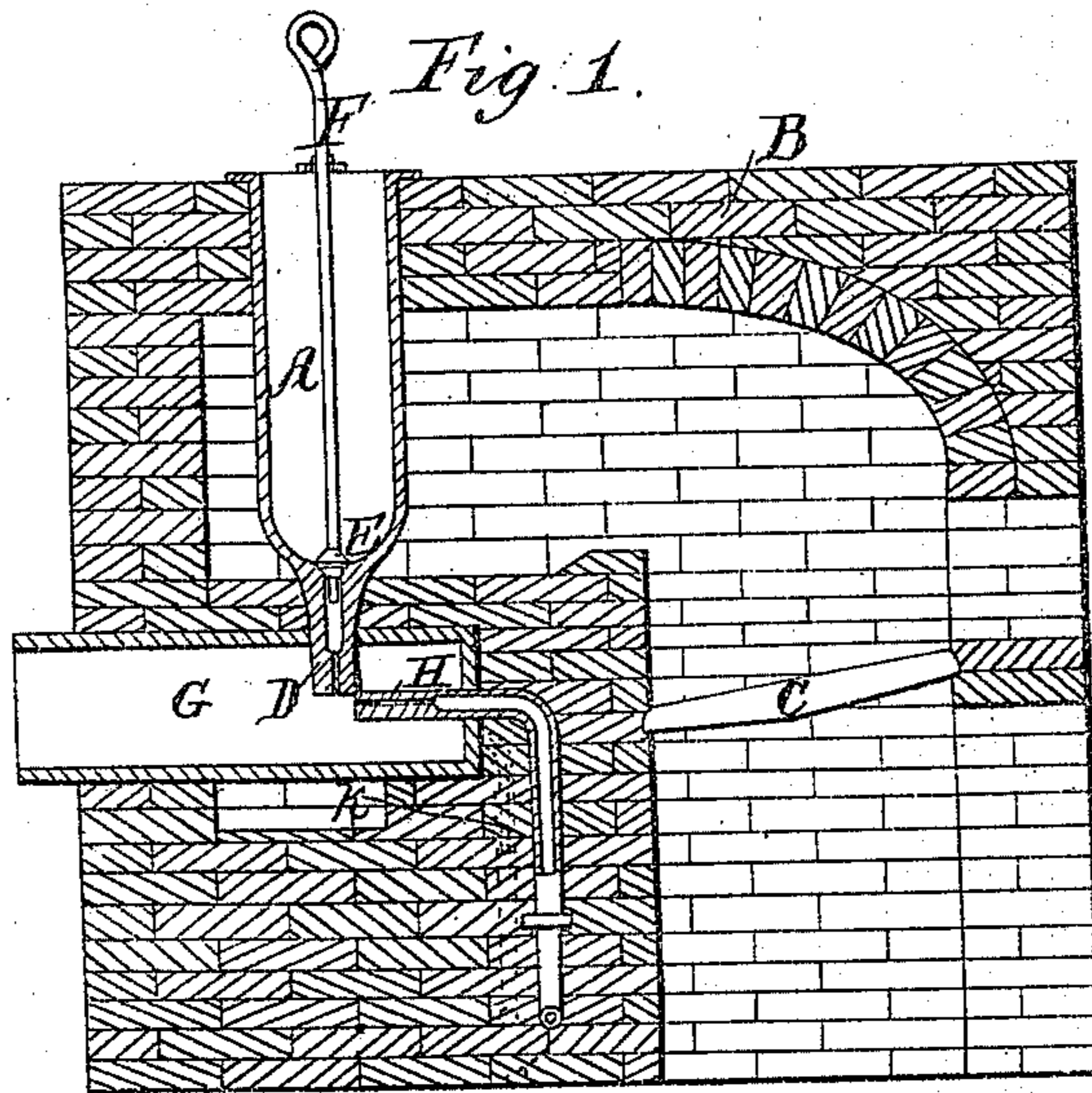


*Willard & Adams.*

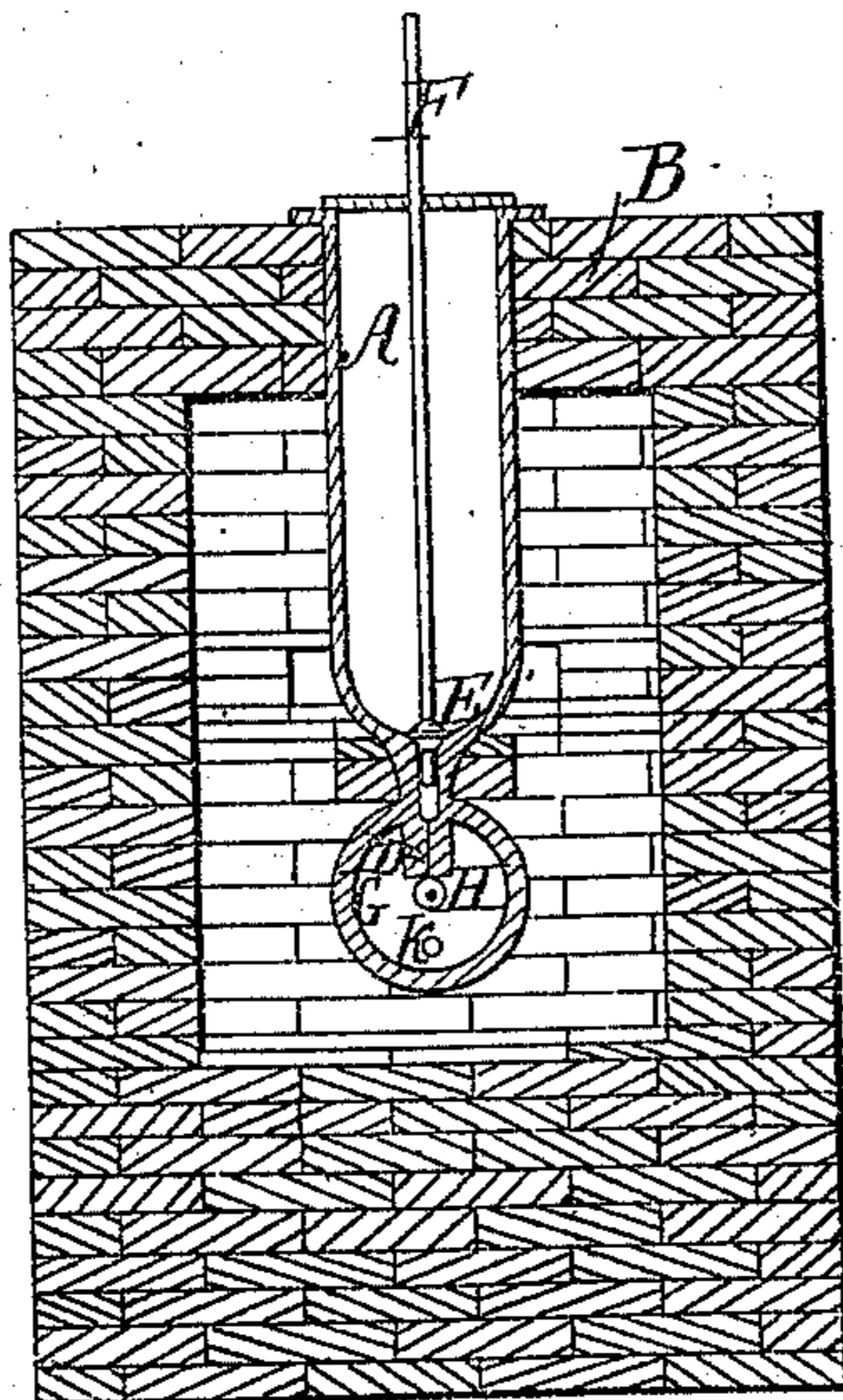
*Making Paint Pigments.*

*N<sup>o</sup> 78,168.*

*Patented May 19, 1868.*



*Fig: 2.*



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# United States Patent Office.

ZABDIEL A. WILLARD, OF BOSTON, AND WILLIAM G. ADAMS, OF FRANKLIN,  
MASSACHUSETTS.

*Letters Patent No. 78,168, dated May 19, 1868.*

## IMPROVEMENT IN TREATING METALS AND MINERALS.

*The Schedule referred to in these Letters Patent and making part of the same.*

### TO ALL WHOM IT MAY CONCERN:

Be it known that we, ZABDIEL A. WILLARD, of Boston, in the county of Suffolk, and WILLIAM G. ADAMS, of Franklin, in the county of Norfolk, both in the State of Massachusetts, have invented a new and useful Method or Process of Treating Metals, Minerals, or other substances that may be treated in like manner; and we do hereby declare that the following is a full, clear, and exact description of the same, taken in connection with the accompanying drawings making a part of this specification, in which—

Figure 1 represents a longitudinal sectional elevation of the apparatus for carrying on our process, and

Figure 2 a transverse section of the same.

Our invention may be said, in general terms, to consist in a new method or process of treating metals and minerals, or other substances, for the purpose of producing therein various chemical combinations and reactions, and mechanical changes in their condition; such, for instance, as the separation of metals from their ores, the separation of metals from their alloys, the separation or subdivision of metallic substances into fine powder, and the conversion of metals into their oxides or salts, with other operations of the same general character, and to effect this by a continuous operation.

This mode of operation may be described as consisting, in the first place, in melting the metal or mineral to be acted upon in a suitable crucible, or by other suitable means, such as are usually employed for that purpose, and raising its temperature to the degree necessary for subsequent operations. From the bottom of this crucible, or other reservoir for containing the melted mass, and maintaining it at the proper temperature, the metal is caused to flow in one or more fine jets or streams.

Immediately after the stream of melted metal leaves the orifice of the crucible, it encounters a jet or blast of atmospheric air or other gas, which is projected across the jet of metal with considerable force. The effect of this blast is to subdivide and dissipate the metal into exceeding fine particles, diffused through the atmosphere of the blast, which, if the metal is below the temperature of oxidation, will be deposited in the form of a fine metallic powder, but if the temperature of the metal is sufficiently high to produce or allow a chemical combination with the blast, or with any of the gases of which it is composed, the metal, being in a state of minute subdivision, is instantaneously acted upon chemically by the blast, and converted into an oxide, or salt, or other product, according to the nature of the blast employed. If the blast is composed of atmospheric air, oxides would generally be produced, but if it is composed of some other gas, some other chemical reaction or combination would follow, corresponding to the chemical character of the blast, or some chemical reaction or combination would be thereby prevented which might otherwise take place.

This operation of the blast upon the jet of metal is intended to take place, generally, within a chamber or enclosed space, which can be maintained at a temperature adapted to the nature of the operation to be performed, and which also can be charged with such a gaseous atmosphere, independently of the dispersing-blast, if need be, as will either facilitate the chemical reactions that are desired to be produced, or prevent those which might otherwise take place, and would be prejudicial. Suitable means are to be employed, in connection with the chamber, to permit the escape therefrom of the spent gases, and to retain the valuable products of the operation, such as are now in use.

If several successive chemical reactions are required to be produced, other jets of the appropriate chemical character may be employed, so arranged as to operate in succession upon the material, in substantially the same way as the first one operates.

The apparatus shown in the drawings is one of the simplest forms in which we have embodied our invention, and serves to show clearly its nature and principles, and the relation which the several parts of the apparatus should sustain to each other. This apparatus is adapted to the production of either litharge or carbonate of lead directly from metallic lead, and at the same time to eliminate therefrom any silver or gold that may be present, and also to perform several other simple metallurgic operations.

A represents a pot or crucible of iron, for containing the melted metal to be operated upon. It is set in a furnace of masonry, B, and is heated by a fire upon the grate C, which also heats the entire working part of the apparatus.

At the bottom of the crucible is a pipe, D, which has a small orifice, say one-fiftieth to one-hundredth of an inch in diameter, which is closed by the valve E, operated by a rod, F, as is shown. This pipe projects downward some distance into the converting-chamber G, and close to the outlet of the same is the horizontal blast-pipe H, which has an orifice a little larger than that of the pipe D, and throws a jet of compressed air or other gas across the jet of metal that flows from the crucible. This blast may be heated, if the operation requires it, before being injected, and its admission is to be controlled by suitable valves or cocks. It is supplied by a condensing-pump, operating in the usual manner, which is itself supplied with atmospheric air, or gas, or a mixture of them, as the case may require.

The chamber G may be made of any form required, and provided with suitable means at the outlet, to permit the escape of the spent gases and retain the valuable products of the operation; but as these form no part of the invention herein set forth, they are not shown.

The operation of the apparatus is as follows, taking, for example, its application to the oxidation of lead in making litharge, or the carbonate of lead, or the separation of lead from its alloys, either and all of which the apparatus shown is capable of effecting:

The crucible A is filled with the metal to be operated upon, and heated by the furnace to a red heat, and a blast of atmospheric air, of, say, fifteen to twenty pounds' pressure to the square inch, more or less, is supplied to the pipe H. The valve E then being opened, allows a small stream of hot metal to flow from the pipe D, which, meeting the blast from the pipe H, is dispersed into a fine metallic mist, and in that subdivided condition instantly combines chemically with the oxygen of the blast, and is completely converted into oxide, with a considerable disengagement of light and heat, and leaves any silver or gold that may be present in the lead in minute metallic particles mixed with the oxide, which may be separated therefrom by well-known means.

If it be desired to convert the oxide into carbonate of lead, the blast from the pipe H would be supplied with carbonic-acid gas to a sufficient degree to carbonize the lead as fast as it is converted into oxide, or the carbonic-acid gas might be introduced into the chamber G by a separate pipe, K, shown in red lines, by which, also, any other gas may be supplied to the chamber in regulated quantity instead, so as to act upon the oxide at the instant of its formation.

If it were desired simply to reduce the metal to a fine powder without oxidizing it, then the blast from the pipe H should be supplied with such gas that it would not or could not furnish oxygen to the melted metal, while its mechanical or dispersing power would be retained.

These examples will serve to explain the general mode of operation, and the nature of the modifications that would be made to adapt the apparatus to any special use.

In the drawings, but one delivery-jet to the crucible, in combination with one blast-jet, is shown in the converting-chamber, as this is the simplest form in which the apparatus can be presented, but in practice it is intended to employ a series of delivery-jets, and a corresponding series of blast-jets in the same chamber, but co-operating in precisely the same way.

It is obvious that the apparatus may be modified in a great variety of ways, and that a part of the entire process may be usefully employed in certain operations without employing the whole of it, as, for instance, in dispersing or subdividing metals without acting upon them chemically, in which case the converting-chamber might not be required; also, the blast of air or gas may be usefully employed in a converting-chamber in operating upon a continuous regulated stream of heated minerals, which had been previously reduced to a fine powder by other means, with such a gas supplied to the blast-jet as would act chemically upon the minerals in that condition, and other modifications of our invention, of the same general nature, may obviously be made.

We are aware that it has been heretofore essayed to break up streams of melted iron by a blast, and reduce the metal to a granular or globular form, for the purpose of decarbonizing it somewhat in the process of converting it into wrought iron or steel, but in those instances the apparatus employed was not such as would reduce the metal to particles so small that they could be instantaneously and entirely reduced or converted into other products by the chemical action of the blast, for the reason that unless the particles of metal are made exceedingly minute, so that their area of surface presented to the action of the gases present shall be very great in proportion to their diameter, and the chemical action be thus rendered general and instantaneous, the conversion or reduction of the metal will not be effected, and the process practically carried out.

What we claim as our invention, and desire to secure by Letters Patent, is—

1. The process of dispersing or subdividing melted metals or minerals into fine particles, by means of a blast of highly-compressed air or other gases, which impinges upon one or more fine streams thereof, the gases present, and the temperature of the metal, being respectively such that chemical action shall be thereby prevented, substantially as described.
2. The process of converting metals or minerals into other products, by means of a jet or blast of air or gas, acting upon one or more fine streams of said metals or minerals in a melted state, as described, which jet or blast subdivides and disperses the material, and also acts chemically upon the same, substantially as described.
3. The process of converting metals or minerals into other products, by means of a blast of air or other gas applied thereto, when said metals or minerals are continuously supplied in regulated quantities to said blast in a subdivided and highly-heated condition, substantially as described.
4. The treatment of metals or minerals, by either of the methods before claimed, in a chamber filled with an atmosphere chemically so composed that by means of the same, in combination with the gas introduced by the dispersing-blast, the desired chemical reaction may be produced or prevented, substantially as described.

5. An apparatus, (for performing some of the operations described,) consisting, substantially, of the combination of a crucible or reservoir with one or more delivering-jets, a furnace for heating the same, and one or more blast-pipes corresponding to said jets, co-operating substantially as described.

6. An apparatus, consisting of the combination last claimed, in combination with the converting-chamber, substantially as described.

7. Combining with the converting-chamber, as described, a means for supplying gas thereto separate from the dispersing blast, substantially as described.

Executed, December 7, 1867.

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