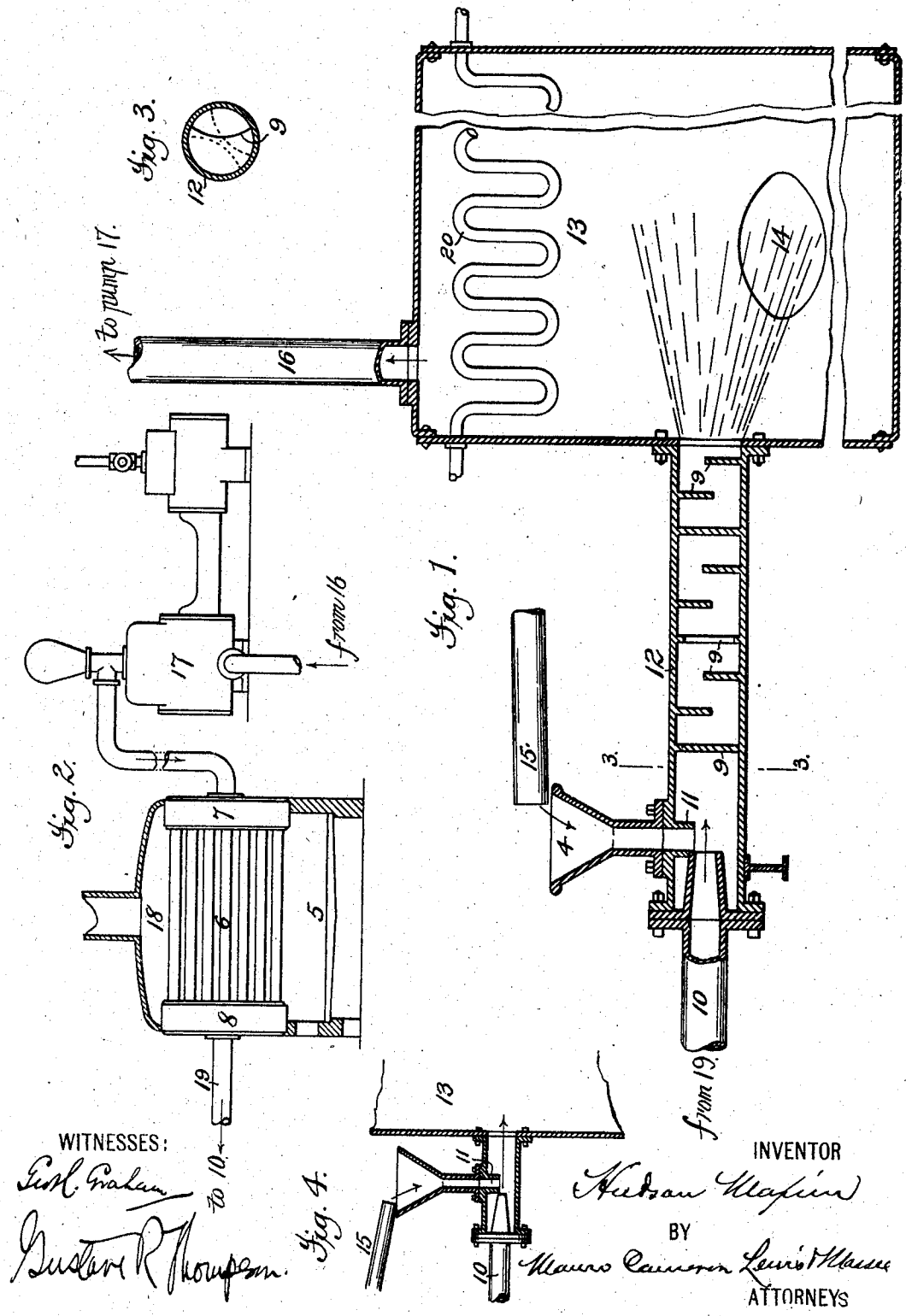
No. 796,338. PATENTED AUG. 1, 1905.

H. MAXIM.

PULVERIZING METALS.

APPLICATION FILED MAR. 9, 1904.

2 SHEETS—SHEET 1.



WITNESSES:

Earl Graham

Gustave R. Thompson.

INVENTOR

Hudson Maxim

BY

Munn Cameron Lewis & Munn

ATTORNEYS

ANDREW B. GRAHAM CO., PHOTO-LITHOGRAPHERS, WASHINGTON, D. C.

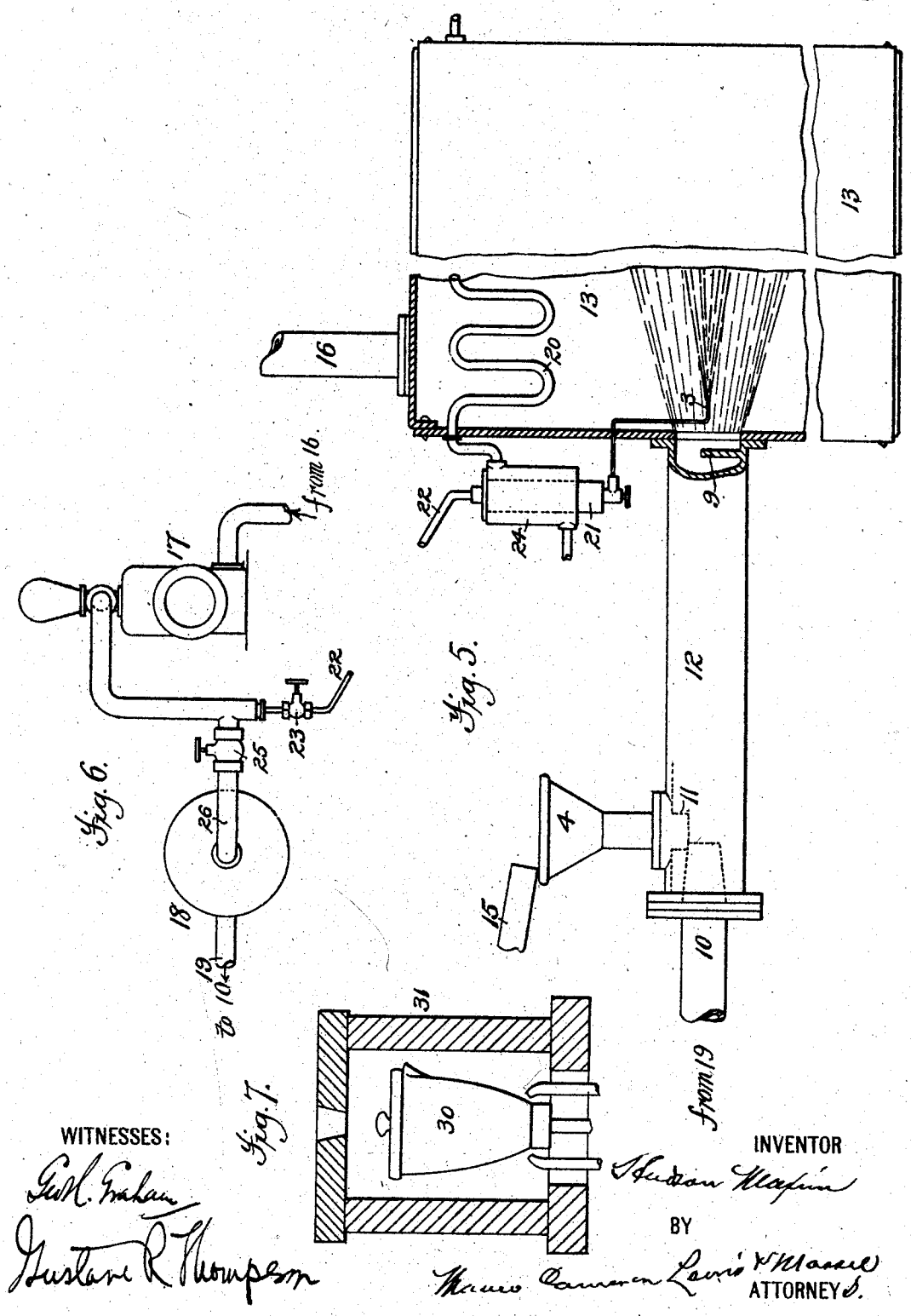
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2 SHEETS—SHEET 2.



WITNESSES:

Geo. L. Graham

Gustave R. Thompson

INVENTOR

Hudson Maxim

BY

Munn Cameron Lewis & Masselle

ATTORNEYS.

ANDREW. B. GRAHAM CO., PHOTO-LITHOGRAPHERS, WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

HUDSON MAXIM, OF NEW YORK, N. Y.

PULVERIZING METALS.

No. 796,338. Specification of Letters Patent. Patented Aug. 1, 1905.

Application filed March 9, 1904. Serial No. 197,258.

To all whom it may concern:

Be it known that I, HUDSON MAXIM, of the borough of Brooklyn, city of New York, State of New York, have invented a new and useful Improvement in Pulverizing Metals, which invention is fully set forth in the following specification.

This invention relates to a new and improved process of reducing metals and other fusible substances to a finely-comminuted or pulverulent condition, and has for its object mainly the reduction of aluminium to an impalpable powder, that it may more efficiently serve as a combustible ingredient in explosive compounds.

In carrying out the invention the aluminium is first melted in any suitable furnace, crucible, or retort, and the molten metal is then poured or admitted in a stream to a blast or current of a suitable gas or vapor under high pressure, by which it is atomized, and thence forced by the gas-current preferably through an additional atomizing device, whereby the fluid aluminium is atomized and blown into a fine mist or spray, which, being allowed to escape from the outlet end of the atomizer into a chamber of suitable dimensions or capacity, falls or settles down to the bottom in the form of a fine dust or impalpable powder, the fine particles solidifying from loss of heat before reaching the bottom of the receiving-chamber. As the melting-point of aluminium is only about 625° centigrade, the apparatus may be made of steel or nickel-steel, or nickel-steel may be employed for the construction of only the atomizing device of the apparatus hereinafter described and for any other parts of the apparatus where it may be found necessary.

The gas or vapor used for atomizing the aluminium is preferably an inert one, such as carbonic-acid gas or nitrogen gas, in order that there may be no oxidation of or compound formed with the aluminium. The gas is preferably heated to a temperature nearly or quite equal to that required for the fusion of aluminium, although this is not absolutely essential; but it is desirable for the production of the highest results. It is obvious that the inert gas may be drawn from the chamber into which the aluminium-dust is ejected and be reheated and used over again for the continued atomizing of aluminium.

A cooling device is preferably provided for cooling the gas or atmosphere of the receiving-chamber. For this purpose any well-known refrigerating means may be employed, such as that employing liquefied ammonia-gas.

The inert gas from the dust or receiving chamber is admitted or conducted to an air-pump, whereby it is compressed to any degree of compression desired before its admission to a reheating device. A portion of the compressed gas may be drawn off between the pump and the reheating device, thence into a refrigerating device, which may consist of a cylinder inclosed in a suitable casing connected with or in circuit with the refrigerating device or apparatus used for cooling the dust-chamber. The high pressure, together with the low temperature, serves to liquefy the carbonic acid, or if a non-liquefiable gas is used serves to render it very dense. This liquefied carbonic-acid or dense gas is thence conducted to a nozzle lying in the path of the aluminium-spray being blown into the dust or receiving chamber, which by its evaporation or expansion instantly absorbs a large quantity of heat, thereby facilitating and quickening the cooling and solidifying of the minute particles forming the aluminium dust or spray.

While I have described the employment of a wholly-inert gas, still I may employ a blast of superheated steam when atomizing a substance which is not oxidized thereby, the employment of which obviates the necessity of employing an air-pump and the necessity of pumping out and reusing the vapor from the dust-chamber.

In order to aid a more ready understanding of the improved process, a detailed description of an apparatus by which it may be practiced will be given, reference being had to the accompanying drawings, in which—

Figure 1 is a sectional elevation of a preferred form of the apparatus. Fig. 2 is an elevation of a gas-pump and reheater, on a much reduced scale, for use in connection with said apparatus. Fig. 3 is a cross-section on the lines 3 3 of Fig. 1. Fig. 4 is a sectional detail of a modified form of the apparatus. Fig. 5 is a sectional elevation of another modification of the apparatus. Fig. 6 is an end elevation, on a reduced scale, of the gas-pump and reheater with an addition for use with the modified apparatus of Fig. 5. Fig. 7 is a

sectional elevation of a melting-furnace for the fusible substance.

The atomizer may be of any desired form, but as shown consists of a tube or pipe 10, conveying the heated gas under high velocity from any suitable source of supply, and another tube or pipe 11 for the molten metal or substance, the mouths of the two tubes being arranged with respect to each other so that the blast of heated gas will cause the molten metal to be atomized into a fine mist or spray. The mouth ends of the two tubes are located within and near the closed end of a conduit 12, that at its other end opens into a dust or receiving chamber 13 of considerable dimensions in depth and width, in which the mist or spray will collect and wherein the molten particles, finally becoming solidified, fall to the bottom as a finely-comminuted dust or powder to be collected, when desired, through a manhole or door 14 in the side of the chamber. The tube 11 will be provided with a hopper 4 and the molten metal be directed thereto by a pipe or trough 15, supplied from a crucible 30, contained by a suitable melting-furnace 31. (Shown in Fig. 7.) The conduit 12 for the atomized molten mist may be provided with a plurality of partial crosswise extending baffle-plates 9, so disposed with relation to each other as to form a circuitous passage for the mist through the conduit and presenting a plurality of variously-disposed vertical surfaces or edges, as in Fig. 3, to the atomized blast to serve to more thoroughly and completely break up the molten particles into a still finer mist or spray. In other words, each baffle-plate edge serves as additional means for atomizing the onward-rushing molten metal or other substance. The gas having served as the atomizing-vehicle may pass off from the collecting-chamber 13 by a pipe 16 to waste or for use. The gas or vapor, however, is preferably conveyed onward for reuse. Thus the gas-outlet pipe 16 may connect with the suction side of a suitable pump 17, (see Figs. 2 and 6,) which draws the gas from the chamber 13 and forces it through a reheater or evaporator 18, and thence outward by a pipe 19, having connection with the pipe 10 of the atomizer.

The heater 18 may be of any ordinary construction adapted to the purpose. As herein shown it consists of two hollow headers 7 8, connected by many small tubes 6, the whole being mounted over a furnace 5. The gas forced by the pump is received by the header 7, and thence passes through the small tubes, where it becomes highly heated, and into the other header 8, to pass onward to the atomizer as a highly or superheated gas or vapor under great pressure or velocity.

The collecting-chamber 13 is preferably cooled in some suitable manner, as by a cooling-coil 20, making a circuit through the upper portion of the chamber, as shown in Figs. 1 and 5. The cooling medium passing through the coil may be liquefied ammonia and is preferred; but any other refrigerant or cooling medium may be used.

In the modification Fig. 5 the blast of atomized metal or substance may be more or less directly cooled by contact with a jet of expanding liquid carbonic-acid or a dense gas supplied from a tank 21 and issuing from a jet or nozzle 3 directly into the midst of the blast issuing from the atomizing device or from the conduit 12 into the chamber. The very rapid expansion of the liquefied carbonic-acid gas as it issues from the nozzle causes it to thoroughly commingle with said blast, and thus quickly absorb its heat, so that the molten particles quickly solidify to fall as fine dust to the bottom of the chamber.

The refrigerant carried by the cooling-coil 20, if the same be used, may also serve the further purpose of liquefying the carbonic-acid gas or for cooling a dense gas for use, also in cooling the atomized metal or substance. Thus the pump 17 may force a portion of the carbonic-acid gas by a pipe 22, controlled by a valve 23, to the tank 21, which is provided with a surrounding jacket 24, having communication with the cooling-coil 20, through which jacket the refrigerant circulates to cool the incoming carbonic-acid gas and liquefy it and keep the tank supplied with the medium for supplying the jet or nozzle 3. The quantity of gas returned to the tank 21 will be controlled by the valve 23, and the gas passing to the reheater 18 may also be controlled by a valve 25 in the pipe 26.

In the modification of the apparatus shown in Fig. 4 the molten metal or substance is atomized and sprayed directly into the dust or receiving chamber 13, the metal being subjected to a single atomizing action.

The degree of fineness of the dust or powder produced by the atomizing action may be regulated by the pressure of the blast or velocity of the atomizing or spraying vehicle. The greater the velocity the more finely comminuted the atomized dust will be.

While the metal aluminium has been more especially mentioned, it is to be understood that the improved process is applicable to the pulverization of other fusible substances, and the atomizing vapor may be of any other than those herein mentioned.

The form of apparatus herein shown for carrying out the process may be varied within wide limits.

What is claimed is—

1. The herein-described process of reducing a metal to a pulverulent condition, which consists in fusing the metal, atomizing the fused metal by the action of a highly-heated gas, cooling the atomized metal by the expansion of a refrigerant and collecting the metallic particles.

2. The herein-described process of reducing a metal to a pulverulent condition, which consists in fusing the metal, atomizing the fused metal by the action of a highly-heated inert gas, cooling the atomized metal by the expansion of a like gas and collecting the metallic particles.

3. The process of reducing a metal to a pulverulent condition, which consists in fusing the metal, converting the metal while fused into a mist or spray with an inert gas, cooling the sprayed particles by the expansion of the same inert gas and collecting the finely-comminuted metal.

4. The process of reducing a metal to a pulverulent condition, which consists in fusing the metal, atomizing the fused metal with a heated and inert gas, allowing the metallic particles to separate from the gas and reheating the gas for continued use.

5. The process of reducing a metal to a pulverulent condition, which consists in fusing the metal, atomizing the fused metal with a heated and inert gas, cooling the atomized particles by a like inert gas, allowing the metallic particles to separate from the gas, reheating a portion of the gas and compressing the remaining portion for continued use.

6. The process of reducing a metal to a pulverulent condition, which consists in fusing the metal, atomizing the fused metal by a heated gas, cooling the atomized metal by a fluid out of physical contact therewith, separating said metallic particles from said gas, compressing the said gas, cooling a portion of the same by aid of said cooling fluid, and introducing said cooled portion into the body of atomized metallic particles, and heating the other portion of said compressed gas to atomize fresh portions of fluid metal.

7. A process of comminuting or pulverizing metals, which consists in subjecting a stream of molten metal to a highly-heated blast of gas inert toward said metal, comminuting the resulting fluid particles of metal in their passage through a confined space in presence of said gas, and introducing an inert cooling fluid into the resulting body of suspended metal particles.

In testimony whereof I have signed this specification in the presence of two subscribing witnesses.

HUDSON MAXIM.

Witnesses:
REEVE LEWIS,
S. T. CAMERON.