NOVATEUR PUBLICATIONS
INTERNATIONAL JOURNAL OF INNOVATIONS IN ENGINEERING RESEARCH AND TECHNOLOGY [IJIERT]
ISSN: 2394-3696
VOLUME 7, ISSUE 5, May-2020

STUDIES OF AXES OF HYELIOSTAT ROTARY TURNING DEVICES

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ABSTRACT
This work is conconsidered the questions of orientation of the heliostats on screen of steam generator and research of rotary support of heliostats under orientation. It is dealed with questions of precalculation of exactness of orientation and reflecting surface of heliostats.

KEY WORDS: heliostat, facet, mirror, deformation, alignment, relay, orientation, steam generator.

INTRODUCTION

The operation of precision structures, such as large solar installations, is possible only with strict geometrical accuracy of the main technological elements of solar installations. Quite often, a situation arises in which, after manufacturing and technological elements of a structure, discrepancies between measured and calculated parameters are revealed, i.e. distortions in the geometry of elements of SES (solar power plant) from the theoretical form, caused by both systematic and random errors. Such errors arise mainly on the one hand, due to some idealization of calculations, and on the other, due to violations of the geometric scheme - inaccuracies in the manufacture and installation of individual elements of SES. Consequently, when designing a system of elements of SES, it is necessary to solve a number of issues related to the geometric scheme of individual structures and elements of SES. These are, first of all, questions of the accuracy of manufacturing and installation of the mirror surface of heliostats and its deformability within specified limits under the influence of external loads.

The accuracy requirements for observing the geometry of such objects in most cases are formed from the physical prerequisites that determine the optimal mode of their operation, and the deformability of the foundations of structures, building structures and technological elements of SES.

The task of justifying the tolerance system at the SES is not only technical, since excessively small (tight) tolerances lead to an increase in capital investments in the SES and a corresponding decrease in the efficiency of their implementation in the national economy. Therefore, the issues of justification of the tolerance system for the manufacture and adjustment of solar systems and SES elements are of paramount importance based on the study of the influence of geometric parameters on the efficiency of SES.

The energy parameters of SES depend to a large extent on the relay properties of heliostats, which are determined by the geometric dimensions $\alpha \times \alpha$, orientation to the direction γ of the incident flux of radiant energy, distance from the screen of the steam generator R, and intrinsic reflectivity.

For an approximate determination of the accuracy requirements for the assembly of heliostats from fairly formal positions, we consider the relay scheme of the light flux incident on the surface of a properly oriented heliostat. After reflection from the facet of the heliostat, the flow with the cross-sectional area $\alpha^2 \cos\gamma$ highlights the regular place on the screen of the steam generator. With some error $\Delta\gamma$ the orientation of the heliostat, the flow highlights a different area on the screen, shifted relative to the standard by the amount $R\Delta\gamma$. The consequence of this is the negative effect of the double action. Firstly, the flow did not illuminate some area that was outside the regular place, secondly, the same area of the regular place on the screen of the steam generator, and secondly, the same area was outside the regular place. Approximately this "lost" area can be represented as

$$\Delta S = 2R\alpha\Delta\gamma\cos\gamma \quad (1)$$

relative losses are expressed through

$$\frac{\Delta S}{S} = \frac{2R\Delta\gamma}{\alpha} \bullet \cos\gamma \quad (2)$$

Since the required product of technological parameters should not be less than 0.9, i.e. with a flow loss of a at 10%, we have a relative error

$$\frac{2R\Delta Ɣ\cos Ɣ}{\alpha}=0{,}1 \qquad (3)$$

From the formula (3.3) we determine the required value

$$\Delta Ɣ=\frac{0{,}1\alpha}{2R\cos Ɣ}\bullet\rho'' \qquad (4)$$

While α=5м, $R=70-230$м $Ɣ=0+50^{o}$ we get $\Delta Ɣ=12'$-$3{,}7'$

To standardize the accuracy requirements° to the design of the heliostat, regardless of its position on the heliostat field, we present the obtained values $\Delta Ɣ\min$ and $\Delta Ɣ\max$ in the form of harmonic mean $\Delta Ɣ=\sqrt{\Delta Ɣ\min}\bullet\Delta Ɣ\max=6{,}6'$ Assuming that the obtained value is the marginal error of orientation of the heliostat, we turn to the mean square error M=$\frac{\Delta Ɣ}{2{,}6}$, such M=,5′,

The obtained value is essentially a synthesized error, including all:

M_1 - manufacturing error of the facet reflective plane;

M_2 - facet assembly error in the general design of the reflector;

M_3 - reflector design deformability

M_4 - error in the relative position of the axes of the rotary heliostat device;

M_5 - error of execution of program orientation.

We will present the shown as

$$M=\sqrt{M_1^2+M_2^2+}\,M_3^2+M_4^2+M_5^2\ , \qquad (5)$$

Accepting the principle of equal influence of errors, i.e. $M_1=M_2=M_3=M_4=M_5=M_o$, we have the reflective surface of the heliostat is a collection of individual flat mirrors (facets). Requirement (3.6) represents the accuracy of the manufacture of some synthesized facets. Representing the value M_o as the mean square error of the middle, we define the mean square error of the position of the normal to the facet surface, based on their total number in the design of the heliostat-45:

$$M\ гел= M_o\sqrt{5}\ ,$$

where η – facet number in heliostat.

while η – 45 get

$$\mu\ gel = 1{,}1\sqrt{45} = 7{,}3'.$$

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