New ways and prospects of stove heating

or solving the questions concerning energy saving in central heating systems operating on electricity, oil fuel and gas as well as stove - heated houses.

By I.V. Kuznetsov

Here we will speak about heating private houses. Why do we speak about partial return to wood stove heating?

Some ten years ago mankind gave up the idea of using wood as traditional type of fuel and began to use oil fuel, later on partially gas and electricity. Wood is mainly used in open fire places, metal fireplaces – heaters with ceramic doors as well as masonry stoves

Heating Stoves

In Russia the majority of houses are stove heated, these stoves are also used for cooking food. A smaller part of houses is central heated, using solid fuel, oil fuel, gas and electricity.

Wood heating requires consideration for wood storage

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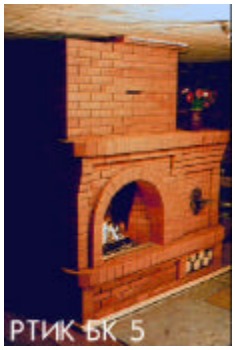
Wood should be carried and added into the hearth gradually. In early years it was possible to produce heat energy by burning oil fuel or using electricity almost without limitations. The use of oil fuel, gas and electricity for heating was easily automated. Oil fuel storage for annual consumption could be brought into the yard of a living house easily by a lorry.

Nowadays oil fuel, gas and electricity are quite expensive. The prices for these types of fuel are constantly getting higher. Besides, the delays in oil fuel supply from oil-producing countries showed that it is not always possible to buy oil even at high prices. In a TV program on the Russian NTV channel Gasprom, manager R. Vyakhirev, stressing the fact of difficulty with oil and gas supply for the country made a joke saying that it was high time he thought over using stove heating in his house. There is a deep thought in his saying. The politics of "cheap" energy carriers has gone never to return. Therefore it is necessary to find alternative power sources or improve the systems using traditional sources. Wood is a renewable resource whereas oil, gas and coal resources are limited. Besides, each type of fuel should be used for certain purposes. There are tens thousands of woodshops in Russia.

The chips, sawdust, woodchips are often wasted. There are enormous deposits of this valuable stuff for many years. Manufacture of chipboard and fiberboard is not paying due to small amounts. However, these wood residues can be used as fuel, having a calorific capacity 15- 25% greater as wood. It is necessary that cheap, not energy-consuming technologies (even hand-held) of

residual processing into swarf and chip briquette (chip brick) to be used as fuel be developed on competitive base. The fuel shall include aromatic fuel, fuel with color additives for fireplaces, fuel for cold smoking of products, fuel for baking bread using traditional old Russian recipes.

The significant difference of heat supply of private houses in Russia is mass usage of local fuel, sometimes of low quality but rather cheap. The most common fuel used in energy balance of individual development is wood, peat, etc. It is also worth mentioning that the majority of houses in rural area do not possess a backup heating system. The electric transmission lines are overloaded and not reliable, they do not ensure the required parameters.



In these conditions heating and hot running water supply of a living house is easily solved by means of wood stoves. Another variant possible is to use stove heating in combination with oil fuel, gas, electricity. Moreover, in later years thermal insulation of living houses proved to be much better (the requirements for that are getting stronger every year), also **new efficient stoves have been constructed** (to maintain constant temperature indoors only 4-8 dry birch billets are necessary).

Until now I have designed more than 150 types of stoves for various application made of brick having different heat rating (heating stoves, heating and cooking stoves, Russian stoves “teplushkas”, bath heaters with water heating regulation. Besides, a long dream to combine a stove with a fireplace finally came true. I also did something new in this direction by inventing stoves combined with fireplaces, whereas the fireplace walls are being heated and are part of the stove. The location of the fireplace could be different: it could be front, at the side and rear, i.e. behind the stove. Stoves of various application with low stove-bench as well as **stoves with built-in boiler to be used in individual water central heating systems** have been designed as well. All of them have been built. Some of the drawings of these stoves are available in computer variant.

At present perpend plans (on CD-ROM) of 80 stoves of various types are available.

For two- or three- storey houses stoves with transit chimney of various application have been designed, that makes it possible to provide projects of individual two-or three-storey stoves with fireplaces of any combination for any body-planned solution of building, whereas all the stoves are using one and the same chimney. All the stoves can be also operated by means of electricity which is used as standby service. Metal heaters with ceramic doors can be mounted into the fireplace (with clearance). In this case the fireplace can be used as powerful, additional heater. With the firebox door open (raised up) it can be used as an open fireplace. In this case, using the fireplace in summer the excess heat convection goes outside.

Excellent thermotechnical rating and the work quality have been highly appreciated by the users and ensured great stove demand. They say “good outside, gold inside”.

The majority of these stoves have no analog in the world. Here we mean an advanced direction in stove development. Using the principle of “free gas movement” it is possible to improve the design of existing commercial European and North American heater brands in accordance with the process used by these companies, and it will be more efficient. It is possible to construct a stove of any

imaginable form, and it will be efficient (e.g. stove in the form of a glove with fingers pointing up). It is impossible to achieve in other convection systems, including those with “counterflow”. Try to organize a constrained gas movement in the stove having the form of a glove (with fingers up) due to chimney draught in order to provide its uniform heating along the horizontal cross-section, with a minimum resistance to gas movement. Using the system of “counterflow” it is not possible to construct efficient multipurpose stoves, neither is it possible to consider the diversity of customer’s and architect’s requirements as well as design peculiarities of the house. Such stoves possess great resistance to out-going gases and a non-uniform stove heating along its horizontal cross-section. The fact is certain that **future belongs to the system using the principle of “free movement of gases”.** These stoves have a decisive advantage over the other systems. In the lower part of these furnaces a chamber is being made where high temperature necessary for bringing the reaction of combustible gases burning is being maintained. In this chamber a separation of hot and cold gas flows takes place. The hot gases are accumulated in the stove whereas the cold gases are charged into the chimney without cooling the stove.

For more information concerning stoves see *www. stove.da.ru*

Besides I propose some of the principles for private houses construction using stove heating, the costs spent for heating are being reduced (item 2.3).

Maximum comfort should be maintained in a living house in any season. Let’s have a look into some of the systems used in houses from this point of view:

1. Centralized heat supply system.

It is too bulky and awkward to handle. Due to necessity of preoperational activities on the supply lines in piping arrangement in the house and in other houses, it cannot react in due time to the changing weather conditions. Those who live in such houses must remember those periods of time when the heating system is out of operation or has not been run yet, while it is cold outside as well as during the period of peak necessity in heating power which arises during short periods with the intervals of 3-5 years, when it is realized that additional heating is necessary .

In such a case **it is necessary to install an auxiliary (backup) system**. Fireplaces can serve as a second heating system - heaters of western manufacturers and also **domestic heating stoves with fireplaces or heating and baking stoves with fireplaces.**

However, western fireplaces-heaters cannot be used as a fireplace in summer as they warm the house and serve only for decoration. Russian stoves with built-in fireplaces do not possess such a drawback. They could be heated simultaneously or separately. While the stove is being heated, the stove and the fireplace walls are getting warmer. While the fireplace is operating the stove walls do not get warmer.

2. Individual system of central hot-water heating.

This system is more flexible in comparison with the centralized system, however, it requires a certain experience and more attention. It may be operated using oil fuel, gas, electricity solid fuel.

Before we consider the operating peculiarities using different types of fuel, we will dwell on the following question. The word ”heating” is used for definition of two significantly different notions:

- heating for air temperature increase;
- heating for constant air temperature maintenance.

It is known that for the increase of temperature in a room a much greater power is required than that needed for constant temperature maintenance, and the quicker you want to increase the temperature, the more power you will need. To maintain constant air temperature indoors you do not need much power, but its action should be even during a long period of time. Some heating devices are suitable both for indoor air temperature increase and for maintaining constant temperature.

The question of heating device selection is one of the most important. A good heating system should be efficient in rather a large field of heat rating, i.e. in a wide range of outside temperature.

It is a pity, but according to data provided by the Finnish specialists the efficiency of modern heating systems is dependent upon what temperature the system is functioning at.

The lower the grade of the system usage (base-load heating capacity is 12 kWt, and we use 3 kWt), the lower is the efficiency, and the greater is the fuel consumption. It should be pointed out that in heaters used in the west, that operate all kinds of fuel this question is solved due to the use of automation. But in Russian condition they do not always function efficiently due to the above-mentioned reasons, and therefore need backup heating.

2.1. Individual system of central heating that uses electricity as the basic fuel.

Let’ s have a look at what could be done to increase the efficiency and reduce the costs of this system. Everyone who wants to build his private house wants to have in the system a boiler-thermal receiver to accumulate energy at night, when its cost is low, and later on use it for heating purposes and besides, use the boiler-thermal receiver for standby purposes. In Russia, as a rule, development does not have a second electrical heating, therefore it becomes important to install an

additional, i.e. a standby boiler that uses another kind of fuel. So we install a huge stove with a built-in boiler that uses wood and electricity, increasing the system's inertia.

Such stove should meet the following requirements:

1. it should be suitable both for increasing the air temperature indoors and for maintenance of constant temperature;
2. it should be cost-saving;
3. it should possess thermal capacity , acting as accumulator of heat;
4. in should not possess a big cold body in the burning zone as this reduces the temperature in the burning zone and leads to incomplete burning of gaseous wood content and , as a result, to efficiency decrease.

It should be noted that **the installation of our stoves into the heating system will lead to certain economic efficiency even in the case you do not fire it.**

Traditionally electricity is used for heating of energy carrier. In our case it is more efficient to use electricity for heating of heat-receiver (of the stove), as in this case the system heat inertia is being increased. In that case additional investment will repay with interest by the maintenance costs. In practice, heating expenses are much more lower.

2.2. Individual system of central heating that uses oil fuel and gas as basic fuel.

At complex development of the living district when the questions of constant energy supply are solved, these systems are reliable and efficient. The use of automation makes it possible to operate boilers with equal maximum efficiency in all modes of operation, irrespective of the fact what is the temperature like outside and what temperature you have preset in the living rooms. However, the delay in gas and electricity supply, supply of oil fuel may also take place here (as the system does not function without automation), as well as disturbances of equipment.

In this case **one should possess a backup system operating on local fuel which should be quite cheap and be capable of increasing the system inertia. Our stoves with built-in boiler equipped both with electric heaters or without them can be considered such a system.**

At individual construction work in the suburbs of the cities and beyond their limits (this refers to major part of development in Russia), there are no reliable sources of electricity supply. The voltage in the lines is being supplied with great deviations from the norm and sometimes is shut off for a certain period of time. In such condition the heating systems automation operating on gas and oil fuel functions unsatisfactorily or does not function at all. For that reason the installation of stoves with a built-in boiler being used as backup system is of primary importance.

2.3. Wood stove heating , electricity may be used as backup fuel.

While considering a variant of house heating by means of using stoves it is necessary to subdivide it into several heat circuits. Let us call the volumetric space of the house which is limited by protective constructions, and which needs heating a heat circuit. The house can have one or several heat circuits in every storey, the circuit size is up to 60 m^2. Each circuit is being heated by its own stove, the capacity of which corresponds to heat circuit size. Layout, square and designation of each circuit are different, and they are equipped with stoves of different functional purposes.

It is known that in order to increase the indoor temperature a larger power is necessary than the power needed to maintain constant temperature. In order to maintain constant temperature in heat circuit of 60 m^2 , about 1.5 kW of electric energy is needed.

The design of our stoves provides an opportunity of using electric energy as a backup type of fuel that enables to maintain constant temperature in any circuit and is used for hot water preparation. In case of built-in the fireplace metal heater the stove capacity is increased considerably. One can use only one type of fuel. At such version of the building it is possible to live in cold season in any circuit separately or at total house square simultaneously, depending on the number of people living at a given moment.

Observing the above mentioned conditions at design layout and installing our stoves the inhabitants have a possibility of heating the flat having a larger area and using less amount of local cheap fuel, cook food, have hot-water supply, use electricity as backup fuel (i.e. heat the stove by electricity) and at the same time have an efficient fireplace integrated in the stove.

I look forward to partners for manufacturing such stoves according the western standards and developing new stove systems.

I.V. Kuznetsov