HEAT PIPE WITH A WORM

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An experimental study was made of a winter heat pipe with a worm. The thermal resistance of such a heat pipe was found to be 1.5 times lower than without the worm.

One possibility of improving the processes of heat and mass transfer in low-temperature heat pipes is to twist the vapor stream by means of a worm [1, 2]. Such a twisting of the vapor stream yields a better heat transfer in both the evaporator and the condenser zone of a heat pipe, it also is effective in removing the pocket of residual uncondensated gas and in dispelling the liquid film above the condenser surface. In order to verify all this, the authors tested a heat pipe with a worm (Fig. 1).

The heat pipe was made of stainless steel with an inside diameter 39 mm and 190 mm long. The case wall thickness was 0.3 mm. As the wick along the pipe walls served an oxidized mesh of stainless steel, wire thickness 0.12 mm and hole size 0.16 mm, folded in two. The wick porosity amounted to 70%, the maximum height of capillary rise was 5.1 cm, and the permeance was $K = 1.35 \cdot 10^{-9}$ m^2.

For twisting the vapor stream and increasing the rate of heat and mass transfer in both the evaporation and the condensation zone, we used a variable-pitch worm 187 mm long and 38 mm in diameter.

Energy was supplied to the evaporator segment from a nichrome heater wound around the pipe. At the other end of the pipe was placed an 85 mm long condenser segment of the coaxial-tubing type through which water at 12°C was driven.

The transmitted thermal power was determined from wattmeter readings, also by recording the rate of water flow through the condenser and measuring the inlet and the outlet temperatures. The temperatures along the heat pipe were measured with 10 copper—constantan thermocouples connected to a model ÉPP-09 and a model R/306 potentiometer.

The temperature profiles along the heat pipe with and without the worm are shown in Fig. 2, while the ratio of thermal resistances with and without worm respectively is shown in Fig. 3 as a function of the transmitted thermal power. Measurements of the temperature profile in the vapor phase have shown that the worm does not appreciably change the pressure along the heat pipe.

Thus, the use of a worm with the heat pipe has made it possible to significantly improve the heat

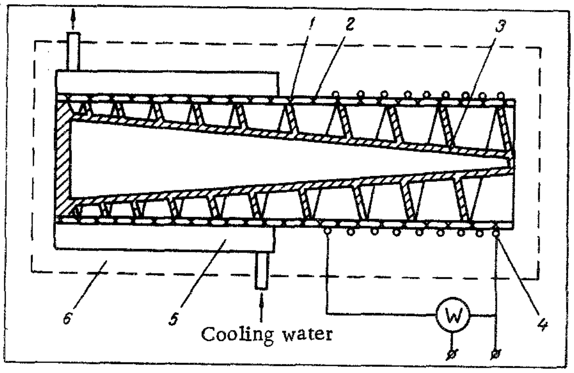

Fig. 1. Layout of a heat pipe: 1) case, 2) wick, 3) worm, 4) heater, 5) condenser, 6) thermal insulation.

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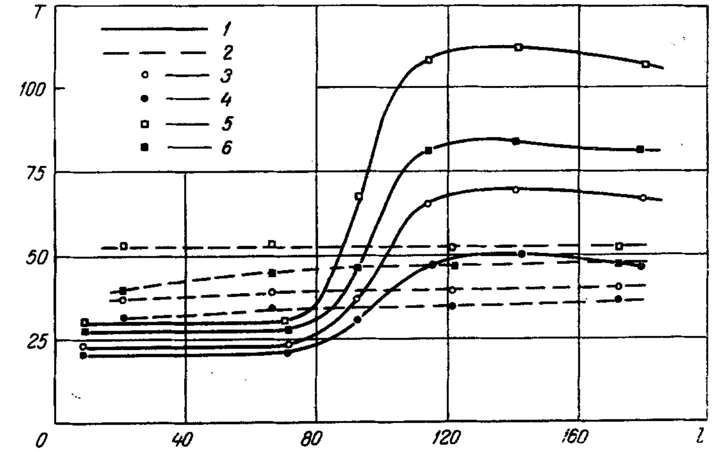

Fig. 2. Temperature profile (T, °C) along the pipe (1, mm): wall temperature (1), vapor temperature (2), pipe without worm 75 W (3), 125 W (5), pipe with worm 75 W (4), 125 W (6).

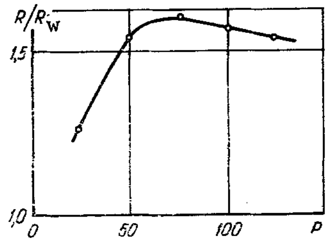

Fig. 3. Ratio of thermal resistances of heat pipe without and with worm respectively, as a function of the transmitted thermal power (P, W).

transfer in both the evaporator and the condenser zone, with a reduction in the total thermal resistance of the heat pipe by a factor of 1.5-2.

LITERATURE CITED

1. L. L. Vasil'ev, "Heat pipe", author's disclos. No. 313040, Byull. Izobret., No. 26 (1971).
2. L. L. Vasil'ev, "Operating principle of a heat pipe", author's disclos. No. 313041, Byull. Izobret., No. 26 (1971).