The application of surface coatings possessing special properties to machine components by the technique of spray deposition of powder materials is extensively employed in engineering practice. One of the most important process parameters affecting the quality of spray-deposited coatings is the uniformity of feed of powder to the spray gun.

The feeding devices in current use are not always capable of ensuring a smooth flow of powder, and use of powder vibrators and stirrers greatly complicates the design of feeders. Furthermore, such units are totally unsuitable for handling small volumes of powder (in some practical applications, the amount of powder may be as little as 5-10 g).

Fig. 1. Feeding device: 1) body; 2) regulating needle; 3) seal; 4) cover; 5) return spring; 6) regulating nut; 7) funnel; 8) radial openings.
Fig. 2. a) Rate of powder flow through feeding device vs particle size (gas flow rate, 2 liters/min); b) rate of powder flow through feeding device vs rate of carrier gas flow (particle size, -150 + 200 mesh). Powder material: 1) Relit (cast WC base hard alloy); 2) Colmonoy; 3) alumina.

A new design of feeding device for supplying powder materials to plasma spraying installations (Fig. 1), which is free from these drawbacks, has been developed at the Scientific-Research Institute for Technology of Tractor and Agricultural Engineering [1]. The feeding device operates as follows. With the regulating needle 2 fully lowered, the powder is poured through the funnel 7 into the housing 1. Rotation of the regulating nut 6 causes the needle to rise, thereby gradually opening the outlet passage. A carrier gas is then allowed to flow through the needle. The gas escapes from the needle at high velocity through the radial openings 8 and at the same time consolidates the adjacent powder volume. The chamber 1 is hermetically closed with the seal 3. Under the action of excess gas pressure in the chamber, the powder flows through feed passages to the spray gun. Constancy of flow rates of the carrier gas entering and leaving the regulating needle is ensured at the ratio

\[
d_1 = \frac{d}{n},
\]

where \(d_1\) is the diameter of the radial openings connecting the regulating needle passage with the chamber, \(n\) the number of openings, and \(d\) the diameter of the carrier gas passage in the regulating needle. The radial openings are located at a distance \(l\), equal to the maximum needle travel \(h_{\text{max}}\), from the tip of the needle.

Rotation of the regulating nut 6 gradually opens the outlet passage by increasing the gap \(t\) between the regulating needle and the housing wall. The magnitude of the gap depends also on the taper \(\alpha\) of the regulating needle tip, and is calculated with the formula

\[
t = h \tan \frac{\alpha}{2},
\]

where \(h\) is the lift of the regulating needle (Fig. 1). The optimum position of the regulating needle in each specific case is chosen according to the nature and particle size of the powder to be sprayed, the power characteristics of the spray gun used, and the size of the part to be coated.

Figure 2a shows data upon the rate of powder flow from the feeding device as a function of powder particle size for two positions of the regulating needle. It follows from this graph that, as the particle size is increased from 40 to 160 \(\mu\), the rate of powder flow through the feeder falls. To ensure a given rate of flow (as determined, for example, by considerations of maximum spray gun output for each specific material), with increase in particle size it is necessary to increase the gap (curves 1' and 2').

In Fig. 2b are shown experimental curves of powder flow rate plotted against carrier gas flow rate, from which it follows that uniform flow (solid parts of the curves) for each material begins at a certain minimum value of gas flow rate. Also, to ensure a smooth feed, a higher rate of flow of carrier gas is required with heavy than with light powders.

*The feeding device used in the experiments had the following characteristic dimensions: \(D = 8\) mm, \(d = 2.5\) mm, \(n = 6\), \(\alpha = 30^\circ\), \(l = 10\) mm, and \(\beta = 45^\circ\).

†Measured with an RS-3A rotameter.