyclonoid* have a laminar flowing regime, describing cycloids that start from a common center. By moving vertically, up and down, the *cyclonoid*, the vertical, static or downward flight is achieved. This is made by using semi-discoidal surface for hyper or hipo-sustentation, by blowing the jets of air above or below the semi-lenticular surface.

As observed ever since the first attempts of making an individual flying machine, from technological standpoint arose a number of impediments: the relatively large bearing surface (cca.15m^2) necessary to support in the air of a man of medium build, which has made to fail all the attempts to achieve artificial wings that could catch on the pilot's arms (to be manually driven); the need for a prime mover (a machine that transforms energy from/to thermal, electrical or pressure to/from mechanical form) capable of high power but also compact and light enough so that it can be worn by a man, condition virtually fulfilled only by the Coanda and Liciar inventions; the need for a compact and easy folding flying apparatus, which can be easily attached on the human body, in a short period of time; the condition as the prime mover possess enough autonomy and does not require an expensive fuel or complicated technology for the fuel supply system; regarding its structure and functioning, the individual flying machine must not involve major hazards and also it must be characterized by an acceptable level of reliability.

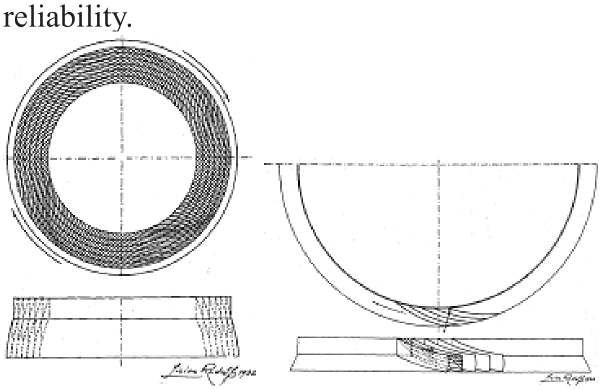

Fig. 2 *Cyclonoidal* rotors

Left overlapped so that their blades to be disposed one in the extension of the other, and therefore the surface between the blades to be increased, known that as the surface over which the vacuum is made, is higher, the performance will be better.

The cycloidal blades (**right**) forming segments which are placed at equal angles to each other and bordered at their upper side by the wall of the ring device on which the blades are mounted, so that the air cannot invade the space between the blades once it has been ejected from there, the moment when the rotor reached the tangential speed of 396 m/sec.

To meet all these criteria, according the technology used by Coanda and Liciar, the author of this paper proposes the following solutions in order to build an experimental/ demonstrative individual flying machine:

-the use of *vacuum-propulsion* technology to ensure the vertical take-off/landing without the need for use of the same method throughout the flight, but necessarily during the take-off; the optional use of the same technology to achieve a relatively high speed propulsion inside the dense layers of the atmosphere;

-the use of flexible wings partially manually driven, which must be a folding wing, and allows the controlled modification of geometry in order to achieve the flight maneuver during gliding or propelled flight; this flexible and fully folding wing would allow the gliding and safe landing in case of failure of mechanical sustentation and propulsion system, regardless of flight altitude; also, it would allow the long-marsh gliding flight, using the atmospheric streams;

-the achievement of the individual flying apparatus must apply a hybrid formula between the classic glider (improved by adopting the bat wing mechanism used as a mobile wing, not rigid, manually operated) and the sustentative/ propeller *cyclonoid* invented by Liciar, devices which will be relatively small and the pilot could worn them as a knapsack; at take-off, the pilot would use only the sustentative *cyclonoid* then he will open the folding wings and optionally, the propeller *cyclonoid*. At a sufficiently altitude, he may shut down the sustentation/propulsion engines and continue the gliding flight.

3. THE AERODYNAMICS OF THE *CYCLONOID*

When a body is moving through the air or in other fluid environment, against its displacement is exerted the resistance of the environment, the value of which varies depending on the shape of the body and its speed. If we take the case of a body which fall from a great height, its speed would increase according the laws of mechanics (regarding the motion in gravitational field, the fall of bodies) but at the same time, it would increase the air resistance (the drag) that opposes motion. When the two forces (weight and drag) come to be equal, it will reach an equilibrium and hence the movement of the body become uniform, compared to the initial constant acceleration. We say therefore that *the speed limit* has been reached. But if we take the case of a plane that moves at a speed of 100 Km/h, it is similar to the case in which the plane would stand still and the wind would move with the speed of 30 m/sec, the device thus supporting a pressure of 100 Kg/cm^2. The locomotive of a train moving at a speed of 100 km/h will have to consume approx. ½ of the power to overcome the air resistance (the drag) ! Despite the huge progress made in the last two centuries in the field of aerodynamics and its applications, the laws of aerodynamic drag are not fixed, because they depend on many factors. However, it have been determined in practice a series of general formulas that give satisfactory results and therefore it does not insist on this. For example, the first determination of the laws for aerodynamic drag, more empirical, was made for speeds between 4 and 60 m/ sec. At higher speeds, the laws are changing. Currently, we have adopted some simplistic formulas that seek to give sufficiently accurate values of aerodynamic resistance, regardless of the speed. The changes of the laws of aerodynamics at high speeds are given by the regime of discontinuity. At a speed between 4 and 60 m/sec the aerodynamic drag is lower for a body in the form of a drop of water, moving at the curved part forward. Contrary to the expectations, when a drop of water moves with the sharp part forward, it will face an higher aerodynamic drag.

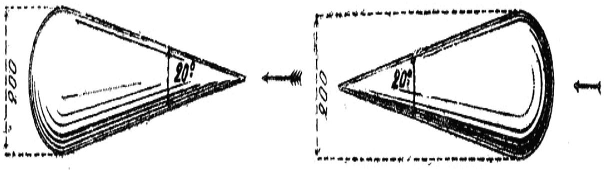

Fig. 3 The case of droplet of water: for the sharp leading edge, the aerodynamic resistance is higher, but with the rounded leading edge and a sharp trailing edge, the aerodynamic drag is lower

For a flat surface, it was observed that the air resistance is a function of surface size, velocity and angle of the direction of motion. In this case, we can say that: R = f (s, v, α) and the variations of this function proved difficult to study. In the case of an orthogonal movement, we have a surface moving in a direction perpendicular to its plane, and the air resistance are given by the relation:

$$R = k\Delta S v^2 \quad (1)$$

so that, the pressure is proportional to the value of surface and the square of speed, where Δ ("delta") is the density of the fluid (air), with the observation that in fact, this relation expressed the lows of Newton but applied to fluid resistance. Note that the relations and the calculation presented in these pages, follow the models applied to the early XXth Century by Rudolf Liciar and Viktor Schauberger. Therefore, they did not work corresponding the IS (International System), but at that time accepted systems. Furthermore, if we consider $k\Delta = \varphi$ and also consider the air as fluid, we have the air resistance expression:

$$R = \varphi S v^2 \quad (2)$$

The determination of φ can be theoretical or experimental. For example, Newton and Poncelet sought to express it depending on the density of air. If the surface *S* is moved orthogonally, it will hit the air volume *Sv*, which put into movement receives the kinetic energy:

$$\frac{1}{2} mv^2, \quad (3)$$

but

$$\frac{1}{2} mv^2 = \frac{1}{2} \cdot \frac{Sv\Delta}{g} v^2, \quad (4)$$

wherein $\Delta = 1.293$ Kg/m^3 at t = 0 ^{0}C and p = 760 mmHg.

In this situation, the mechanical work developed because the aerodynamic drag is Rv and will be equal to the kinetic energy, ie:

$$R \cdot v = \frac{1}{2} \cdot \frac{Sv}{g} v^2 \quad (5)$$

or

$$R = \frac{\Delta \cdot S \cdot v^2}{2g}, \quad (6)$$

if S = 1 m^2 and v = 1 m/sec, we will have:

$$R = \varphi = \frac{\Delta}{2g} = 0{,}065\ sv^2, \quad (7)$$

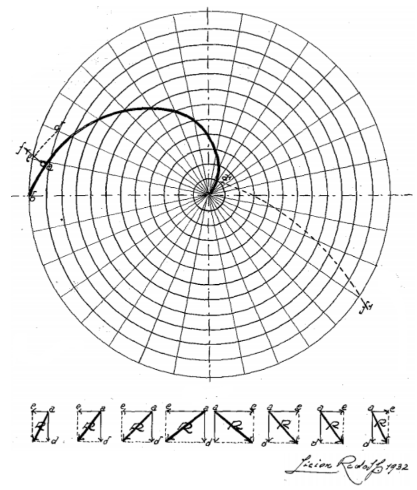

Fig. 4 The *cyclonoid* device (above view), composed of multiple rotors disposed symmetrically.

The cycloidal trajectory of air streams (bold line) from a common center towards the periphery. Such a trajectory is described by the jets of air from all the inter- blades spaces. The air is expelled from the space between the blades to the periphery of the rotor describing cycloids; it is also presented the variation of radial angle but this Newton's coefficient may have much larger values up to 0.13. Especially because φ varies with altitude and temperature. It is already known that φ is dependent on Δ, but Δ varies with temperature and pressure, according the Gay-Lussac relation:

$$\Delta = \Delta_0 \frac{H}{760} \cdot \frac{1}{1+\alpha t}, \qquad (8)$$

where Δ_0 is the air density at t = 0^0C and p = 760 mmHg

and Δ is the density of air at the temperature *t* and pressure *p* = *H*,

$1 + t$ is the binomial of gas expansion, with the value $\alpha = \frac{1}{273}$ = 0,00366.

Considering all these aspects, Newton was the one who formulated the first law of dependence between drah and other physical quantities, such as: the drag is proportional to the density of the fluid; it is also proportional to the square of velocity; at the same time, it is proportional to the surface; from the point of view of the application mode, the drag is perpendicular to the surface and proportional to the square sine of the incidence angle (angle formed by the studied surface with its direction of movement).

These have been the starting observations, but in fact, the laws of aerodynamics that give us the aerodynamic resistance, are more complex because we must consider not only the action of air on the leading edge of the considered body, but also the action at the trailing edge.

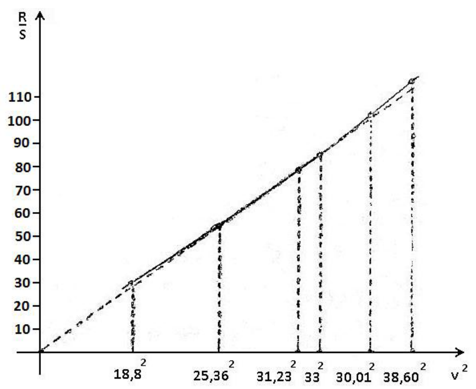

Fig.5 The graph showing the variation of drag/surface ratio depending on square velocity, according to G. Eiffel

Thereby, the experiments have demonstrated that the drag doesn't vary rigorous with the square velocity and even less with the square sine of the incidence angle.

Obviously, this should not mean that the Newton's observations were not correct, but they was incomplete.

Those comments concerned therefore only one part of the casuistry, ignoring the case of the high speeds, which Newton did not have how to experience during his era.

At present, from the study of the largest part of books and scientific papers of aerodynamics, resulted that the calculation of the drag is often used the so-called "law of square speeds", since it often corresponds to the majority of practical cases.

The reason for this is quite simple: a body moving through the air at a speed v = 1 m/sec, strikes every second a number *M* of air molecules, and thus, at the speed v it will hit a number of *vM* molecules. Therefore, it will result a proportional reaction force, in the first case with ($M \cdot 1$) and in the second case, with ($M \cdot v$) where appears the term v^2. As it can be seen, we took into account the existence of friction forces between the molecules, which is acceptable at low speeds but completely unacceptable for high speeds. Since the end of the XIXth Century, after Eiffel's experiences, it was known that it can draw a curve of which ordinates are proportional to the drag on the known surface, and the abscissas are proportional to the square velocity (Fig. 5). If the relation

$$R = \varphi s f(v^2), \qquad (9)$$

should be strictly accurate, the experimental curve would have to be confused with a straight line passing through the origin. The drag is then increased by the low pressure formed in the rear side of the studied body, near its trailing edge. To this is added the air compression in the leading edge region, which also enhances the aerodynamic drag, especially in transonic speed regime, and at the emergence of sonic boom, on which the compression makes the maximum effect for that velocity regime.

The maximum speed of the air which is expanded in vacuum was considered that given by:

$$V = \sqrt{2gh}, \qquad (10)$$

where *h* is the atmospheric pressure.

Both the acceleration of gravity and the pressure are given in centimetric values. This is basically the Galileo's relation applied in this case in an interesting way. The question is how calculated from the beginning of the XXth Century, Schauberger and Liciar, the speed of air expansion from the normal atmosphere pressure to vacuum, using the Galileo relation ?

The pressure at sea level is approximately 10^5 N/m^2 and the standard air density is 1.29 kg/m^3. If we consider as the air density would be relatively constant with the altitude, the height of the column of air required to produce the nominal pressure at sea level, is about 7900~8000 meters. Because the negative gradient of air density is small enough corresponding to the altitude the range of 0~8000 meters, we may thus conclude that the predominant mass of the dense Earth's atmosphere is concentrated in this layer. If it releases an object to fall from a height of 8000 meters and it should ignore the drag, the speed of the object obtained until the impact with the ground, would be 396 m/sec. Therefore, that is the speed reached by an object which falls through a vertical column of air, between the standard pressure at sea level and the pressure which theoretically is considered a relatively "vacuum", at 8000 m height, where the dense atmosphere ended. Of course, in real terms, at H = 8000 m the pressure is not equal to 0 but it is 3.56 x 10^4 Pa, ie about three times lower than at ground level. It is known that, the relation of the baric gradient in the troposphere is:

$$p = 760\left(1-\frac{h}{44300}\right)^{5,256} \qquad (11)$$

The air density at H = 8000 m is 0.5252 Kg/m^3 ie approx. 0.43 the density at sea level. According the calculations made in the early XXth Century, resulted a value of 396 m/sec, regarding the above approximations. Because this latter value was considered by Viktor Schauberger the Rudolf Liciar, also being tested in practice, we will consider as valid.

When the considered body will have a higher speed than the above mentioned value, the air will not be able to follow that body, and in the trailing edge region will be not only a low pressure, but vacuum. In this case, because of vacuum, the total drag remains constant.

The aforementioned aspect is very important because the method of *vacuumpropulsion* virtually is based on it, also the technology underlying *cyclonoid*. The device known as propeller, which is a system that uses a series of blades (at least two), which "cut the air" using some edges with the shape of the inclined plane, in order to provide a screwing inside a fluid body (air), which by the axially moving of the device, described an helix in the air.

Therefore, if we consider the example of points situated at the extremity of the above-mentioned device, they should describe in air a helical trajectory. That's why, the device is called "helix" ("propeller", in english), name which has already been consecrated, especially in the in the francophone languages. The thrust/power ratio relative to a conventional propeller is about 3 ~ 7 kgf/1 HP, in recent decades these performances have been improved through the adoption of special propeller configurations, as will be explained below. Moreover, the propeller started from the principle of operation of the bearing surfaces, ie achieving the buoyancy (lift) on the wing of an aircraft. The bouyancy is made with the inclined planes action on the jets of air which hitt the leading edge of the wing, with relatively high speed.

From their interaction with the inclined plane, results the frictional force that opposes to movement, tending to contribute to reducing the speed, but also contributes to the lift force. It follows from this brief description that the bouyancy within the classic wing is achieved by the conjugated action of the air flow on the inclined plane and the drag that arises from this interaction.

As correctly observed the inventor Rudolf Liciar since 1923, this principle of operation *is fundamentally wrong*. Unfortunately, this wrong principle of operation has been taken from the case of wing (bearing surface) and also used to produce thrust/propulsion, the case of propeller.

The propeller, generally, is a mobile rotary wing, which blows the air sufficiently strong, so that the air jets strike *the inclined plane* (the edge of propeller blades) at a high speed and by the screwing of propeller in the air, it is thrown backwards to provide a reaction force to be used for thrust or propulsion, as the propeller is positioned on front side or rear side of the aircraft. The ratio between the developed thrust and the power consumption is therefore small, and if we try to increase the size or the number of blades, the propeller becomes too heavy and it has other disadvantages related to the gyroscopic torque etc. Because of the need for resistance, the propeller blades must be sufficiently thick, which increases their total weight and the aerodynamic drag. Therefore, the modern propellers are big and heavy, presenting high aerodynamic drag, among other inconveniences.

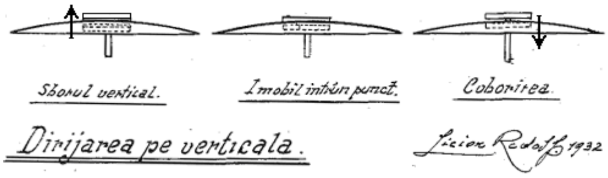

Fig.6 The *cyclonoid* rotor for vertical flight is positioned above the hipo-hypersustentation surface, on which it blows the air so that on the upper surface of this semi-lenticular device is made a low pressure boundary layer; for static flight (hover) the *cyclonoid* would be placed in the middle position, so that it blows the air equally on the extrados and intrados of the hipo-hypersustentation surface, to reach a state of equilibrium; for the descending flight the *cyclonoid* have to be moved under the intrados of hipo-sustentation surface and blowing it with air, it creates a low pressure in the underside, which gives rise to a force applied from top to bottom (hipo-sustentation) contrary to the lift force.

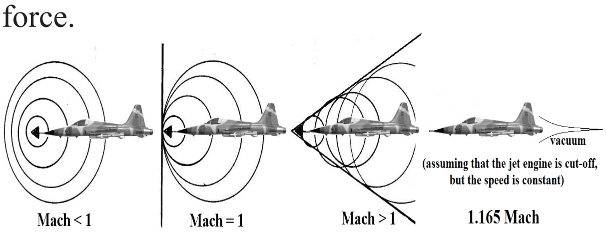

Fig.**7** The mechanical waves formed around a moving body in the atmosphere, once again demonstrates the operation of the *cyclonoid*: at subsonic speeds the air jets (on the aircraft) formed around it mechanical waves which have a spherical configuration, propagating as spherical waves; at transonic speed regime, the air tends to compress in front of the aircraft, greatly increasing the drag, and if the geometry of flying machine is not appropriate, the forces become so high that tend to destructure the plane. If it manages to resist and to enter in the supersonic flight regime (above Mach 1 = cca.340 m/sec = 1224 Km/h) the shock wave tends to detach from the surface of the flying machine, which actually exceeds the sonic waves, having a speed greater than these. At the speed of 396 m/sec (about 1.165 Mach) the air can no longer invade the region behind the trailing edge of the supersonic flying machine, where it will form the vacuum. Exactly on this phenomenon is based the *cyclonoid* and the method of *vacuum-propulsion*

Another big problem of conventional aviation propellers and wings is the control of the air jets flowing regime in the boundary layer region.

This flowing regime is the one that determine further the aerodynamic drag and the flying quality, because in certain situations (turbulent flow, the detachment of air jets from the wing surface) it occurs the loss of bouyancy and the uncontrolled flying trajectories.

To a large extent, the blades of the propeller reproduce the operating principle of the wing, except how the propeller is twisted along its length to facilitate the air flowing without its prematurely detachment from the blade surface.

Since the early XXth Century, it became evident for some scientists that the propeller has not good characteristics for this use: to ensure the lift force and the propulsion for an aircraft.

Both Viktor Schauberger and Rudolf Liciar have realized that the optimum device for lift and propulsion have to be small, lightweight, durable and based primarily on the pressure difference between the region above of a parallel plan to the direction of motion, and the rear side region (the trailing edge) where the pressure have to be in excess.

It is also known the fact that the pressure at sea level is 1033 g/cm^2 and the expansion speed of the air in vacuum is 396 m/sec,- if the air on the upper surface of a horizontal plan situated in the atmosphere at sea level, should be completely evacuated and another air masses cannot took its place, the lift force made under this plan will be in accord with the atmospheric pressure below the plan, ie 1,033 Kg/cm^2.

In general, the attempts to modernize the propeller started from the observation that the efficiency of compressors and turbines is typically higher than the propeller efficiency, so it tries to make for the propeller a similar configuration, like the aviation compressor models.

Models of new propellers having multiple and twisted blades were adopted, and the rotor/stator assembly, like the classic compressor has. Despite an overall improvement in performance, the reconfigured propeller on the model of aviation compressor, continued to have the same major disadvantages related to its poor yield, the gyroscopic effect and the transverse orientation of the exhausted air jets. Other attempts to improve the performance of the propeller, often aimed at: preventing the air jets to move laterally by placing a cowl around the propeller, avoiding the turbulence of the axial air flow by using a stator guiding device (similar to that used at the conventional axial compressors) and to adopt the solution of orientable engines (thrust vectoring or thrust vector control) provided with multiple propellers equipped with relatively large twisted blades; thereby, it attempted the reducing of drag and increasing the efficiency.

But usually, the technological difficulties assumed by adopting all these improvements, proved to be greater than the benefits. Therefore, such propellers often have only an experimental status, and their performances are not at all convincing.

Special applications of *vacuum-propulsion* method could be: to make UAVs with discoid or spherical shape, with outstanding flight performances; to create an individual flying apparatus for paratroopers and scouts; to achieve high speed military aircraft, like the aerospace vehicles etc.

CONCLUSIONS

Vacuum-propulsion technology proposed the use of certain rotary devices generically similar to classic aviation propeller or compressor (centrifugal or axial), but able to create on the upper surface extreme low pressures. This aspect leads to many advantages in terms of simplifying the aircraft technology and a significant increase in flight performances. The author therefore proposes to introduce to the attention of military research the *vacuumpropulsion* method and even to achieve a small individual flying apparatus for experimental and/or demonstrative use.

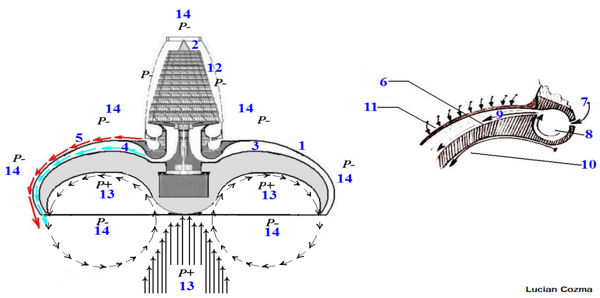

Plate 1. An example of *cyclonoid* application, the high-speed aircraft type Liciar-Coanda: 1- the porous wall is provided with orifices having a diameter between 1.5 and 3 mm, according to the total size of the surface; 2- the shaft is mobile, therefore the cone for conversion of the shock wave can be moved forward and backward; 3- the flowing surface is provided with helical guiding blades (aerodynamic fins); 4- the relatively cold air is drawn axially, and then it will be blown on an inner surface provided with spiral guiding blades (fins); 5- the mixed jet, consisting of exhausted flue gases and cold air; 6- the flowing surface which vortexed the fluid jets; 7- the pressure chamber (where it is the compressed air); 8- the combustion chamber; 9- Coanda profile and the exhaust slot; 10- the cool air jet from the intrados; 11- the porous wall; 12- the multistage propulsive *cyclonoid* (according to Rudolf Liciar patent); 13- the low pressure region; 14- the high-pressure region; 15- the supply installation and the power source

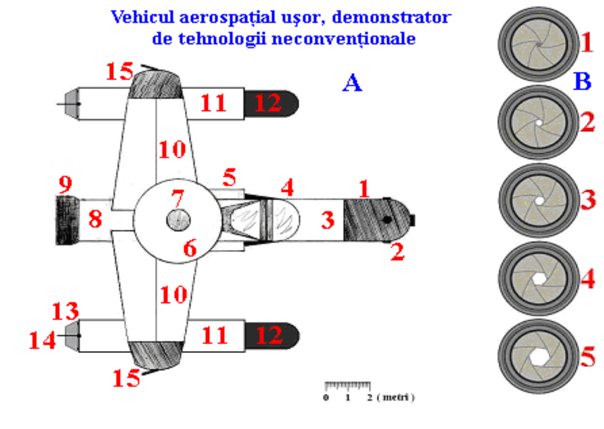

Plate 2- In figure A: 1- *thrust vector control* engine used especially for orientation/ stabilization in the upper atmosphere (provided with a steam generator type Vuia-Moraru, which works anaerobic) supplied with high-pressure jets of steam; 2- system of fixed pairs of mini-nozzles which are oriented antagonist-symmetric (up-down, left-right); it ensures the vector controls (*thrust vectoring* or *thrust vector control*- TVC); also 15 are orientable nozzles; 3- the pressurized compartment; 4- the cockpit; 5- the air intakes of main engine (at the advanced models it renounced at the air intakes in favor of the *wings with internal flowing*, which are systems of propulsion themselves); 6- surface hypersustentation (as a folding diaphragm) on which is flowing the air blown by the *cyclonoid*; 7- the *cyclonoid* type Liciar-Schauberger; 8- the service module; 9- the MHD accelerator of the main engine;

10- the wings; the improved variants are equipped with internal flowing surfaces with "profile Coanda" and the air intake is even the leading edge of the wing, the nozzle being disposed along the entire trailing edge of the wing, and inside the nozzle are placed flight control surfaces like the vanes which deflect motor exhaust; at the extremities of wings can be observed the small nozzles (15) which can move up and down by 15^0, working antagonistic and being in fact some reactive ailerons; 11- the electrothermal jet engines; they use annular compressors (*cyclonoid*) type Liciar and microwaves to heat the compressed air; for supplying of the ultra high frequency coil it would use a klystron operating in pulsed power, which is in its turn powered by a capacitive electrostatic high voltage generator; 12- the cones for conversion of the shock wave; they are designed with leading edge hemispherical (as well as the leading edge of fuselage) since this form is more advantageous for hypersonic speeds in the upper atmosphere; 13- vector manoeuvring elevons (mechanical deflection vanes or paddles enables jet deflection) disposed in the nozzles airflow, at the auxiliary engines; 14- the vertical stabilizer with the rudder are also conceived as a *thrust vector control* being disposed in the nozzle of the jet engine; 15- the reactive ailerons also work as *thrust vector controls*. In figure B: 1- the device denoted by 6 in fig.A is folded; 2, 3, 4- it is opened gradually as a diaphragm, gaining a domed shape; 5- when the aperture is open, in the central area can move up/down the *cyclonoid* 7 on its axis.

BIBLIOGRAPHY

1. the patent RO 21370 from 1933, belonging to Rudolf Liciar;
2. CARAFOLI, Elie si OROVEANU, Th., *Mecanica fluidelor* vol.1-2, Editura Academiei RSR, Bucuresti 1952;
3. DUMITRESCU, Horia si altii, *Calculul elicei*, Editura Academiei române, Bucuresti 1990;
4. group of authors, *Fizica aplicată la războiu*, Litografia Scolii Militare de Infanterie, cca. 1920;
5. IACOVACHI, Ion si COJOCARU, Ion, *Traian Vuia- viata si opera*, Editura Stiintifică si Enciclopedică, Bucuresti, 1988;
6. IACOVACHI, Ion si COJOCARU, Ion, Henri Coandă- viata si opera, Editura Stiintifică si Enciclopedică, Bucuresti, 1988;
7. LIPOVAN, George, *Traian Vuia- realizatorul zborului mecanic*, Editura Tehnică, Bucuresti 1956;
8. SĂLĂGEANU, Ioan, *Aerodinamica vitezelor subsonice*, vol.1-2, Editura Academiei Militare, Bucuresti 1981;
9. SĂLĂGEANU, Ioan, *Aerodinamica vitezelor mari*, Editura Academiei Militare, Bucuresti 1987.