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## INFORMATIONAL EFFECTIVE CONTACT MEASURING TRANSDUCERS FOR MODERN CONTROL AND MANAGEMENT SYSTEMS IN THE AGRICULTURAL SPHERE

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**Annotation:** *The article shows the necessity of application of irrigation systems, power supply, control and automation of hydraulic structures and pumping stations of noncontact conversion and measurement of large direct currents with the help of effective information measuring magnetomodulation noncontact ferromagnetic converters for the needs of amelioration and irrigation in the electric power industry, and results are presented on the development of such converters.*

**Key words:** *irrigation systems, magnetomodulation transducer, process unit, ferromagnetic converter, noncontact converter, separable magnetic circuit, integrating circuit.*

### 1. Introduction

The development of the automated monitoring systems and managements of various technological and physical processes in agroindustrial sphere is characterized by wide use of primary means of the tax and processing of the information [1]. Thus the primary converter is a part any информационно - measuring or managing system and practically completely determines her метрологические of the characteristic. Losses in accuracy and reliability of final result connected with unsuccessful application of the primary converter, is unable to restore even the most perfect system of transformation of the information [2]. The task essentially becomes complicated in case of influence of the astable factors, such, as change of temperature, humidity, environments, influence of

aggressive environments, electrical and magnetic fields, vibrations, radiations etc. [3].

Now it is possible conditionally to consider electro power systems and electro technological installations in electric power industry, including in an agriculture, as organic unity powerful **сильноточного** and high-voltage power equipment incorporated by concept " primary system ". In modern time of an opportunity of the further development of primary systems by an extensive way - increase of weight and dimensions of the equipment, and also creation of stocks in him - practically are exhausted. In maintenance of economic, reliable and qualitative job of primary systems the increasing meanings got byso-called secondary systems of electric power industry - measurement, control, management, regulations and relay protection in electric power industry, in amelioration and irrigation, in zones of agriculture [4].

Here it is necessary to say, that being rather inexpensive, they allow not only to avoid significant expenses necessary for creation of stocks in the basic expensive equipment of primary systems, but also to decide many qualitatively new tasks of an effective utilization of power resources and electro technical devices [5].

Thus primary and secondary system the processing's and transfers of the information constructed are interconnected by paths of

reception, on the basis of measuring converters of electrical sizes, in particular, of large constant currents (LCC). The necessity of transformation of the large currents for various branches of a national economy, in particular, in amelioration and irrigation and as a whole in an agriculture arises at the control and management of modes of operations of powerful electric motors, substations and different consumers, where are used information effective бесконтактные measuring converters LCC (MCC) [6].

Necessity of break токовой of a circuit for temporary inclusion of electric devices, presence of losses of capacity in shunts, undesirability or impossibility on conditions of technological process of break of a circuit, together with the requirements of the safety precautions have caused noncontact transformation and measurement of a constant current in circuits without their break, i.e. without destruction of integrity токопроводящей of the trunk [7].

## 2. Purpose of researches

The consideration of questions of transformation of the large constant currents in electro power systems and electro technological installations has shown, that one of the reasons of their low efficiency are the unsatisfactory characteristics of their secondary systems - control systems both control by modes of operations of electro power and electro technological installations and, in particular, used in them MCC [8].

Is revealed, that MCC, used in secondary systems of electro power systems and electro technological installations, should have an adjustable range of transformation, best dynamic properties in transitive modes of operations of electropower systems and electro technological installations, together with stability of the characteristics under extreme conditions of operation.

By consideration of places not destroying бесконтактного of the control LCC the basic requirements to MCC are revealed. To them concern: high accuracy, reliability, sensitivity, small weight, dimensions, материалоемкость and cost, adaptability to manufacture of a design,

absence of errors from influence of external magnetic fields, return trunk with a current from the centre of an integrating contour, ferromagnetic of weights, absence гальванической of connection between измеряемым by an alternating current and measuring circuit and presence in some cases of an opportunity as fixed regulation of sensitivity MCC in a wide range преобразуемых of the large constant currents and flexibility of an integrating contour, and execution(performance) MCC both portable, and stationary [9].

In this connection rather important are development and research such MCC, which would have the raised efficiency (extended range преобразуемых LCC at small dimensions both weight and raised accuracy), simplified and технологичную a design at low her материалоемкости and cost.

The decision of the specified problem can be promoted by development effective information measuring magnetomodulation contactless ferromagnetic of converters (MMCC) for monitoring systems and management in electric power industry.

Here it is necessary to notice, that the basic tasks, which are necessary for deciding at designing MMCC according to modern lines of development of means of measurements and transformations of constant currents, is in the basic expansion of a range измеряемых and преобразуемых of sizes of a constant current, expansion of his top range, reduction of overall dimensions MMCC both increase of their sensitivity and accuracy. More often named tasks are necessary for deciding in aggregate for one MMCC, choosing the circuits and designs allowing to satisfy simultaneously the requirements of a wide range linearity, low threshold of sensitivity and wide controllable токового of a range at small volume MMCC. In this connection the consideration of ways and methods deserves special attention, with which help it is possible to decidethe listed tasks and to provide given metrology and operational characteristics MMCC.

Is shown, that one of effective opportunities of expansion of a range линейности of the static characteristic MMCC and reduction of a threshold of sensitivity is the increase of length demountable

magnetic core magnetic core MMCC and area of his section up to the extreme allowable sizes.

We develop a lot MMCC, in which the put tasks are decided by application in magnetomodulation converters of special designs demountable closed magnetic core with поперечно and is longitudinal in the allocated magnetic parameters and increased length of a way of a working magnetic flow on steel [10].

### 3. Functioning model

In figure the design MMCC with is longitudinal in the allocated magnetic parameters is shown. MMCC has closed demountable About - figurative magnetic core 6, placed in the protective case 7. Demountable magnetic core is assembled from identical ferromagnetic of elements 1 and 2 with cross and longitudinal backlashes. Ferromagnetic

elements 1 and 2 have the through apertures and are located in parallel planes, normal to an axis of the trunk 5 with a controllable large constant current. Through each two separate through apertures in ferromagnetic elements 1 and 2 are reeled - up magnetomodulation of a winding 3. Thus magnetomodulation of a winding 3 are connected consistently in such a manner that everyone previous and subsequent of a magnetomodulation winding 3 are switched on under the attitudeto each other встречно. To consistently connected magnetomodulation to windings 3 the source of an alternating current is connected. On demountable magnetic core in intervals between through apertures on ferromagnetic elements the measuring windings 4 are located, connected among themselves it is consecutive and agrees.

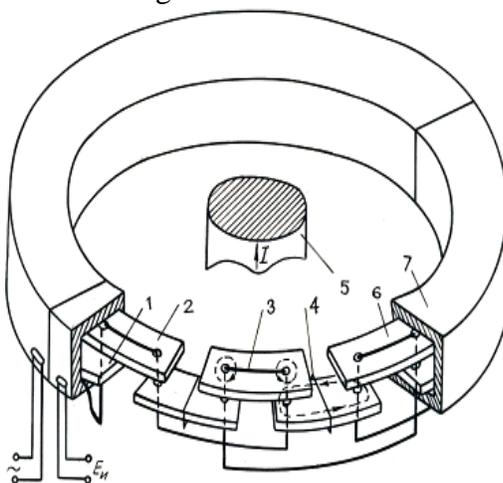


Figure. MMCC with is longitudinal in the distributed(allocated) magnetic parameters.

The principle of job MMCC consists in the following. At a feed(meal) magnetomodulation of windings the alternating current in everyone ferromagnetic an element 1 creates variable magnetic flows  $\Phi_m$ , directed in space of a measuring winding встречно and it is normal to its plane of section. In this case signal on an exit of a measuring winding will be absent. After grasp of the trunk 2 with controllable constant current last in demountable magnetic core is created longitudinal magnetic flow  $\Phi_c$ , which, due to modulation of magnetic resistance magnetic core variable field of modulation, induces in measuring

windings ЭДС, dependent from controllable current, which total meaning is defined as

$$e = w_u \omega SK_1 H_{\epsilon.M} \left[ \frac{1}{ch^2(H_x - H_{\epsilon.M} \sin \omega t)} - \frac{1}{ch^2(H_x + H_{\epsilon.M} \sin \omega t)} \right] \cos \omega t .$$

Here  $w_u$  - number of coils of a measuring winding;  $\omega$  - angular frequency;  $S$  - section of an element 1, participating in prompting EMF in a measuring winding, equal

$$S = h_1(\epsilon - d),$$

where  $h_1$  - thickness of a set of an element magnetic core;  $\epsilon$  - width of an element magnetic

core;  $d$  - diameter of an aperture under a winding of excitation;  $H_x$  - intensity of a magnetic field from преобразуемого of a constant current;  $H_{\text{в.м}}$  - intensity of a magnetic field from a current of excitation equal

$$H_{\text{в.м}} = K_2 H_{m\sim};$$

$K_1, K_2, K_3$  - factors of approximation of a curve of magnetization by expression

$$B = K_1 \mu H + K_2 H^2 + K_3 H^3.$$

Thus

$H$  - intensity of a resulting magnetic field in element 1 MMCC from constant current  $I_u$  as and from current of excitation  $H_{\sim}$

$$H_{\sim} = H_{m\sim} \sin \omega t,$$

equal one half of element

$$H_1 = H_u + H_{\sim} H_{\sim}$$

and in other half of element 1

$$H_2 = H_u - H_{\sim};$$

$H_m$  - peak meaning of intensity of a magnetic field from a current of excitation equal

$$H_{m\sim} = \frac{I_{m\sim} w_{\sim}}{l_{cp}},$$

where in turn  $I_{m\sim}$  - peak meaning of intensity of a magnetic field from a current of excitation;  $w_{\sim}$  - number of coils of a winding of excitation MMCC;  $l_{cp}$  - average length of a line of intensity of a field of excitation in an element 1 MMCC.

#### 4. Results of researches

Counter connection among themselves everyone previous and subsequent magnetomodulation of windings 3 and arrangement of measuring windings 4 in intervals between through apertures in ferromagnetic elements 1 have allowed to carry out longitudinal modulation of magnetic resistance magnetic core on ways of a working flow  $\Phi$ , created by a controllable constant current, and, hence, and to increase sensitivity MMCC. In developed MMCC the error from influence of external magnetic fields next trunks with currents, displacement of the trunk with a current from the centre demountable magnetic core and residual magnetization is reduced.

The characteristics of one of developed as applied for needs of amelioration and irrigation MMCC is below given.

Range of constant currents - 0 - 8000 And; sensitivity - 2 мV/and; the basic given error - 1,5 %; a pressure of isolation - 2 кV; a diameter of an internal window demountable magnetic core - 220 mm; weight - 0,7 kg.

#### 5. Conclusion

Are developed information effective contactless measuring magnetomodulation converters of constant currents for modern monitoring systems and management in the agroindustrial sphere distinguished by an extended controllable range of constant currents at small dimensions and weight, raised by accuracy and sensitivity, simplicity and adaptability to manufacture of a design at low her материалоемкости both cost and opportunity of noncontact of the control of constant currents with an error 1,5 %.

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