СЕКЦИЯ 6 «ПРОЦЕССЫ, АППАРАТЫ И ОБОРУДОВАНИЕ ПИЩЕВЫХ ПРОИЗВОДСТВ»

Миром правят Числа, все в мире – есть Число!
Пифагор
Величайшие истины – самые простые!
Л. Толстой
Настоящая наука – всегда революционна!
В. Груданов

УДК 62-1/-9

USE OF THE GOLDEN PROPORTION IN ENGINEERING PROBLEMS OF FOOD INDUSTRY

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A large number of different technological equipment is used in enterprises of food industry. This equipment differs from each other by it's functional purpose, construction, operating principle and the power source. The calculation and construction of working members of technological equipment is carried out mainly in accordance with individual empiric methods with bringing in of large number of corrective factors, which have no sufficient theoretical basis and don't reflect the real work process. It makes impossible the creation of machines with high technical-economic factors. At the same time the world's practice of machines and apparatus design shows the tendency of using international series of preferable numbers: R5, R10, R20, R40 and R80, which in their turn are the foundation for creation of branch and firm's standards. For example Swedish standard "Gastronorm" generally accepted in EU today in the area of food machinebuilding has been worked out. At the same time the analysis has shown that the golden proportion and Fibonacci numbers turn up as theoretical fundamental principle of the international series of preferable numbers R5,R10, R20, R40 and R80. There fore we find the using of Fibonacci numbers' characteristics and the golden proportion's regularity as one of the ways of improvement of work members design for technological equipment, so in every concrete case it is possible to attain high (the best) technical-economic factors [1].

So using of the golden proportion's principles and Fibonacci numbers' characteristics in design of the cutting mechanism of meat grinders has permited to get the minimum hydraulic resistance of the work members and to increase considerably machines' productivity in the time of stable energy expenses and noticeable improvement of grinded stock's qualities. Simultaneously the problems of the cutting mechanism maximum unification for all standard types of meat grinders and wolfs can be solved (fig. 1-3).

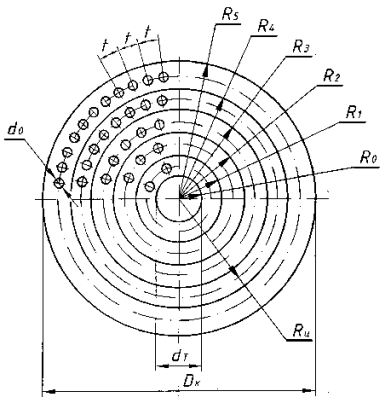

Fig.1 – Calculation scheme of the knife flap:

D_k – the outer diameter of the grid; d_T – the diameter of the landing hole; d_0 – the diameter of the holes; R_0 – the radius of the landing hole;
R_1 – the radius of the first conditional ring;
$R_{2...5}$ – are the radii of the second... fifth conditional rings;
$R_ц$ – is the central radius of the nth conditional ring.

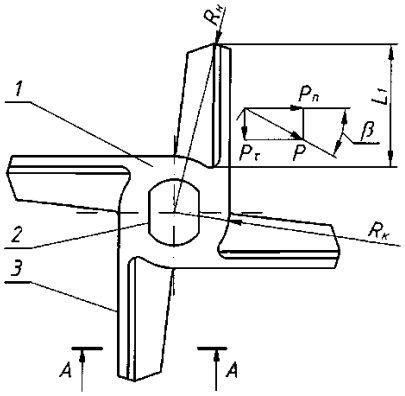

Fig.2 – Calculation model of the knife: *1* – base of the knife; *2* – landing hole; *3* – cutting edge (blade) of the knife; $R_н$ – radius of the knife; $R_к$ – radius of the base ring; β – sliding angle;
P – is the total cutting force; $P_н$ – is the normal component of the cutting force; P_τ – is the tangential component of the cutting force;
L_1 – is the length of the cutting edge.

There is a great perspective of using the golden proportion (the golden section) in design of composite range's decks for universal thermal apparatus - ranges for public nutrition's enterprises. The partition of the range's deck (working surface) by the golden section has allowed to get the minimum warpage of the working surface and, as the consequence, the largest efficiency (fig. 4).

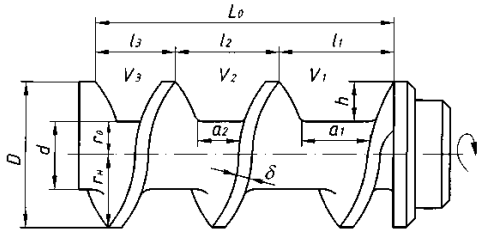

Fig. 3 – Diagram of a pressure type screw:

Lo – the length of the working part of the auger; l_1 –the width of the first screw groove of the auger along its outer diameter; l_2 – the width of the second screw groove of the auger along its outer diameter; l_3 – the width of the third screw groove of the auger along its outer diameter; h is the depth of the screw groove; V_1, V_2, V_3 – are the volume, respectively, the first, second and third inter-turn spaces; δ – the thickness of the screw turn; d – is the diameter of the screw shaft; r_o – the inner radius of the screw; $r_н$ – the outer radius of the screw; D – the outer diameter of the screw; a_1, a_2 – the width of the screw grooves along the inner diameter of the screw.

On the basis of the golden proportion and Fibonacci numbers' characteristics we worked out a new class of standardized heat exchangers of "gas-gas" and "gas-liquid" types. This kind of heat exchangers have the minimum hydraulic (aerodynamical) resistance from heat medium as well as from heated medium with the maximum heat effectivity and insignificant mass: for 1 kilowatt of collected heat power is due 1 kilogram of their mass. This kind of heat exchangers have already found the application in warmed bread vans, mobile feeding centers, motorcar kitchens, utilization's woterheaters and pasteurizators (fig. 5).

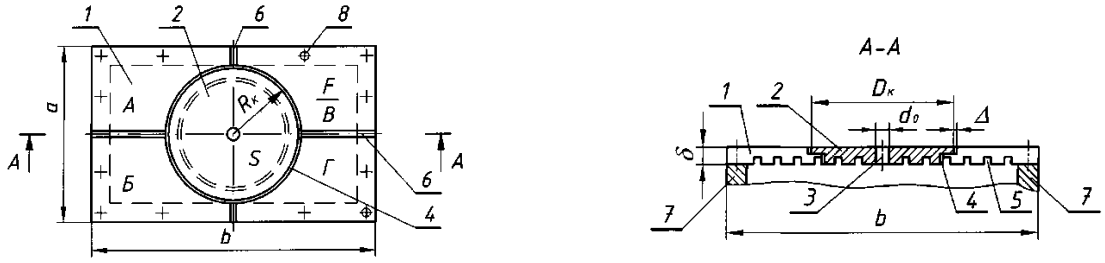

Fig. 4 – Diagram of a composite slab flooring:
a – the width of the flooring; *b* – the length of the flooring;
δ – the thickness of the flooring;
S – the area of the circle; *F* – the area of the base (most of it);
Δ – the size of the temperature gap;
$D_к$ – the diameter of the liner; d_0 – the diameter of the central hole

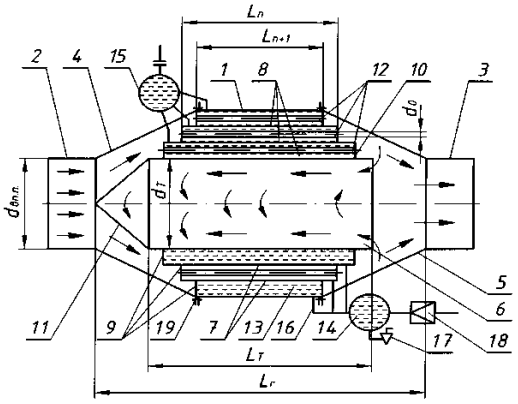

Fig. 5 – Diagram of a multifunctional unified "gas-liquid" heat exchanger:
d_0 - diameter of the flue pipe;
$d_{в.п.}$ – inner diameter of the inlet pipe;
$d_т$ – diameter of the central pipe;
$L_т$ – length of the central pipe;
L_0 – length of the nth longitudinal partition.

On the whole the researches have shown that the golden proportion's laws and Fibonacci numbers' characteristics are applicable for technological equipment regardless of it's functional purpose, design, operating principle; at the same time the new created equipment is automatically integrated into the world's system of new technique construction, based on international series of preferable numbers R5, R10, R20, R40, R80 and their derivatives.

List of sources used

1. Груданов, В.Я. Основы инженерного творчества. Учеб. Пособие / В.Я. Груданов. – Мн: Изд. Центр БГУ, 2005. - 299 с.