A continuous-flow device for radiation-chemical investigations in gaseous, vapor, and liquid phases at temperatures of 400-600 deg C and under pressures of 1-30 atm, designed for the IRT-2000 reactor of the Institute of Physics, Academy of Sciences, Geor. SSR, was constructed in collaboration with three institutes—the Institute of Petroleum-Chemical Synthesis (INKhS), Academy of Sciences, USSR (Moscow), the Yu. G. Mamedaliev Institute of Petroleum-Chemical Processes, Academy of Sciences, Azer. SSR (Baku), and the Institute of Physics, Academy of Sciences, Geor. SSR (Tbilisi)—and brought into operation in February, 1962. The design of the device is based on the engineering calculations performed at INKhS, Academy of Sciences, USSR, in collaboration with the INKhS Special Design Bureau (SKB). The experience gained in the construction of the devices described earlier [1-6] was also used in this design. This device considerably differs from those described in the literature by the design features of the loop that is introduced in the nuclear reactor channel and by the fact that the pressure created by the vapor of the substance under investigation can be maintained in the loop and that the work can be performed in a wide range of temperature and pressure values.

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Fig. 1. Technological layout of the device. 1) Reactor core; 2) B4C filter; 3) electric furnace; 4) reaction zone; 5) current-conducting evaporator tube; 6) thermocouples; 7) reactor channel; 8) electric supply; 9) and 24) standard pressure gages (p = 1-60 atm); 10) reducing pressure regulator (from 0-150 to 0-60 atm); 11) breather; 12) flowmeter with capillary (p = 100 atm); 13) capillary; 14) tank with raw material (1.5 liters); 15) liquid pump; 16) thermometer (0-50 deg C); 17) to ventilation system; 18) 1-GSB-400 gas meter; 19) line for conveying samples to KhT-24 chromatograph; 20) U-shaped differential pressure gauge (p = 600 mm of water); 21) hydroseal (p = 600 mm of water); 22) water; 23) "check" pressure regulator; 25) cooler; 26) gas separator; 27) scavenging.
Any type of radiation-chemical investigation with gases, vapors, and liquids which are not corrosive can be performed in this device. Automatic temperature and pressure control and automatic sampling and analysis of gaseous samples are provided.

The device has been tested and used in a series of experiments (80) on the radiation-thermic cracking of vapors of petroleum hydrocarbons.

The technological layout of the device is shown in Fig. 1. Liquid hydrocarbon from the small tank (14) which contains the raw material is conveyed by means of an adjustable pump (15) to a current-conducting stainless-steel communication tube. As it passes through the tube, the liquid evaporates and is overheated as its temperature rises to that of the tube walls, and the vapor enters the electrically heated reaction zone (4). From the reaction zone, the reaction products are conveyed through the current-conducting stainless-steel tube to the “check” pressure regulator (23), which is installed in the hot line, making it possible to create a higher pressure in the system with the hydrocarbon vapor itself without adding inert gases.

Beyond the pressure regulator, the reaction products are conveyed to the gas separator (26) through the cooler (25), which is cooled by running water. The gaseous reaction products are led off to the drum gas meter (18), then conveyed to a KhT-2M chromatograph through the unit for automatic sampling, and finally expelled through the ventilation system. The liquid reaction products are conveyed from the gas separator to calibrated containers, after which they are measured and analyzed.

In work with hydrocarbon gas, the gas is conveyed from the tank through reducing pressure regulator (10) to the flowmeter with capillary (12), after which it passes through the system described above. Standard pressure gauges (9 and 24) are provided at suitable points in the device for measuring the gas supply pressure and the vapor pressure ahead of the pressure regulator.

The temperatures of the walls of the communication supply tube, of the vapor inside the reactor core, and of the core walls are measured by means of chromel-alumel thermocouples (6) and recorded automatically by means of an ᵃᵖ⁻⁰⁹ potentiometer. The temperature of the core walls is automatically maintained by means of an ᵃᵖ⁻¹¹ device.

Carbon dioxide from a cylinder is discharged into the raw-material line between the pump and the supply tube for removing air and remnants of the product from the system. A drainage line is also provided in the device.

Many of the device’s structural elements were determined by the parameters of the horizontal channel of the IRT-2000 reactor at the Institute of Physics, Academy of Sciences, Geor. SSR. The channel length is 320 cm, and the diameter is 100 mm.

The characteristics of certain units of the device are the following:

1. The adjustable liquid pump, designed at SKB INKhS, makes it possible to vary the feed rate of the liquid raw material from 50 to 3000 ml/hr by means of a regulating sleeve.

2. The “check” pressure regulator, designed at SKB INKhS, which has a membrane made of special thermoplastic, resistant plastic, makes it possible to regulate in a reliable manner the pressure of hot vapors of organic liquids (up to 300 deg C) in the pressure range from 1 to 30 atm.

3. The electrically insulated disconnection plugs, designed at SKB INKhS, are capable of operation under pressures exceeding 30 atm and at temperatures of up to 300 deg C.

4. The communication tubes (the supply tube, which has a 6x1-mm cross section and a length of 6 m, and the outlet tube with a cross section of 8x1-mm and a length of 5.5 m) are made of 1Kh18N9T stainless steel. Current from an ST-120 welding transformer is transmitted through

Fig. 2. Wiring diagram of the device. 1) Electric furnace; 2) two parallel-connected transformers; 3) 10-A group switch; 4) thermocouple leads; 5) electronic self-recorder; 6) electric plugs; 7) welding transformer; 8) ammeter; 9) voltage regulator; 10) ammeter.