Self-propelled percusive pneumatic machines — pneumatic drifters — are used in various industries, for example, driving underground link-ups between mining units and for driving prospecting holes, blasting or other holes. In the case of holes 20-25 m long, driven in reasonable homogenous strata, the average deviation of drifters is 15-20 cm. For long holes, in inhomogeneous strata, the deviation can be considerable, so that the hole may be unsuitable for any practical application. Rectilinearity of drifting is governed by the density, moisture content and homogeneity of the ground, the presence of inclusions, the geometry and dimensions of the tool, the depth of hole from the surface, the spacing between parallel holes, and a number of other factors.

Research aimed at determining the effect of some of these factors on the deviation of the hole axis was carried out in the Mining Institute of the Siberian Department, Academy of Sciences of the USSR. The aim was to study the rectilinear aspects of tool movement as a function of the length of the body, the distance between the axes of parallel holes, their depth from the surface, and certain physicomechanical properties of the ground. The research was performed in two districts, in one of which the ground consisted of heavy loam and in the other light loam. The reversible IP 4603 pneumodrifter used was designed for a body length varying between 2500 and 1000 mm. The body diameter remained constant at 136 mm.

To determine the deviation of the axis of the hole from the given direction, a moving grid target and photogenerator were designed and built (Fig. 1). The grid (3) comprised a light metal tube 500 mm long and 132 mm in diameter, enclosing a 200 W lamp supplied through the special cable (5). A glass fixed at the front of the grid was fitted with a grid as shown in section B-B in Fig. 1. A rope (4) attached to the grid target was coupled to the winch drum (6) and moved thus along inside the hole. Divisions on the rope showed the position of the grid target in the hole.

The photogenerator was composed of a tube (2) with a Zenit-S camera with an MTO-500 telescopic lens. The generator was installed at the mouth of the hole and used to photograph the grid target as this was moved by a fixed amount along the axis of the hole. The deviation of the hole axis from the given direction was determined by the size of the darkened (vanished) segment on the grid target.

As an example Fig. 2 shows the profilograms of an actual total deviation for various holes as obtained by measurements based on this type of photograph. Processing of the photographs revealed that the total deviation
of the hole increases with its length. Where the holes are less than 1.1-1.2 m from the surface, the drifter tends to emerge on the latter; deviation of the tool to left and right when driving holes in homogeneous strata was identical.

Figure 3 shows the relationship between hole axis deviation and length when the hole is driven with tools of differing cylindrical length. After the tool has entered the ground, it runs virtually straight for a certain length. In the case of a drifter with a cylinder 1000 mm long, this straight sector is around 6 m. The length of the straight sector increases with that of the calibrating portion and reaches 10-13 m for a cylinder length of 2000-2500 mm.

After driving this rectilinear sector, the drifter begins to deviate, depending to a large extent on the length of the calibrating part of the body. Maximum deviation is found in holes driven by drifters of cylinder length 1000 mm. With a body of this length a 10 m hole deviates on average 30-40 mm. Maximum rectilinearity occurs in holes driven by cylinders 2000-2500 mm long. A drifter with this body length deflects the axis of its hole from the given direction by half the hole diameter, i.e., 65-70 mm, for a hole 25-27 m long.

From Fig. 3 it is clear that with a relatively short body (1200-1500 mm) holes can be driven accurately enough to 20-25 m; for longer holes, it is necessary to extend the length of the calibrating part of the drifter body.