Analysis of Two Concepts of VTOL to Improve their Sustainability by Using the Internet

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Abstract - **There have been performed experimental studies as testing of models and comparative analisis of the process of creating elevating force in different versions of fulfillment of two annular wings, performed with three concentric annular wings in each version: with their radial inter-positioned in one case and with vertical inter-ones in another case.**

Index Terms —Internet, VTOL, Stability.

1. *Introduction*

"The incredible story of Flying Saucer's Crash In 1937 Nazi Germany, has been covered-up by both the U.S. and U.S.S.R. for more than 70 years—is allegedly the actual basis for the Nazi's intense research into wingless, disc aircraft" (in reality aerodynamic VTOLs) [1, 2].

According to captured documents, the radio-controlled VTOL were made at the underground factories in Thuringia and their sizes varied from 10 to 15-feet across. Reportedly, they were amazingly maneuverable and were able to achieve speeds of more than 1,250 miles per hour [1].

According to witnesses, retired military officer, Colonel Mr. Ushangi Nikabadze, who served at a secret airfield Baikonur, the sizes of the radio-controlled VTOL of U.S.S.R. were varied from 1.5 to 3 m across and they also often suffered the accidents.

It should be noted that a specific feature of most VTOL consisting in inability of their forms to maintain stability, since center of gravity is positioned above the center of the volume, though other likelihoods also existed [1].

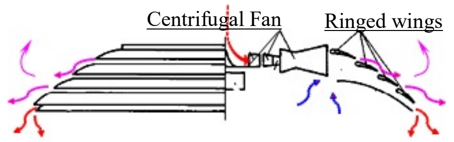
Independently of the given sensitive information, the author of this article has developed and in 1976 applied (in USSR) for the aircraft of vertical take-off and landing with a conic annular wing and the centrifugal fan in the middle, and there was also made its fragment model, in the middle of annular wing of which there was placed in the cupped wheel (blowing wheel of centrifugal fan) with a bottom solid wall, which prevented air dragging in into the middle from the reverse (bottom) side. As is seen, in the simplified fragment model there were no the stator vanes, although there were indicated in the application, since its effect is known from the practice of the centrifugal fans. The model was made of light-weight Brazilian wood (balsa). After the single untwisting, the mentioned model continues to rotate by inertia and it exhibited good flying properties, but stability of flight was preserved not long. In the former USSR it was called "the closed topic" and was never published.

Thus, the achievements of the Nazis, and then, after World War II as a Nazi experience exchange, Soviet researchers on the above topics, not reflected in the publication of patent databases. But only information posted on the Internet proved to be quite enough to identify the problem and to establish the root cause of the flight instability of these types of VTOL (similar to the so-called "flying saucers").

2. *Materials and Methods*

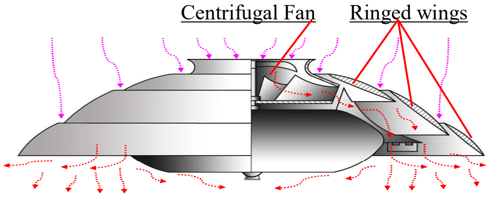
It is necessary, through the scientific research and experimental design works, to create an unmanned aircrafts of vertical-take-off and landing i.e. so-called VTOL which will be able to ensure the reduction of consumption power during the take-off and to improvethe maneuverability properties of the flying vehicle during the flight, to capable of accomplishing the vertical take-off and landing using a centrifugal fan in order to form the lifting force and preserve the stability during the flight.

Under complicated conditions, during execution of reconnaissance operations, in comparison of unmanned aircraft with classic scheme [3], which needs a special landing strip for execution of take-off and landing or catching with hands, the preference should be given to helicopter (drones) or unmanned VTOL with centrifugal Fans [4]) with various schemes mutual placing of their ringed wings [5, 6].



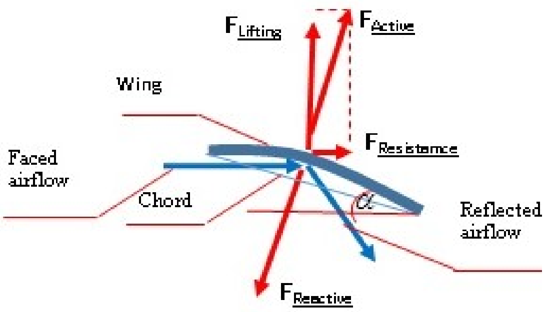
Pic. 1. Scheme of VTOL published in 1994 (in Russia).

However, achieving this goal due to the difficulties associated with the loss of energy in the collision of centrifugal flow with standing layers of ambient air. With this circumstance associated the different directions of technical solutions to the given problem. This paper presents an attempt to analyze two variants of improvement of one and the same basic technical solutions to choose the best of them. To achieve this goal, has planed and performed practical researchs with testing of models with two different mutual placing of the three concentric annular wing.



Pic. 2. Scheme of VTOL published in 1997 (in Georgia).

For comparative analysis are presented VTOL according to patent of Russia (Pic.1) [5] with vertical placing of one on other ringed wings and VTOL according to patent of Georgia (Pic2) [6] with radially arranged one after the other ringed wings.



Pic.3. Process of forming of lifting force.

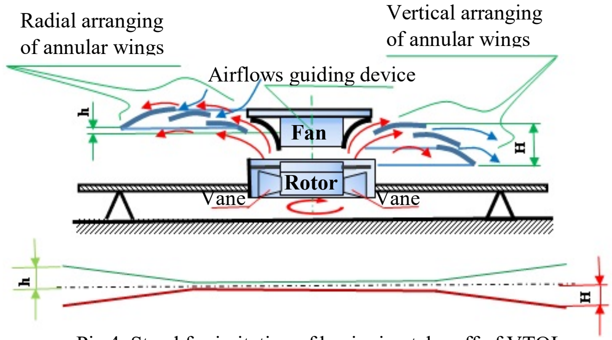
Pic.3 shows the process of forming of lifting force. Where, **F**$_{\text{Active}}$ – is active force, formed by pressure on the wing bellow surface; **F**$_{\text{Reactive}}$– is reactive force, formed by active force; **F**$_{\text{Resistamce}}$– is resistance force and **F**$_{\text{Lifting}}$ – is lifting force; The resistance force (**F**$_{\text{Resistamce}}$) and lifting force (**F**$_{\text{Lifting}}$) is formed by the decomposition of reactive force. Here, тhe active force (**F**$_{\text{Active}}$) is directed as perpendicular to the chord of wing's profile and the reactive force directed oppositely of reactive force.

$$F_l = 0{,}5\rho u^2 SC_l, \qquad (2.1)$$

where F_l - Lifting force (**F**$_{\text{Lifting}}$), ρ - Air density, u - Airflow speed, S - Total area of wing-surface, C_l - Coefficient of lifting force.

Also, $F_l = F_{reactive} \cdot \cos\alpha$ i.e. $F_{reactive} = \dfrac{F_l}{\cos\alpha}$,(2.2)

thereby $F_{reactive} = \dfrac{1}{2 \cdot \cos\alpha} \cdot \rho u^2 SC_l$ (2.3)

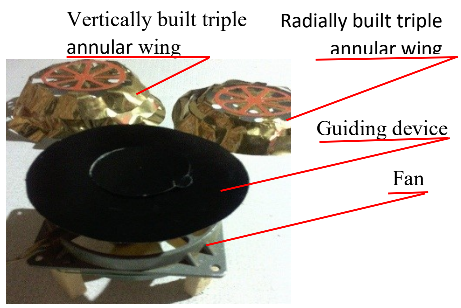


Pic.4. Stand for imitation of beginning take-off of VTOL with two version of annular wings arranging.

There has been carried out a laboratory research of airflows' behaviour by means of immitation of starting take-off of VTOL by using the mock-up models (with two various annular wings regarding each other - radial and vertical) on the test bench, which was designed specifically for this purpose (see the scheme on the Pic.4, photo with common view on the Pic.5 and photos during operation on the Pic.6 and Pic.7), also was carried out a comparative analysis.

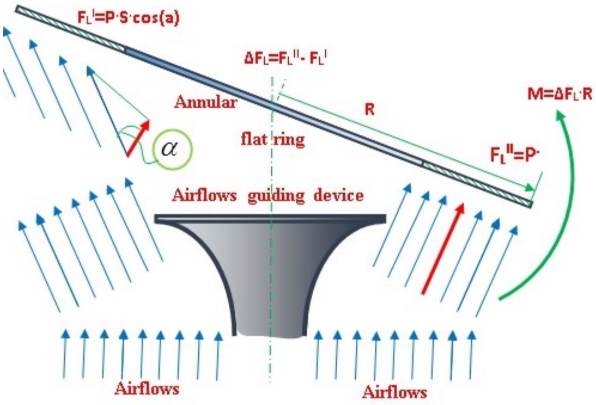
3. *Discussion*

In order to identify the experiment there were made two complete equipment of three polyethylene conic rings with dimensions 14X18sm, 16X20sm and 18X22sm and made two models with a triple built in one to another (radial and vertical) annular (ring-like) wing (Pic.5).



Pic.5. Branch equipment for immitation of beginning take-off of VTOL.

The first thing that can be clearly seen is that the vertically built-in triple annular (ring-like) wing with the same diameter covers more space (takes up more volume) than radially built triple annular wing. Based on this, a vertically built-in triple annular wing can also cover more width of centrifugal airflow and, the vertically built-in triple ring wing can also cover the width of the centrifugal airflow, and as a result, more airflow will be around, that made impossible to guess, reasoning from the descriptions (especially by graphical Figures in pic.1 and pic.2) when comparing the mentioned patents; and quite the contrary - the image in Figure 10 in pic.1 has four annular wing and with the less height, but in this experiment, for assembling the annular wing, there were used three pairs of annular wings with the same dimensions.

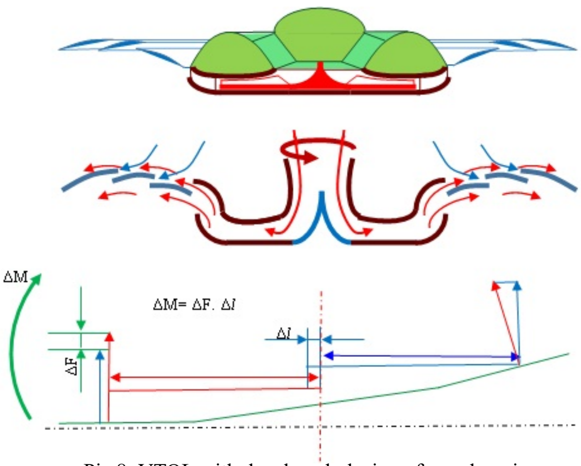


Pic.6. Conditions of maintaining stability of the flat ring as it rotation at the centrifugal up-streams.

For alignment (centering) guiding device relatively to the axis of the fan, there was used the method of rotation of the annular flat ring in the centrifugal up-streams (Pic.6 and pic.7), and one of the compared triple annular (ring-like) wing were fastened to this device by threads and fan was set in motion (Pic.4). Then, experienced triple annular (ring-like) wing was replaced by another (comparative) triple annular wing and fan was restarted again.

Pic.7.Rotation of the annular flat ring by the centrifugal up-stream.
https://www.facebook.com/archil.geguchadze/videos/vob.100000604877230/1054045167958969/?type=2&theater

On the test bench with a fan and guiding device of airflows (Pic.4 and pic.5), on which the triple annular wings in the first case with a radial arrangement of annular wings with upper (stable) positioning of the lower edge of the external annular wing at the height of "h", and in another case, with a vertical arrangement of annular wings with lower (unstable) positioning of the lower edge of the external annular wing at the height of "H". So, this experiment allowed for "discerning" the convenient scheme of relative position of annular wings with a backup balance torque: $\Delta M = \Delta F.\ \Delta l$ (see. Pic8.).



Pic.8. VTOL with developed placing of annular wings.

Let's consider the proposed scheme as a nozzle with the air gaps (with internal d_1 and external d_2 diameters) between the annular wings, and calculate the reactive force of airflows in the gaps between annular wings equals [7]:

$$\Phi = \rho k^2 g \Delta_p \frac{J}{\sigma}. \qquad (3.1)$$

Here, ρ - Air density, k - Proportionality factor of a cross section, g - Acceleration of gravity, Δ_p - Air pressure difference below and above annular wings and $\Delta_p = P_B - P_A$; Where, P_B - Air pressure below annular wings and P_A - Air pressure above annular wings, J - Moment of inertia of torsion, σ - An area of the alive section.

Also here, $\phi = \frac{\Phi}{\sigma}$, $j = \frac{J}{\sigma}$ and $K = \rho k^2 g \Delta_p$; (3.2)

When $K = const$, then $\phi = Kj$ (3.3)

Here, ϕ - Specific reactive of airflows in the gaps between annular wings, K - Function of (j), j - Function of moment of inertia of torsion (J).

The maximum value of $\boldsymbol{j}$ is obtained in case of annular section. In particular, when $\frac{d_1}{d_2} = 0{,}9$ then $j = 1{,}52$; but with an annular section $j = 0{,}16$ the given scheme, when choosing the optimal parameters of annular wings creates the possibility of 9,5-times higher efficiency (that is a huge resource).

4.Conclusion

According to well-known principles of aerodynamics, the composite wing with a vertically placed conic rings develops elevating force greater than, which means (indicates) the presence of Coanda effect, as a result of appearance of the vacuum on the back sides of the conic rings i.e. on the top of the triple wing. Regarding this can be concluded that the composite wing with a vertical placing of conical rings consumes less power and according formula (2.3) can be more efficient in horizontal flight. The second device (with the radial arrangement of conical rings) operates on the principle of ejection (i.e. interception of air) with inverse conical side rings inside and it turns increased pressure in the lower part of the composite triple wing, but due to downdrafts on back sides of conical wings there it seems that this absence effect Coanda. However, the composite wing with a radial arrangement of the same conical rings, due to downdrafts on back sides of conical wings according formula (3.3) can develop high lifting speed that may be important when performing of difficult maneuver.

As regarding stability, it can be noted that both old versions do not ensure any stability in a free air space that was caused by the upper positioning of the center of gravity relatively to the center of the volume. However, the composite wing with radially arranged conic annular wings with a less positioning of the center of gravity relatively to the center of the volume, accordingly “more stable” than the composite wing with a vertical installation of conic rings. Besides, the radial arrangement of conic rings of the composite wing ensures lower position of the center of gravity.

And only the above mentioned experiment which has been planned on database of the Internet resources allowed for developing the convenient scheme of relative placing of annular wings with a backup torque.

Therefore, it is necessary to state one more prospective advantage, which consists in a possibility of combination of two different principles of lifting force creation: at the account by air flow around of cone ring-shaped wings and air ejection between them at the bottom. The mentioned advantage and lower position of the center of gravity, allows this VTOL a stable flying and sustainable “hovering” in a required position even during a wind.

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