As is well known [1-3], the starting material—granulated aluminum powder—for the manufacture of sintered aluminum powders is prepared in several operations. Spraying of liquid aluminum yields a powder consisting of globular particles measuring 50-450 μ in diameter. This powder is further ground in ball mills to extremely thin petal-shaped slabs of down to 0.1 μ thickness. During the grinding process, the aluminum particles are not only broken down, but also combined to form larger conglomerates by cold-welding. Grinding and cold-welding (granulation) of the aluminum particles in the mill take place in two stages; first, the particles are ground, and, later granulated. The longer the duration of the first stage, the greater the dispersion of the elementary petal-shaped slabs (particles) of the powder and the higher the content of aluminum oxide. The apparent specific weight of the elementary particles equals 0.1-0.3 g/cm³, and granulation increases the apparent specific weight to 1.0-1.4 g/cm³. The mean particle size of the granulated particle size may be as high as 200-450 μ.

According to GOST 10096-62, the granular composition of APS-1 powder is characterized by an amount of 1% of residue left on 1.6 mesh sieves (GOST 3584-53). Consequently, the powder may contain conglomerated particles of about 1.5 mm in diameter. If it is taken into consideration that the conglomerates consist of minute elementary particles not larger than a few tenths of a micron, it might seem that the size of the conglomerates cannot affect the properties and structure of semi-finished products. In practice, however, it was found that coarse oxide and aluminum particles are left intact during grinding and hardly participate in granulation.

The broad ranges of the granulometric composition now admitted by the existing GOST specification do not favor removal of these particles. Their incorporation in semi-finished products results in formation of regions of lower strength and hardness [4], or regions with coarse inclusions of oxide particles (Fig. 1) which are sources of micro- and microdistortions and defects in the metal. The presence of such particles in a sintered aluminum powder deteriorates the mechanical characteristics and results in a considerable scattering of the values of the mechanical characteristics [6].

We studied the effect which the granulometric composition of a granulated APS-1 brand aluminum powder has on the properties of semi-finished SAP sheets. The standard APS-1 powder (7.7% Al₂O₃) was previously sieved into the following size fractions: smaller than 50 μ, 50-100, 100-160 and over 160 μ. Sieving was done in a mechanically vibrated equipment containing a set of standard sieves. The shape and relative sizes of the granulated particles in the aluminum powder are shown in Fig. 2.

It is quite understandable that these four groups of sieved powders differ in apparent specific weight. The diagram in Fig. 3 shows how the apparent specific weight of the powder depends on the granulometric composition. The apparent specific weights of the four sieve fractions separated from the standard powder batch...
Fig. 2. Shape and relative size of the granulated particles in APS-1 powder (7.4% Al₂O₃) after separation into the fractions (μ), 250-fold magnifications: a) less than 50; b) 50-100; c) 100-60; d) over 160.

Fig. 3. Diagram showing the apparent specific weight of APS-1 aluminium powder as a function of the granulometric composition. Powder batches used in our experiments varied from 0.89 to 1.30 g/cm³. Analysis of the plot of the apparent specific weight versus the particle size (Fig. 4) shows that the apparent specific weight varies the most distinctly in the size range from 1-2 to 100μ (parabolic initial range of the curve). Beyond this limit, the apparent specific weight rises linearly with the particle size, but the increase is only slight.