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COMBINED AIR AND HEATING SUPPLY SYSTEMS OF AIRPROOF BUILDINGS

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Nowadays the exterior envelope of buildings demands the constant increase in its heat-shielding characteristics. The buildings are designed according to the normative base of the Republic of Belarus. But on the stage of calculating the temperature balance there often occurs the following situation: the heat loss is much less than the heat gains. In this case the entire heating load is directed to the heating of infiltrating air. This air has to be taken inside disorderly but that is not possible because of the high airtight packing of the building envelope. This report represents the technological schemes and practical solutions to the effective energy and heat air supply to the leak tight buildings.

The embedded panel systems are widely used in the buildings with the high standard comfort. The heating elements of the embedded panel systems are normally the coil pipes made of stainless steel.

Water is basically used as a heat carrier in the house construction. Steam is rally used at industrial enterprises and domestic household. This report considers the possibility of overheated air use. The latter can be used as a heat carrier which can be low n through the evacuated canals of concrete panels. This will solve two problems at the same time: heating and air supply.

Heat supply and ventilation systems are the most power- and resource-consuming. Modern engineering equipment must provide the reliability and comfort of handling together with its low value, steel intensity, labor intensity during its installation and the high-tech industrial development of the building construction.

Heat energy, gas and electric power are the most widespread types of power consumption in urban planning branch of economics.

Gas is still most widely used for cooking and water heating but in the near future it will be replaced by electric power because of the hygienic, economic and strategic reasons.

City and industrial heat power plants, big district boiler houses are the source of heating in residential and public places. Individual local boiler houses will be used more seldom because of the air contamination.

The production efficiency of the heat energy is 2,5 times higher than that of the electric power at the ordinary heat power plant. Still the use of the electric power can be economically practical because of the considerable transit waste of heat energy of the branchy centralized systems in big cities or far-away districts.

According to sanitary and ecological standards the biggest heat supply sources are located outside cities. That increases the cost of the construction and operation of heat supply systems.

Heat supply troughs are constructed for heating, ventilating and hot water supply systems. Their structure of the feed through is complex and demands considerable space (from 15 to 100 square meters) depending on the equipment, type and parameters of the carrier. The presence of boosting recycling pump demands the increase of space up to 25 square meters.

Heating systems are related to ventilating systems concerning their final goal-the creation of human comfort in the buildings. That is why the foreign experience of the use of air conditioning systems shows its high operational characteristics.

To compare the achieved level and perspectives of heating-ventilating systems development one must take into consideration the climatic conditions. The climate of the Republic of Belarus is colder than that of many foreign countries. The open air average temperature of the coldest month in Minsk is -6,9 °C, in Vitebsk -7,9 °C, in Berlin -0,3 °C, New York +0,8 °C, in Paris +2,3 °C, in London +4 °C. Because of these differences man) heating-ventilating devices can't be applied in our country.

The research in the sphere of updating the heating-ventilating systems has been constantly carried out for over 25 years by the Chair of Heat/Gas Supply and Ventilation at Polotsk State University. It has been either state financed or self-supported. The huge amount of work has been fulfilled within the sphere of its implemen-

tation into the national economy of the Republic of Belarus, the former USSR with the considerable technical and economical effect.

Figure 1 presents one of the process flow sheets of the building air heat supply. It is suggested to use. The natural and waste energy (solar radiation and exhaust air) are actively used along with the primary source - natural gas and air supply in it.

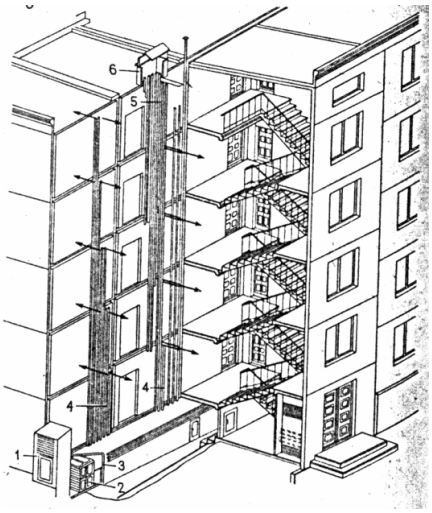

Fig. 1. Air heating of the buildings

The peculiarity of the architectural-planning operation of the multistoried building is the accommodation ladder cage and sectional air flue 5. It gets through all the building. Air flue is constructed as a vertical shell-and-tube heat exchanger. There are gas-burning, devices for air heating (13) in the bottom part of the air flue and also a pan for condensate gathering and drainage. The top part contains clack valve and ventilator (15) for the spent air emission into the atmosphere.

Inside the heat-exchanging hole (dr. 6) there are heat-exchange pipes (6) which are vented to the atmosphere air through the horizontal air flues (7) in the top part and air-intake pipes (3). The air-intake pipes (3) are made up of high-angle panes (2) and the face the outer wall load carrying structure (4). In the bottom part the heat-exchange pipes (are vented to the atmosphere air through the horizontal air flue (8), located in the basement and the air diffusion pipes (9), constructed as attachable ones to the inner surface of the outer wall (4), through supply registers are connected with the rooms, which are vented to atmosphere through the exhaust air terminal (10), vertical pipes (11), horizontal air flues (8), tube space of the heat exchanging hole (5), clack valve or ventilator (15) are vented to the atmosphere.

This process flow diagram shows the natural or positive circulation of the open air through the positive-pressure network of the heating ventilation system. First the open air enters the vertical air-intake pipes. Passing the pipes bottom-up the air is simultaneously and preparatory heated because of the solar radiation heat and transmission heat. Then the air is directed to the heat-exchange hole through the top horizontal air-flues and moves the heat-exchange pipe downwards. The air is simultaneously heated up to 70 % because of the heat utilization of exhaust air which moves as an approach flow bottom-up through the tube space. The final heating to the reference temperature of the incoming air is done with the help of gas-burning devices, equipped with the safety automatics and air temperature control.

Figure 2 shows the temperature calculation results of the incoming and evacuated air during its motion through the heat-exchange hole with the variable conditions depending on the setting temperatures of the open air.

The recommended combined system of heat and air supply has three vertical riser flows in the flow circuit. These riser flows have the height of all the building. There is also a descending current with the changing height. This provides steady natural circulation of the air heat carrier during the heating season. When the open air temperature is increased ($t_п$ > C) and the gravitational pressure is decreased the hole ventilator usage is needed.

The new progressive heat and air supply technologies of residential and public buildings are to be created nowadays. They can provide human comfort according to the criteria of energy, resource-saving and ecology.

Together with the rise of heat-shielding properties of the walling and its tight packing (that twice decreases heat consumption of the buildings) the other efficient way in the urban planning is the further development of the heat supply technology of the buildings with the water replacement on steam and air. That will make possible to get rid of expensive and energy-consuming pumping facilities, which are used to pump huge amounts of water in multitube long-distance and distributing systems and lift on the multistoried building height.

Water pipe lines branchy network, numerous multipurpose hardware, various heating devices are characterized not only by high capital outlays but are also hard to operate because of the high persistence of the water heat carrier.

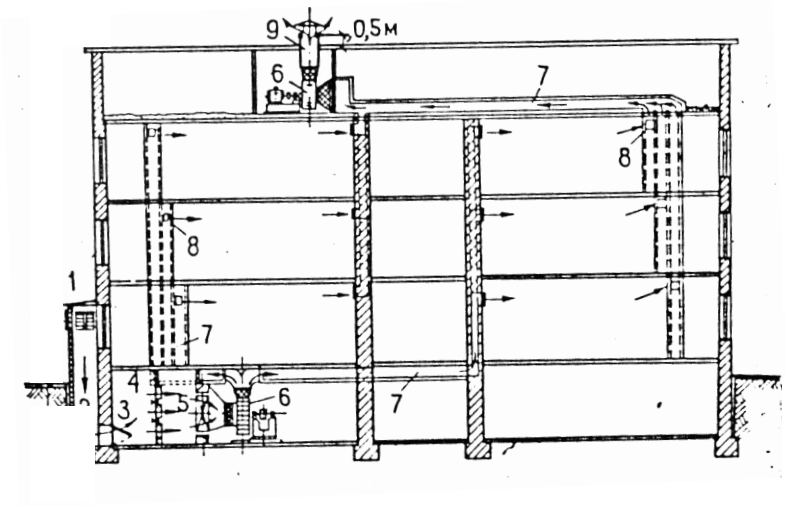

Fig. 2. Ventilating system

The air heating process flow sheet of the multistoried and public houses has many advantages in comparison with the certain analogues. The air heating terminal is practically combined with the ventilation in which the quick-acting types of heat carriers (superheated steam and air) are used.

Figure 1 shows the heating system of the multistoried building of cellar structure (residential buildings, hostels, hotels, sanatoriums etc.), in which the air intake goes through the intake hole 1, heating centre 2, air diffusing hole 3, and vertical channels 4 of the blowing ventilation. The spent air vent is provided through holes 5 of the exhaust ventilation and exhaust hole 6. Only one ventilator can be installed in the enclosures for the rated air change in summer and also during the transition period if there is a little natural draft or there is a lack of it.

The host-based system of mechanical ventilation is preferable for public buildings, demanding high-level of air exchange (shops, banks, hospitals etc). Such systems work according to the heating schedule in which the air motion is forcibly performed by the ventilator, installed in the air handling or exhaust chamber (Fig. 2).

The high pressure air-conditioning systems are installed in multistoried public buildings of cellular structure abroad. The speed of air in their air flues is 20 – 30 m per sec. This allows to decrease the profile of the air flue and the volume it takes in the building. These systems must be equipped with a high-pressure ventilator, an airproof air flue and special acoustic absorbers that set to work during the air outlet into the rooms to prevent aerodynamic noise. These systems can perform heating functions, but they may have high capital and operational costs and are not widely used in the civil engineering construction in our country [2, 3].

It is important and economically practical to construct more effective heating-ventilating systems of residential and public buildings in the Republic of Belarus which imports energy raw resources in the conditions of the world energy crisis. That is a heavy burden for the economy of the whole nation.

Thanks to the implementation of the pipeless heating technology combined with the air supply systems the huge amount of the expensive pumping equipment will be disengaged. Shut-off-and-regulating armature from steel, iron and non-ferrous metal, steel pipes and metal-roll can be used in industry or in agriculture for irrigation systems construction and water supply.

On condition that the energy consumption is decreased (using the air heating technology) more than a third of energy output can be directed on export increase and currency receipts.

The economical effect of the suggested technology implementation in the housing complex of the Republic of Belarus (calculation due to 01.01.2000) is 8, 04 billion US dollars. As for the actual pay off period it is T = 7,18 year. If the competitive product is marketed in Russia the economical effect will be much higher.

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