

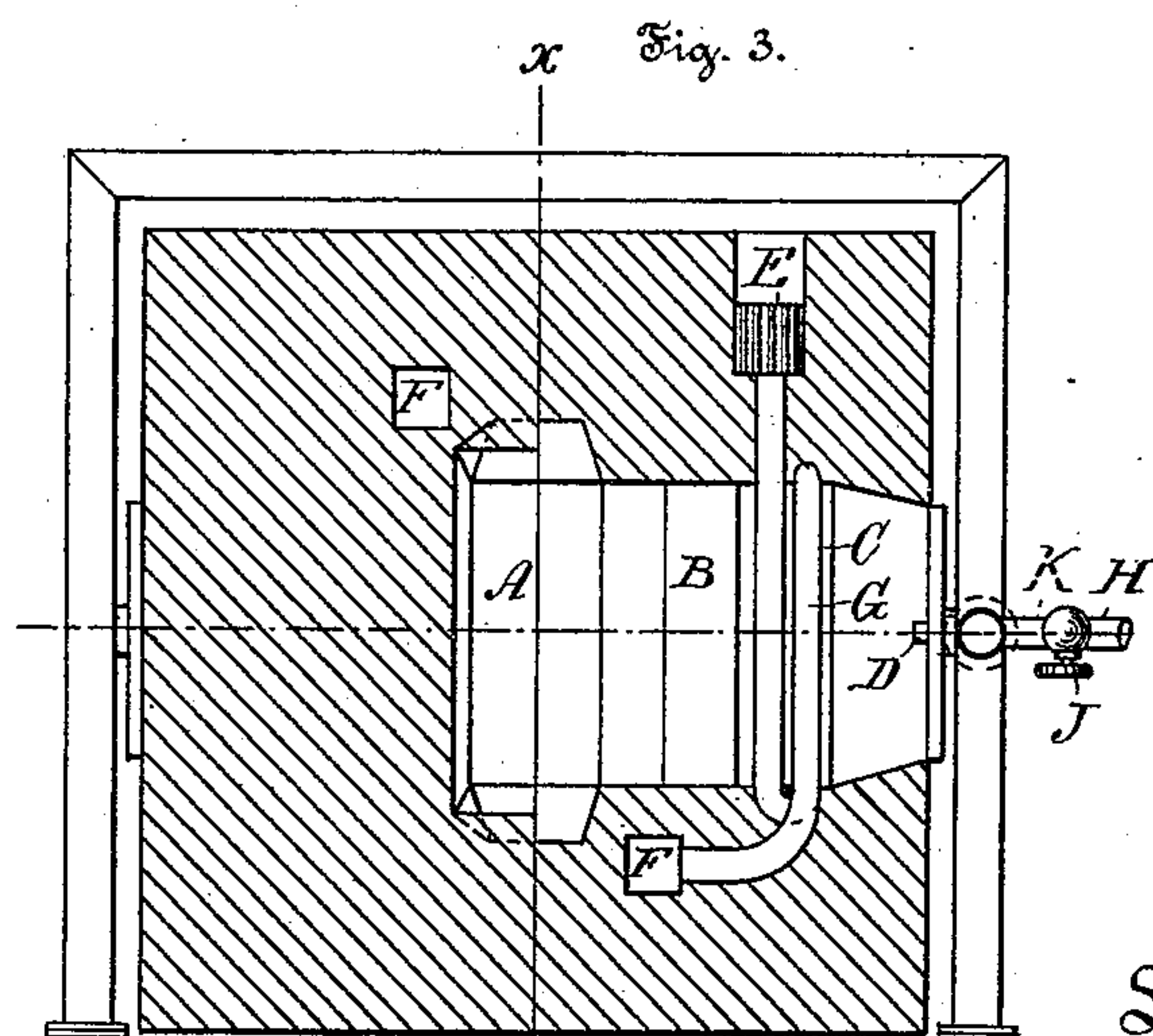
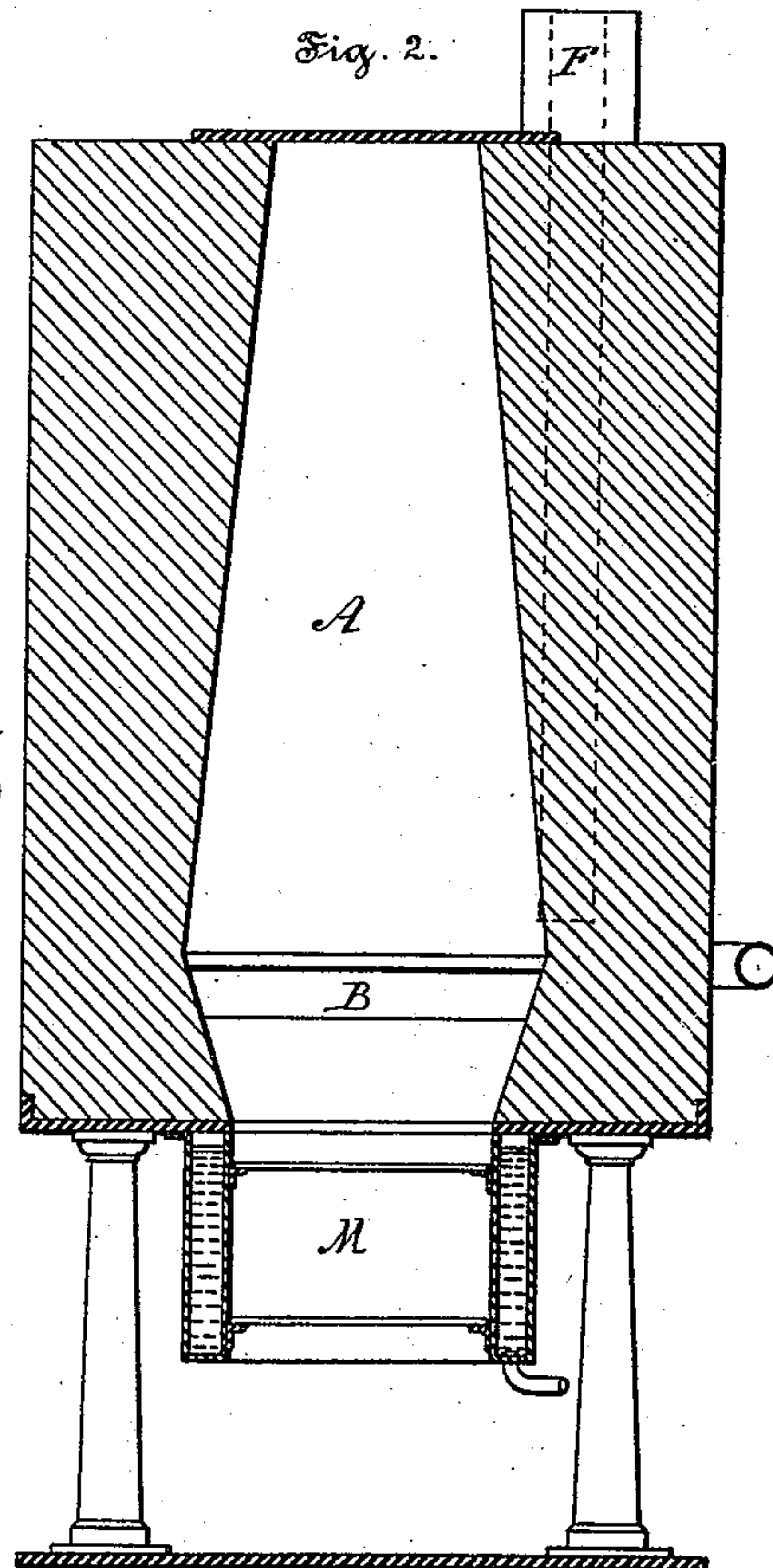
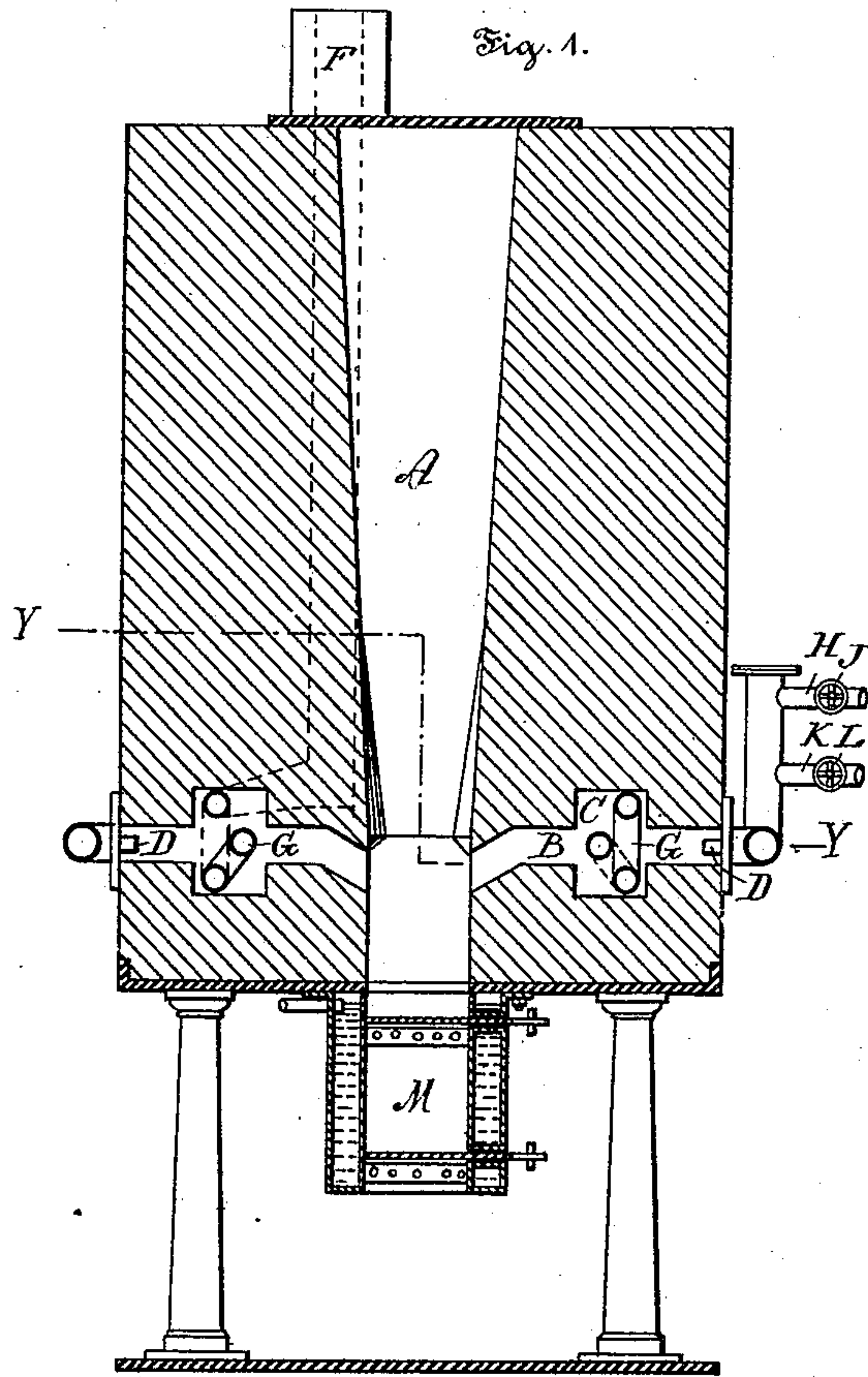
(No Model.)

L. G. LAUREAU.

PROCESS OF REDUCING METALLIC OXIDES TO THE METALLIC STATE.

No. 420,945.

Patented Feb. 11, 1890.



Witnesses:  
Hermann Borman &  
Thomas M. Smith.

Louis G. Sawman

Inventor:

by James W. See

att'y.



# UNITED STATES PATENT OFFICE.

LOUIS G. LAUREAU, OF PHILADELPHIA, PENNSYLVANIA.

PROCESS OF REDUCING METALLIC OXIDES TO THE METALLIC STATE.

SPECIFICATION forming part of Letters Patent No. 420,945, dated February 11, 1890.

Application filed March 8, 1889. Serial No. 302,442. (No model.)

*To all whom it may concern:*

Be it known that I, LOUIS G. LAUREAU, of Philadelphia, and State of Pennsylvania, have invented certain new and useful Improvements in Processes of Reducing Metallic Oxides to the Metallic State, of which the following is a specification.

In the execution of my improved process I employ natural gas or equivalent hydrocarbons.

Heretofore, so far as I know, in attempts at reduction of ores by means of natural gas the result has been defeated by the deposits of solid carbon from the gas.

While the employment of natural gas is my main contemplation, it is also in contemplation to employ the waste hydrocarbons resulting from the distillation of petroleum.

In the execution of my process I combine with the hydrocarbon an amount of oxygen sufficient to transform the carbon of the gas into carbonic oxide. I heat the hydrocarbon to the temperature of dissociation of carbon, the carbon then uniting with the oxygen, the result being carbonic oxide and hydrogen, both reducing agents. I heat these resulting gases to the proper temperature for reduction and inject them thus heated to the metallic oxides to be treated. I thereby reduce the oxides to the state of metallic sponge, which may be bloomed or melted and run into ingots.

In the accompanying drawings I show an apparatus merely exemplifying in its character adapted for the execution of my improved process.

In the drawings, Figure 1 is a central vertical section; Fig. 2, a vertical section on line X X, and Fig. 3 a horizontal section on line Y Y.

In the drawings, A represents the main reduction-stack; B, ducts leading thereinto; C, enlarged intermediate portions of these ducts, forming chambers to receive heating-pipes; D, tuyeres serving to convey the gases to these ports; E, hearths; F, chimneys; G, heating-pipes leading from the hearths to the respective chimneys, these pipes being coiled in the chambers of the ducts; H, a pipe to be connected with a source of supply of the hy-

drocarbon under pressure and leading to the tuyeres; J, a regulating-cock in the hydrocarbon-pipe; K, a pipe to be connected with a source of air-supply under pressure, and connecting, in common with the hydrocarbon-pipe, with the tuyeres; L, a regulating-cock in the air-supply pipe; M, the base of the reduction-stack arranged in a common manner for the withdrawal of the reduced ore.

Having determined from the composition of the hydrocarbon the amount of oxygen required to transform its carbon to carbonic oxide, I adjust the supply of air and hydrocarbon to the tuyeres accordingly. I then fill the stack with ore broken into small pieces and close the top gas-tight. I then build fires in the hearths and get the coils of pipe in the chambers to a cherry-red heat. I then admit the mixed gas and air through the tuyeres. The mixture passes over the heating-coils and the oxygen of the air acts at once, combining with the carbon of the hydrocarbon, forming carbonic oxide, the hydrogen remaining free. As the decomposition of the hydrocarbon does not absorb so much heat as the combination of carbon and oxygen into carbonic oxide generates, there is a necessary surplus of heat, which is communicated to the heating-coils. Therefore, after the operation is once started, but little heat need be communicated by means of the hearths. The hearths may be fired, or they may be fed with the resulting gases of reduction, and any system for supplying heat to the mixed gases may be substituted for the one shown in the exemplification. The carbonic oxide having been formed and having attained the temperature at which reduction is active, it, together with the hydrogen, passes to the stack and communicates its sensible heat to the ore. The body of ore does not at once reach the temperature of reduction, which is between 550° and 1,000° centigrade; but an equilibrium is gradually reached, after which the operation goes on uninterruptedly. The extraction of the reduced ore takes place at regular intervals at the base of the stack. The nitrogen of the air, injected with the carbonic oxide and hydrogen, being neutral, acts as a diluent and keeps the reducing tem-



perature within bounds, thus preventing the fusing of the ores and consequent stoppage of reduction.

5 The ores of most metals found in nature as oxides—such as copper, iron, manganese, &c.—can be reduced by my process by varying the temperature of the gases between 550° and 1,000° centigrade, according to the different metals and physical structures of  
10 the ores. Iron ore, for instance, if in the shape of a light hematite, is well reduced at a temperature of 600° centigrade, while the hard magnetites require up to 750° centigrade. Manganese ores require up to 900° centigrade.

15 I claim as my invention—

The improvement in processes for reducing

metallic oxides to the metallic state, which consists in mixing hydrocarbon gas with atmospheric air in such proportion that the oxygen of the air will transform the carbon 20 of the hydrocarbon into carbonic oxide, subjecting the mixture to the temperature of combination of oxygen and carbon and such higher temperature as the ore reduction calls for, and injecting the carbonic oxide, hydro- 25 gen, and nitrogen thus formed into the mass of ore to be treated.

LOUIS G. LAUREAU.

Witnesses:

J. W. SEE,

CHARLES F. ZIEGLER.