J. M. NEIL.

PROCESS OF AND APPARATUS FOR ATOMIZING METALS, &c.

APPLICATION FILED DEC. 12, 1911.

1,036,689.

Patented Aug. 27, 1912.

3 SHEETS—SHEET 1.

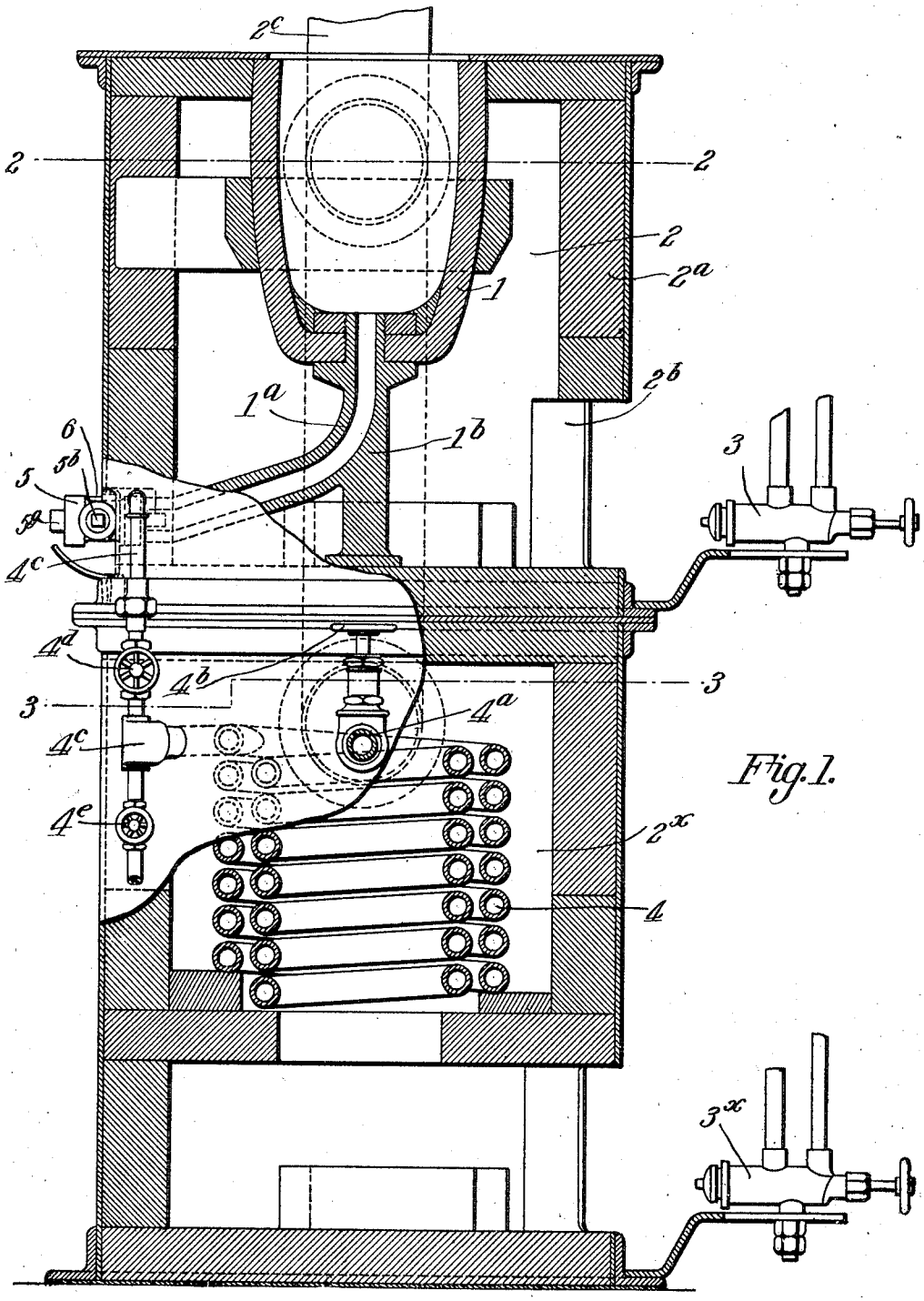


Fig. 1.

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3 SHEETS—SHEET 2.

Fig. 2.

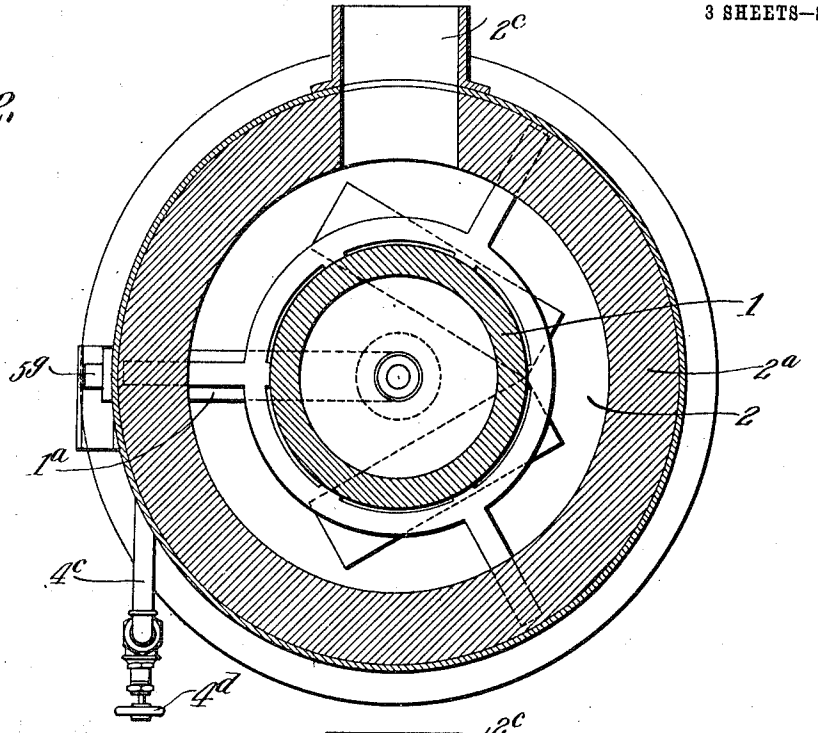
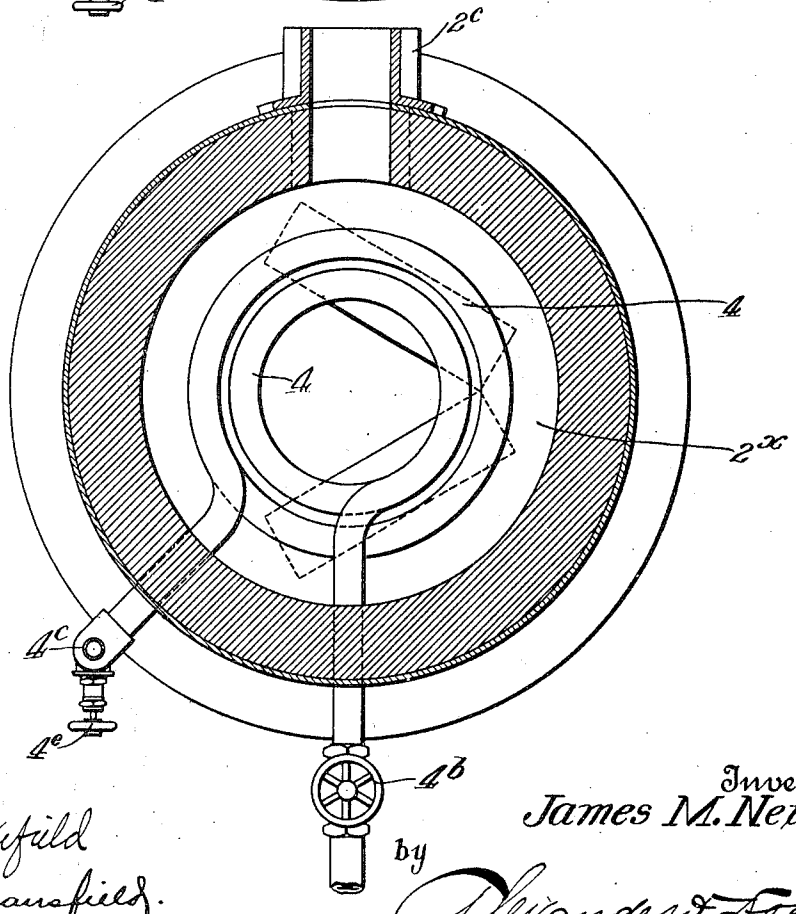



Fig. 3.

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3 SHEETS—SHEET 3.

Fig. 4.

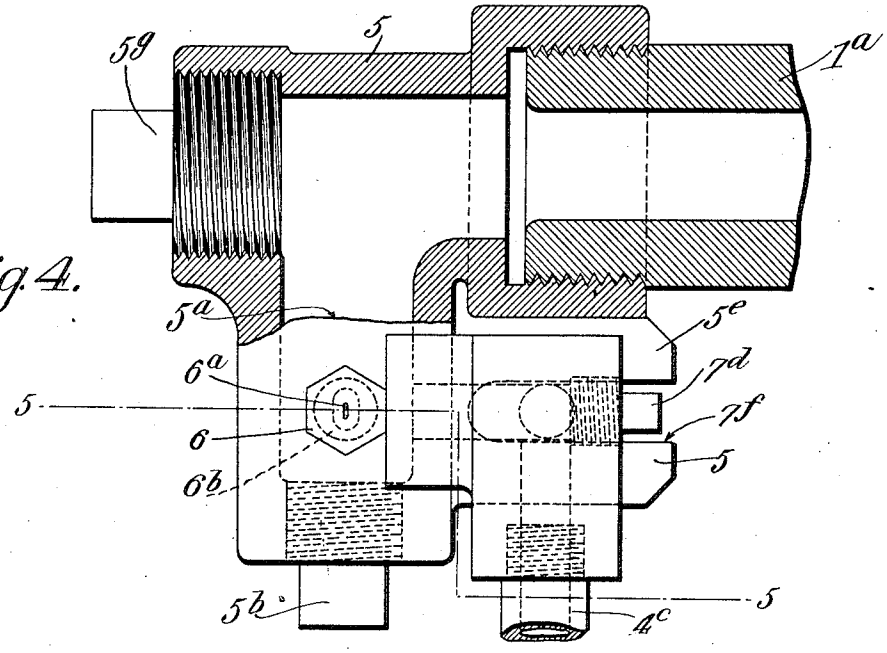
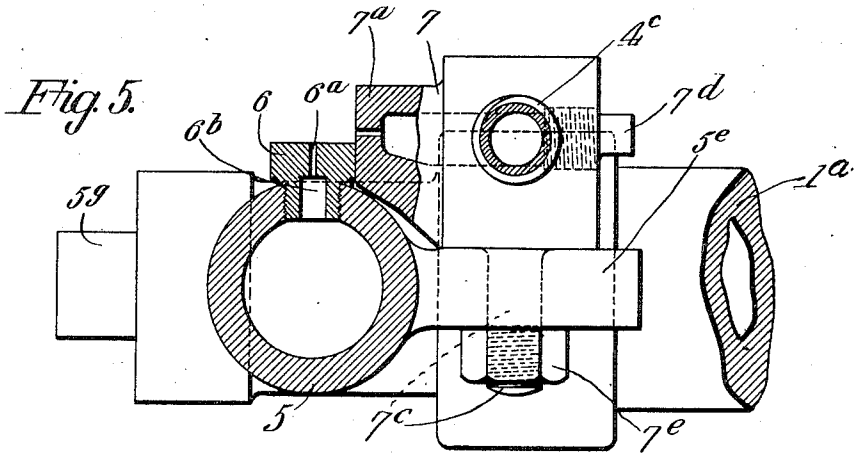



Fig. 5.

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# UNITED STATES PATENT OFFICE.

JAMES MILLAR NEIL, OF TORONTO, ONTARIO, CANADA.

## PROCESS OF AND APPARATUS FOR ATOMIZING METALS, &c.

1,036,689. Specification of Letters Patent. Patented Aug. 27, 1912.

Application filed December 12, 1911. Serial No. 665,229.

*To all whom it may concern:*

Be it known that I, JAMES MILLAR NEIL, of Toronto, in the county of York, Province of Ontario, Dominion of Canada, have invented certain new and useful Improvements in Processes of and Apparatus for Atomizing Metals, &c.; and I hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings, which form part of this specification.

This invention is a novel process of, and apparatus for, atomizing metals, etc., or in other words, reducing them to an extremely fine powdery or floury condition.

One of the principal objects of my invention is to enable metals, such as lead, zinc, etc., to be converted from a molten condition into impalpable powder without oxidation thereof, and without the necessity of performing the atomizing operations with the exclusion of air, or within a chamber containing inert gases.

The invention consists broadly in atomizing metals, etc., which have been reduced to a molten or fused state by means of a blast or jet of air, gas or steam, under pressure, and at a temperature equal to and preferably higher than the melting point of the metal or material being treated; such blast being directed against a minute stream or jet of the molten metal whereby the latter is disintegrated, dissipated, or dispersed in an extremely fine powdery or floury condition by the superheated blast; and the minute particles of the metal or material solidify before the oxygen in the air, steam or atmosphere has any appreciable effect thereupon. In practice for example, I am able to reduce lead or zinc to a floury or atomized condition by my process without any appreciable loss by oxidation; and the lead, or zinc, thus reduced to a very finely divided metallic non-oxidized form, is of great value for use in the arts; being particularly useful in cyaniding processes for the recovery of the precious metals.

I will explain my process more in detail in connection with the at present preferred form of apparatus for carrying out the process; which apparatus is illustrated in the accompanying drawings, in which—

Figure 1 is a partial vertical section through such apparatus showing the atomizer in elevation. Fig. 2 is a transverse horizontal section on line 2—2, Fig. 1. Fig. 3 is a transverse horizontal section on line 3—3, Fig. 1. Fig. 4 is an enlarged horizontal section through the atomizer head on line 3—3, Fig. 1. Fig. 5 is a vertical section on line 5—5, Fig. 4.

As shown in the drawings: the apparatus comprises a crucible 1 which is suspended within a furnace 2 which may be formed of a metal cylinder lined with refractory material $2^a$; and this furnace may be heated in any suitable or desired manner. As shown I have provided a hydrocarbon burner 3 attached to the side of the furnace and adapted to supply oil or gas thereto, the blast of burning oil or gas enters the furnace beneath the retort 1 through an opening $2^b$ in the side of the furnace. The waste products of combustion can escape from the furnace through an outlet $2^c$. The crucible 1 is adapted to contain the metal to be atomized, such as lead, zinc, etc., and it is connected at bottom with an eduction tube $1^a$ which may be formed in a metal casting $1^b$ which supports the crucible 1, and said tube—by reason of its location in the furnace, will be highly heated and maintain the metal descending thereinto from the crucible in a molten condition. This tube conducts the molten metal to the atomizer hereinafter referred to.

Preferably the furnace 2 is supported upon a similarly constructed furnace $2^x$ which may be heated in any suitable way; but preferably by a hydrocarbon burner $3^x$. In this furnace $2^x$ is a superheating coil or coils 4, one end of which is connected to a pipe $4^a$ by which air, steam or gas, at high pressure can be conducted to coil 4 from any suitable source (not shown); the supply being regulated by valve $4^b$. The other terminal of coil 4 is connected to a pipe $4^c$ which conducts the superheated fluid to the atomizer, hereinafter referred to. A drain cock $4^e$ is connected to the pipe $4^c$ and the latter is provided with a regulating valve $4^d$. When this apparatus is properly operating the metal can be reduced to molten condition in the crucible and duct, and the atomizing agent or fluid can be heated in the furnace $2^x$ to a temperature equal to or preferably slightly greater than the melting point of the metal being treated.

I propose to provide the apparatus with pyrometers (not shown) by which the tem-

perature of the molten metal and of the atomizing agent can be readily determined.

The atomizer consists of a hollow metal body or head 5, preferably having a right-angled duct $5^a$, one end of which duct is connected to the eduction tube $1^a$, as shown in Fig. 4; and the other end of the duct $5^a$ is preferably closed by a removable threaded plug $5^b$. In the wall of the head directly opposite the eduction tube $1^a$ is an opening connected with the duct but closed by a removable plug $5^g$. By removing said plugs access can be had to the interior of the head if it should become necessary to clean the same. In the upper side of duct $5^a$, adjacent the plug $5^b$, is an opening closed by a preferably threaded nipple 6, which nipple has a flat head, preferably polygonal, in which is a preferably thin and wide aperture $6^a$ which communicates with a larger bore $6^b$ in the plug, which bore communicates with the duct $5^a$ in the head 5; so that when molten metal enters the head it will rise through the nipple and jet or exude through the aperture $6^a$ onto the head of the nipple. The exuding molten metal is flattened out upon the surface of the nipple head in a thin sheet or film and then immediately thrown off the head and dissipated in atomized condition by means of a jet of superheated steam, air or gas forcibly issuing from a nozzle connected with the superheating coil 4. As shown the nozzle consists of a hollow head 7 having a jet aperture $7^a$ in one end; and back of the jet opening $7^a$ is a screw plug $7^d$, which can be removed to allow access to the interior of the nozzle to cleanse the jet opening. The nozzle is connected with the pipe $4^e$ so that the superheated fluid is supplied directly to the nozzle from the coil 4. The nozzle 7 and head 5 may be connected in different ways: As shown the nozzle 7 rests upon a slotted flange $5^e$ projecting from the head adjacent the nipple 6; and the nozzle has a shank $7^c$ engaging the slot $5^f$ in the flange $5^e$; and said nozzle can be secured where adjusted by means of a nut $7^e$ on the lower end of the shank $7^c$; see Fig. 4. The head and nozzle are so adjusted and positioned that as the molten metal exudes from the head through the aperture $6^a$ it is struck by the atomizing agent issuing from the aperture $7^a$, and is flattened out a thin sheet or film on the head of the nipple and forced to the outer rim or edge of the head and forcibly dispersed in a finely divided condition, being in practice reduced to a fine almost impalpable powder, like flour.

An important feature of the process and of the apparatus is that the atomizing agent issuing from the jet $7^a$ shall have a temperature at least equal to, and preferably higher than, the melting point of the metal being treated; and the apparatus is adapted to supply the atomizing jet at this temperature. As a result of this essential feature of the process, the metal is atomized and solidifies before oxidation can occur.

By my process the metals can be atomized or finely subdivided without the necessity of surrounding the atomizer with de-oxygenated gases; as my process can be performed in the open air. But because of the extremely fine powdery condition to which the metal is instantly reduced by my process suitable means should be provided for catching and collecting the atomized metal.

By this process and apparatus a large quantity of metal can be reduced to powder very rapidly and efficiently without oxidation; and the invention is particularly useful for treating ductile metals, such as lead, which cannot be comminuted by the ordinary grinding or stamping processes and apparatus.

Another important practical feature of my apparatus is that the molten metal issues upwardly through the aperture $6^a$, and remains at the mouth of the aperture until it is subjected to the full force of the atomizing agent; which is preferably directed in a jet substantially at right-angles to the path of the exuding metal; and the jet is so adjusted that as the molten metal exudes onto the head through the aperture $6^a$, it is struck by the jet of atomizing agent issuing from the aperture $7^a$ and is forced or flattened out in the first instance into an extremely fine sheet or film on the head, which film is then broken up and dispersed by the blast in a finely divided condition; the metal being in practice reduced to a fine impalpable powder like flour.

While it is possible to atomize a downwardly directed jet of metal by my process, better results are obtained by directing the metal upwardly, as described, as the stream of exuding metal remains practically uniform, whereas if the metal is delivered in a downwardly directed jet it has a tendency to cohere and separate in drops, instead of flowing in a continuous uniform stream. In my apparatus the metal exudes evenly and remains in and gently approaches the path of the atomizing jet; and the disadvantageous effects of coherence and gravity on a downwardly directed jet of molten metal are obviated.

What I claim is:

1. The herein described process of atomizing metal, etc., consisting in exuding molten metal upwardly through an opening in a flat surface and directing a forcible blast of an atomizing agent against the exuding molten metal so as to first flatten the exuding metal in a film on said surface and then dissipate the metal off said surface, substantially as set forth.

2. The herein described process of atomiz-

ing metals, consisting in causing the molten metal to flow upwardly through a suitable aperture and simultaneously directing an atomizing agent forcibly against the exuding molten metal, substantially as set forth.

3. The herein described process of atomizing metals, consisting in causing the molten metal to exude upwardly through a suitable aperture, and simultaneously directing a forcible blast of an atomizing fluid, superheated to a temperature approximating the melting point of the molten metal, against the exuding molten metal, substantially as set forth.

4. An apparatus for atomizing metals, comprising means for melting the metal to be atomized, an upwardly directed outlet for the molten metal, means for directing the molten metal to said outlet, means for superheating an atomizing agent, and means for directing such agent against the metal as it exudes from said outlet, substantially as described.

5. In apparatus for atomizing metals, etc., means for melting the metal to be atomized; a head having an upwardly directed outlet for the molten metal, means for directing the molten metal to said outlet; and means for directing a jet of superheated atomizing fluid against the exuding metal as it exudes through said outlet, whereby the metal is first flattened out on the head and then forced off the head in a finely divided state, substantially as described.

6. An apparatus for atomizing metals, etc., comprising means for melting the metal to be atomized; a head having an upwardly directed outlet for the molten metal; means for directing the molten metal to said outlet; means for superheating an atomizing fluid; and means for directing a jet of such fluid against the metal as it exudes from said outlet, substantially as described.

7. In apparatus for atomizing metals, etc., a head having a duct, and an upwardly directed outlet for the molten metal; a nozzle beside the metal outlet adapted to direct a jet of an atomizing fluid against the molten metal as it exudes from said outlet; means for melting metal and conducting same to the duct in the head; means for superheating an atomizing fluid to a temperature equal to or above the melting point of the metal being treated, and means for directing such fluid to the said nozzle.

8. In an apparatus for atomizing metals, etc., a melting furnace, a head having a duct, a nipple on said head having an upwardly directed outlet for the molten metal, and a nozzle beside the nipple having an aperture adapted to direct a jet of an atomizing agent against the molten metal as it exudes from the outlet; with means for conducting the molten metal to the duct in the head; and means for superheating such atomizing agent to a temperature equal to or above the melting point of the metal being treated, and directing same to the nozzle.

9. The herein described apparatus for atomizing metals, etc., comprising a furnace, a crucible therein, an eduction tube in the crucible; a head connected with said tube and having an upwardly directed outlet aperture for the molten metal; with means for superheating an atomizing fluid to a temperature equal to or above that of the molten metal, a nozzle attached to the head adjacent the outlet thereof adapted to direct a jet of such superheated fluid against the molten metal as it exudes from the outlet; and connections between the nozzle and the superheater, substantially as described.

10. The herein described apparatus for atomizing metals, etc., comprising a furnace, a crucible therein, an eduction tube leading from the crucible to the atomizer head; a head connected with said tube; and a nipple connected to said head having an upwardly directed outlet for the molten metal; with means for superheating an atomizing fluid to a temperature equal to or above that of the molten metal; a nozzle adjustably attached to the atomizer head adjacent the outlet thereof adapted to direct a jet of such superheated fluid against the molten metal as it exudes from the outlet, and connections between the nozzle and the superheater, substantially as described.

In testimony that I claim the foregoing as my own, I affix my signature in presence of two witnesses.

JAMES MILLAR NEIL.

Witnesses:
JAMES R. MANSFIELD,
WM. M. ALEXANDER.