(0.2% C) steel powder of good compressibility, is particularly suitable for mixing with other powder grades. MP36 contains 0.4% sulfur, which facilitates machining of parts produced from it and ensures the attainment of properties comparable to those of wrought materials. MP52 and MP55 are prealloyed steel powders, the former containing 0.7% molybdenum and 0.3% nickel and the latter 1.9% nickel. Mixed with graphite and a plasticizer addition, they are used for the manufacture of parts with a tensile strength of up to 61 kgf/mm², which can further be substantially increased by heat treatment. MP61-MP65 are powders intended for the production of welding electrodes. MP61-MP63 powder grades have the same chemical composition and identical, low sulfur and phosphorus contents, but differ in particle size distribution. MP64, which is characterized by low sulfur and phosphorus contents and a high carbon content, is employed as a carbon source in the manufacture of manual-welding electrodes.

Japan. In Japan use is made of iron powders produced by the atomization and reduction methods (Table 14): 300M, a pure iron powder; 400M, a free-cutting steel powder; 4600, 46F2, and 9400, low-alloy steel powders; and 300PC, a high-purity powder employed for the manufacture of electromagnetic cores.
pounds, and other factors). With some components, e.g., dispersion-hardening phases, addition in the course of milling is more effective than other methods of introduction as a result of the mechanochemical alloying phenomenon.

Both abroad and in the Soviet Union a number of materials and production processes have been developed based on the use of powders produced by swarf comminution. In Britain, components of industrial and domestic sewing and business machines are being mass-produced from a material based on a cast iron powder obtained from comminuted swarf [4]. In Japan, production processes involving use of swarf are being developed in the following directions: sintering of compacts from uncomminuted swarf, followed by hot forging into bushings, gears, and sprockets; production of antifriction materials and parts from cast iron powder; use, instead of graphite, of cast iron powder as a high-carbon component in the manufacture of iron-graphite and iron-copper-graphite materials; reduction of two- and three-layer carbon steel/porous cast iron and stainless steel/carbon steel/porous cast iron sheets. Japanese investigators consider the processing of swarf by powder metallurgy techniques to be so efficient that it justifies the employment of special cutting tools and machining techniques ensuring the formation of swarf which is best suited for subsequent processing into powder [5]. In the United States processes are being developed for the manufacture of parts of high dimensional accuracy from powders produced by mechanical comminution of aluminum swarf [6]. In the Soviet Union, a method has been devised for manufacturing lock nuts and other components from ShKh15 ball-bearing steel sludge wastes [7]. At the Scientific-Research Institute of Powder Metallurgy of the Belorussian Polytechnic Institute, a technique has been developed for producing dies from ShKh15 steel powder obtained by milling from machining and grinding swarf [8, 9]. At the Moscow Institute of Steel and Alloys (MISA), a number of Ferro-TiC type materials (titanium carbide with alloy steel binders) have been formulated whose binders are powders prepared by comminuting R18 and R9K5 high-speed steel swarf [10].

Work at the MISA, All-Union Scientific-Research Institute of Hard Alloys, Moscow Institute of Chemical Technology, and Gorkii Polytechnic Institute has resulted in the development of a method of obtaining powders from R18 and R6M5 high-speed steel waste with a titanium carbide addition. The life of a tool from an R18 steel powder is two to five times that of a tool made of a cast-and-forged steel [11, 12]. The process is at present undergoing pilot-plant trials at the AvtoGAZ Association. At the Scientific-Research Institute of Tractors and Agricultural Machinery, MISA, and Moscow Institute of Chemical Technology, a technique has been developed for processing ShKh15 steel swarf into powder and for the manufacture from this powder of sealing rings for the traction system of track-laying tractors. The comminuted powder obtained from this swarf has an apparent density of 2.5-2.8 g/cm³ and is composed of particles of angular shape ranging in size from 0.15 to 0.312 mm. The material of the rings has a density of 7.35-7.74 g/cm³, a porosity of 2-7%, a transverse rupture strength of 140-180 kgf/mm², and a Rockwell C hardness of 18-25 after sintering and 58-62 after heat treatment. Its cost is estimated at about 100 rubles per ton. Use of metallic swarf as raw material will reduce the consumption of the strategic ShKh15 steel tubes by 2300 tons and give a saving, by decreasing total costs, of the order of 1,000,000 rubles. On the basis of the technique developed, a sealing ring producing plant has been designed and is now being constructed at one of the tractor spare parts factories.

In ball production at ball-bearing factories about 30% of dedititus is in the form of sludge. The sludge is the lubricating and cooling fluid employed containing debris from the plates between which balls are shaped and ShKh15 steel particles less than 100 µm in size. At the GPZ-2 ball-bearing factory alone about 2000 tons of metallic waste passes into sludge each year. According to researches carried out jointly at the Scientific-Research Institute of Tractors and Agricultural Machinery and a branch of the GPZ-2 factory, this metallic waste is a valuable raw material for powder metallurgy, and it costs less to process it than to produce similar powders by other methods. Processing this sludge yields a powder having an apparent density of 0.92-1.05 g/cm³. Its particles are of 0.1-mm size and lamellar shape. A tentative technique has been devised for the production of parts from such powder. The properties of the material of these parts are: density 6.8-6.9 g/cm³, porosity 15-20%, and Brinnell hardness after sintering 170-210. Powder from ShKh15 steel sludge can be successfully used as raw material instead of ZhGr1 and ZhGr2 iron-graphite powders [13-15].

At the Institute of Titanium, researches in the field under consideration are being conducted in two directions: processing of titanium and titanium alloy waste (swarf, trimmings, coupons) from factories in which these metals are machined and processing of lower grades of sponge titanium produced at titanium-magnesium enterprises [16-18]. For processing these