METALLURGY

Dust Makes War Tools

Powdered metals put under pressure in precise molds and then specially heat-treated make superior heavy-duty machinery parts.

By A. C. MONAHAN

➤ A PILE of dust, under the pressure of a new industrial process, becomes a major war tool.

It may seem a bit round-about in the rush of production today to turn pieces of steel or other metal into a fine powder and then reform this powdered metal into tools, gears and other pieces of heavy-duty machinery working for war.

One of the latest technologic processes, the art of powder metallurgy, is doing just that to speed and cheapen the production of the things we need to fight our enemy. In fabricating machine parts, instruments and tools by powder metallurgy, the metal is not melted. It is not poured into molds. Instead, under great pressure in very precisely machined forms, the minute pieces of pulverized metals are squeezed together and then heated to bind them permanently and give them as much or more strength than the ordinary cast, forged, rolled or stamped metal.

Recent developments have given this process, in limited use before the war began, a prominent place in manufacturing ordnance, munitions and other equipment for our fighting men. Results are obtained which cannot be accomplished in any other way. Two decades ago it was used only with metals very difficult to melt. Now it is used with practically all metals and with some non-metallic minerals. It is used with alloys and mixtures of metals which are not alloyed, and mixtures of metals and non-metallic minerals.

Use of Pressure

In the fabrication of an article made from metal powder, a mold is employed, usually of hardened steel. The mold is the precise size and shape of the object desired. The exact amount of the metal powder is put in the mold and controlled pressure is applied. The amount of pressure may be very slight; in fact, in making porous metal filters, practically no pressure is used. It is very great where strength is important, sometimes exceeding 100,000 pounds per square inch.

When shaped the object is removed from the mold and heat-treated—"sintered," metallurgists call it. This is done at a high temperature, but one below the fusion or melting point of the metals used. The sintering temperature necessarily is different with different metals and different combinations of metal. Steel is sintered at around 2,000 degrees Fahrenheit.

The time required for the heat-treatment differs also with different metals. For steel, it is about 20 minutes. In commercial practice, objects to be sintered are passed on endless belts through gas or electric ovens or furnaces at a controlled rate which assures their being under treatment the proper length of time.

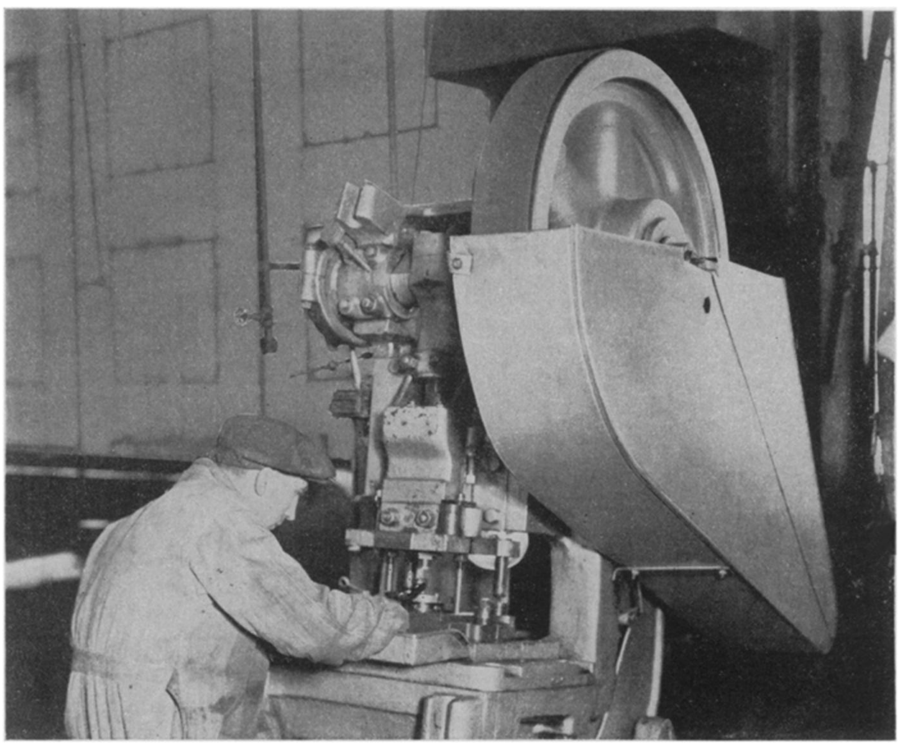
The furnaces must contain a controlled atmosphere, otherwise oxidation would take place. Hydrogen, carbon monoxide, cracked ammonia or other gases are used.

In this sintering process, the particles of metal are interlocked or knitted together; one scientist says they are "zippered." The parts come out of the furnace with a bright, smooth finish. They are ready for use without machining or finishing.

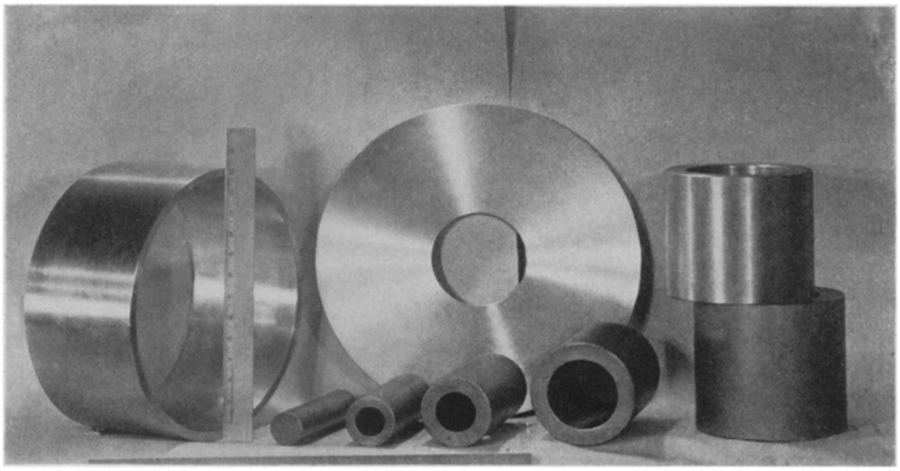
Porous Metal

Porous metal parts are often needed. These may be obtained in powder metallurgy by using metals with proper characteristics, and controlling the amount of pressure. Gas-forming substances are sometimes added which in the sintering process form capillary inter-connected passages.

One of the highly important uses made of porous parts is in self-lubricating bearings. These bearings must have sufficient porosity to hold a certain amount of oil or other lubricant. The lubricant works its way through the capillary passages to the rubbing parts. Sometimes the lubricant added is enough



TO SQUEEZE POWDER—To form tools and machine parts the minute pieces of pulverized metal are pressed together and then heated so that they are permanently bound together.



FROM METAL DUST—Durable metal-cutting tools and gears as well as numerous other objects needed to aid our production program are made today from powdered metal.

to last the life of the machines; in other cases additional lubricant must be supplied from time to time.

The history of powder metallurgy goes back at least a hundred years; some claim much longer. It is certain that platinum powder was used in making platinum articles over a century ago. Platinum has a very high melting point. Because of this, great difficulty was encountered in trying to put it into use. Platinum powder was easily obtainable. Scientists found that by pressure and heating at a temperature well below its melting point, satisfactory platinum objects could be formed. Similar results were obtained with iridium.

Powder metallurgy found another important application early in the present century. It was used to produce thin filaments of metallic tungsten for electric lamps. This extremely refractory metal, the melting point of which is about 6,000 degrees Fahrenheit, can be made available in powdered form. After its formation into briquets by pressure and sintering, it can be made stronger and more ductile by hot forge treatment.

New Development

The success of powder metallurgy in putting platinum, tungsten and other refractory metals to work is probably responsible for laboratory investigations made in the past two decades which, in turn, are responsible for the present wide use of the process and the many new uses developing each year.

Progress has now developed to a point where many types of machine parts, instrument parts and tools are made from powders of single metals, metal alloys, metal mixtures that alloy during sintering, metal mixtures that remain unalloyed, and mixtures of metallic and non-metallic minerals. Pieces, composed of layers of different materials, are fabricated. Others are made of mixtures of metals whose specific gravity is so different that they would separate if melted.

Nearly As Hard As Diamonds

Hard cemented carbide-tool material is one of the most important products of powder metallurgy. It is nearly as hard as diamonds. It cuts metals at speeds several times as great as tools made from molten metals. Its use has greatly speeded up war production. The material consists of very small particles of a hard metallic carbide cemented together with a small amount of an alloy.

Tungsten-carbide was first used as the metallic carbide because it provided great strength and hardness. The cement used with it is a molten alloy formed by cobalt which has dissolved certain small amounts of tungsten carbide while in a liquid state. Tantalum carbide and titanium carbide are also used. No other practical method has been found for making satisfactorily this important tool material.

Wartime developments require a large number of electrical resistance parts made from powdered talc or steatite with electrical and dimensional properties obtainable by powder metallurgy, but in no other way now known. They require parts made of metal mixtures in which each metal retains its original electric characteristics. Alloying often destroys these characteristics. Powder metallurgy is the answer. Combinations of copper and tungsten, and combinations of silver and nickel, tungsten or graphite, are examples.

Metal powders of practically all metals are now available, and also of many alloys. Commercial manufacturers use powders made by the reduction of metal salts by gases, electrolysis or atomization, or by mechanical disintegration of the metals themselves. Relatively pure iron oxide ores, in the presence of a reducing agent, form an iron-sponge at a temperature below the melting point of the metal. The sponge is pulverized mechanically. The atomization process consists of spraying a molten metal into a current of air or steam.

Until recently powder metallurgy was used only when melting and casting was not possible. Newer methods have now changed this. The process is economical, often less costly than the old process which involved melting, forming and machining.

The importance and possibilities of powder metallurgy to America's industries was foreseen a few years ago by Stevens Institute of Technology at Hoboken, N. J. In 1940 it established, under the sponsorship of eleven industrial concerns, a special powder metallurgical laboratory to conduct research work and to teach the art to student engineers in metallurgy. It was placed under the charge of a professor taken from an industrial concern which for several years had been using metal powders in manufacturing processes and had conducted much research in its own laboratories.

Science News Letter, October 2, 1943

ENGINEERING

Electrical Device Locks All Car Doors at Once

➤ GASOLINE may be rationed and car driving limited, but patents for many new devices for automobiles continue to be issued. A "coincidental locking system for automobiles" is among them. The inventors are Robert N. Ward of Royal Oak, Mich., and Roy H. Dean of Detroit. They assign rights in the patent (2,329,309) to the Ternstedt Manufacturing Co. of Detroit.

It is an electrically controlled device which locks all doors at the same time. It may be operated from either front door. By use of a switch the rear doors may remain locked whenever wanted.

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