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The study of the dynamic characteristics of converters using reed gerkon effects

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ABSTRACT: The article considers the accounting of distributed parameters of converter circuits through the parameters of structural schemes. Let us consider reed-on force transducers using the direct and inverse piezoelectric effect and the Lorentz force effect, as well as directly using the force transformation effect to convert sealed contacts. In all cases, the reed effect is used, consisting in the conversion of displacement into electrical conductivity. For this, a sufficiently large number of parallel connected and shunted sealed contacts is used so that the number of parallel connected conductivities ΔG is proportional to the displacement q_m

KEY WORDS: Block diagrams, parameter, sensor, inverse piezoelectric effect

I.INTRODUCTION

Consider the gerkon of force using the direct and inverse piezoelectric effect and the Lorentz force effect, as well as the direct use of the effect of the conversion of force to the conversion of sealed contacts. In all cases, the gerkon effect is used, consisting in the conversion of displacement into electrical conductivity[1,2]. To do this, use a sufficiently large number of parallel connected and shunted sealed contacts so that that the number of conductivities ΔG connected in parallel will be proportional to the displacement q_m, therefore[3].

$$G_3 = K_{m_2} qm \quad (\text{П-1})$$

The block diagram will be presented in the following form (Fig. 1).

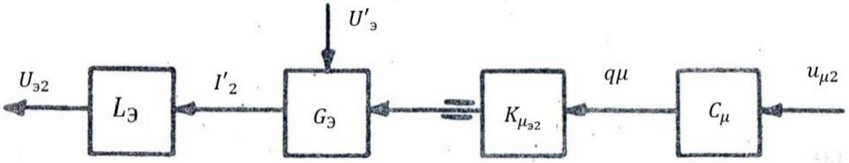

Fig. 1

$$U_{э2} = L_э \cdot U_э \cdot K_{мэ2} \cdot C_м \cdot U_{м2} \quad (\text{П-2}),$$

from here

$$S = L_э \cdot U'_э \cdot K_{мэ2} \cdot C_м \qquad (\text{П-3})$$

where typical values of parameters and electric voltage supplied to the contact:

$$C_m = 10^{-1}\left[\frac{M}{H}\right],\ K_{мэ2} = 20 \cdot 10^3\left[\frac{1}{омм}\right],\quad U'_э = 5\left[\frac{в}{ок}\right],\quad L_э = 10^{-3}[2 \cdot н]$$

Then the sensitivity of the converter:

$$S = 10[в/н]$$

a) Consider the transient in the converter with a linear change in conductivity $G_э$ (Fig. 2)

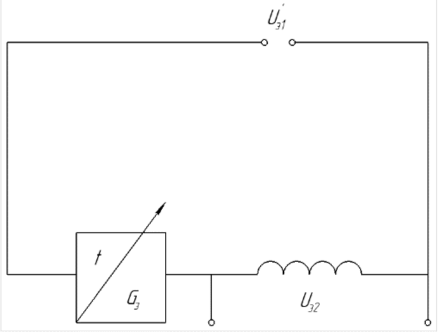

Fig. 2

The corresponding block diagram will be presented in the following form (Fig. 3):

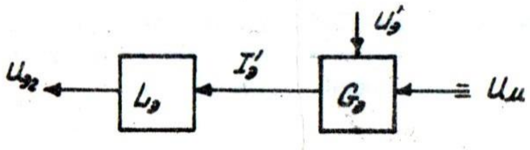

Fig. 3

$$U_{э2} = L_э \cdot G_э \cdot \; U'_э \quad (\Pi\text{-}4)$$

In operator form, this expression can be written as:

$$U_{э2}(P)\frac{L_{эр}\cdot G_{эр}(P)\cdot U'_э}{1+PG_{эр}(P)L_{эр}} \qquad (\Pi\text{-}5)$$

where is the p operator

If $G_{эр}$ changes in direct proportion to time

$$G_{эр} = Kt \qquad (\Pi\text{-}6)$$

then the $G_{эр}(P)$ image in the operator form (according to Carson):

$$G_{эр}(P) = \frac{K}{P} \qquad (\Pi\text{-}7)$$

then the expression (П -5) will be rewritten in the form:

$$U_{э2}(P) = \frac{L_{эр}\frac{K}{P}U'_э}{1+pL_{эр}\frac{K}{P}} = \frac{1}{p}\frac{L_{эр}\cdot KU'_э}{1+L_{эр}\cdot K} \qquad (\Pi\text{-}8)$$

The original corresponding to the expression (П -8) according to Carson has the form:

$$U_{э2}(P) = \frac{L_{эр}KU'_э}{1+L_{эр}K}\cdot t \qquad (\Pi\text{-}9)$$

An analysis of the expression (П -9) showed that when the conductivity $G_{эр}$ changes at a constant speed in time, output value $U_{эр(}$t) such changes with constant speed[4]

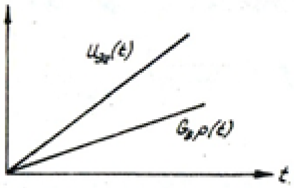

Fig.4

B) Consider the case where the conductivity of G_p changes stepwise, starting from zero to the final value (Fig.5)

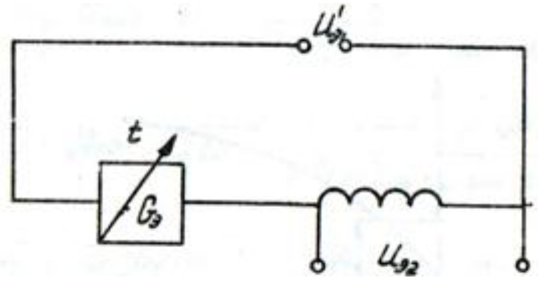

Fig.5

The image according to Carson of stepwise changing conductivity has the form:

$$G_{эр}(P)=G_{эр}\,,$$

then

$$U_{э2}(P)=\frac{L_{эр}G_{эр}U'_{э1}}{1+pL_{эр}G_{эр}}\,,U_{э2}(P)=\frac{L_{эр}G_{эр}U'_{э1}}{1+pL_{эр}G_{эр}}\cdot t$$

where from

$$U_{э2}(P)=U_{э1}\frac{1}{\frac{1}{L_{эр}G_{эр}}+P}\,,$$

Corresponding (П -12) original:

$$\frac{U_{э1}}{\frac{1}{L_{эр}G_{эр}}}\left(1-l-\frac{t}{L_{эр}G_{эр}}\right)=U_{э2} \qquad (П\text{-}13)$$

$$U_{э2}(t)=U'_{э1}L_{эр}G_{эр}\left(1-l-\frac{t}{L_{эр}G_{эр}}\right) \qquad (П\text{-}14)$$

Thus, with an abrupt change in conductivity (or circuit effort), the output voltage changes exponentially,starting from zero and approaching the value:

$$(U'_{эр};L_{эр};G_{эр})$$

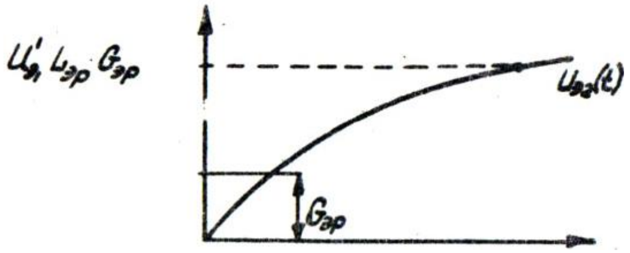

Fig.6

B) Consider the process occurring in the converter with a sinusoidal change in conductivity, i.e. at $G_{эр}(t) = G_{эра}\sin(wt)$ (П-15)

Image of this dependency according to Carson

$$G_{эр}(P) = \frac{G_{эра}wp}{p^2 + w^2} \qquad (П\text{-}16)$$

Then the output characteristic in operator form is written in the form:

$$U_p(P)\quad \frac{L_{эр}G_{эра}\cdot\dfrac{wP}{p^2+w^2}U'_{э1}}{1+L_{эр}\cdot a\cdot G_{эр}\cdot a\dfrac{wP^2}{p^2+w^2}} = L_{эр}G_{эра}\cdot U'_{эр}\frac{G_{эра}wp}{p^2+w^2+L_{эр}G_{эра}\cdot wp^2} =$$

$$= L_{эр}G_{эра}\cdot U'_{эр}w\frac{p}{p^2\left(1+L_{эр}+G_{эра}w\right)+w^2} = \qquad (П\text{-}17)$$

$$= \frac{L_{эр}\cdot G_{эра}\cdot U'_{эр}\cdot w}{\left(\sqrt{1+L_{эр}G_{эра}\cdot w}\right)^2}\frac{p}{p^2+\left(\dfrac{w^2}{\sqrt{1+L_{эр}G_{эра}\cdot w}}\right)^2} = \frac{\lambda L_{эр}G_{эра}\cdot U'_{эр}\cdot\lambda p}{w\cdot p^2+\lambda^2}$$

where

$$\frac{w}{\sqrt{(1+L_{эр}G_{эра}\cdot w)}} \qquad (П\text{-}18)$$

The corresponding (П -17) original will look like:

$$U_{э2}(t) = \frac{\lambda L_{эр}\cdot G_{эра}\cdot U'_{э1}}{w}\sin\gamma \qquad (П\text{-}19)$$

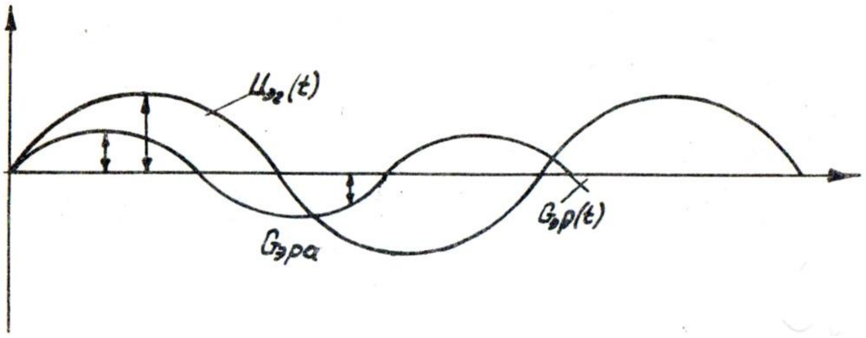

Fig.7

II. CONCLUSION

Thus, with a sinusoidal change in conductivity, the output voltage will also change according to the sinusoidal law, but with a lower frequency.

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