# CLAIMS

1. A medical neutron source, comprising

- a nuclear reactor, with a core formed by a parallelepiped-shaped housing having a front, rear and two side walls, as well as a lid and a bottom,

reflector of neutrons, covering the core from the rear, side, top and bottom sides and including the rear, side, upper and lower reflectors,

located on the housing of the upper supporting and lower distancing grids,

fuel rods, the upper shanks of which are fixed stationary to the upper support grid with the possibility of vertical movement of the lower shanks under temperature expansion of fuel rods,

channels located on the lid of the housing for the placement of CPS controls,

located on the housing the supply branch pipe and the discharge branch pipe of the heat-stabilized primary circuit coolant,

partitions separating the internal volume of the housing to ensure the washing over of fuel rods and channels for the placement of CPS controls by the coolant;

- a collimator with a conical hole made of a material having a large scattering cross-section and a large atomic mass,

- a neutron filter placed in the conical hole of the collimator in such a way that the larger diameter of the conical hole is adjacent to the front wall of the shell of the core of the reactor,

- protection covering the neutron reflector and the collimator and subdivided into the front, back, side, top and bottom,

- channel for neutron-capture therapy, formed by a hole in the frontal protection, located coaxially with the conical hole of the collimator,

- at least one channel for fast neutron therapy, formed by a through hole in the side protection and a side reflector,

- the first movable gate for opening and closing the neutron exit channel for neutron-capture therapy,

- the second movable gate for opening and closing the neutron exit channel for fast neutron therapy.

2. A medical neutron source according to claim 1, wherein the first circuit includes a circulation pump, the coolant temperature stabilizer at the inlet to the core and a volume compensator.

3. A medical neutron source according to claim 2, characterized in that the circulation pump, the coolant temperature stabilizer, and the volume compensator connected to the hydraulic circuit are located outside the protection.

4. The medical neutron source according to claim 1, characterized in that in the rear protection and in the rear reflector, channels are arranged for locating the first circuit pipelines connected to the supply branch pipe and to the discharge branch pipe of the coolant to the core.

5. A medical neutron source according to claim 1, characterized in that the housing cover is provided with at least four channels for placement CPS controls.

6. A medical neutron source according to claim 5, characterized in that the channels for placement the CPS controls are provided with threaded connections with associated CPS movement mechanisms.

7. A medical neutron source according to claim 6, characterized in that in the upper protection and the upper reflector channels are provided for locating the drives of the mechanisms for moving the controls of the CPS.

8. A medical neutron source according to any one of claims 5 to 7, characterized in that at least four control rods are used as CPS controls, which are movable by the movement mechanisms of the CPS controls in the channels for placement the CPS controls.

9. A medical neutron source according to any one of claims 5 to 7, characterized in that one of the CPS controls is selected as a regulator of the nuclear reactor core outlet for a nominal power.

10. A medical neutron source according to claim 1, characterized in that the rear, side, upper and lower reflectors are made of stainless steel blocks.

11. The medical neutron source according to claim 1, characterized in that the thickness of the rear, side, upper and lower reflectors is selected from the interval from 290 mm to 310 mm.

12. The medical neutron source according to claim 1, characterized in that the length, height and width of the parallelepiped of the inner volume of the core housing are selected from the intervals, respectively, from 490 mm to 498 mm, from 172 mm to 180 mm and from 410 mm to 490 mm.

13. The medical neutron source according to claim 1, characterized in that the fuel rods in the core are arranged in a square grid whose step length is selected from an interval of 11.6 mm to 12.4 mm.

14. A medical neutron source according to claim 1, characterized in that uranium dioxide ($UO_2$) with $^{235}U$ enrichment selected from an interval of 15% to 20% is used as fuel in fuel rods.

15. A medical neutron source according to claim 1, characterized in that $B_4C$ is used as the absorbing material of the control rods.

16. A medical neutron source according to claim 1, characterized in that Pb is used as collimator material.

17. Nuclear reactor for a medical neutron source, containing

a core formed by a parallelepiped-shaped housing having a frontal, a rear and two side walls, as well as a lid and a bottom,

and a neutron reflector covering the core from the rear, side, top and bottom sides,

on the housing there are upper support and lower distancing grids,

on the upper support grid, the upper shanks fuel rods are fixedly fixed with the possibility of vertical movement of the lower shanks under the temperature expansion fuel rods,

on the cover of the housing are located (fixed) channels for the placement of controls CPS,

the housing is provided with a supply branch pipe and a discharge branch pipe of the heat-stabilized primary circuit coolant,

and the internal volume of the housing is divided by partitions to ensure the washing over of fuel rods and channels for placement of CPS controls by the coolant.

18. The nuclear reactor according to claim 17, wherein the first circuit includes a circulating pump, a coolant temperature stabilizer at the inlet to the core and a volume compensator.

19. The nuclear reactor according to claim 17, characterized in that at least four control rods are used as CPS controls, which are movable by the movement mechanisms of the CPS controls in the channels for placement the CPS controls.

20. The nuclear reactor according to claim 19, wherein one of the CPS controls is selected as a reactor output control for the nuclear reactor core at a nominal power.

21. The nuclear reactor according to claim 17, characterized in that uranium dioxide ($UO_2$) with $^{235}U$ enrichment selected from an interval of 15% to 20% is used as fuel in fuel rods.

22. A nuclear reactor according to claim 17, characterized in that $B_4C$ is used as the absorbing material of the control rods.

23. A method of using a medical neutron source, comprising:

in the core of the nuclear reactor according to claims 17-22, which is in the subcritical state, a coolant is supplied with a predetermined temperature,

withdraw the core of the nuclear reactor from the subcritical to the critical state until the nominal power of the nuclear reactor is reached,

open the neutron output channel for the neutron therapy session,

support the operation of the reactor at rated power during the time of the neutron therapy session,

simultaneously close the neutron exit channel and transfer the reactor core to the subcritical state after the time of the neutron therapy session,

while maintaining the temperature of the coolant at the entrance to the core unchanged and equal to the set temperature, both during the core withdrawal to the critical state and during the operation of the nuclear reactor at rated power.

24. The method of claim 23, wherein water is used as a coolant.

25. The method of claim 24, wherein the predetermined water temperature at the entrance to the reactor core is selected from an interval of from 18°C to 24°C.

26. The method of claim 23, wherein the transfer of the core from the subcritical state to the critical one and from the critical state to the subcritical state, respectively, by removing one of the CPS control rods from the core or entering the core.