L 61705-65 EEO-2/EEC(k)-2/EMG(v)/EED-2/EMA(c)/EMT(d)/T/EEC(j)/FSS-2 Pn-4/Po-4/Pg-4/Pg-4/Pk-4/P1-4 BC

ACCESSION NR: AP5016241

UR/0373/65/000/003/0156/0159

AUTHOR: Krementulo, V. V. (Moscow)

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TITIE: The stability of the motion of a gyroscope in a Cardan suspension in the presence of a moment about the rotor axis

SOURCE: AN SSSR. Izvestiya. Mekhanika, no. 3, 1965, 156-159

TOPIC TAGS: Cardan suspension, gyroscope motion, gyroscope mounting, gyroscope stability, Lyapunov Chetayev method, perturbation

ABSTRACT: The stability of certain motions of a heavy gyroscope in a Cardan suspension was studied with the help of the Lyapunov-Chetayev method in the bounds of a commonly applied model. In the model selected it is assumed that the moment acting about the z axis is such that a certain steady motion ($\phi = \omega = a$ constant) occurs. The solution is carried out for two conditions: 1) the moment is external to the mechanical system studied; 2) the moment is internal. In the internal approach, the ring and rotors together form an electric motor (synchronous or nonsynchronous) and the moment W_{z} is internal in respect to the system. If the moment W_{z} is created with the help of a device not appearing in the system (rotor + inner ring + outer ring), then W_{z} is external in respect to the system. The internal moment case was studied for a heavy gyroscope with the axis of the outer ring vertical, with the

L 61705-65 ACCESSION NR: AP5016241 inner ring and rotor together forming a nonsynchronous electric motor. The solution is similar to the treatment using another model (a torque relative to the z spin exis is generated by a motor and is entirely used in overcoming the moment of the forces of resistance, so that there is a cyclic integral which expresses the constancy of the components of the absolute transient angular speed of the rotor on the z exis). Both perturbed and unperturbed motions were considered. The treatment of the external moment solution was compared with similar earlier studies. In this paper, different external moments were investigated and the integral involved was not expressed in a Lyapunov function. The conditions for some of the real roots of the equation were expressed on the basis of Hursitz criteria. In both types of moments discussed, the necessary and sufficient conditions for stability are presented. Orig. art. has: 18 formulas. ASSOCIATION: none SUBMITTED: 11Jun64 SUB CODE: NX NO REF SOV: 008

EWT(d)/FSS-2/EEC(k)-2 BC L 20999-66

ACCESSION NR: AP5013132

UR/0373/65/000/002/0069/0075

AUTHOR: Krementulo, V. V. (Moscow)

TITLE: On the stability of motion of some adjustable gyroscopic instruments on a movable base

SOURCE: AN SSSR. Izvestiya. Mekhanika, no. 2, 1965, 69-75

TOPIC TAGS: gyroscope, gyroscope stability, gyroscope motion, approximation method, stability criterion

ABSTRACT: The stability of a spherical gyro-vertical compass with aerodynamic suspension and of a gyro-horizontal compass in the presence of dissipative forces was studied analytically. The equations of motion of the gyro-vertical are written first, and are followed by the particular solution

$$\alpha = \beta = 0$$
, $\alpha' = \beta' = 0$, $\rho = \gamma'\alpha' \sin \beta = \omega$.

The angular momenta are expressed by

$$M_x^{(1)} = (C - A)\Omega v + C\omega v, \quad M_y^{(2)} = Av, \quad M_z^{(3)} = C(\omega + \Omega).$$

where A is the equatorial moment of inertia of the gyroscope, C is the axial

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ACCESSION NR: AP5013132

moment of inertia, and ω is the angular velocity around the z-axis. From these, perturbation equations are obtained and the following Lyapunov function is defined

$$2V = A (y_1^2 + y_2^2) + Cy_2^2 + [(C - A) (\Omega^2 - v^2) + H\Omega] x_1^2 + [(C - A) \Omega^2 + H\Omega] x_2^2 + \dots (H = C\omega)$$

It is shown that the sufficient conditions for the derivative of V to have the opposite sign of V and hence insure stability to the gyro-vertical compass are:

$$(C-A)(\Omega^2-\nu^2)+\frac{CA}{K}\Omega^2\Omega>\lambda_1>0$$

for all $t > t_0$,

$$(C-A) \Omega^2 + \frac{CA}{K} \Omega \Omega > \lambda_2 > 0$$

$$2K (C-A) v'v - C^2 v'^2 > 0 \qquad (t > t_2)$$

and

$$(A-C) \Omega'\Omega - \frac{1}{2}CAK^{-1} (\Omega'\Omega) > 0 \qquad (t > t_0).$$

A small example is given to illustrate this point. Next, the exact equations of motion for the horizontal gyrocompass are written with the following expression for the angular momenta: $M_x^{(1)} = -K(\alpha \psi_1 + \beta \cos \gamma)$, $M_y^{(1)} = -K(\alpha \psi_2 + \gamma)$

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$$M_s^{(1)} = -K(\alpha \psi_0 + \beta' \sin \gamma) \qquad (K > 0) .$$

L 20999-66

ACCESSION NR: AP5013132

The motion is described by $\alpha = \beta = \gamma = 0$,

with the following two conditions for asymptotic stability:

$$\frac{mlR + C - A > \lambda_1 > 0}{g - vv - R\Omega^2}$$

$$\frac{mgl + (C - B)}{s}$$

$$\frac{\Omega^2 > \lambda_2 > 0}{(t > t_0)}$$

$$4K(B-C)\Omega\Omega - B^2\Omega^2 - C^2v^2 > \kappa_1 > 0$$

$$4K (mlR + C - A) \dot{v}\dot{v} + (A - mlR)^2 \dot{v}^2 < - \varkappa_2 \leq 0 \cdot (\iota \geq \iota_0)$$

$$\Delta_2 > \kappa_3 > 0$$
.

In all above the parameters v, \O, H are assumed to be functions of time. Orig. art. has: 29 formulas.

ASSOCIATION: none

SUBMITTED: 12Feb64

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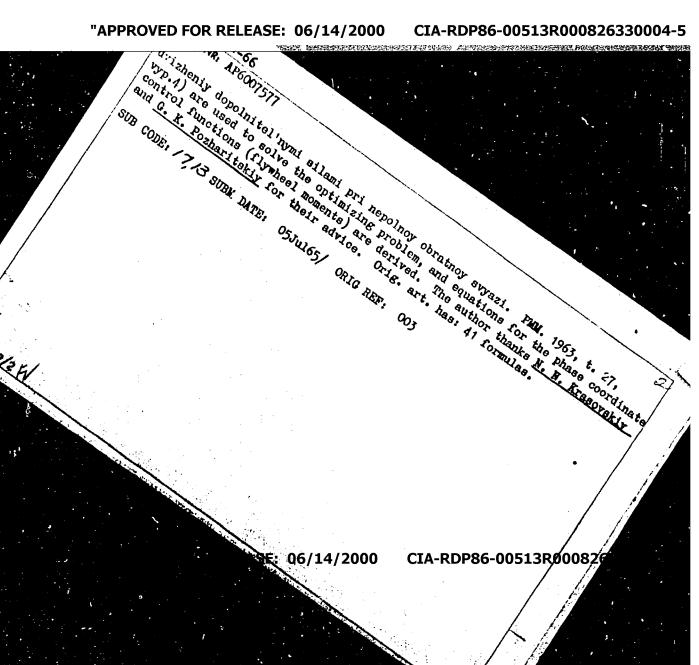
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OTHER: 000

ACC NR: AP6007577 AUTHOR: Krementulo, V. V. (Moscow) ORG: none 23 TITLE: Optimum flywheel stabilization of a rigid body having one stationary point SOURCE: Prikladnaya matematika i mekhanika, v. 30, no. 1, 1966, 42-50 TOPIC TAGS: flywheel, gyroscope, rigid body motion, dynamic system ABSTRACT: The analytical design problem of providing optimum stabilization of a rigid body having one stationary point is solved by using a theory similar to the simple of motion are derived for three identical flywheels directed along three orthogonal nate functions v_1 so as to minimize $ \sum_{i} \Omega(p_i, p_i, p_3, \alpha_{11}, \dots, \alpha_{33}, p_1, \nu_1, \nu_2) dt $ and to make the zero solution $ p_i = 0, \alpha_{1k} = 0 (i, k = 1, 2, 3) $ asymptotically stable (where p_1 , α_{1k} are the angular velocity and position coordinates). The methods described by N. N. Krasovskiy (0 stabilizatsii neustoychivykh Cord $1/2$	L 23444-66 EWT(1) IJP(c)	Later Charles	
ORG: none ORG: none 32 TITLE: Optimum flywheel stabilization of a rigid body having one stationary point SOURCE: Prikladnaya matematika i mekhanika, v. 30, no. 1, 1966, 42-50 TOPIC TAGS: flywheel, gyroscope, rigid body motion, dynamic system ABSTRACT: The analytical design problem of providing optimum stabilization of a rigid body having one stationary point is solved by using a theory similar to the simple of motion are derived for three identical flywheels directed along three orthogonal axes. Then the optimum stabilization problem is formulated to find the phase coordinate functions v_1 so as to minimize $ \int_{v_1}^{\infty} \Omega(p_1, p_2, p_3, a_{11}, \dots, a_{23}, p_1, v_2, v_3) dt $ and to make the zero solution $ p_1 = 0, a_{1k} = 0 (i, k = 1, 2, 3) $ asymptotically stable (where p_1 , α_{1k} are the angular velocity and position coordinates). The methods described by N. N. Krasovskiy (0 stabilization)	ACC NR. AP6007577	2/0050	1 - 1
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hyapunov method. The equations of motion for steady state and the perturbed equations of motion are derived for three identical flywheels directed along three orthogonal nate functions v_i so as to minimize	TOPIC TAGS: flywheel, gyroscope, rigid body motion, dynamic system		
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UR/0424/56/000/006/0011/0018 SOURCE CODE: ACC NR: AP7002588

AUTHOR: Krementulo, V. V. (Mozcow)

TITLE: The use of flywheels for the optimum stabilization of the rotary motion of a

SOURCE: Inzhenernyy zhurnal. Mekhanika tverdogo tela, no. 6, 1966, 11-18 solid body with a fixed point

TOPIC TAGS: motion stability, spacecraft stability, astrionic stabilization, gyroscope motion equation, Euler equation, Volterra equation, Poisson equation

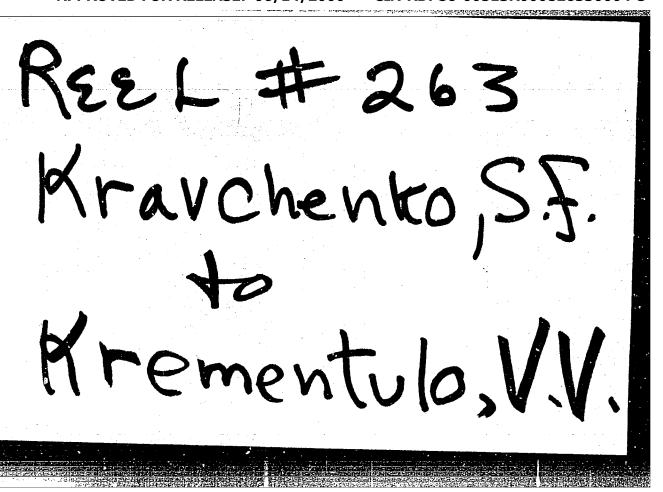
ABSTRACT: This work is a generalization of research performed previously and aimed at the optimization of flywheel control, and the determination of the optimum stability of the initial equilibrium position with respect to speed and coordinates. The motion of the system is defined by three Euler-Volterra equations, nine Poisson equations (kinematic), and three equations of the rotary motion of the flywheels. The problem is somewhat simplified for the case of a symmetrical gyrostat; the Euler-Krylov angles and their vectorialization lend themselves to some additional simplifications, so that the gyrostat motion is defined completely by 12 equations. To solve the stabilization problem, a "shortened" system of equations is introduced. The fundamental theorem of Lyapunov's second method is used for the solution of the analytical design problem of

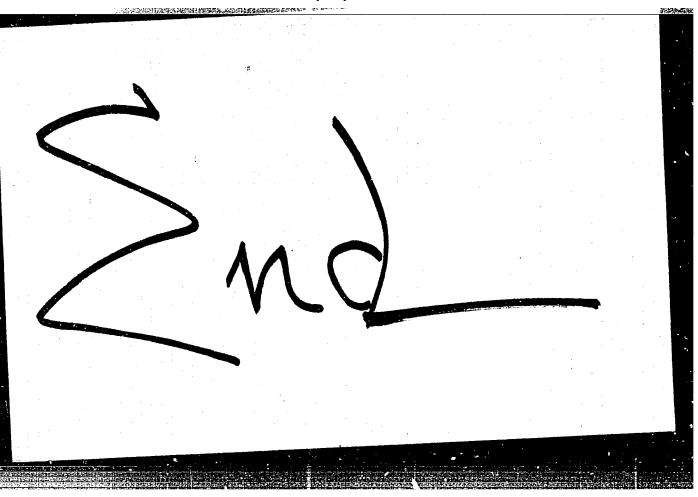
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