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RESEARCHING OF AIR SUPPLY DEVICE EFFICIENCY WHICH CREATING SWIRL AND SPREAD AIR JETS IN POULTRY HOUSES

Graphical dependences of axial air velocities and surplus temperatures of swirl air jet have been obtained. Expedience of application of air supply device that creates swirl and spread air jets in birds growing buildings with cascade cages batteries is confirmed.

Key words: air supply device, cascade batteries, swirl air jet.

Побудовано графіки розподілу осьових швидкостей і надлишкових температур закрученої струмини, що виходить з повітророзподільника. Підтверджено доцільність застосування повітророзподільника з закрученими і настильними струминами в приміщеннях пташників з каскадними клітковими батареями.

Ключові слова: повітророзподільник, каскадні батареї, закручена струмина.

Entry

Intensification production of stock-raising, including poultry, requires continuous introduction of industrial technology maintenance and birds breeding. These technologies are characterized with large concentration of birds in the room and provide the creation of bulky bird’s complexes. Therefore more expansion growing placing birds in cellular batteries, allowing it to grow a large number within one poultry house.

Statement of problem

At the present stage of development of industrial poultry farming with the widespread introduction of cage maintenance of different groups of bird’s mechanical ventilation systems, combined with air heating are popular. Existing general exchanging ventilation systems of poultry houses are unable to provide the fresh air flow directly into the zone of poultry location that leads to the formation of dead zones with gas harmfulness accumulation [1]. Therefore, the establishment of effective systems of microclimate in poultry houses with modern technologies is an actual task. The main aim of the paper is researching of air supply device which is used for creating swirl and spread air jets in poultry houses.

Design features of the ventilation systems in poultry house

Recently more popular obtained the poultry location in cascade cellular batteries. Using of cellular cascade type batteries allows providing fresh air incoming to each cage and preventing the formation of dead zones in poultry location [2]. Thus it is reasonable to use effective air supply device that supplies fresh air with swirl and spread jet and their actions area extends over the entire height of poultry house.

With the help of air supply device supply air is flown into the space between the cellular batteries. Through effective design of air supply device attenuation of air flow in the short distances from the supply device is achieved (Fig. 1). It allows providing fresh air supply with small possible velocities directly into cellular battery and thereby preventing overcooling of organism.

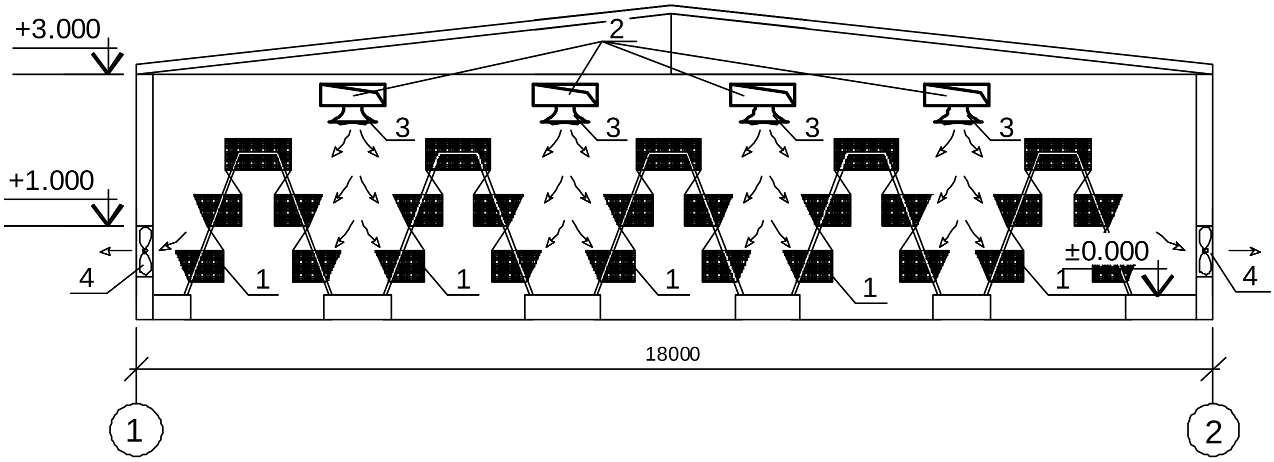


Fig. 1. Poultry house with poultry location in cellular batteries
1 – Cage Battery cascade type; 2 – supply duct;
3 – air supply device; 4 – exhaust fan

Experimental researches of air supply device

Experimental research has been carried out on the installation, that is presented on fig. 2 [3].

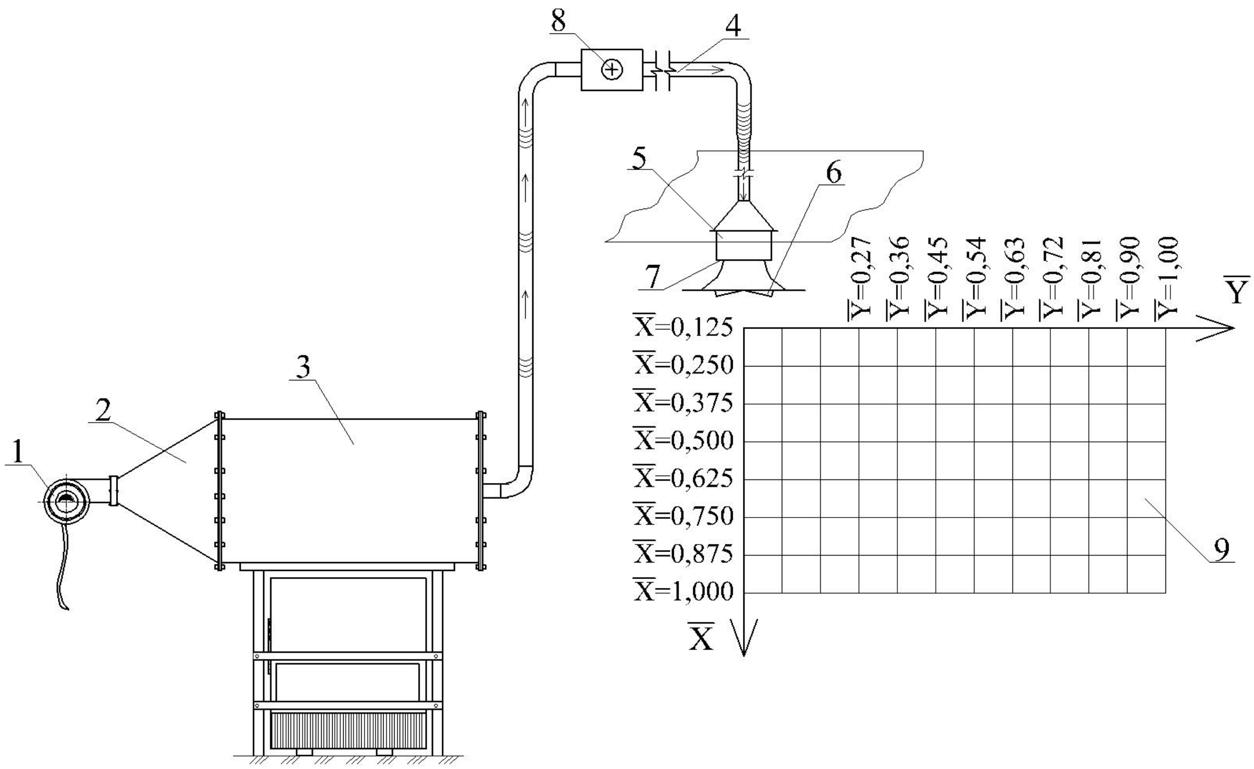


Fig. 2. Scheme of experimental installation
1 – ventilator; 2 – contractor; 3 – chamber of static pressure; 4 – collector (flexible hose);
5 – air supply device; 6 – swirl plates; 7 – circular crack; 8 – heater; 9- co-ordinates net

Experimental researches of swirl air jets presented.

Experimental installation works in such a way. Air with the help of ventilator (1) (direct-current motor) through the contractor (2) goes to chamber of static pressure (3), where air flow smoothed. After air flow goes to heater (8), and then through a flexible air-channel (4) in investigated swirl air supply device (5). Part of air flow goes through circular crack (7) and creates spread air jet other part comes through swirl plates (6) and creates swirl air jet. Adjusting of the productivity of the supply system was conducted by the change of ventilator (1) capacity. The metering of air flow velocity V and temperature Δt were carried out by thermal electric anemometer testo-405 with using coordinate grid of 10x10 sm. (9).

Experimental research has been carried out at such conditions and simplifications:

– jets are non-isothermal;
– the linear sizes of air supply device did not change;
– the height of air supply device installation didn't change;
– the angle of slope of swirling plates changed 30˚, 60˚ and 90˚;
– a circular crack was opened – 20 mm;
– the amount of swirling plates was 6 pcs.

Measuring were conducted in cycles no less than two times, at divergence of results more than on 10%, research were repeated in third time. Randomization in time was maintained. In addition, measuring of velocity in every point of co-ordinates net was conducted not less than 120 seconds with the discrete (in 10 seconds) writing down of shows and their subsequent average. The temperature of air in laboratory was measured by thermal electric anemometer testo-405 before and after the experiment. Average value was taken in calculations.

For realization of experimental investigations 3-factor chart has been designed taking into account the effect of factor interaction, was taken non-linear mathematic model [4, 5]. As a starting point were taken such values:

– $x_1 = \bar{X} = x / l$ – relative vertical running data, where x – vertical distance from air supply device to point, where air flow velocity conducted; l – general vertical distance from air supply device to working zone;

– $x_2 = \bar{Y} = y / b$ – relative horizontal running data, where y – horizontal distance from air supply device to point, where air flow velocity conducted; b – general horizontal distance from air supply device to working zone;

– $x_3 = \alpha$ – the angle of slope of swirling plates.

As optimization parameters there were:

- a relative axial velocity of air flow

$$y_1 = \bar{V}_{oc} = V / V_0 , \quad (1)$$

where V – a current velocity of air flow in the calculated zone of air supply device, and V_0 is initial (maximal) velocity;

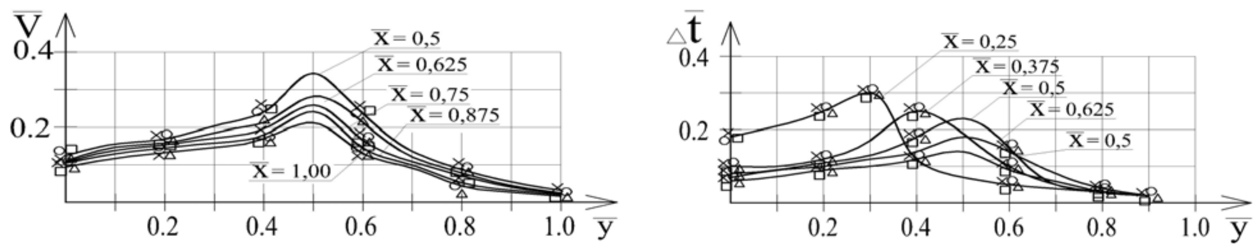
- a relative surplus temperature of air flow

$$y_2 = \Delta\bar{t} = \Delta t / \Delta t_0 , \quad (2)$$

where Δt – a current surplus temperature of air flow in the calculated zone of air supply device, and Δt_0 is initial surplus temperature;

Consequently, we need to establish functional dependences $\bar{V}_h = f_1 (x_1; x_2; x_3)$ and $\Delta\bar{t}_h = f_2 (x_1; x_2; x_3)$.

As a result of experimental research charts for air velocities and surplus temperatures in supply air jet at different distances to working zone and at different angles of slope of swirling plates have been designed fig. 3, fig. 4, fig.5.



a *b*

Fig. 3. Graphical dependences of relative velocities (a) and surplus temperatures (b) of incoming air flow in different cuts at the angle of slope of swirling plates 30˚

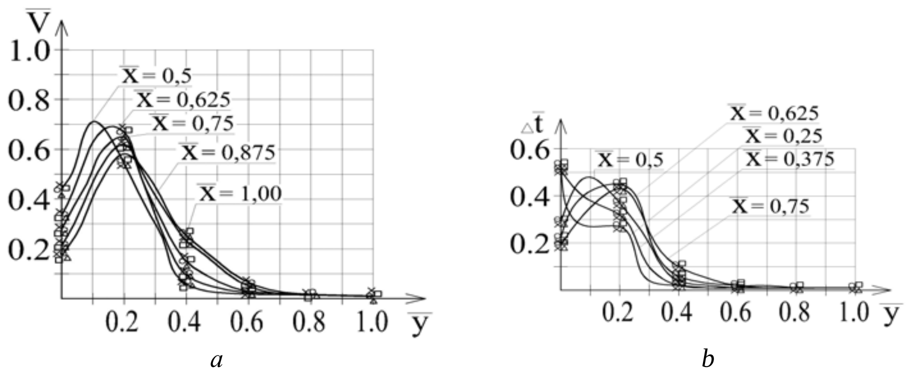


Fig. 4. Graphical dependences of relative velocities (a) and surplus temperatures (b) of incoming air flow in different cuts at the angle of slope of swirling plates 60˚

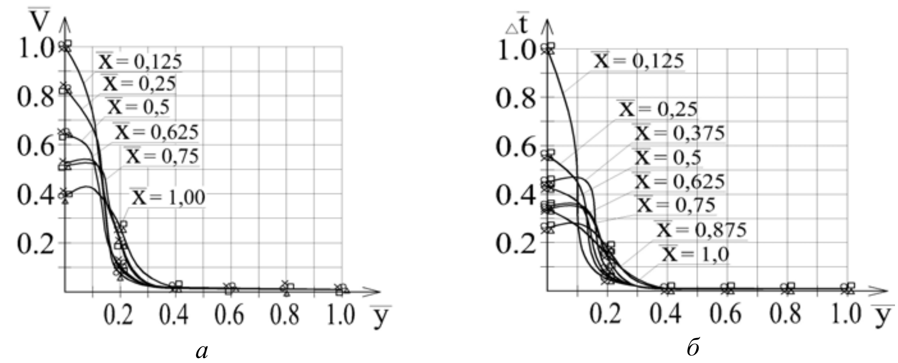


Fig. 5. Graphical dependences of relative velocities (a) and surplus temperatures (b) of incoming air flow in different cuts at the angle of slope of swirling plates 90˚

On the basis of the conducted experimental researches we can assert that swirl air jets provide falling of air flow velocity at short distance to working zone. Influence on falling of air flow has the angle of slope of swirling plates. Thus, at the angle of slope of swirling plates 60˚ and relative distance from air supply device $\overline{X} = 0{,}5$ axial velocity is $0{,}45\overline{V}$, at the angle of slope of swirling plates 30˚ on the same distance $0{,}13\overline{V}$, at the angle of slope of swirling plates 90˚ on the same distance $0{,}65\overline{V}$. At the angle of slope of swirling plates 90˚ swirl air jet is close to usual air jet.

Conclusions

As the result of researches graphical dependences of axial velocities and surplus temperatures of swirl air jet are built. At lower angle of slope of swirling plates falling of axial velocities is bigger. Application of air supply device that confirm spread and swirl air jet in the building of poultry houses with cascade cellular batteries is confirmed.

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