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THE NUMERICAL PRETEND OF BEHAVIOR IN A IMPERMANENT SYSTEM OF SLOW HYDROSTATICAL MOTIVE WITH RADIAL PISTONS AND MULTIPERIODICS SINUSOIDAL CAMS

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ABSTRACT

The work is approaching theoretical and experimental appearances in concerning static and dynamic characteristics of slow hydrostatical motive with radial pistons. Is presented the static model of characteristics of flow and couple for this motive and the dynamic characteristic of these. The static characteristics are certified experimental by path are a specialired stall. Are presented relations for the coeficients calculus from the static and dynamic models.
The mathematical model conceired were certified on a slow motive with swivel-carcass-engine wheel code R2A – size 3 – Promex Braila fabrication.

1.The describe of simulation object

From the year 1970 in world are fabricate slow hidrostatical engine with radial pistons, with one or two regims of turations [4, 6, 7]. The constructions is achieved in two variants, slow hydrostatical engine with fixed caecass and revolving axle abd with fixed axle and revolving carcass, knowed below the comercial name of engine wheel. These second variant is used for the actions of displace sistems of the technological equipments of constructions and are moment directly in the rim of wheel equipment.

The engine wheels are execute in variant with fixe capacity displacement, when the capacity displacement of engine is constant for all work system and with capacity displacement variable, in two systems of work.

The first work system the slow system-when the wheel capacity displacement is the maxime capacity displacement and the fast system, characterized by a reducing of accordingly capacity displacement round of a thivals from the maxime capacity displacement. The slow work system covers the area of turations on the wheel necessary the work technological area of the equipment. The quiq work system cover the turations needfulness removable on the public roads or in the advance faces on site. The slow work system is characterized of big moment and turations of carcass of the order 2-55 rot/min. The quick work system is characterized by turations of the order 100-250 rot/min on reduced moments what cover the resistance on roll on arrange roads (beaten roads, asphalts, rocs, concrete, etc). The work has discipline of study the engine wheel R2A-size 3, from S.C. Promex S.A. Braila fabrication, with only one slow work system , with the capacity displacement V_{OM}=1,78 l/rot, the maxime turation n_{max}=32 rot/ min, the minim stabil turation n_{min}=1,5 rot/min, the nominal pressure p_n= 280 bar, the maxime pressure p_{max}= 320 bar, the hydraulic used-up enviroument: aditivate hydraulic oil – STAS- 9691/94 it achieved a numerical model of experimental stall. Who permited the compare of real characteristic with those theoretical. Were establishead relations of calcule of the mathematic model coefficients depended relations of geometrically series, constructives of the model of testate engine. Are established and influences which it hav them on the features hydraulic agent about coeficients of mathematical model in this way the model achieved for a engine size can be extent to all fabrication of slow engine of romanian conception.

2.The static features of engines

The used stall for testing of slow hydrostatical engine, in permanent system is presented in fig no. 1 and is used for attempt engines to manufacturer.

The scheme present the connexion of the mechanics and hydrostatical components and the way of connecting of the used measure apparatus.

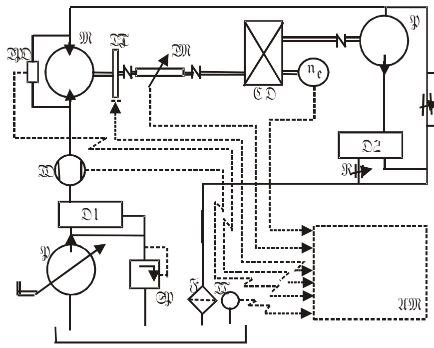


Fig..1-The stall sceme of tedting engine wheel
P- with manual regulator of flow; D_1- hydraulic 3/2; SP-valve of protection; M- subdued me the proof; CD- gearbox; P- Pump with fixed capacity displacement; D_2- Hydraulic distributor 3/2; DC- throttle of way; R- rezistenta hidraulica reglabila; F- Filter; TD- transcriber of inducible flow; TPD- Transcriber of differential pressure; TIT- Inducible transcriber of revs; TM- Transcriber of couple; TT- Transcriber of temperature; n_e- Tachometer; AM- System of defended against measure and register the signals.

In fig.2. is presented images ale standing experimentally.

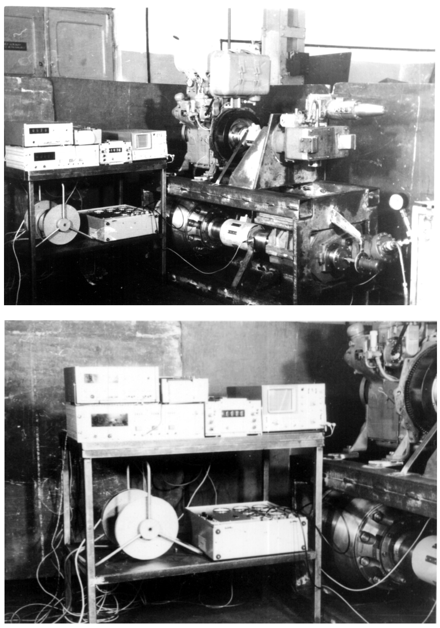


Fig. 2. Experimental stall
a)stall image; b) system of defended against measure and registration

On certified stalls the features of the permanent engine system, respectivly static feature of flow and static feature of couple presented in [7], that binds and diagrams are presented in relation (1) and fig. no. 3.

The static features of slow engine are definte by relations:

$$\begin{cases} Q = (q_M - \Delta q).\omega_e + \\ + \alpha^*_M.p^2 \; ; \\ M = (q_M - \Delta q)\cdot \\ \cdot\left[p - \delta^*_M.(\omega_e - \omega_s)^2\right]; \end{cases} \qquad (1)$$

The first relation exprime the static feature of flow, respectively binds $Q = f(p,\omega_e)$, and the second relation static feature of couple, respectively binds $M = f(p,\omega_e)$ – in relation (1) it was noted the momentaury pressure on engine – p; ω_e – the angular speed of engine, q_M – the engine capacity displacement, $\Delta q;\alpha^*_M;\delta^*_M;\omega_s$ – coefficients what depending on the building of definites engine in [7].

With specific date of the engine model submissive the analysis the static features become:

$Q=1,8.n+0,00011.p^2_M;[1/\min]$;

$M_e=2,4.\left[p_M - 0,028(n - n_s)^2\right];[daN.m]$; (2)

and the theoretical and experimental diagrams are presented in fig. no. 3.

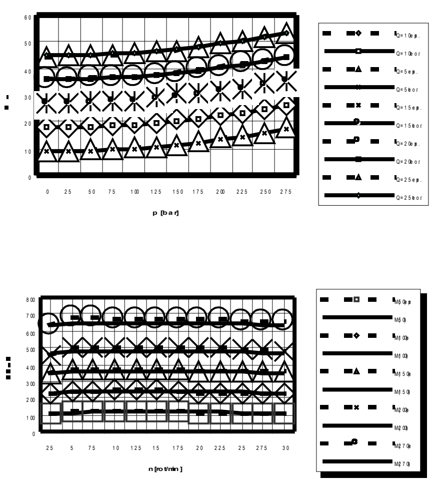


Fig. 3. The static features of engine
a) flow characteristic; b) couple characteristic

3.The characteristic in impermanent system (dynamic) of engine.

The obtain model for the behavior in impermanent system of engine is describe by ecuations:

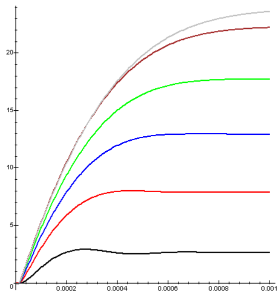
$$\begin{cases} (q_M - \Delta q).\omega_e + \\ + \alpha^*_M.p^2_M + \beta^*_M.\dot{p}_M = Q; \\ J_{SM}.\dot{\omega}_e + (q_M - \Delta q).\delta^*_M(\omega_e - \omega_s)^2 + \\ + M_e = (q_M - k_4).p_M; \end{cases} \quad (3)$$

where $\beta^*_M; J_{SM}; k_4$ - represent the coefficients specifically to dynamic model, M_e- represent the resistent moment who win the engine.

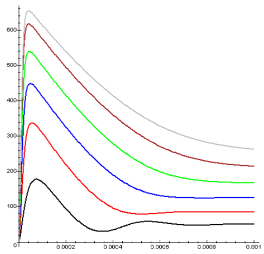
The dynamic model of engine represented by relation (3), transposed in technical system and with determinated coefficients accordingly is rendered by system (4).

$$\begin{cases} 1{,}8.n + 0{,}00011.p^2 + \\ + 1{,}06.10^{-6}.\dot{p} = Q; \\ 0{,}015.\dot{n} + 0{,}0672(n - n_s)^2 + \\ + M_e = 2{,}4.p\ ; \end{cases} \quad (4)$$

The system brings (4) using proper programs in nule initial conditions (the departure from vest), drives to diagrams as the ones reprezented in fig. no. 4. The diagrams represented: the engine answer at a signal stair of flow and hydraulic agent, respectively Q=5,15,25,35,45,50 l/min – fig no.4 a – and the engine answer to a jump stair of couple, represented valuable ale couple of M_e=110,200,300,400,500,600 daN.m-fig.no.4.b.



a



b

Fig. 4. Dynamic feature hydrostatical slow engine

a) feature of rev to flows of Q=5,15,25,35,45,50l/min; b)feature of pressure to moments of M_e=110,200,300,400,500,600daNm.

4. Conclusions

From undertaked analysis in the work detached next conclusions about the object studied represented of hydrostatical slow the engine with radial pistons with sinusoidal cam -R2A-the size 3:

- The static theoretical features described of the equations (1), (2), he estimates with sufficient accuracy the experimental erect features on stalls. For static feature of flow Q=f(p)- charm n, with parameter the error absolute maxim between the theoretical values described of (2) and one experimental the by-path below 1,5% for whole valuable functional. For static feature couple M=f(n)- charm with the parameter p, the error absolute maxim between the theoretical values described of (2) and o the one experimental by-path below 5,3% for whole valuable functional area.

- The coefficients from the static theoretical features described of the equations (1), (3) are dependent on the constructive parameters have motive the si of the average hydraulic used-up features, what fact permits the evaluation precisely and confide these specific to different tipodimensions of such engine.

- The dynamic features of engine can be studied on the base of the dynamic model (3), confirmed experimental model through the static features infered from (2). The terms what they step in additionally in the dynamic model (3) against the static models be dependent on the compressibility hydraulic agent the si of the moment of reduced inertia of the system acted of engine.

- From analysis of dynamic regime consisted as the hydrostatical slow engine R2A-the size 3, constituted the object work has a dynamic stable behavior incite to the variation of feeder how much flow and resistant couple.

- The building-up time of dynamic features is below the thousandth of second. The pressure touches the adjusting values of protective clack (350 bar), to moments what exceed the value of 300 daN. The overtaking pressure of thing and open the adjusting clack demonstrated as an another factor of disturb motive operation.

-The suggested model for the dynamic behavior engine can life to dynamic analysis of draft systems to the technological self-propelled equipments.

Bibliography

[1] Axinti, G;Tont,V-Dinamica echipamentelor si sistemelor de actionare hidrostatica-Univ. Dunarea de Jos din Galati-Facultatea de Inginerie Braila-1999-pg.43;

[2] Arghirescu, C- Studiul regimurilor sistemelor hidrostatice in circuit inchis utilizate in tractiunea masinilor pentru lucrari de pamant-teza de doctorat –Univ. Tehnica de Constructii-Bucuresti – 1980-pg.106-110;

[3] Axinti, G-Dinamica aparatelor hidraulice autoexcitate-Editura Impuls Bucuresti-1998-ISBN-973-98409-1-4;

[4] Backe,W-Vorausbest immung das statischen und dynamischen Vershalten hydraulischer Gerats und system-Olhydraulischer und pneumatik,nr.5-1980;

[5]Beneteau,P;Esnault, F-Hydrostatique, Hydrodynamique.Transmision de puissance-Editura Elipses –Paris-1997-isbn-2-7298-4776-6;

[6] Oprean, A;Ispas,C-Actionari si automatizari hidraulice –Editura Tehnica- Bucuresti-1989;

[7] Axinti,G- Simularea numerica a comportarii in regim stabilizat a motoarelor hidrostatice lente cu pistoane radiale si came sinusoidale multiperiodice-SINUC-Bucuresti-2006-Universitatea Tehnica de Constructii Bucuresti.

[8] ***- Cercetari experimentale asupra utilizarii rotilor motoare la utilajele tehnologice de constructii-ICPUC-Braila-1981;

[9]***-Motoare hidraulice lente –Prospecte ale firmei PROMEX.