MODEL INVESTIGATIONS OF TRACTION PROPRIETIES OF THE HIGH-SPEED TRACKLAYING VEHICLE

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Abstract

Among grandnesses characterizing fighting vehicles is the so called mobility whose propriety have the essential influence on the dynamic of the vehicle in the field and the active protection against paralyzing chemicals. One of factors having the influence on the motility is the kind and the type of the driving system.

Nowadays, the overwhelming majority of tracked fighting vehicles (tanks and infantry fighting vehicles)are equipped with drive unit of the hydro-mechanical type. This type of systems significantly increase motion and mobility proprieties of the vehicle. In the basic tank is implemented a drive unit of the mechanical type. One made an attempt modernizations and the replacement of him with the hydro-mechanical system. As supplementary was accepted hydro-mechanical drive unit whose the construction is modeled on the system HSWL for the heavy vehicle. One skipped the range of adaptive works of the system inside the vehicle. The main attention was concentrated on the influence of the modernization on his traction proprieties. One worked out the original numeric program to determine the traction characteristic of tracked fighting vehicles and special vehicles named DYNH. Data for the analysis one prepared and one worked out using the accessible technical documentation and the expert knowledge of the investigative team.

On the work one included some results of numerical calculations of traction proprieties of the tracked fighting vehicle equipped with hydro mechanical drive unit of the type arranged in rows, first class. Results were presented in the form of charts of dynamic and turn characteristics.

Keywords: *the tracked fighting vehicle, the tank, drive unit, the hydro-kinetic drive*

1. The introduction

One of fighting characteristics that characterizing high-speed tracklaying vehicles (tanks and infantry fighting vehicles) is their mobility. The mobility is understood as the ability of the vehicle to the displacement himself in the tactical and operational sense as well as the element of the active protection. It is a very wide idea and in the general case qualifies dynamics, maneuverability of the vehicle, the ability of crossing of the ground, in this a obstacles, in established service conditions. She has a growing importance also in survive ability of the tank in the fight. About the mobility of high-speed tracklaying vehicles decide following factors:

- the ability of attaining of maximum and average travelling speeds in different weather and road condition, especially average travelling speeds in the field, both on the run forward as and backward,
- the range of the drive on one unit of filling in any terrain conditions,
- the gradeability, ability of crossing terrain obstacles, natural and artificial (perpendicular wall, ditches, acclivity etc.), in this also overcoming of fords and deep water obstacles and the contaminated ground with NBC weapon factors,
- the quality of the driving unit and the kind of applied driving system,
- the ease of the control with the tracked fighting vehicle (the kind of the steering mechanism and service brakes),
- the kind and the quality of the suspension of the tank and the track mechanism, and in this the smoothness of the movement in the field during the drive with any speeds,

- the adaptation to the transport on great distances,
- the ability to self-hilling up and passage clearings in a field of mine and the cooperation with infantrymen.

In the general event it adopts that fighting grandnesses which are fire power, the armour and the mobility, should be harmonized and fulfil so called the rule of the chain which illustrates Fig. 1. This rule consists in these, that all chain links for the maintenance of the equilibrium must be the similar „endurance". The change of the propriety of one of links must entail the change of remaining links.

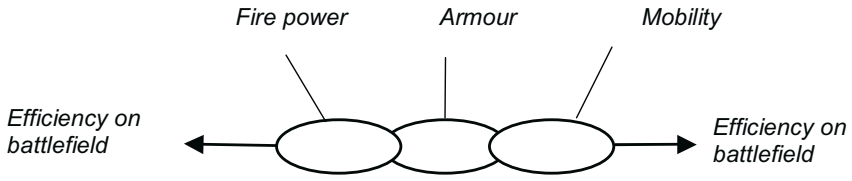

Fig. 1. The schema of the interrelationship of fighting-features of the fighting-vehicle

In the Professorship of Motor Vehicles and the Transportation works the team that for many years interesting himself with the problems of the dynamics and with traction properties of high-speed tracklaying vehicles and special multiaxial vehicles. The team, has at her disposal with the classiness apparatus measuring - registering and with the original and standard computer software.

The aim of presented work is the attempt of the modernization of the driving system of the tank and the illustration of the possibility of computational worked out original numeric programs in the analysis of the property of traction high-speed tracklaying vehicles. The example of calculations bases itself on technical characteristics of tracklaying vehicles being found on the equipment of some armies. To underline however one ought that these characteristics are only nearing to characteristics of entity objects. From here also presented results of calculations one cannot refer compactly to the concrete high-speed tracklaying vehicle and treat it as hypothetical and having the qualitative character.

2. The modernization of the driving system and traction properties of the fighting vehicle

An object of the analysis is the vehicle presented on Fig. 2, on the chassis of the base tank T-72, equipped with mechanical drive unit with the initial drive and two planetary gear-boxes. This system assures smooth start-up, the obtainment of seven gears at the drive forward and one reverse, turns with different radius and the applying of the brake of the vehicle. Along with the engine and his systems creates separated, seated in the rear part of the tank, the driving section. On Fig. 3 were presented the schema of the distribution and the fastening of sets of the driving system in his interior.

Fig. 2. The object of the analysis

In analysed driving system has not separate parts such as the main clutch, the turning mechanisms and service and parking brakes. The part of these sets fulfill two planetary gear-boxes. Planetary gear-boxes constitute in constructional point of view the equal whole with side-drives.

An aim of research is determine the influence of the use in the vehicle the hydromechanical power transmission system (HPTS) on his traction proprieties. One assumed that mechanical drive unit (Fig. 3) will be replaced by an arranged in rows type system „the hydro-mechanical gear-box-the mechanism of the turn about the double bringing of the power", as Fig. 4. The kinematic schema of the system represents Fig. 5.

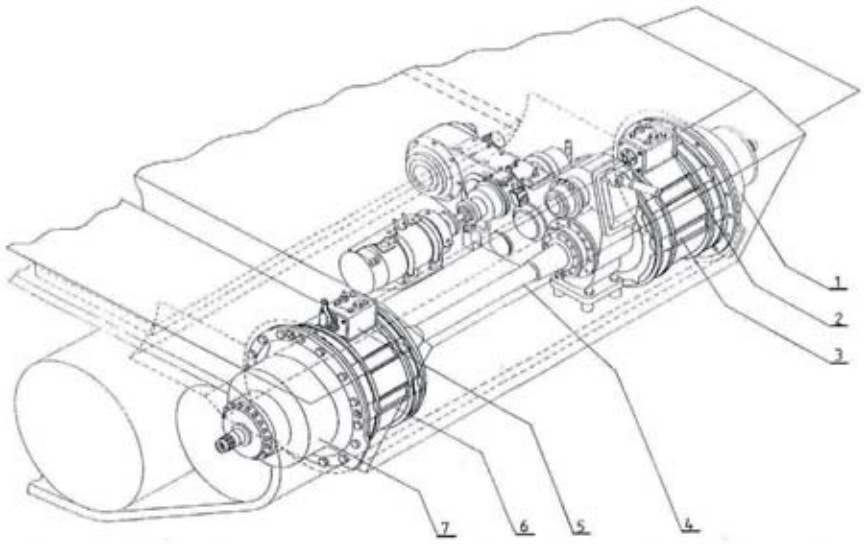

Fig. 3. The schema of the driving system and the distribution and fastening of gear-boxes of the basic tank in the driving section: 1, 7 - side-drives; 2, 5 - distributive mechanisms; 3, 6 - geared boxes; 4 - the geared shaft

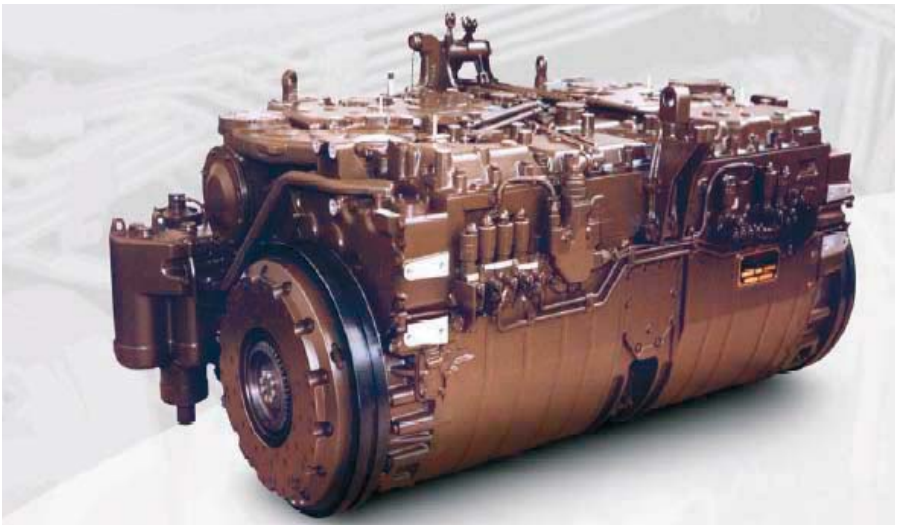

Fig. 4. The view of the hydro-mechanical driving system *[1]*

The system consists of following components: the two-range drive hydro-kinetic with the blocking clutch S_b, the reversing drive (controlled with brakes H_p and H_w), four gears planetary gear-box (controlled with brakes H_i, and i = 1, 2, 3 and with the clutch S_4), two planetary lines adding up , the hydrostatic drive of the control, the turning hydro-kinetic clutch SH_l and SH_p, the hydrodynamic brake H_d and service brakes H_g.

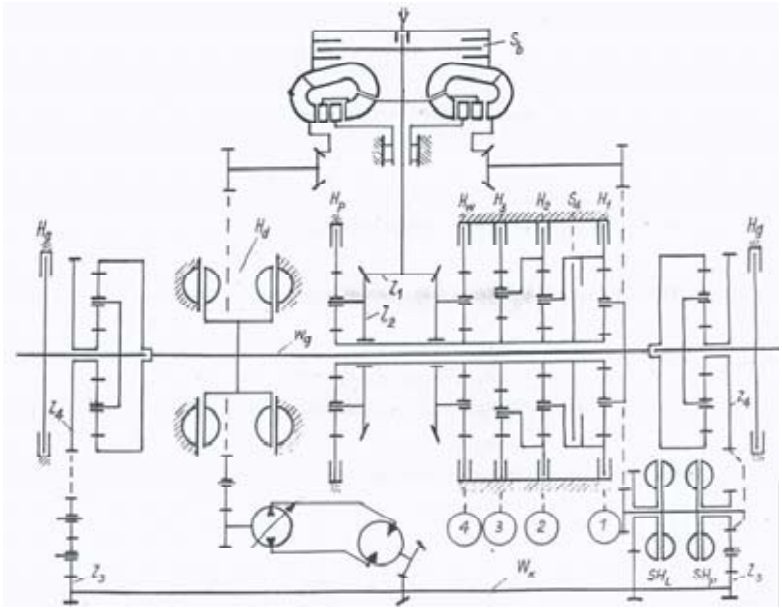

Fig. 5. The kinematic schema of the hydro mechanical driving system *of the tank*

The two-range hydro kinetic drive with established active diameter D has a definite nondimensional characteristic which presents Fig. 6.

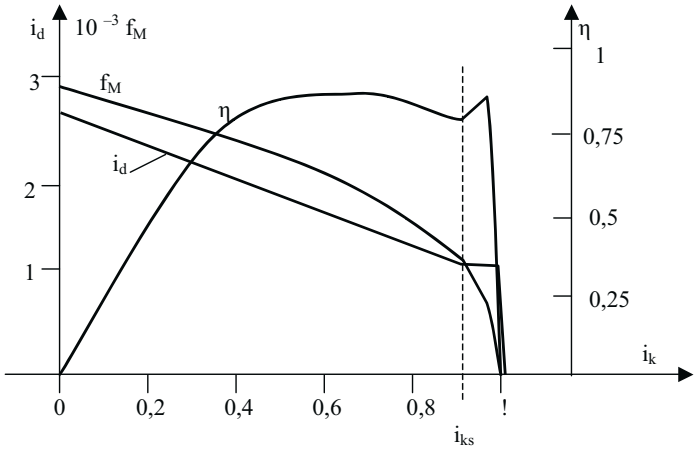

Fig. 6. The nondimensional characteristic of the two-range hydro kinetic *drive*

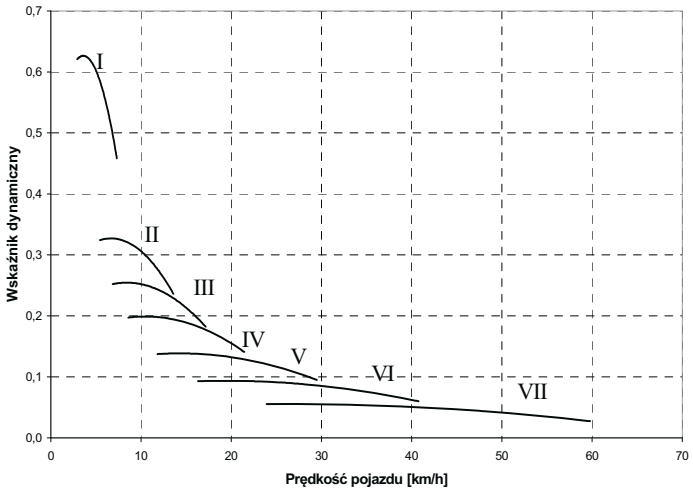

Fig. 7. The dynamic characteristic for the basic vehicle

Appointed, by means of numeric programs , dynamic characterizations for the basic vehicle and modernized one presented properly on Fig. 7, 8.

The turning characteristic of the form of the unit power f_p for the basic tank one showed on Fig. 9, and for the vehicle with HDS on Fig. 10. On Fig. 11 were presented the unit power $f_{T(p)}$ determined by the moment on the turbine shaft.

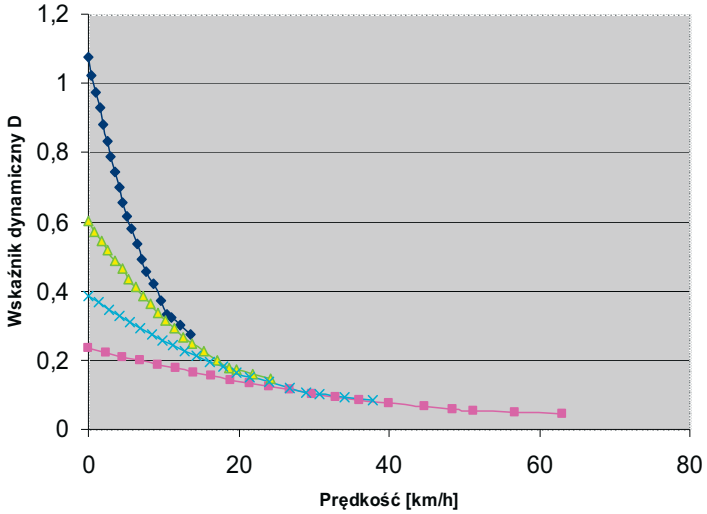

Fig. 8. The dynamic characterization for the vehicle with HDS

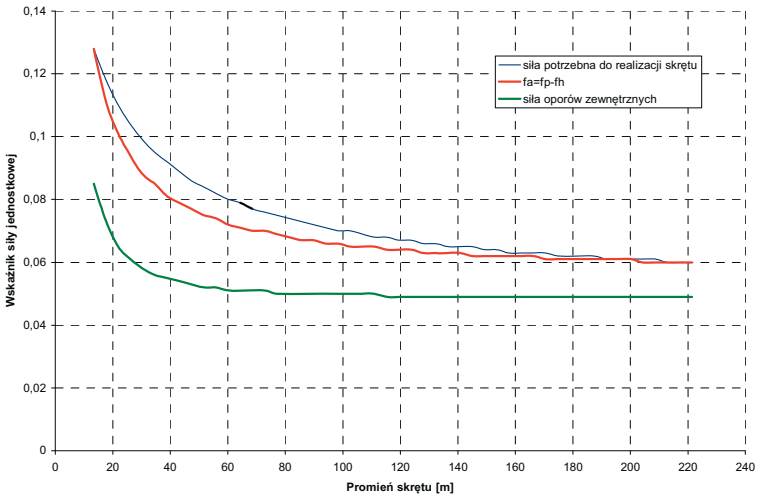

Fig. 9. The turning characteristic of the of the basic vehicle on the deformable ground: f_p - the unit power necessary for the realization of the turn, f_h - the unit force of friction in breaking elements, $f_a = f_p - f_h$, f_{oz}- the unit power of external forces

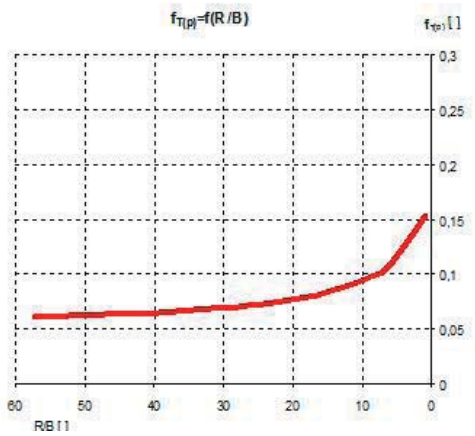

Fig. 10. The unit power $f_{T(p)}$ determined by the moment on the turbine shaft

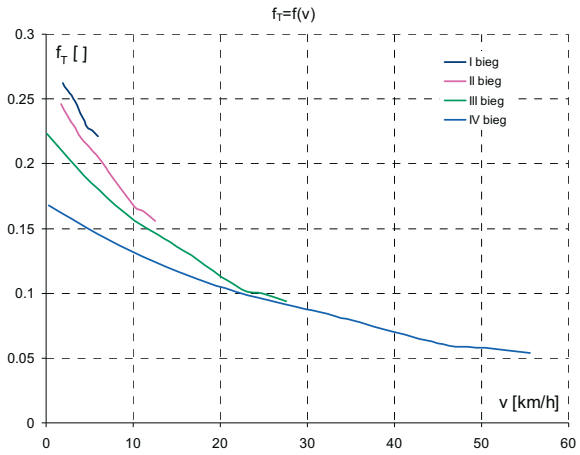

Fig. 11. The turning characteristic of the vehicle equipped with four gears HDS

3. Final conclusions

The use of the hydro mechanical driving system makes possible:

- the considerable improvement of the motility of the vehicle in the field and overcoming natural and artificial obstacles,
- smooth start-up and the running under the charge,
- attaining of the speed v = 32 km/h in gear 3, whence for average tractive resistances one can begin the drive,
- the realization of the turn over a wide range with the settled turning radius ($B \leq R \leq \infty$) from the turn with R = B to the straight movement, thanks to the use as the steering drive the hydrostatic type drive,
- the improvement of conditions and dynamics of the straight movement and the turn on slopes and heights.

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