April 27, 1948. W. ZEBROSKI 2,440,531

APPARATUS FOR MAKING METAL POWDER

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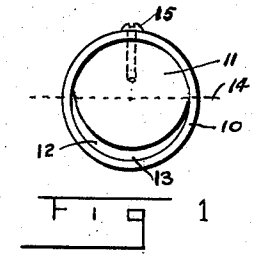


Fig 1

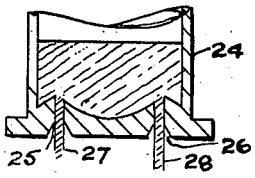


Fig 2

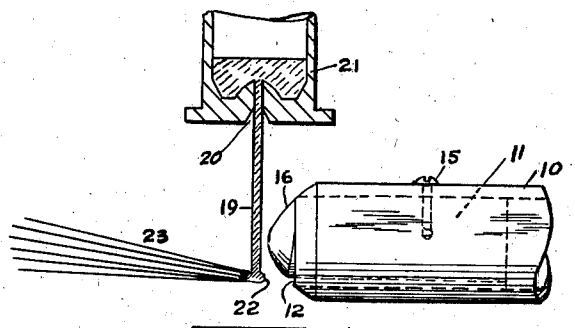


Fig 3

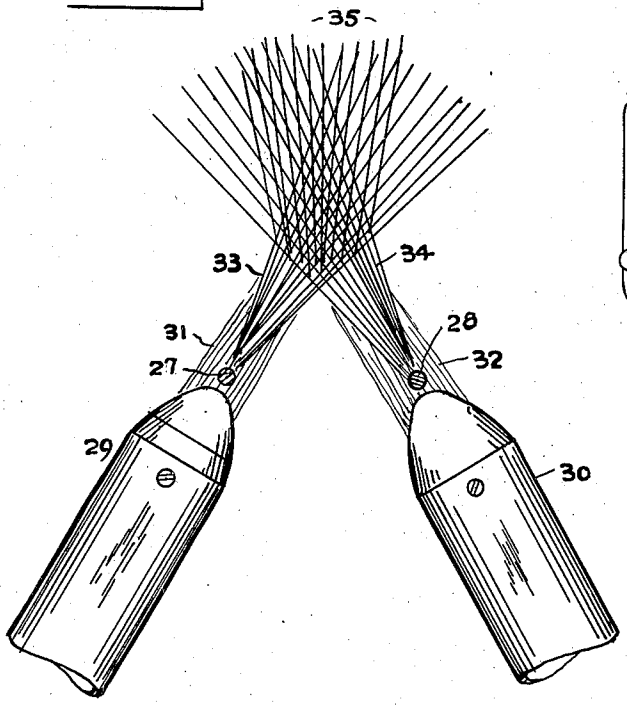


Fig 4

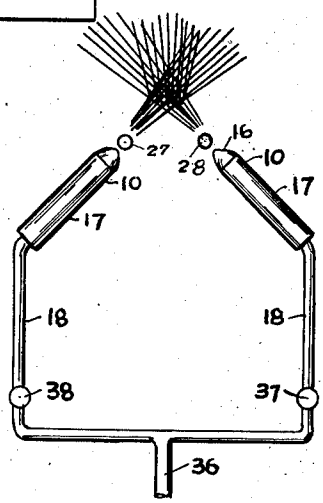


Fig 5

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APPARATUS FOR MAKING METAL POWDER

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1 Claim. (Cl. 18—2.5)

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This invention relates to an apparatus for making metal powder.

Additional objects and advantages will be apparent from the following specification and the accompanying drawings, in which is disclosed a preferred apparatus for practicing the method. It will be understood, however, that this disclosure is merely illustrative and is not limitative, as the details of construction and arrangement of the various component parts of the apparatus can be varied, the invention being that defined in the appended claim.

In the accompanying drawings:

Fig. 1 is an end view of a gas nozzle to produce a gas jet and used in practicing the method of making metal powder as herein disclosed;

Fig. 2 is a sectional view of a discharge nozzle to produce a jet of molten metal and used in the aforesaid method;

Fig. 3 is a side view of a pair of nozzles arranged in cooperative relationship;

Fig. 4 is a plan view of four nozzles arranged in cooperative relationship; and

Fig. 5 is a plan view of the nozzles of Fig. 4, showing the piping for the gas supply to the gas nozzles and the regulating valves therein.

Heretofore, metal powder has been produced by melting the desired metal—for example zinc, brass, lead, etc.—in a melting pot by applying heat in any suitable manner. The pot has a pipe or nozzle depending therefrom to deliver downwards by gravity (or pressure can be applied to the metal in the pot) a uniform non-wavering stream of molten metal.

A jet of any desired gas (atmospheric air is commonly used) at 75 to 150 lbs. pressure p. s. i., is caused to impinge upon the aforesaid stream of molten metal. This gas jet is usually of definite shape, having a V or U formation, and is adjusted so that the jet cuts the metal stream at a point a few inches below the tip of the nozzle or pipe from which the metal emerges. The result is that the metal falls between the upright legs of the V or U, is atomized and chilled and reduced to fine particles.

The prior art method just described requires careful regulation of the streams of metal and gas, and the relative positions thereof in order to produce metal powders of uniform particle size. It is also necessary to carefully shape the gas jet to produce the desired V or U shaped stream, and to maintain said shape in spite of wear of the material forming the orifice of the jet.

The orifice of such jets is often formed by what is termed a "nozzle plate," the outer surface

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of which is flat and placed parallel to the stream of molten metal, a gas supply pipe being connected directly to the plate. Pulsations in the gas in the pipe therefrom appear directly in the gas jet emerging from the orifice.

As previously stated, one of the objects of the present invention is to provide an improved gas nozzle that eliminates the objections encountered when using known types of nozzles or nozzle plates. This improved gas nozzle is particularly useful for use in connection with the method to be presently described, but may be used to advantage with any known method.

Referring to Fig. 1, the nozzle 10 may be made of tubing of proper size for the work. A suitable size for ordinary work has an inside diameter of 27/32 in., and is fitted with a plug 11 secured in the outer end of the nozzle which is so shaped as to provide a lunate-shaped opening 12 in the tip, which may be 3/32 in. wide at its widest point 13. The opening 12 is so formed that its tips or extremities are approximately at a horizontal line 14 passing through the axis of the tube 10. The plug 11 extends rearwardly of the tip for a suitable distance, which may be twice the diameter of the tube 10, and is held therein in any suitable manner, as by the screw 15. By slotting the wall of tube 10 through which this screw passes in a manner that will be obvious, the plug can be adjusted with its nose 16 projecting more or less from the tube 10.

The gas nozzle 10, 11 as just described is preferably connected in any suitable manner to an expansion reservoir 17, which can in many instances be formed as an enlargement of the nozzle tubing or of the gas supply pipe 18. This can also have a resilient wall and can be formed of rubber, a Sylphon bellows, or in any other manner so it can expand and contract to smooth out pulsations in the gas before it is discharged via the nozzle. The nose 16 is rounded as best seen in Fig. 3, so as to present a comparatively sharp point to the stream 19 of molten metal which issues from the discharge opening 20 of the metal discharge nozzle 21 connected to a metal melting pot (not shown). This prevents a phenomena which occurs when a nozzle plate is used with a metal jet spaced a short distance therefrom: the combined action of the metal and gas jets apparently sets up a suction or vacuum action between the outer surface of the plate parallel to the metal jet and the latter—in spite of the gas blast outward—is drawn inward toward the plate and spattering and wavering of the metal stream re-

sults, causing a variation in the size of the metal particles produced and difficulties in operation.

With the rounded nose 16 the foregoing difficulty is overcome, the metal jet 19 has no tendency to contact the tip. It may be drawn slightly inwards at 22 but this tendency is stopped by the outward rush of the gas stream with the result that the finely atomized particles of metal are uniformly comminuted and blown outwardly in the gas stream 23.

As the gas stream has no longitudinal form (but only a general outward direction of flow) after it mingles with the molten metal, the latter is not compacted or held together in any way and therefore the particles of metal are quickly cooled out of contact with each other to a great degree. The result is a fairly uniform product and the necessity of shut-downs to clean metal from the outer end of the jet is eliminated.

While the improved gas nozzle as just described can be used to advantage as compared with known nozzles with a single stream 19 of metal, as above described, a preferred arrangement of multiple nozzles, whereby a new and improved method of making metal powders is possible, will now be described, and while this method may be practiced using known gas nozzles, the following description contemplates the use of the improved nozzle herein disclosed.

For the sake of illustration, only two sets of nozzles are shown, but it will be understood that three or more sets of nozzles (each set comprising a device to produce a stream of molten metal and a device to produce a gas jet) may be employed.

Referring to Fig. 2, the metal discharge nozzle 24 has two discharge openings 25, 26 from which streams 27, 28 of molten metal are discharged, as previously described, or two single-discharge nozzles, such as 21 (Fig. 3) may be used. Two gas nozzles, generally denoted by the numerals 29, 30, in Figs. 4 and 5, which may be constructed like the nozzle described in connection with Figs. 1 and 3, but which may be of any desired construction, are positioned so that the gas jets or streams 31, 32 emergent therefrom impinge upon or cross each other at an angle.

In said streams 31, 32 as they emerge from said nozzles, is located the streams 27, 28 of molten metal to be atomized thereby, as described in connection with the single stream arrangement,

Fig. 3. This produces streams 33, 34 which are a mixture of gas and finely atomized metal particles. The streams 33, 34 impinge upon each other where they cross and the metal particles in both streams are further comminuted by impact. The combined or resultant stream 35 will now consist of metal particles which are the resultant of the comminuting action of streams 31, 32 on the metal streams 25, 27 and the comminuting action of the particles in streams 33, 34 on each other.

To regulate the gas flow and prevent spattering, as previously referred to, it is desirable to interpose an expansion chamber 17 between each gas nozzle and the gas supply line 36.

Regulating valves 37, 38 may also be located in the gas supply pipe to each gas nozzle, whereby the pressure of each gas jet may be individually regulated.

What is claimed is:

In an apparatus for atomizing metals, a melting pot having two or more discharge openings for delivering thin streams of molten metal, and a gas nozzle associated with each of said openings for discharging gas streams across the path of said metal streams, said gas nozzles being positioned at an angle to each other whereby the paths of the streams therefrom commingle beyond the points at which they encounter the metal streams.

WALTER ZEBROSKI.

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