Total power losses N_{Σ} in EDP electric drive come from several components:

$$N_{\Sigma} = N_{st} + N_{dr} + N_{c} + N_{a},$$

where N_{st} - losses of steel anchor from hysteresis and whirling currents; N_{dr} - friction loss; N_{c} – loss in copper coil; N_{a} – added loss while load.

Stator and rotor of EPD SV power end are separated with a case that makes rotor immersion into heat-transfer fluid possible. Because of this rotor's friction loss upon heat-transfer $N_{dr.r}$, being part of friction loss becomes higher:

$$N_{dr} = N_{dr.b} + N_{dr.r},$$

where $N_{dr.b}$ – friction loss in bearings.

EPD SV refer to microsized supercharger in which diameter sizes of pump and power end parts of a rotor are comparable. Friction losses $N_{dr.r}$ on rotor depend on type of rotary surface and consist of 2 components: friction losses upon frontal surfaces of a rotor and friction losses upon cylindrical surfaces of a rotor. In EDP the first type of losses is dominating for a pump part, and the second type –for power end part of a rotor. For EP rotor construction rationalization it is necessary to estimate losses in power from friction upon pump $N_{dr.r}$ separately from power end rotor $N_{dr.r}$.

As an example, illustrating the opportunities of rotor construction optimization, let's analyze friction losses in EDP with electro engine DB-9 и characteristics: pressure H= 60J/kg; consumption of a heat-transfer agent $\dot{V}=140\cdot10^{-6}$ m^3/s and rotating speed n=6000 r/min; clearance gap $\Delta=0.3\cdot10^{-3}$ m; working medium viscosity $\nu=0.7\cdot10^{-6}$ m^2/sec; working medium density $\rho=691$ kg/m^3 ; speed of fluid in a clearance gap between rotor and body $v=15\cdot10^{-6}$ m^3/sec. Calculated value of loss relative density in a pump part of a rotor, including element with the largest diameter – rotor wheel (RW), in the EDP will be $N^{p}_{dr.r}/N_{dr.r}=0.844$. Thus, the most part of friction losses comes to the pump part of the rotor.

Dependance $\left(N_{dr.r}\right) \sim d^{5}_{pi}$, points at advisability of decreasing diameter rotor sizes, particularly diameter RW d_{rw}. One of the constructive methods of decreasing diameter d_{rw} is transition to multistage EDP. Parameter consequence of this becomes coefficient of each stage specific speed n_s growth.

Let's look at the opportunities of decrease $N^{p}_{dr.r}/N_{dr.r}$ by increasing stages of EDP TCS to 2-3, considering that pressure coefficient of each stage will be unchanged , H=0.587.

While transition in EDP from 1 to 2 staged variant d_{rw} should decrease from $32\cdot10^{-3}$ m to $23\cdot10^{-3}$ m, and in 3 staged EDP to $19\cdot10^{-3}$ m. Coefficient of special speed of a stage grows, respectively from $n_s=67$ to $n_s=112$ and $n_s=152$. Relative value of friction loss in a pump part of the rotor $N^{p}_{dr.r}/N_{dr.r}$ with growth of number of stages decreases to 0.677 in 2 staged variant of EDP and to 0.549 in 3-staged EDP, respectively 20% and 35% in comparison to initial level $N^{н}_{тр.р}/N_{тр.р}=0.844$. Such changes of EDP are acceptable from technical point of view and positive from energetic point of view.

The viewed method of friction loss decrease upon rotor EDP is acceptable for different vaned light-duty machine, for instance compresses and ventilators of aero cosmic significance, radial sizes of rotor driving and force parts of which are comparable. Its realization allows decreasing friction loss upon rotor and decreasing power consumption.

The work was submitted to international scientific conference «Prospects for the development of university science», Dagomys (Sochi), September 21-24, 2009. Came to the editorial office on 03.08.2009.

THE ROTOR-TYPE ARTIFICIAL HEART IMPROVEMENT WITH THE SPACE INSTRUMENT MAKING EXPERIENCE USE

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The American cardiosurgeon M. Debeiky has already described the rotor – type artificial heart structure (RTAH) in the following way[1]: "…this pump has the "Duracell" type ordinary electric battery size, and its efficiency – is 5 – 6 liters blood per a minute. There is only one motion part in the pump, which is called the impeller, and it is being made 10 thousands per a minute".

The RTAH is quite similar with the space rotor – type superchargers, having used in the space vehicles temperature control systems, by their hydraulic characteristics.

[1] The"Michael Debeiky Academitian: I rather like it more to be the ordinary physician, than the mature scientist" paper//The "Izvestiya" newspaper, No.72,it is dated from 19.04.2000, p.7, the last passage in the 1-st column.

At present, the RTAH designing analytical and calculating basis has been borrowed just from the industrial goods selling centrifugal pumps designing field. The design procedure is rich in a great number of the empirical coefficients and the factors, not having had their physical bases and the grounds, and it, moreover, is not quite being provided the best parameters achievement.

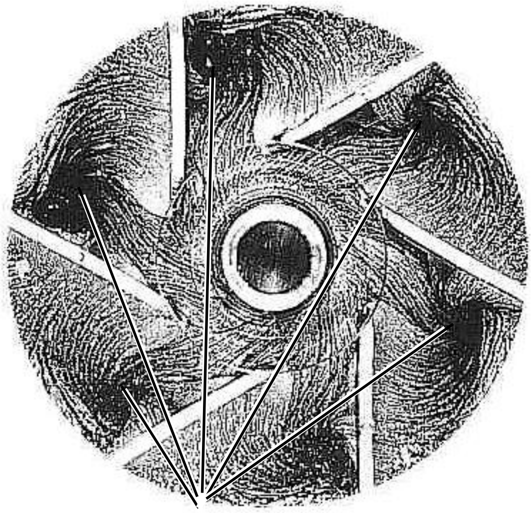
At the flowing in the impeller (which is the RTAH principal element), the flowing in the boundary layer has been become the dominating hydrodynamic factor, because of its diminutiveness. So, the used design procedures are being ignored this peculiarity and the specific feature, and also they are being provided the inefficient, from the power transmission mechanism point of view, the impeller flowing forms, having resulted in the efficiency factor lowering, the vortex formation process increase, and the energy flow pulsation component and the constituent part rise. The existing heart constructions sizes and the required power are being appeared to be the overestimated ones. The above – indicated shortcomings consequence are being become the following:

1. the device increased sizes and the weight;
2. the increased power consumption;
3. the underestimated resource (e.g. action period) for the power unit charging one cycle;
4. the construction overheating because of the increased radial sizes;
5. the impeller increased traumatic influence upon the blood structure, in which the blood clots are being appeared, having provoked the stroke and the heart attack onset.

It has been turned out historically in our country in such a way, that the main works in the dimunitive rotor – type superchargers field have been carried out in the space – rocket hardware. The technological perfection level, having achieved there, has been considerable exceeded the analogous ground and the terrestrial equipment indicators. The aerospace industry offset rotor – type superchargers are much more compact and smart, and also efficient, than the ground destination their analogues. The challenge is being consisted in the fact, that it is quite impossible mechanically to be turned out to transfer the space ingeneering and the space technology designing experience to the artificial organs field, as these devices operation conditions are being obtained the principal distinctions series.

In particular, the aerospace industry offset rotor – type superchargers must be sustained the heat carrier temperatures considerable drops. The tightened requirements and the raised standards on the anticavitation qualities are being made great demands to them, they must reliably to be worked under the zero gravity conditions. The supply voltage must not be beyond the 24 V…27 airborne voltage values limit. There is also the other specific requirements series to the aerospace industry offset devices.

Many requirements, having conditioned by the application space field, are not quite actual for the land – based pumps, and, at the same time, they are considerably influenced upon the rotor – type supercharger flowing part optimization scheme. That is why, it is quite reasonable to use the knowledge in the field of the flowing hydrodynamics, having received at the space technology and the space engineering making for the medical equipment and the artificial organs development.



The vortex formation zones
and the flow separation

Fig.1. The lines of the flow visualization on the impeller disk

In particular, it is necessary to be used the data on, that the local vortex structures are being appeared at the impeller miniaturization, having brought the considerable irregularity in the velocity field and the working substance pressures, having passed along the canals, see Fig.1. Consequently, the impeller deflecting characteristics are being lowered, the pressure qualities of the rotor – type artificial heart are being worsen, the construction radial sizes are being increased. One from the rotor – type application main advantages in the artificial blood circulation systems is being lost – that is, the minimum overall dimensions and the mass. If to be used the theory, on which the space pumps designing is being based on, then the above – indicated drawbacks are quite possible to be removed to the considerable extent.

Besides, it is quite possible substantially the impeller pressure qualities to be raised and, as the result of it, the rotor – type artificial heart to be designed more efficient in the operation, with less the impeller traumatic influence upon the blood.

The work was submitted to international scientific conference «Prospects for the development of university science», Dagomys (Sochi), September 21-24, 2009. Came to the editorial office on 03.08.2009.

THE OPERATING REGIME INFLUENCE UPON THE AEROSPACE PURPOSE LOW-SIZED PUMP TYPE CHOICE

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The low – consumed hydraulic systems (LCHS) with the working substance pump feed have already been found their large – scale and the wide application in the aerospace purpose energy complexes. They usually use the liquid coolants, having circulated in the LCHS pipelines in the flying vehicles with the heat – generating equipment, having situated in the untight chambers, for the heat large quantity transmission on the isolated radiant heating surface, or the heat removal (heat supply) from the high power sources. So, the following pumps types are being used in them: the scapular – centrifugal and the vortex ones, and also the friction – disk pumps. The above – indicated types are being permitted the high – circulating electric drives application by the general industrial measures, that it is being promoted the construction dimensions decrease in the radial – circular plane. Their miniaturization is being provided the calculating operating regimes concordance possibility with the system hydraulic characteristics. The D_2 rotor wheels outer diameter is not exceeded $50{\cdot}10^{-3}$ m, in the range of $n=(3\ldots10)\ 10^3$ rpm.

The centrifugal pump type has a number of its advantages inside of the low – sized pumps group. The main ones from them are the following:

● ***The Work Resource***.

The “Molniya” space vehicles (SV) have been become the first generation of the Soviet communications satellites. The temperature control system (TCS) in these SV has been carried out by the pump – circulation scheme. So, the preference has been given to the rotary gear pump at the pump type choice for the “Molniya” first model TCS (e.g. at the end of the 50 – es), by that time, it has been shown itself to a good advantage in the missiles steering engines composition. Thus, the TCS work resource of the first “Molniya” SV with the rotary gear pumps has been appeared to be inadmissibly low, in the process of its operations and the maintenance. Therefore, they have begun to employ the centrifugal pumps, having permitted to be increased the work resource up to several decades thousand hours in the all subsequent “Molniyakh”.

● ***The Work Economy in the Regime Parameters Wide Range.***

The low – sized centrifugal pumps with the $\varphi \le 0.1$ discharge coefficient are being functioned with the efficiency acceptable level in the n_s=40…200 specific speed values range. This range is considerably narrower for the low – sized pumps another types**.** It is made up n_s=10…30 at the vortex pumps, and it is made up n_s=30…40 at the disk ones. The centrifugal pumps reasonable application field has been become dominating with the following number of revolutions increase up to n=10,000 rpm, for example, on the field of the temperature control (TC) LCHS needed regimes.

At the present day, the centrifugal low – sized pumps are the supercharger main type of the low – consumed hydraulic systems in the aviation and the space technology and the engineering, owing to better combination of the energy, the mass overall dimensions and the resource characteristics.

Let us consider the requirements to the centrifugal pump rotor wheel flowing form, having designed for the functioning in the temperature control LCHS with the following parameters: Δp_{hs} hydraulic resistance of the LCHS circulation tract is being changed in the range of Δp_{hs} =(0.03…0.2) Mpa, and the $\dot{V}$ working substance consumption is not exceeded $300{\cdot}10^{-6}$ m^3/s. Thus, we shall find out the n_s specific speed, having regulated the D_1/D_2 ration of the scapular pumps rotor wheel, having accepted all these indicators, as the pump’s output parameters and, moreover, having taken into consideration, that the electric drives are being employed with the $\omega=(314...1047){\cdot}c^{-1}$ angular frequency of the shaft revolution in the LCHS.

The n_s values bounds are being kept within the n_s= 40…80 values range, having satisfied all the really possible combinations of the working substance combustion and the LCHS circulation tract hydraulic resistance. The $n_s \le 80$ interval is meant, that the centrifugal pumps, having related to the low – speed class, are needed for the LCHS with the working substance active circulation.

The work was submitted to international scientific conference «Prospects for the development of university science», Dagomys (Sochi), September 21-24, 2009. Came to the editorial office on 03.08.2009.

INTELLECTUAL EDUCATIONAL SYSTEM IN THE PROFESSIONAL TRAINING

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The existing system of education unable to provide the necessary level of professional training of information security specialists using basis types of educational and methodological provision, in the modern information society. This fact causes the need of elaboration and using of infocommunicational educational technologies, providing the formation of high competent information security specialists, using the institutes of intellectual educational systems at the educational process.