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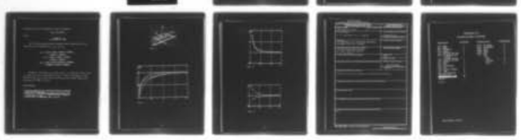

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THE MOVEMENT OF A WING WITH DEFLECTED AILERONS CLOSE TO A SCREEN

by

V. G. Belinskiy, Yu. I. Laptev

FOREIGN TECHNOLOGY DIVISION

EDITED TRANSLATION

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THE MOVEMENT OF A WING WITH DEFLECTED AILERONS CLOSE TO A SCREEN

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Block	Italic	Transliteration	Block	Italic	Transliteration
А а	*А а*	A, a	Р р	*Р р*	R, r
Б б	*Б б*	B, b	С с	*С с*	S, s
В в	*В в*	V, v	Т т	*Т т*	T, t
Г г	*Г г*	G, g	У у	*У у*	U, u
Д д	*Д д*	D, d	Ф ф	*Ф ф*	F, f
Е е	*Е е*	Ye, ye; E, e*	Х х	*Х х*	Kh, kh
Ж ж	*Ж ж*	Zh, zh	Ц ц	*Ц ц*	Ts, ts
З з	*З з*	Z, z	Ч ч	*Ч ч*	Ch, ch
И и	*И и*	I, i	Ш ш	*Ш ш*	Sh, sh
Й й	*Й й*	Y, y	Щ щ	*Щ щ*	Shch, shch
К к	*К к*	K, k	Ъ ъ	*Ъ ъ*	"
Л л	*Л л*	L, l	Ы ы	*Ы ы*	Y, y
М м	*М м*	M, m	Ь ь	*Ь ь*	'
Н н	*Н н*	N, n	Э э	*Э э*	E, e
О о	*О о*	O, o	Ю ю	*Ю ю*	Yu, yu
П п	*П п*	P, p	Я я	*Я я*	Ya, ya

*ye initially, after vowels, and after ъ, ь; e elsewhere. When written as ё in Russian, transliterate as yё or ё. The use of diacritical marks is preferred, but such marks may be omitted when expediency dictates.

GREEK ALPHABET

Alpha	Α	α	∝	Nu	Ν	ν	
Beta	Β	β		Xi	Ξ	ξ	
Gamma	Γ	γ		Omicron	Ο	ο	
Delta	Δ	δ		Pi	Π	π	
Epsilon	Ε	ε	ϵ	Rho	Ρ	ρ	ϱ
Zeta	Ζ	ζ		Sigma	Σ	σ	ς
Eta	Η	η		Tau	Τ	τ	
Theta	Θ	θ	ϑ	Upsilon	Υ	υ	
Iota	Ι	ι		Phi	Φ	φ	ϕ
Kappa	Κ	ϰ	κ	Chi	Χ	χ	
Lambda	Λ	λ		Psi	Ψ	ψ	
Mu	Μ	μ		Omega	Ω	ω	

RUSSIAN AND ENGLISH TRIGONOMETRIC FUNCTIONS

Russian	English
sin	sin
cos	cos
tg	tan
ctg	cot
sec	sec
cosec	csc
sh	sinh
ch	cosh
th	tanh
cth	coth
sch	sech
csch	csch
arc sin	$\sin^{-1}$
arc cos	$\cos^{-1}$
arc tg	$\tan^{-1}$
arc ctg	$\cot^{-1}$
arc sec	$\sec^{-1}$
arc cosec	$\csc^{-1}$
arc sh	$\sinh^{-1}$
arc ch	$\cosh^{-1}$
arc th	$\tanh^{-1}$
arc cth	$\coth^{-1}$
arc sch	sech^{-1}
arc csch	csch^{-1}

Russian	English
rot	curl
lg	log

GRAPHICS DISCLAIMER

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THE MOVEMENT OF A WING WITH DEFLECTED AILERONS CLOSE TO A SCREEN

V. G. Belinskiy, Yu. I. Laptev
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The movement of a wing with deflected ailerons in a boundless fluid has been investigated by many authors [1, 2 and others]. However, the effect of the flow boundaries on the characteristics of such a wing has been insufficiently studied.

The effect of a free surface on the characteristics of an underwater wing with deflected ailerons was investigated by T. Nishiyama [4]; he showed that the proximity of a free surface decreases the lift and rolling moment but increases the induced drag and the yawing moment.

This work has obtained simple analytical dependences which permit estimating the effect of the proximity of a solid screen on the hydrodynamic characteristics of a wing with deflected ailerons.

The distribution of the circulation along the span of a horizontal wing with a large aspect ratio which is moving steadily at a velocity of v_0 over a distance H_0 from a plane solid screen (Fig. 1) is determined by the equation [3]

$$\bar{\Gamma}(\bar{y}) = \frac{a_0}{2\lambda(\bar{y})}\psi(\bar{y})\left\{\alpha(\bar{y}) + \frac{1}{2\pi}\int_{-1}^{+1}\bar{\Gamma}(\bar{\eta})\left[\frac{1}{(\bar{y}-\bar{\eta})^2} - \right.\right.$$

$$\left.\left. - \frac{(\bar{y}-\bar{\eta})^2 - 4\bar{H}_0^2}{[(\bar{y}-\bar{\eta})^2 + 4\bar{H}_0^2]^2}\right]d\bar{\eta}\right\}. \quad (1)$$

Here a_0 - the tangent of the angle of slope of the relation $C_y = = C_y(\alpha)$ for a boundless fluid; $\psi(\bar{y})$ - the function which considers the change a_0 in a limited flow; where $\alpha(y)$ - the angle of attack of the wing;

$$\bar{\Gamma}(\bar{y}) = \frac{\Gamma(y)}{\lambda B v_0};\ \bar{y} = \frac{2y}{L};\ \bar{z} = \frac{2z}{B};\ \bar{H}_0 = \frac{2H_0}{L};$$

$\lambda(\bar{y})$ - the aspect angle of the wing equal to L/B (L - the wing span, B - the wing chord).

Let us consider the case where such a wing moves when the ailerons have been deflected by a small angle. We will assume that the deflection of the ailerons by a small angle is equivalent to some twisting of the wing. The deformation of the wing with the deflection of the ailerons leads to an asymmetrical distribution of circulation along the span. We present the circulation in the form of symmetrical and asymmetrical parts

$$\bar{\Gamma}(\bar{y}) = \bar{\Gamma}_c(\bar{y}) + \bar{\Gamma}_a(\bar{y}) = \frac{\bar{\Gamma}(\bar{y}) + \bar{\Gamma}(-\bar{y})}{2} + \frac{\bar{\Gamma}(\bar{y}) - \bar{\Gamma}(-\bar{y})}{2}. \quad (2)$$

Similarly, we write the angle of attack of a deformed wing

$$\alpha(\bar{y}) = \alpha_c(\bar{y}) + \alpha_a(\bar{y}) = \frac{\alpha(\bar{y}) + \alpha(-\bar{y})}{2} + \frac{\alpha(\bar{y}) - \alpha(-\bar{y})}{2}, \quad (3)$$

where $\alpha_c(\bar{y})$ is the wing's angle of attack with undeflected ailerons; $\alpha_a(\bar{y})$ is the angle of twist of the wing which considers the deflection of the ailerons.

The Kernal of equation (1) can also be presented in the form of a symmetrical and asymmetrical parts:

$$G(\bar{y}, \bar{\eta}) = G_c(\bar{y}, \bar{\eta}) + G_a(\bar{y}, \bar{\eta}).$$

In turn

$$G_c(\bar{y}, \bar{\eta}) = G_{cc}(\bar{y}, \bar{\eta}) + G_{ca}(\bar{y}, \bar{\eta});$$
$$G_a(\bar{y}, \bar{\eta}) = G_{ac}(\bar{y}, \bar{\eta}) + G_{aa}(\bar{y}, \bar{\eta}). \tag{4}$$

Analysis shows that in this case

$$G_{ca}(\bar{y}, \bar{\eta}) = G_{ac}(\bar{y}, \bar{\eta}) = 0. \tag{5}$$

Considering formulas (2)-(5), equation (1) can be reduced to two independent equations which determine the symmetrical and asymmetrical parts of the circulation:

$$\bar{\Gamma}_c(\bar{y}) = \frac{a_0}{2\lambda(\bar{y})}\psi(\bar{y})\left\{\alpha_c(\bar{y}) + \frac{1}{2\pi}\int_{-1}^{+1}\bar{\Gamma}_c(\bar{\eta})G_{cc}(\bar{y}, \bar{\eta})\,d\bar{\eta}\right\}; \tag{6}$$

$$\bar{\Gamma}_a(\bar{y}) = \frac{a_0}{2\lambda(\bar{y})}\psi(\bar{y})\left\{\alpha_a(\bar{y}) + \frac{1}{2\pi}\int_{-1}^{+1}\bar{\Gamma}_a(\bar{\eta})G_{aa}(\bar{y}, \bar{\eta})\,d\bar{\eta}\right\}, \tag{7}$$

where

$$G_{cc}(\bar{y}, \bar{\eta}) = \frac{1}{2}\left\{\frac{1}{(\bar{y}-\bar{\eta})^2} - \frac{(\bar{y}-\bar{\eta})^2 - 4\bar{H}_0^2}{[(\bar{y}-\bar{\eta})^2 + 4\bar{H}_0^2]^2} + \right.$$
$$\left. + \frac{1}{(\bar{y}+\bar{\eta})^2} - \frac{(\bar{y}+\bar{\eta})^2 - 4\bar{H}_0^2}{[(\bar{y}+\bar{\eta})^2 + 4\bar{H}_0^2]^2}\right\};$$
$$G_{aa}(\bar{y}, \bar{\eta}) = \frac{1}{2}\left\{\frac{1}{(\bar{y}-\bar{\eta})^2} - \frac{(\bar{y}-\bar{\eta})^2 - 4\bar{H}_0^2}{[(\bar{y}-\bar{\eta})^2 + 4\bar{H}_0^2]^2} - \right.$$
$$\left. - \frac{1}{(\bar{y}+\bar{\eta})^2} + \frac{(\bar{y}+\bar{\eta})^2 - 4\bar{H}_0^2}{[(\bar{y}+\bar{\eta})^2 + 4\bar{H}_0^2]^2}\right\}.$$

But with $\bar{H}_0 \to \infty$ equations (6) and (7) have the form

$$\bar{\Gamma}_c(\bar{y}) = \frac{a_0}{2\lambda(\bar{y})}\left\{\alpha_c(\bar{y}) + \frac{1}{4\pi}\int_{-1}^{+1}\bar{\Gamma}_c(\bar{\eta})\left[\frac{1}{(\bar{y}-\bar{\eta})^2} + \frac{1}{(\bar{y}-\bar{\eta})^2}\right]d\bar{\eta}\right\}; \tag{8}$$

$$\bar{\Gamma}_a(\bar{y}) = \frac{a_0}{2\lambda(\bar{y})}\left\{\alpha_a(\bar{y}) + \frac{1}{4\pi}\int_{-1}^{+1}\bar{\Gamma}_a(\bar{\eta})\left[\frac{1}{(\bar{y}-\bar{\eta})^2} - \frac{1}{(\bar{y}+\bar{\eta})^2}\right]d\bar{\eta}\right\}. \tag{9}$$

For a wing of elliptical form in a plane, we present the approximate solutions of equations (6)-(9). In accordance with this, we assume

$$\frac{\phi(\bar{y})}{\lambda(\bar{y})} = \frac{4\phi}{\pi\lambda_0}\sqrt{1-\bar{y}^2}. \qquad (10)$$

We will look for the solutions to the equations in the form

$$\Gamma_c(\bar{y}) = A\sqrt{1-\bar{y}^2},$$

$$\Gamma_a(\bar{y}) = \beta\bar{y}\sqrt{1-\bar{y}^2}. \qquad (11)$$

where A and B are constants.

Integrating by parts, we reduce equations (8) and (9) to the integral-differential form:

$$\bar{\Gamma}_c(\bar{y}) = \frac{a_0}{2\lambda(\bar{y})}\left\{\alpha_c(\bar{y}) - \frac{1}{4\pi}\int_{-1}^{+1}\bar{\Gamma}'_c(\eta)\left[\frac{1}{(\bar{y}-\eta)} - \frac{1}{(\bar{y}+\eta)}\right]d\bar{\eta}\right\}; \qquad (12)$$

$$\bar{\Gamma}_a(\bar{y}) = \frac{a_0}{2\lambda(\bar{y})}\left\{\alpha_a(\bar{y}) - \frac{1}{4\pi}\int_{-1}^{+1}\bar{\Gamma}'_a(\bar{\eta})\left[\frac{1}{(\bar{y}-\bar{\eta})} + \frac{1}{(\bar{y}+\bar{\eta})}\right]d\bar{\eta}\right\}. \qquad (13)$$

In the solution of equation (12) we consider that $\omega_c(\bar{y}) = \alpha$, where α is the angle of attack of a wing with undeflected ailerons.

Solution of this equation with consideration of equalities (10) and (11) provides

$$A_{\infty} = \frac{\frac{2a_0}{\pi\lambda_0}\alpha}{1+\frac{a_0}{\pi\lambda_0}}. \qquad (14)$$

As a result of the solution of equation (13) with consideration of expressions (10) and (11) we obtain the linear law of distribution for the twist angle of a deformed wing along the span

$$\alpha_{e}(\bar{y}) = \alpha_{\kappa}\bar{y}, \tag{15}$$

where α_{κ} is the twist angle of the end section of a deformed wing.

Here, constant B_{∞} is determined by the formula

$$B_{\infty} = \frac{\frac{2a_0}{\pi\lambda_0}\alpha_{\kappa}}{1 + \frac{2a_0}{\pi\lambda_0}}. \tag{16}$$

After integration by parts equations (6) and (7) are reduced to the integral-differential form:

$$\bar{\Gamma}_c(\bar{y}) = \frac{a_0}{2\lambda(\bar{y})}\psi(y)\left\{\alpha_c(\bar{y}) - \frac{1}{4\pi}\int_{-1}^{+1}\bar{\Gamma}'_c(\bar{\eta})\left[\frac{1}{(\bar{y}-\bar{\eta})} - \right.\right.$$

$$\left.\left. - \frac{\bar{y}-\bar{\eta}}{(y-\eta)^2 + 4\bar{H}_0^2} - \frac{1}{(\bar{y}+\bar{\eta})} + \frac{\bar{y}+\bar{\eta}}{(\bar{y}+\eta)^2 + 4\bar{H}_0^2}\right]d\eta\right\}; \tag{17}$$

$$\bar{\Gamma}_e(\bar{y}) = \frac{a_0}{2\lambda(\bar{y})}\psi(\bar{y})\left\{\alpha_e(\bar{y}) - \frac{1}{4\pi}\int_{-1}^{+1}\bar{\Gamma}'_e(\bar{\eta})\left[\frac{1}{(\bar{y}-\bar{\eta})} - \right.\right.$$

$$\left.\left. - \frac{\bar{y}-\bar{\eta}}{(\bar{y}-\bar{\eta})^2 + 4\bar{H}_0^2} + \frac{1}{(\bar{y}+\bar{\eta})} - \frac{\bar{y}+\bar{\eta}}{(\bar{y}+\bar{\eta})^2 + 4\bar{H}_0^2}\right]d\bar{\eta}\right\}. \tag{18}$$

Solving these equations with consideration of expressions (10) and (11) and accepting the linear law of distribution of a wing twist angle along the span, we obtain the following formulas for the determination of constants A_H and B_H:

$$A_H = \frac{\frac{2a_0\psi}{\pi\lambda_0}\alpha}{1+\frac{a_0\psi}{\pi\lambda_0}\zeta_1}; \tag{19}$$

$$B_H = \frac{\frac{2a_0\psi}{\pi\lambda_0}\alpha_\kappa}{1+\frac{2a_0\psi}{\pi\lambda_0}\zeta_2}. \tag{20}$$

In these formulas

$$\zeta_1 = 1 + \frac{1}{\pi^2}\int_{-1}^{+1}\sqrt{1-\bar{y}^2}\,d\bar{y}\int_{-1}^{+1}\frac{\bar{\eta}}{\sqrt{1-\bar{\eta}^2}}\left[\frac{\bar{y}-\bar{\eta}}{(\bar{y}-\bar{\eta})^2+4\bar{H}_0^2} - \frac{\bar{y}+\bar{\eta}}{(\bar{y}+\bar{\eta})^2+4\bar{H}_0^2}\right]d\bar{\eta}; \tag{21}$$

$$\zeta_2 = 1 - \frac{2}{\pi^2}\int_{-1}^{+1}\bar{y}\sqrt{1-\bar{y}^2}\,d\bar{y}\int_{-1}^{+1}\left[\frac{1}{\sqrt{1-\eta^2}} - \frac{2\eta^2}{\sqrt{1-\eta^2}}\right]\times \left[\frac{\bar{y}-\eta}{(\bar{y}-\eta)^2+4H_0^2} + \frac{\bar{y}+\eta}{(\bar{y}+\eta)^2+4H_0^2}\right]d\eta. \tag{22}$$

Coefficients of lift, induced drag, rolling moment, and yawing moment are found from the expressions

$$\left.\begin{aligned}
C_y &= \lambda_0\int_{-1}^{+1}\Gamma_c(\bar{y})\,d\bar{y};\\
C_{xi} &= \lambda_0\int_{-1}^{+1}[\bar{v}_{is}\Gamma_c(\bar{y}) + \bar{v}_{ia}\Gamma_a(\bar{y})]\,d\bar{y};\\
C_{mx} &= \frac{1}{2}\lambda_0\int_{-1}^{+1}\bar{y}\Gamma_a(\bar{y})\,d\bar{y};\\
C_{my} &= \frac{1}{2}\lambda_0\int_{-1}^{+1}\bar{y}\,[\bar{v}_{ia}\Gamma_c(\bar{y}) + \bar{v}_{is}\Gamma_a(\bar{y})]\,d\bar{y}.
\end{aligned}\right\} \tag{23}$$

Here $\bar{v}_{ic}$ and $\bar{v}_{ia}$ are the symmetrical and asymmetrical parts of the induced velocity $\bar{v}_i$. For these values, we have the expressions

$$\left.\begin{aligned}
\bar{v}_{ic\infty} &= -\frac{1}{4\pi}\int_{-1}^{+1}\Gamma_c(\bar{\eta})\left[\frac{1}{(\bar{y}-\bar{\eta})^2}+\frac{1}{(\bar{y}+\bar{\eta})^2}\right]d\bar{\eta};\\
\bar{v}_{ia\infty} &= -\frac{1}{4\pi}\int_{-1}^{+1}\Gamma_a(\bar{\eta})\left[\frac{1}{(\bar{y}-\bar{\eta})^2}-\frac{1}{(\bar{y}+\bar{\eta})^2}\right]d\bar{\eta};\\
\bar{v}_{icH} &= -\frac{1}{4\pi}\int_{-1}^{+1}\Gamma_c(\bar{\eta})\left\{\frac{1}{(\bar{y}-\bar{\eta})^2}-\frac{(\bar{y}-\bar{\eta})^2-4\bar{H}_0^2}{[(\bar{y}-\bar{\eta})^2+4\bar{H}_0^2]^2}+\right.\\
&\left.+\frac{1}{(\bar{y}+\bar{\eta})^2}-\frac{(\bar{y}+\bar{\eta})^2-4\bar{H}_0^2}{[(\bar{y}+\bar{\eta})^2+4\bar{H}_0^2]^2}\right\}d\bar{\eta};\\
\bar{v}_{iaH} &= -\frac{1}{4\pi}\int_{-1}^{+1}\Gamma_a(\bar{\eta})\left\{\frac{1}{(\bar{y}-\bar{\eta})^2}-\frac{(\bar{y}-\bar{\eta})^2-4\bar{H}_0^2}{[(\bar{y}-\bar{\eta})^2+4\bar{H}_0^2]^2}-\right.\\
&\left.-\frac{1}{(\bar{y}+\bar{\eta})^2}+\frac{(\bar{y}+\bar{\eta})^2-4\bar{H}_0^2}{[(\bar{y}+\bar{\eta})^2+4\bar{H}_0^2]^2}\right\}d\bar{\eta}.
\end{aligned}\right| \qquad (24)$$

Substituting equations (11) and (24) into expression (23) and considering formulas (14), (16), (19), and (20), we obtain the following formulas for the characteristics of a wing with deflected ailerons:

with motion in a boundless fluid

$$\left.\begin{aligned}
C_{y\infty} &= \frac{a_0\alpha}{1+\frac{a_0}{\pi\lambda_0}};\\
C_{mx\infty} &= \frac{\frac{1}{8}a_0\alpha_\kappa}{1+\frac{2a_0}{\pi\lambda_0}};\\
C_{xi\infty} &= \frac{1}{\pi\lambda_0}[C_{y\infty}^2+32C_{mx\infty}^2];\\
C_{my\infty} &= \frac{3}{\pi\lambda_0}C_{y\infty}\ C_{mx\infty};
\end{aligned}\right| \qquad (25)$$

with the motion close to a solid screen

$$\left.\begin{aligned}
C_{y_H} &= \frac{a_0\psi\alpha}{1+\frac{a_0\psi}{\pi\lambda_0}\zeta_1};\\
C_{mzH} &= \frac{\frac{1}{8}a_0\psi\alpha_\kappa}{1+\frac{2a_0\psi}{\pi\lambda_0}\zeta_2};\\
C_{xi_H} &= \frac{1}{\pi\lambda_0}[C_{yH}^2\zeta_1 + 32C_{mzH}^2\zeta_2];\\
C_{mx_H} &= \frac{1}{\pi\lambda_0}C_{yH}C_{mzH}[2\zeta_4+\zeta_3].
\end{aligned}\right\} \tag{26}$$

The function ζ_3 is determined from the expression

$$\zeta_3 = 1 + \frac{4}{\pi^2}\int_{-1}^{+1}\bar{y}^2\sqrt{1-\bar{y}^2}\,d\bar{y}\int_{-1}^{+1}\frac{\bar{\eta}}{\sqrt{1-\bar{\eta}^2}}\times$$

$$\times\left[\frac{\bar{y}-\bar{\eta}}{(\bar{y}-\bar{\eta})^2+4\bar{H}_0^2} - \frac{\bar{y}+\bar{\eta}}{(\bar{y}+\bar{\eta})^2+4\bar{H}_0^2}\right]d\bar{\eta}. \tag{27}$$

The coefficients of the effect of a solid screen's proximity on the hydrodynamic characteristics of a wing with deflected ailerons are determined from formulas

$$\bar{p}_y = \frac{C_{yH}}{C_{y\infty}} = \frac{\psi\left(1+\frac{a_0}{\pi\lambda_0}\right)}{\left(1+\frac{a_0\psi}{\pi\lambda_0}\zeta_1\right)};$$

$$\bar{m}_z = \frac{C_{mzH}}{C_{mz\infty}} = \frac{\psi\left(1+\frac{2a_0}{\pi\lambda_0}\right)}{\left(1+\frac{2a_0\psi}{\pi\lambda_0}\zeta_2\right)};$$

$$\bar{p}_{xi} = \frac{C_{xi_H}}{C_{xi\infty}} = \bar{p}_y^2\,\frac{\left[\zeta_1 + \frac{1}{2}\frac{\left(1+\frac{a_0\psi}{\pi\lambda_0}\zeta_1\right)^2}{\left(1+\frac{2a_0\psi}{\pi\lambda_0}\zeta_2\right)^2}\cdot\frac{\alpha_\kappa^2}{\alpha^2}\zeta_2\right]}{\left[1+\frac{1}{2}\frac{\left(1+\frac{a_0}{\pi\lambda_0}\right)^2}{\left(1+\frac{2a_0}{\pi\lambda_0}\right)^2}\cdot\frac{\alpha_\kappa^2}{\alpha^2}\right]};$$

$$\bar{m}_x = \frac{C_{mxH}}{C_{mx\infty}} = \frac{1}{3}\bar{p}_y\bar{m}_z[2\zeta_4+\zeta_3].$$

Function ψ can be determined from the formula

$$\psi = 1 + \tau^2 + 0(\tau^4),$$

where

$$\tau = \sqrt{\lambda^2 H_0^2 + 1} - \lambda H_0.$$

The following approximate formulas were obtained for the calculation of functions ζ_1, ζ_2, and ζ_3

$$\zeta_1 = 1 - 0{,}5\tau^2 - 0{,}25\tau^4 - 0{,}0625\tau^6 - 0{,}0468\tau^8 - 0{,}0233\tau^{10} - 0{,}0199\tau^{12};$$

$$\zeta_2 = 1 - 0{,}375\tau^4 - 0{,}250\tau^6 - 0{,}780\tau^8 - 0{,}0624\tau^{10} - 0{,}0340\tau^{12};$$

$$\zeta_3 = 1 - 0{,}5\tau^2 + 0{,}125\tau^4 + 0{,}0312\tau^6 - 0{,}1408\tau^8 - 0{,}0692\tau^{10} - 0{,}0700\tau^{12} - 0{,}0356\tau^{14}.$$

Graphs of functions ζ_1 (solid line), ζ_2 (dash-dot line), and ζ_3 (dash line) are presented in Fig. 2 while the graphs of the functions $\overline{p}_y$, $\overline{p}_{xi}$ (solid lines) and $\overline{m}_x$ and $\overline{m}_z$ (dash lines) are presented in Figs. 3 and 4.

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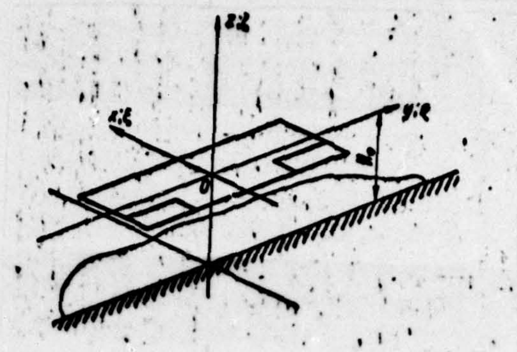

Fig. 1.

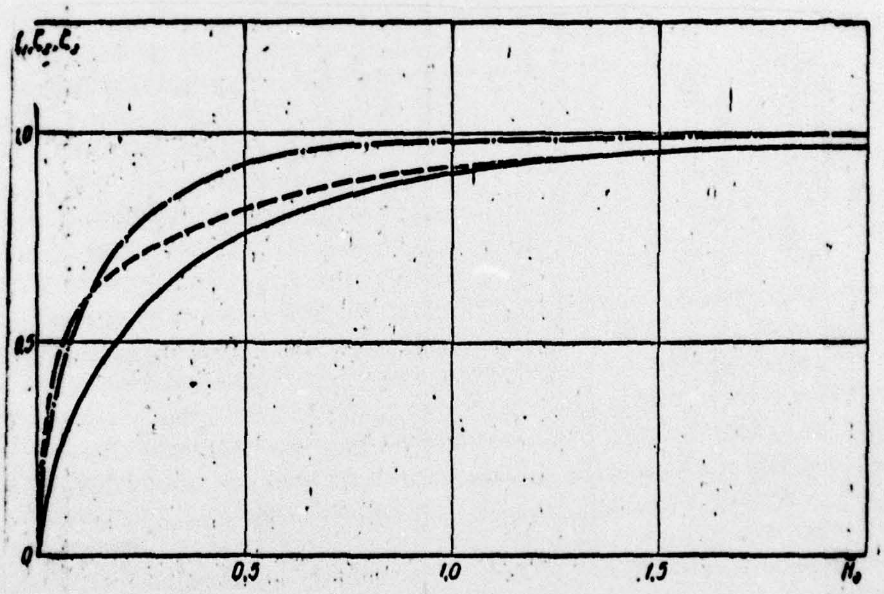

Fig. 2.

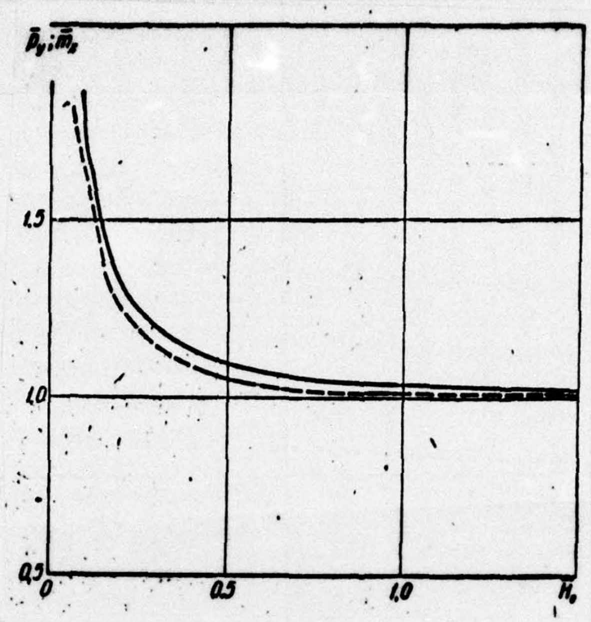

Fig. 3.

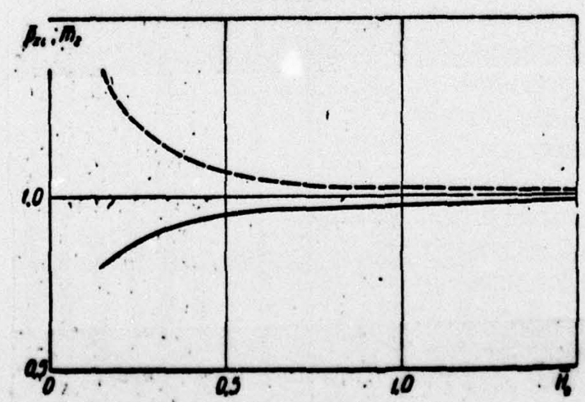

Fig. 4.

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