Aspects of Alternative Energy Supply Concerning Stationary Processes in Agriculture

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Abstract: *The discussion about the future of the energetics should not be reduced only to renewable energy sources; the energy should be treated as an entity. There is only one energy. The energetical processes and systems should be built into the environment in order to utilize (in every moment of time) the maximum quantity of energy from the energy fields of the energy-ecological niches, minimizing the consumption of electric energy and fuels. The means that allow achievement of this goal are the energy loops and control algorithms. The arguments expounded in this report proof that the concept mentioned above could be an alternative for the energetics and ecology and will lead to the creation of new, more effective stationary objects in the field of agriculture.*

Key words: *Energy, agriculture, future development of energetics, basic principles of energy supply*.

Introduction

During the last few decades the problems concerning utilization of the untraditional energy sources (solar energy, wind, water, biomass, energy of tides, geothermal waters, etc.) is been discussed on and on. Simultaneously the traditional sources (gas, oil, electricity and nuclear energy) remain irreplaceable and keep dictating global politic while the humanity is in ecological collapse. The separation between untraditional and traditional (conventional) energy sources remains. The question is: is this the right direction? And here is the answer: there is one eternal thing (*Poincare*) and this is the Energy. The energy is indivisible. Obviously there are no “untraditional” or “alternative” energy sources. The only alternative which should be searched is the alternative of the conventional approaches in energy supply during the design of new power installations and systems. There is an alternative – all energetical processes and systems should be *built into energy fields of the surrounding area* thus utilizing the maximal possible quantity of energy and minimizing the consumption of “traditional” energy. The *economical aspects* of the alternative energy supply should be discussed too in order to escape from confrontation between ecology and economics. Is all this possible? Yes, if all physical and economical optimization criteria are to be taken in consideration during modeling.

What kind of instrument will allow achievement of this goal? After years of researches - design of energy-ecological live stock buildings with aeration, drying installation with combined energy supply (drying during the summer period and storage during the winter), electrified flow lines, etc., the “energy loop” principle was formed. The purpose of the energy loop is to provide maximum energy flow from the energy fields of the surrounding area, thus minimizing the consumption of the conventional energy (electric energy and fuel).

Generalized conditions for technical and economical efficiency

The conditions allowing achievement of technical and economical compatibility of the alternative energy supply for the stationary processes in the agriculture are given in [1,2 and 4]. Basically they are:

1. Achievement of maximum energy flow from the surrounding area trough:
   - utilization of the potential of the energy fields of the surrounding area according to the principle of generalized forces (fig. 1).
   - designing the energy supply systems according to the principle of “energy rings” and “energy loops”.

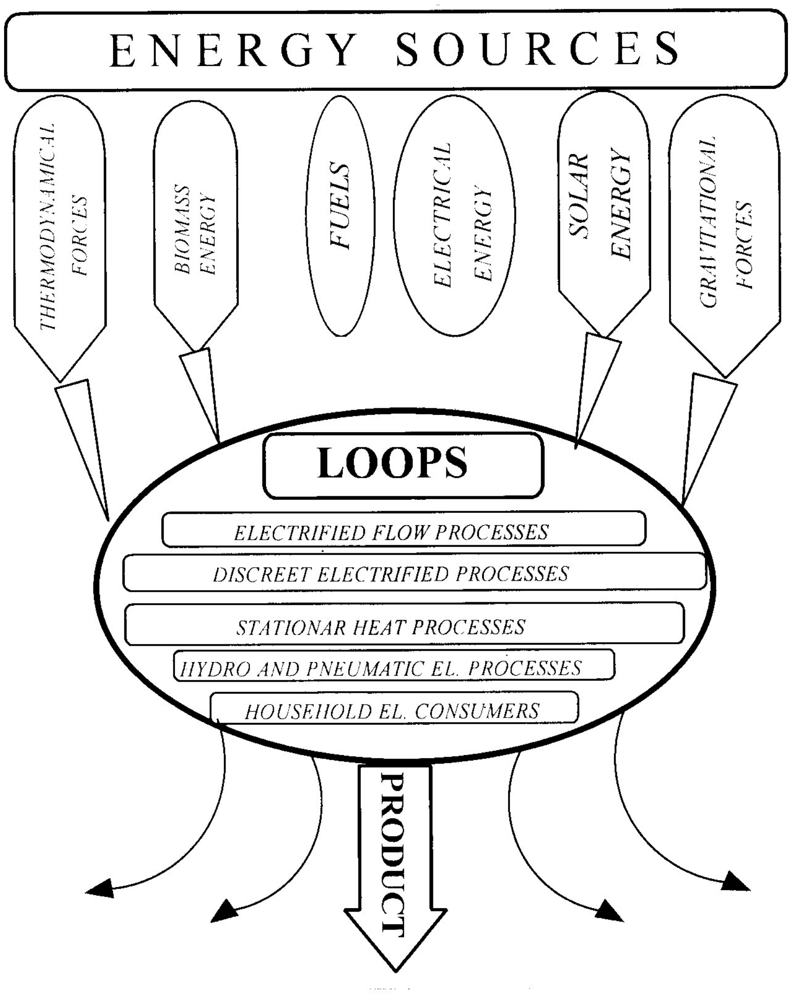

fig.1. Construction principles of the energy loops

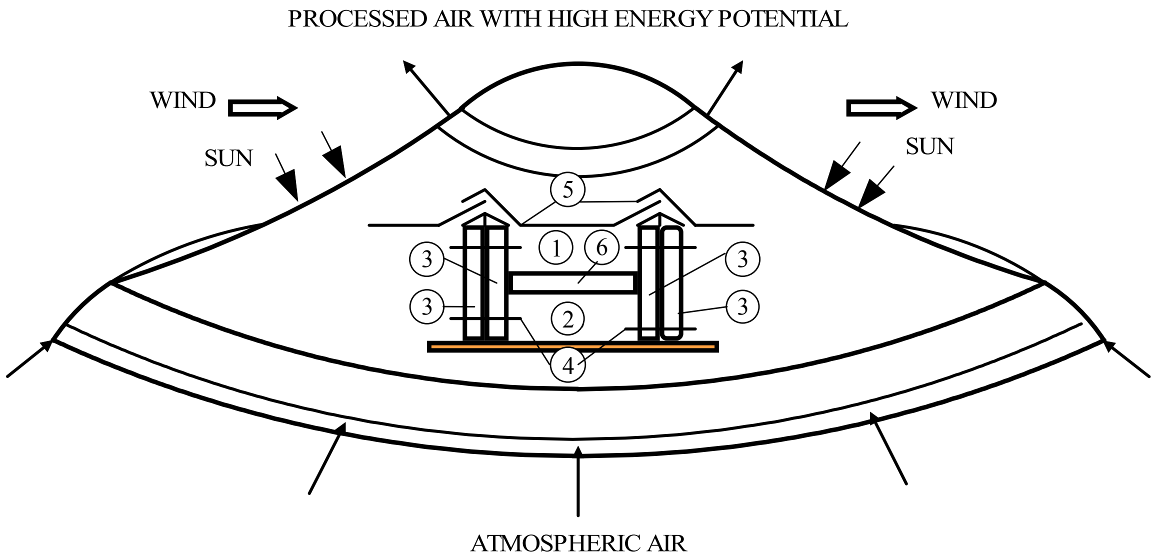

fig.2. Initial surface and modular element for loop formation
(1 – feeding (incoming) channel , 2 – sucking channel , 3 – carrying frame,
4 – attachment bolts, 5 – roof element, 6 – insulating layer)

- all energy processes that cover the manufacturing process should be built into the energy fields of the surrounding area.

2. Design of all constructive and technological parameters in a manner to provide:
   - increase or steadiness of the serviceability of the energetical agents
   - decrease of the linear or angular velocity in case of simultaneous technological operations.
   - energetical compatibility trough combination of different technological processes in one manufacturing system.
   - capturing and utilization of the internal energetical potential and residual energy, specific for given process or object.

3. Investment compatibility and effective turnover during the design and operation of the alternative energy supply systems trough:
   - Assimilation of the investments during the whole year
   - redesign of the existing objects in order to build investment assimilation schemes into the technological cycles.
   - development of models to cover the energetical processes with minimum resources.
   - modular design and construction requiring minimal level of investments.

The initial surface of each loop can be uniform: rotor type with streamlined surface in order to ensure the construction against the wind and to increase the integral income of solar energy during the whole day and during different seasons. Part of the loop is recommended to be under ground [2,8,11] (fig. 2). The modular building element is uniform. See fig. 2 [2].

Energy loops model for covering manufacturing processes in livestock breeding and in drying and storing of crop.

During the design of the models the surface shown at fig. 2 is taken as a base. The construction is modular; loops outlines are designed in accordance with the processes special features [4,11,14].

- Livestock buildings and technological modules

The construction of the loop for livestock breeding is fulfilled with single uniform building element. Air circulation trough controlled natural ventilation (aeration) is provided which leads to decrease in thermal loses trough walls and ceilings. The construction utilizes the internal energetical potential of the closed space and the residual heat. Other construction features include protection against overheating, increased level of aeration during the summer period and utilization of the soil energy (fig. 3 and fig. 4).

The research team has developed and patented two models of energy loops – for floor breeding of animals and birds (fig. 3) and for cage breeding of birds (fig. 4). The floor breeding model combines in one closed space a ventilation system and rotor system (5) with feeding facility (3), which provides feeding, cleaning and delivering a fecal mass to the bio generators for fermentation, disinfection and generation of bio gas. The full description of the technological functions is given in [5,6]. All predefined quality requirement are covered. This aeration scheme can be applied also during the reconstruction of existing livestock buildings [10,11].

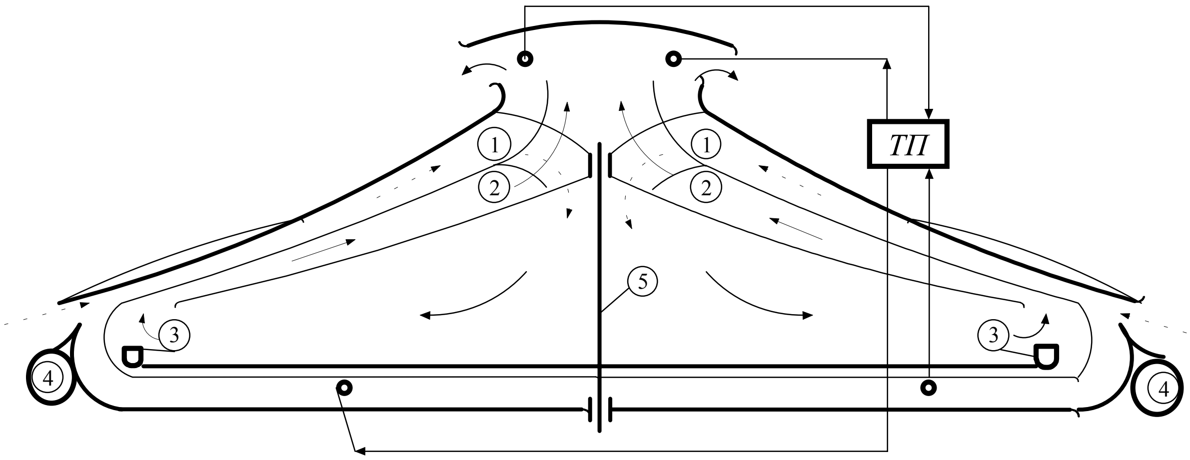

fig.3. Energy loop of energy-economical livestock building for floor breeding of animals and birds (patent [6])(TP –thermal pump, 1 – feeding channels, 2 – sucking channels, 3 – feeding facilities, 4 – bio generator chambers)

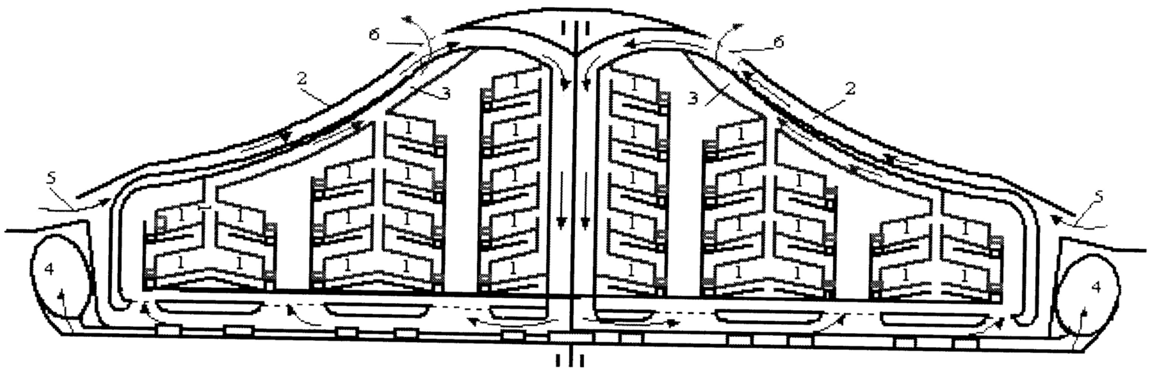

fig.4. Energy loop for cage bird breeding (patent [7])
1 – cages; 2 – fresh air feeding channels; 3 – channels for removal of polluted air; 4- bio gas chambers; 5 – feeding openings; 6 – vent.

The loop for cage breeding of birds is complex too [5,7] (fig. 4). It can be a basic element of unified energy-technological complex for manufacturing of ecologically clean production. The microclimate inside is ensured from the heat given off from the birds, gravity head and air cooling trough natural water evaporation during the summer. A total heat exchange in the building is ensured, with no overheating in the summer. All technological operations – cleaning, feeding, egg gathering and removal of the fecal mass run simultaneously. The frequency rate is equal to the frequency of forage delivery. There are no multiple chain mechanisms, all working elements are rigid; the velocity of the technological operations is highly decreased as well as the power consumption of the electrical motion systems. All the fecal mass goes directly into the fermentation facility for bio gas generation. All prerequisite for perfect sanitary and veterinarian hygiene are present.

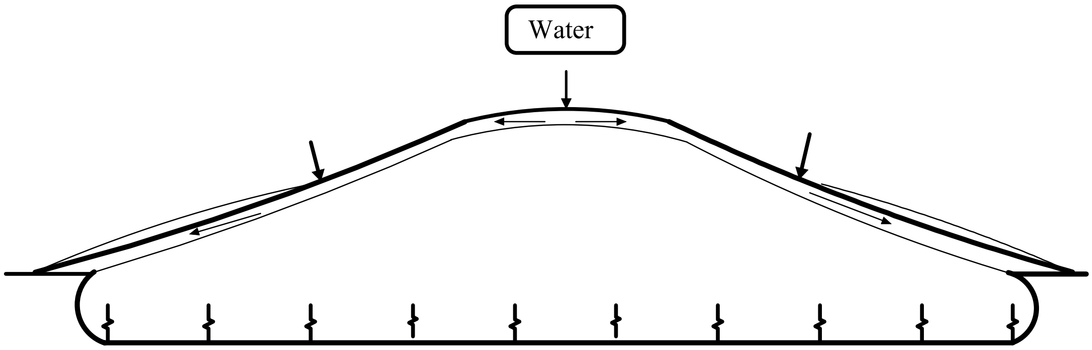

fig.5. Configuration and specific parameters for hothouse loop.

This loop can be modified for hot house buildings (fig. 5). Maximum decrease in thermal loses will be achieved if two optically transparent layers (1 and 2) are used. During cold days when there are conditions for frost forming, with proper water supply, a thin ice layer can be formed in order to increase the heat insulation, keeping at the same time the optical properties.

- Drying and storing of fruits and vegetables

In this case all conditions for energetical and economical efficiency have been taken in consideration: utilization of solar energy, geothermal and waste water energy; maximal utilization of atmospheric air energy; possibility to replace the conventional energy source with no necessity of construction changes; utilization of the residual heat from the processed agents in case of limited heat loses from the drying chamber; equal serviceability of the drying agent trough the entire space of the drying chamber; technology for utilization of the chamber during the whole year in order to optimal assimilation of the investments; light, inexpensive and easy to maintain modular construction; economical scheme, facilitating technological processes; opportunities for export of the production (fruits and vegetables) at the European market; creation of local depots for storage of fresh fruits and vegetables. The configuration of the loop is given at fig. 6 [9,12,13].

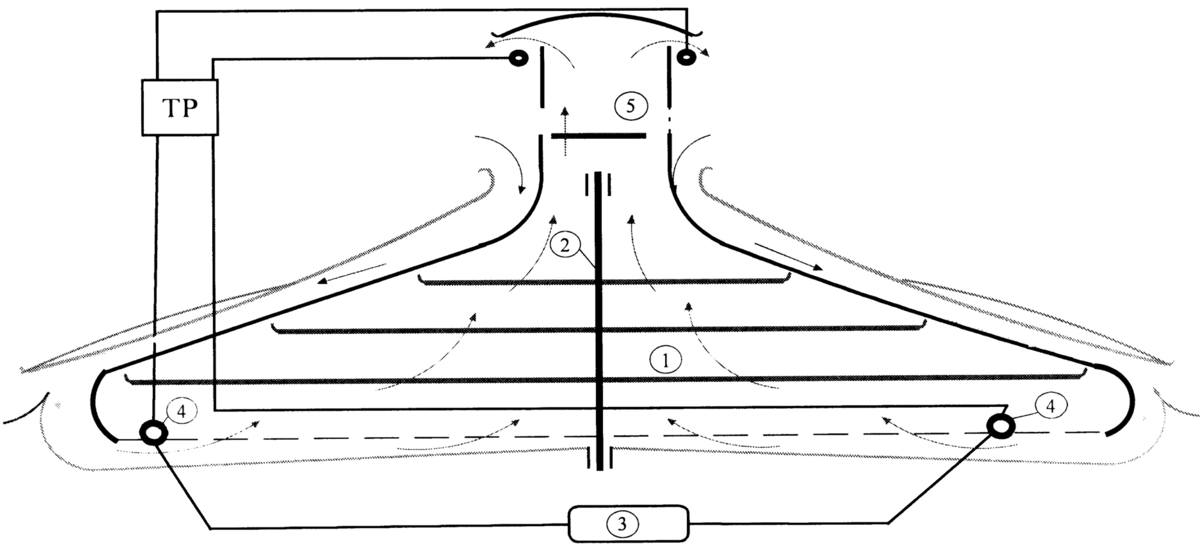

fig.6. Configuration and specific parameters for energy loop for fruit and vegetable dryer (patent [8]) (TP – thermal pump, 1 – working chamber, 2 – carrying axis and grids, 3 – boiler, 4 – heating serpentine)

During the design, an opportunity for energetical and manufacturing compatibility of the energy supply contours of both loops is provided. A principle scheme is given at fig. 7 (combination between animal breeding loop and loop for fruits and vegetables drying). An additional effect is achieved when the air, cooled in thermal pump, is delivered into livestock breeding room instead to the atmosphere.

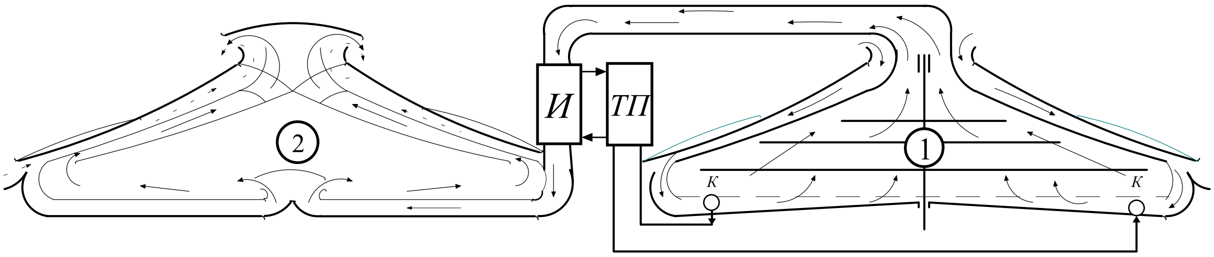

fig. 7. Energetical and manufacturing compatibility of the loops (1 – drying chamber, 2 – livestock building, TP – thermal pump, E – evaporator, K - condenser)

Models and algorithms for process control in the loops.

The models of energy-economical loops provide new algorithms and new controlling schemes [3,14]. All advantages provided by the loops have to be utilized. In order to provide right microclimate, the following conditions have to be satisfied [2]:

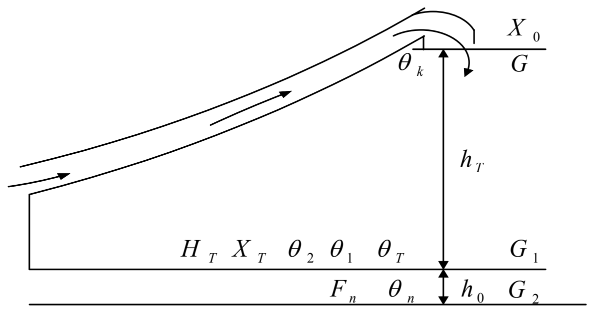

fig. 8. Distribution of the parameters for loop control

1. support of the desired technological parameters in habited zone: $\theta = \theta_T;\ \ X = X_T;\ \ H = H_T$
2. when supporting the technological parameters $\theta = \theta_T;\ \ X = X_T;\ \ H = H_T$, the temperature difference $\theta_T - \theta_k \Rightarrow \max$. The connection is expressed with the equation:

$$\frac{\theta_n\left(\theta_n - \theta_T\right)^{\frac{2}{3}}}{\left(r + \theta_n\right)^{\frac{2}{3}}} = \frac{\theta_2 h_0}{k_t^{\frac{1}{3}} q^{\frac{2}{3}} F_n^{\frac{2}{3}}} \qquad (1)$$

where: X_T - normalized humidity content in the habited zone, kg/kg; H_T - normalized (desired) enthalpy of the air in the habited zone, kJ/kg; G - flow rate of the incoming fresh (atmospheric) air , m^3/s; G_1 - the part of the flow G in the flow formed in the comfort zone, m^3/s; G_2 - up going (because of heat) flow, m^3/s; θ_1 - temperature of the falling air flow, ^0C; θ_2 - temperature of the convective air flow, ^0C; θ_k - temperature of the air flow at the entrance of the room, ^0C; θ_n - temperature of the heaters or heating floor, ^0C; h_0 - distance between the technological line and the floor, m; h_T - distance between the technological line and the entrance opening, m; F_n - heat exchange surface of the heaters (or heating floor), m^2;

The analytical dependencies, describing processes of drying in case of energy loop shown at fig. 7 and providing full utilization of the potential of the agent humid air, are given in [3,14]. The most important condition is: the value of the process constant K must remain steady for the entire process and for all grids in the chamber ($K = const$).
This can be described with the following dependence :

$$K = a_0 + aT_i + bX_i + c\varepsilon v_i , \qquad (2)$$

a_0, a, b, c are constants; T_i - temperature of the drying agent on the grids levels, ^0C; X_i - moisture content in the drying agent on the grids levels, kg/kg; v_i - velocity of the drying agent on the grids levels , m/s; ε - coefficient, showing the fill level for the grids.

The narrowing profile of the drying chamber leads to increase in the velocity of the air flow v_i and to increase in drying ability of the air. Simultaneously there is a decrease in T_i and an increase in moisture content X_i i.e. the serviceability of the agent is diminished. The serviceability of the flow will remain unaffected to the chambers exit if $K = const$ for different ratios $v_i : X_i : T_i$.

Conclusion

All of the above discussed problems and the arguments presented show the necessity of new theory concerning energy supply for the stationary processes in the agriculture and in the municipalities, harmonizing the agricultural business with the surrounding area. The generalized forces principle must take the most important place in this theory. These forces manifest themselves each time when the matter interacts with the energy fields of the surrounding area. This interaction is based on unified structure with concentrically, hierarchically situated and interconnected energetical rings.

The enclosure of each particular space where stationary energy processes are taking place should be made in accordance with the principles of the streamlined surfaces, total heat and mass exchange, utilization of the energy potential of the surrounding area (thermodynamical and gravitational fields and solar energy), and the internal energetical potential of the object.

Minimization of the power consumption and the energy expenses from the conventional sources trough utilization of alternative energy supply sources requires development of new models and algorithms for design and control of the energetical objects and processes which leads to the creation of new, consistent with the nature energetical systems.

The models for utilization of the potential of the energy fields of the surrounding area (energetical niches) should precede the design of the conventional systems (electric power and heat power) and should become an integral part of energy field of the surrounding area.

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