Jet technology for the ground installation of antiseepage curtains and load-bearing designs has recently come into use in the USSR. Use of water-jet energy to cut recesses in the ground, which can later be filled by an antiseepage or hardening material as a function of the purpose of the structure, is based on this technology.

Jet technology has come into widespread use in Japan. A number of firms use this technology to install antiseepage curtains, and also soil-cement and concrete piles of circular cross section 2-5 m in diameter and to 45 m deep [1].

In the USSR, the State Institute for Special Design, Ministry of Energy of the USSR and the Scientific-Research Institute of Bases and Underground Structures are occupied with problems involving use of jet technology in construction. The Scientific-Research Institute of Bases and Underground Structures is addressing jet technology in two areas — its use for work in frozen soils and under normal soil conditions. The first area is brought to light by Fedorov et al. [2]. The present paper is devoted to the second area of jet technology.

The Scientific-Research Institute of Bases and Underground Structures has developed a jet technology for the installation of economic piles, including three- and four-bladed piles, bladed piles with transverse disks, piles with inclined blades, screw piles, and rootlike piles (Fig. 1). Due to their developed lateral surface, the specific (per unit of material consumed) bearing capacity of these piles is 1.5-1.8 times greater than that for a pile of circular cross section. Like circular piles, they can be fabricated from soil cement or concrete.

Three- and four-bladed piles are installed using jet monitors having, respectively, three lateral nozzles located at 120°, and four lateral nozzles located at 90°. In contrast to what is done to install circular piles, the monitors are hoisted vertically upward in a guide hole without being rotated about the vertical axis; this significantly (by an order of magnitude) increases the rate of installation.
If, however, the monitors are turned at a small angle, for example, so that one of the 
nozzles moves into the plane of a neighboring nozzle over the entire height of the ascent as 
the monitor is raised, piles are produced with inclined blades, as a result of which their 
bearing capacity is increased.

Alternation of the vertical ascent of the monitors and their rotation about the vertical 
axis without ascent makes it possible to obtain bladed piles with transverse disks at differ-
ent heights.

Screw piles are installed by raising a monitor having one, two, or more lateral nozzles 
located one above the other with simultaneous rotation about its vertical axis. The number 
of spiral blades on piles installed in this manner corresponds to the number of nozzles on the 
monitor. The spacing of the spiral blades depends on the monitor's rate of ascent.

The rootlike piles are installed using jet monitors, the lateral nozzles of which are 
positioned at an angle of 30-45° to the vertical. These piles are constructed in stages; 
in this case, the rootlike rays are shifted in plan one relative to the other in each stage. 
With horizontal loads acting on the rootlike piles, the angle of incline of the rootlike rays 
may approach 90° to the direction opposite the load; this is achieved by varying the angle of 
incline of the corresponding nozzles on the monitor.

The Scientific-Research Institute of Bases and Underground Structures has designed and 
fabricated a universal head for a jet monitor (Inventor's Certificate No. 838004, Byull. Izob-
ret., No. 22, 1981); use of this head permits the installation of all of the above-cited 
varieties of piles, in addition to the rootlike piles. A valve built into the head of the 
monitor makes it possible to direct the water jet downward to hollow out guide holes and to 
exchange it automatically for lateral nozzles to hollow out recesses in the ground as the 
monitor ascends (Fig. 2). This head can also be used to install antiseepage curtains.

The valve operates in the following manner. When the water pressure in the monitor is 
below a certain limit, the spring-operated piston is in the upper position; in this case the 
lateral nozzles of the monitor are covered, and a water jet is discharged from the lower noz-
dle. When the guide hole has attained the design elevation, the water pressure is increased, 
as a result of which the spring-operated piston is pressed into the lower position, covering, 
in turn, the lower nozzle and exposing the lateral ones. The seating threshold of the valve 
can be regulated by tightening or loosening the spring, adapting the jet monitor to operate 
under specific soil conditions.

The valve modification that we have developed makes it possible to use not high-pressure 
water to reverse the valve, but compressed air, which is required by the technology to form 
a protective air jacket around the water jet (decision concerning issuance of inventor's cer-
tificate on declaration No. 3627471/03, dated June 20, 1983).