MINISTRY OF EDUCATION AND SCIENCE OF THE RUSSIAN FEDERATION
«NOVOSIBIRSK STATE TECHNICAL UNIVERSITY»

Hybrid power plant car "Gazelle"

Faculty: MA
Group: EMM-73
Master Student: Tkach R.

Aims and objectives

Development of an installation that allows the recovery of energy braking in a car with a traditional drive.

Objectives:

- To develop a retarder that implements the accumulation and use of recovered energy
- Traction motor selection
- Traction calculation
- Energy storage system selection

Initial data

Wheel formula, arrangement	4x2.2 , rear drive
Curb weight, kg	1870
Type of engine	petrol
type of transmission	Mechanical
passenger capacity	13
top speed, km/h	116

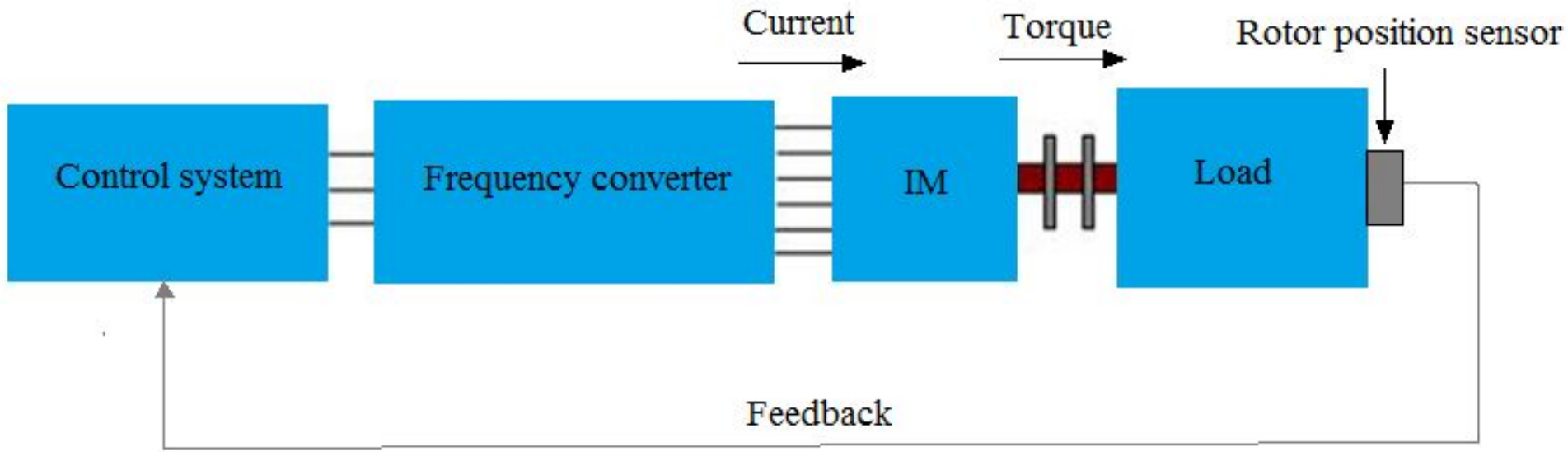
Benefits:

- Reducing fuel consumption
- Reduction of emissions of harmful substances into the atmosphere

Limitations:

- High price
- Difficult maintenance

Gate-inductor motor



Benefits:

- Low cost price
- High efficiency
- High power factor
- High reliability
- Ability to work at high speeds

Engine parameters

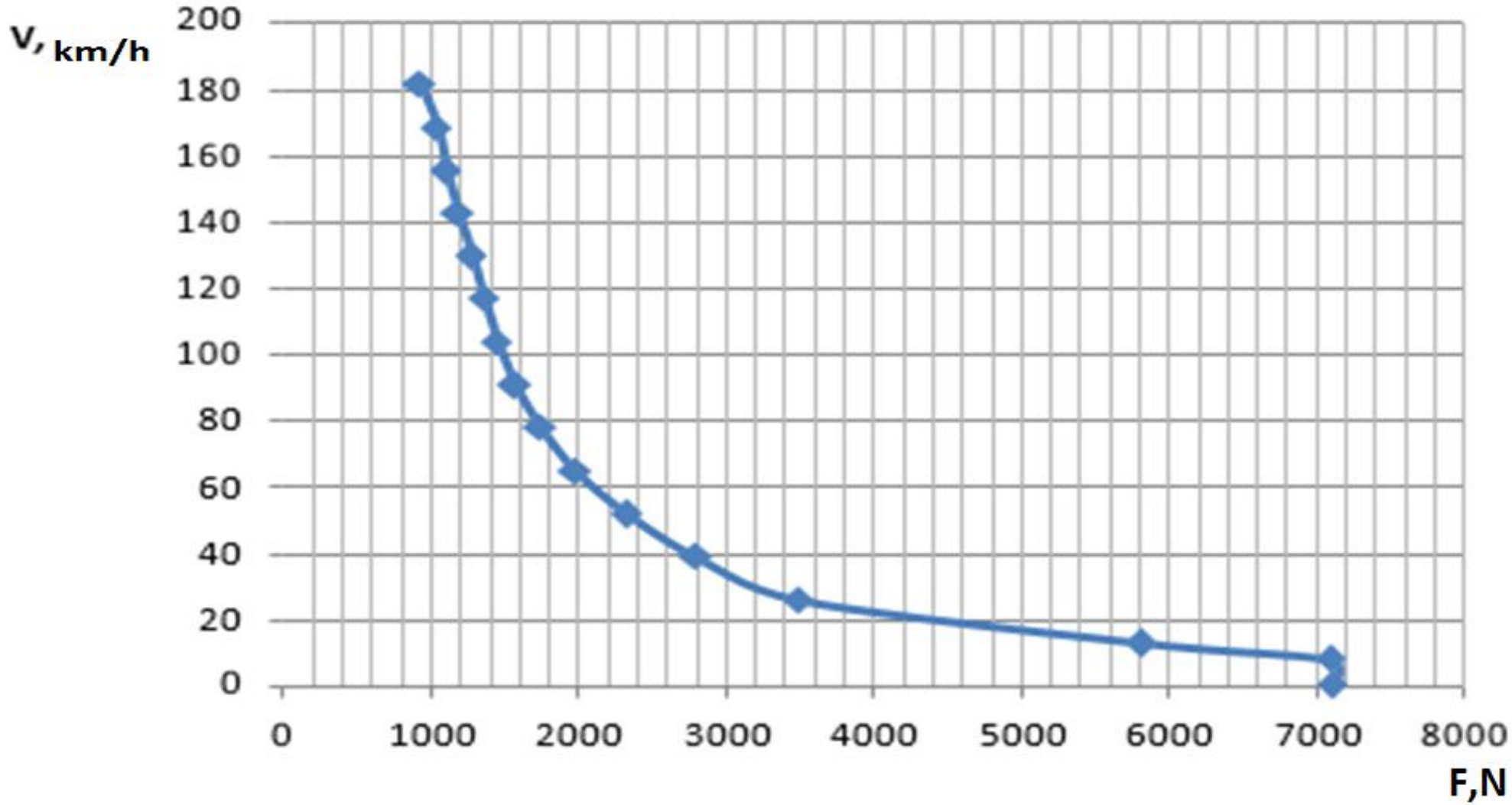
$$A_{reg} = A_{kin} = (1+\gamma)\cdot m \cdot \frac{\left(V^2_{beg\ br} - V^2_{end\ br}\right)}{2}, \text{N}\cdot\text{m}$$

$$t_{br} = \frac{\frac{V_{beg\ br}}{3.6} - \frac{V_{end\ br}}{3.6}}{a}, \text{s}$$

$$P_{reg} = \frac{A_{reg}}{t}, \text{W}$$

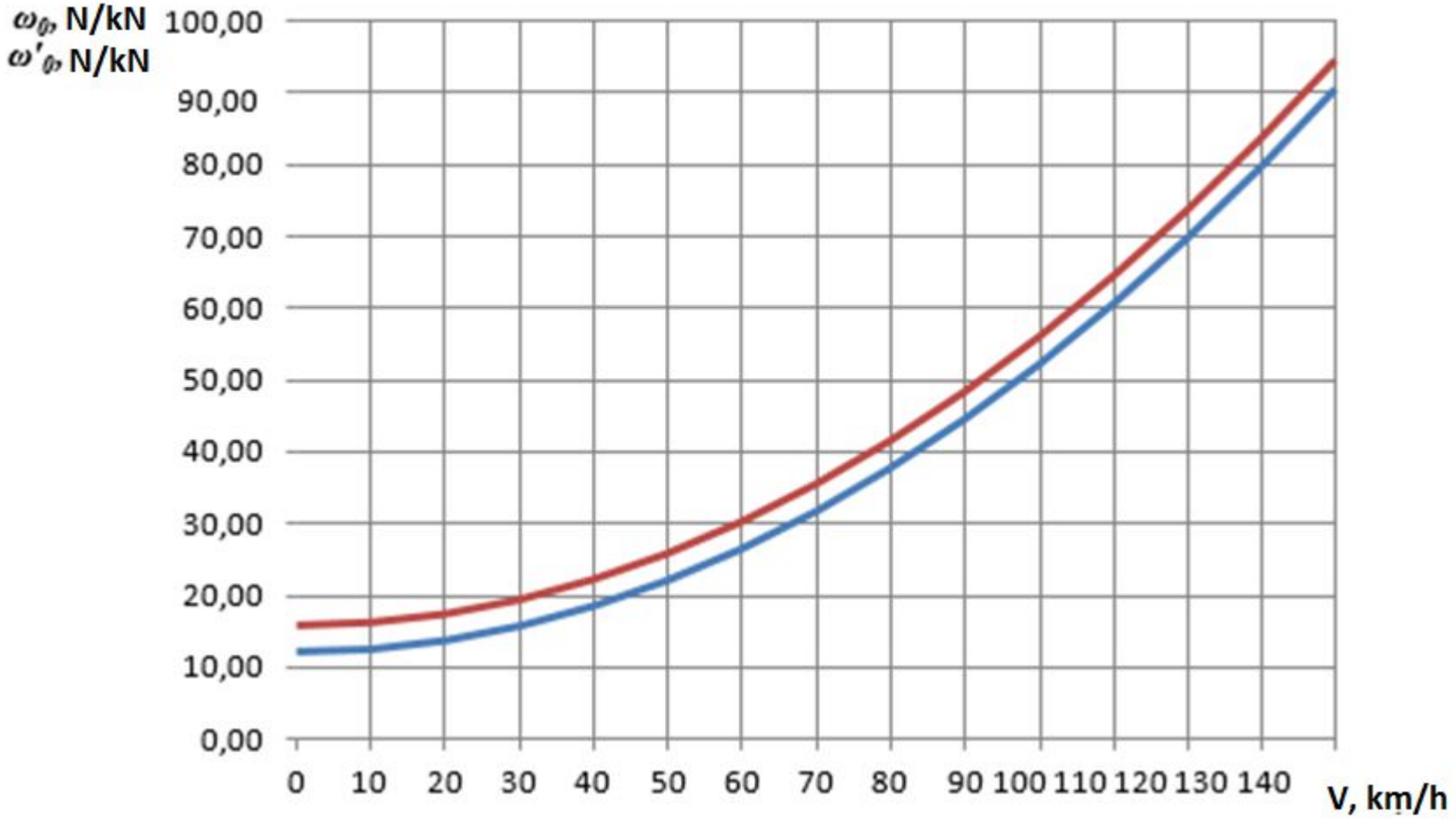
Engine parameters «ОРИОН-18-2»	Unit	Quantity
M_u, starting torque	N*m	676
M_c, rated moment	N*m	169
P_c, rated power	kW	34
Eff, efficiency	%	97
Electrical parameters		
P_{Ut}, thermal power (peak)	kW	11
P_{Ct}, thermal power (rated, wat. cool.)	W	690
K_T, moment constant (20 C)	N*m/A	1,45
K_m, constant of the motor (20 C)	N*m/W	6,43
m, engine weight (housing version)	kg	56

Traction characteristic



$$v = 3{,}6 \cdot \frac{\pi \cdot n \cdot D_к}{60 \cdot \mu} \text{ km/h} \qquad F = \frac{2 \cdot M \cdot \mu \cdot \eta_{зп}}{D_к}, \text{N}$$

Running resistance



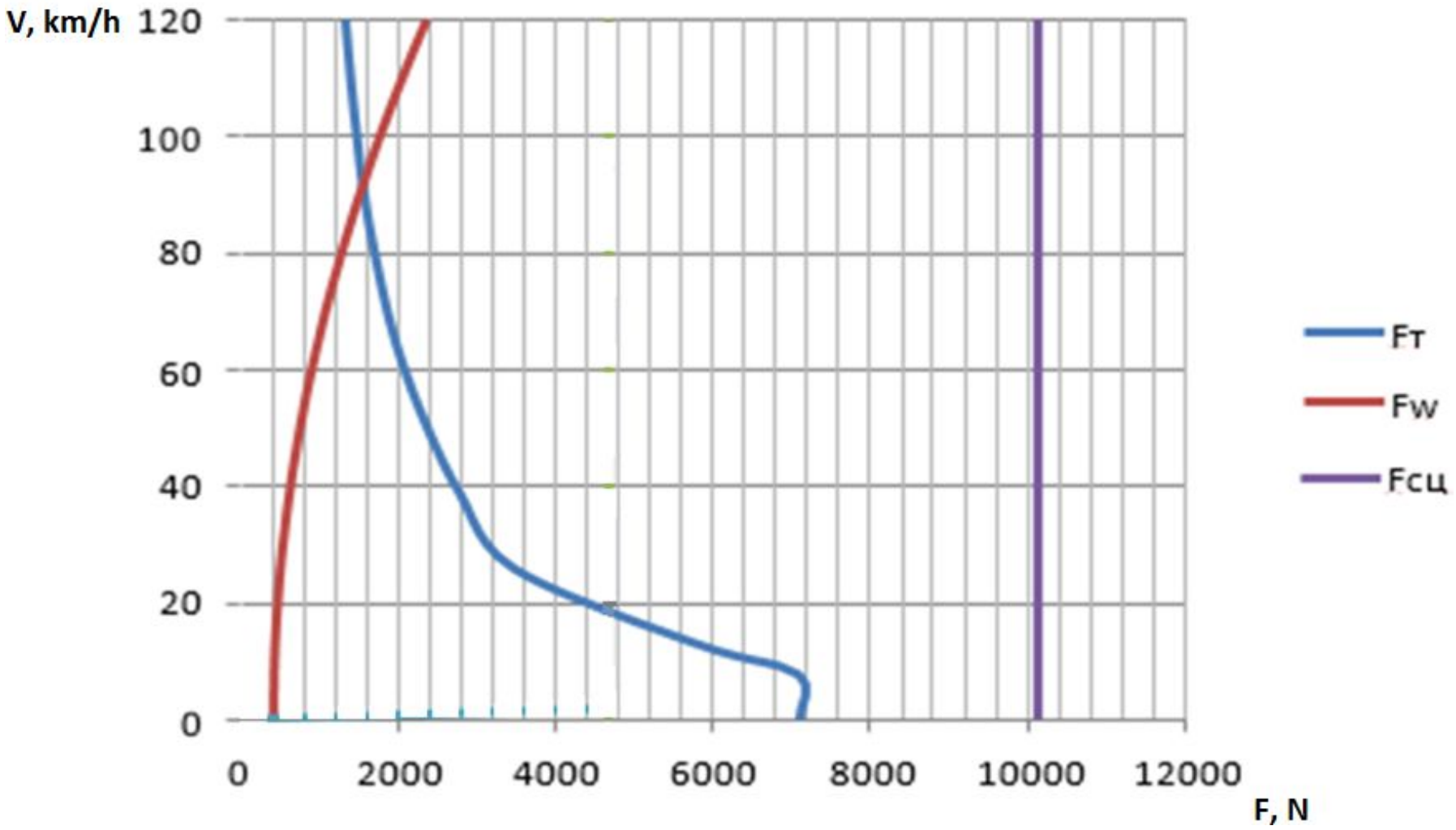
At start and braking

$$w_0 = 12 + 0{,}004 \cdot V^2,$$

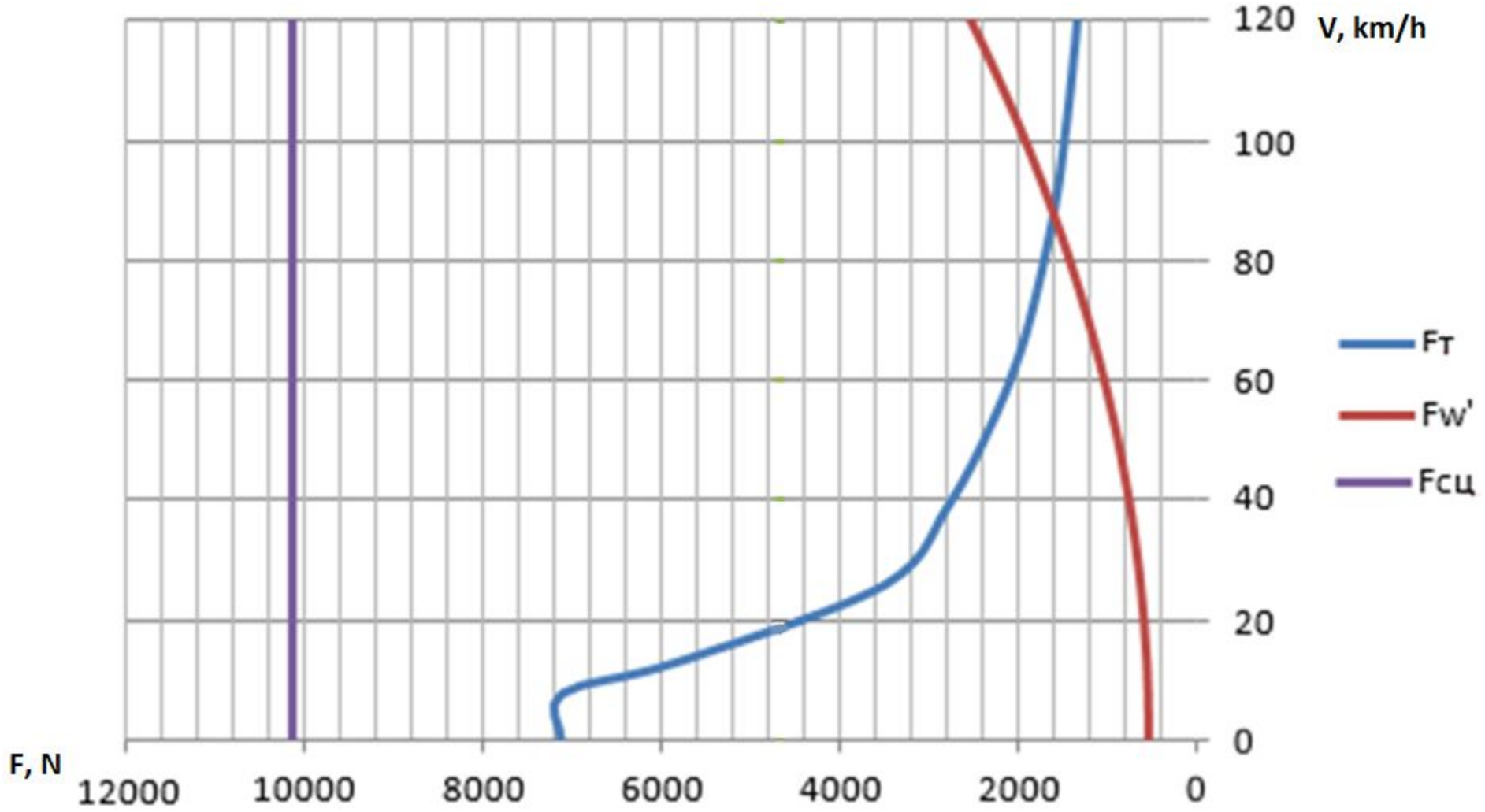
At running out

$$w_0 = 16 + 0{,}004 \cdot V^2$$

Start-up diagram



Braking characteristic



Ultracapacitor selection

Characteristics of ultracapacitor «ИКЭ 25/360»

Rated charge voltage	360 V
Electrical capacitance	0,39 F
Energy at rated voltage	25 KJ
Length	300 mm.
Weight (average), no more than	32 kg
Diameter	230 mm.

$$C_к = \frac{2 \cdot A_{reg}}{\kappa_{min}^2 \cdot (U_{reg}^2 - U_{min}^2)} = \frac{2 \cdot 1{,}029 \cdot 10^5}{0{,}5^2 \cdot (1100^2 - 550^2)} = 0{,}9 \text{ F}$$

$$n = \frac{U_{reg}}{U_{UC}} = \frac{1100}{360} = 3$$

$$N = \frac{C_{com\ UC}}{C_{UC}} = \frac{0{,}9}{0{,}39} = 2{,}72 \approx 3 \text{ rows}$$

Li-ion battery

Li-ion battery initial data:

U_{cell} = 3,2 V
U_n = 550 В
C = 250 mA*h

$$n_{ser} = \frac{U_n}{U_{cell}} = \frac{550}{3,2} = 171$$

To provide the necessary current of 150A, the batteries should be connected in parallel groups, the current per one group should not exceed 0.5-0.6C

$$(0,5 \div 0,6)\,C = (0,5 \div 0,6) \cdot 250 = 125 \div 150A$$

Conclusions

- The structural scheme of the engine and its parameters were considered
- Traction calculation was carried out
- Energy storage system selected

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