No. 749,258. PATENTED JAN. 12, 1904.

A. COCHRAN, DEC'D.

H. S. COCHRAN, ADMINISTRATOR.

IRON FOUNDING.

APPLICATION FILED MAR. 25, 1901.

NO MODEL.

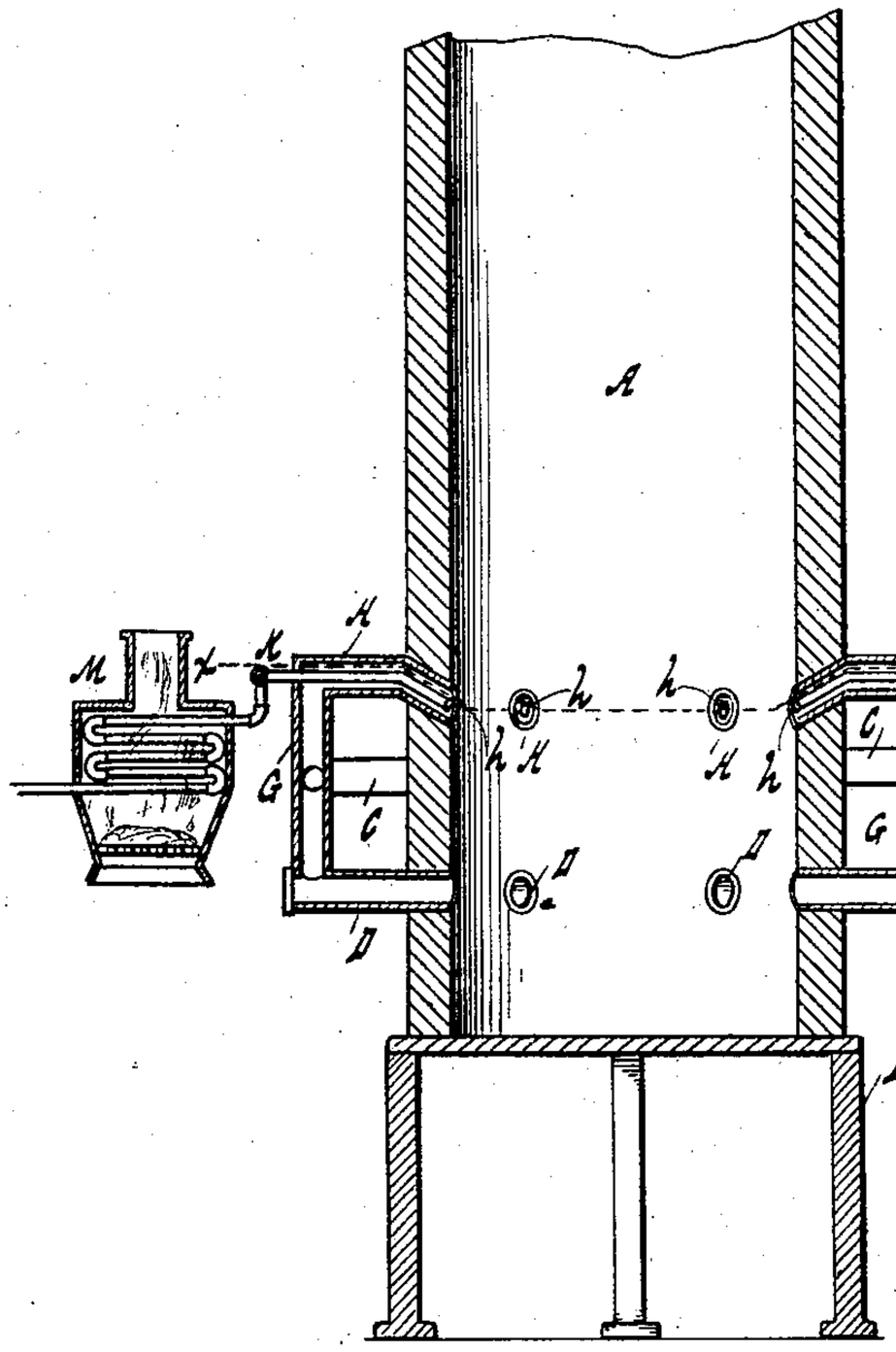

Fig 1.

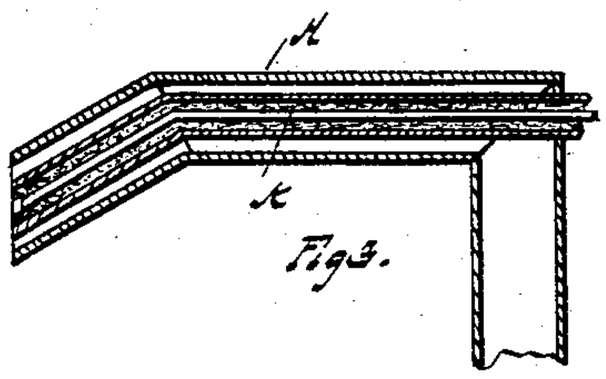

Fig 3.

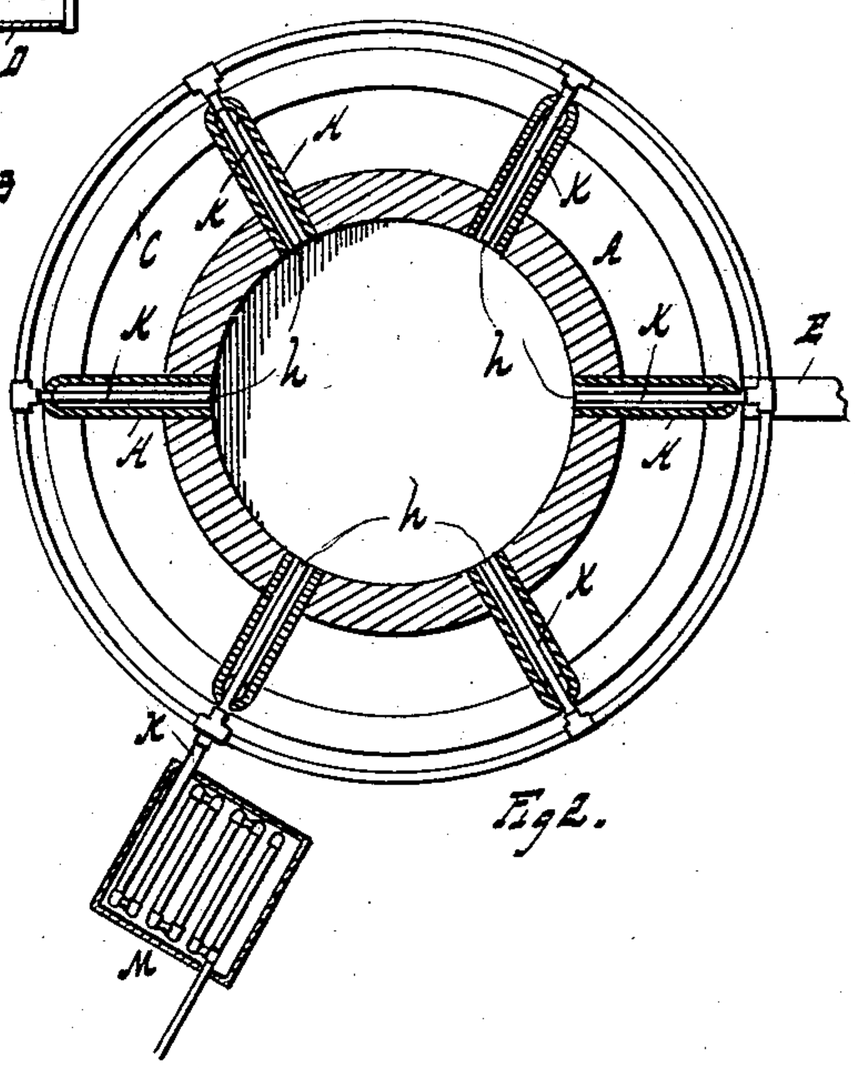

Fig 2.

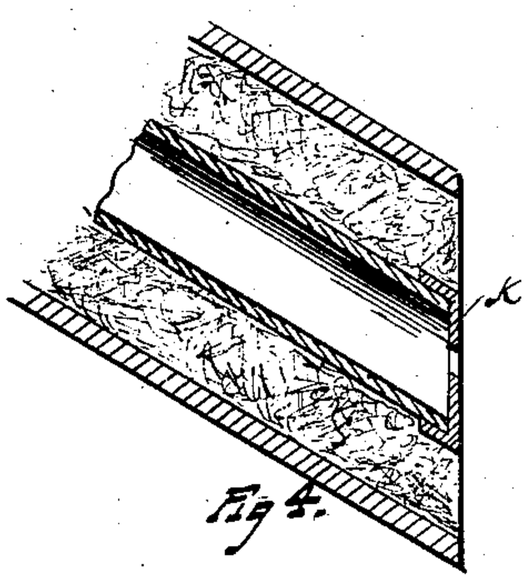

Fig 4.

WITNESSES

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INVENTOR

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By Parker & Burton - Attorneys. Deceased,

No. 749,258. Patented January 12, 1904.

UNITED STATES PATENT OFFICE.

HAGGERT S. COCHRAN, OF KANSAS CITY, MISSOURI, ADMINISTRATOR OF ADAM COCHRAN, DECEASED.

IRON-FOUNDING.

SPECIFICATION forming part of Letters Patent No. 749,258, dated January 12, 1904.

Application filed March 25, 1901. Serial No. 52,733. (No specimens.)

To all whom it may concern:

Be it known that ADAM COCHRAN, deceased, late a citizen of the United States, and a resident of Omaha, in the county of Douglas, State of Nebraska, did invent a certain new and useful Improvement in the Art of Iron-Founding, and that HAGGERT S. COCHRAN, a citizen of the United States, residing at Kansas City, Missouri, having been duly appointed administrator of the estate of said ADAM COCHRAN, deceased, hereby declares the following to be a full, clear, and exact description of the said invention, such as will enable others skilled in the art to which it pertains to make and use same, reference being had to the accompanying drawings, which form a part of this specification.

This invention relates to the art of iron-founding; and it consists in the particular steps or acts hereinafter described and claimed.

Heretofore and for a long period of time attempts have been made to introduce steam either partially saturated with water or superheated into cupolas during the process of melting and casting of iron and into blast-furnaces during the process of manufacturing iron; but all of such attempts have heretofore met with only indifferent success, although experiments at times have seemed to demonstrate an advantage in the introduction of steam. The conditions of its successful introduction have not been heretofore fully understood, and therefore the many failures, interspersed with only a few successes, have prevented the general adoption of steam used in connection with blasting in such furnaces, the successes having been only sufficient to encourage further experimentation.

The process and apparatus hereinafter described have overcome the difficulties heretofore existing and afford sufficient knowledge so that others skilled in the art may practice the invention and secure important results without any more change in the specified adjustments than is required by the varying dimensions and capacities of cupolas and to some extent only due to the varying quality of the coke, pig, and scrap iron used therein, it being understood that it is impossible to give specific directions except with specific sizes of cupolas and specific invariable conditions in other respects. Any person familiar with the art may intelligently vary the apparatus and practice of the process sufficiently to meet all varying conditions, and thus attain substantially a uniform and better result from any process that has hitherto been obtained, and therefore the manner of the introduction of the air-blast, as well as of the steam, the location in the cupola at which either or both is introduced in relation to the heat center of the cupola, and a number of other circumstances when varied all produce variations of the chemical reactions, and consequently vary the result. These chemical reactions are also modified more or less by the amount of moisture in the air conveyed therein, as well as the moisture in the basic sand, which is evaporated during the process of heating. It also may vary to some extent, due to the amount of moisture contained in both fuel and in the iron submitted to its action.

As examples of the sporadical partially successful attempts to increase the quality of the iron produced in blast-furnaces by the introduction of steam may be found in patents to Silas G. Salisbury, No. 54,215, dated April 24, 1866; David W. Hendrickson and James P. McLean, No. 68,565, September 3, 1867; David W. Hendrickson, No. 71,754, December 3, 1867; Alexander Hamar, No. 81,775, September 1, 1868; Sidney Parker, No. 446,168, February 10, 1891; Thomas Doherty, No. 575,518, January 19, 1897, and George L. Morton, No. 646,448, April 3, 1900.

In the drawings illustrating the apparatus, Figure 1 is a vertical section of the cupola and apparatus immediately connected therewith employing the process and embodying the invention. Fig. 2 is a horizontal section on lines *x x* of Fig. 1. Fig. 3 is an enlarged sectional view of one of the twyers detached from the cupola, showing the air and steam pipes in conjunction. Fig. 4 is an enlarged sectional view of the end of the steam-pipe and its casing, showing heat-insulation material.

Similar letters refer to similar parts.

In the drawings, A represents the lower

portion of the cupola of the ordinary construction, the upper portion and a portion of the charge-hole being omitted, they not being necessary to illustrate in connection with the invention. The shell rests upon the framework B in the usual manner, and the bottom is closed by the usual folding trap-doors and has also the usual discharge nozzle or nozzles on a level with the hearth for drawing off the molten iron, which are not illustrated, as not being essential to the invention. Surrounding the cupola is an air-pipe C, and the proper number of air-passages or twyers D D are led therefrom to the interior of the cupola, entering therein the usual distance above the floor and at the base of the charge. A wind-pipe E leads to means F for creating the blast. This may be a fan, as shown, or any other suitable means for creating a wind-pressure. Connected with a circumferential pipe C are a series of branch pipes G G, leading to twyers H H, located at a definite distance above the lower ones and at a point which would bring their entry in the cupola at about twelve inches below the melting-point of the iron. This point can easily be ascertained by considering the manner of charging the cupola by different parties, as in a cupola of forty-two inches in diameter the location of the upper twyer would be about seventeen inches from center to center above the lower twyers. The nozzles of the upper twyers H H at *h h* in the cupola incline downwardly at an angle of about thirty-five to forty degrees from the horizontal line, and in practice the number would be from three to six, depending upon the diameter of the cupola itself. It will thus be seen that the air-blast is divided between two sets of twyers, the lower and upper set, and in practice it will be found best to restrict the size of the lower set, so that the total area of both the lower and upper set shall be about equal to what has heretofore been approved in practice with a single set of twyers, delivering about three-fourths of the total air through the lower set and one-third through the upper set. Into the upper twyers are located a series of steam-pipes K K, and in order to prevent loss of heat therein to the inflowing air the steam-pipes are incased in larger pipes, with a heat-insulating medium, as asbestos, between the two, the steam-pipes terminating in caps, each having therein for a cupola of, say, forty-two inches in diameter one one-eighth-inch hole, through which steam can pass into the cupola as a downward jet corresponding to the angle of the twyer, the essence of this portion of the invention being the angular delivery of the steam-jets, delivering substantially the quantity of steam specified into the cupola a short distance below the melting-point of the iron, thus coming directly in contact with the gases rising from the body of coke below, whereupon the proper reactions take place. A source of steam-supply (not shown) is of course requisite, and to which the steam-pipes are connected through a superheater M, which may be of any type that is sufficient to heat the steam to a degree of temperature high enough to eliminate all moisture and furnish perfectly dry steam, it being absolutely essential to the success of the process that dry steam shall be furnished and that it shall not be allowed to condense between the superheater and the point of introduction into the cupola. With the dimensions of nozzles given and under the circumstances steam is preferably furnished under pressure of about eighty pounds to the square inch, although the pressure can be varied to some extent without materially interfering with the process, provided the steam be dry and provided the law of the delivery of steam through an orifice under pressure is observed, which law is that the amount of steam delivered varies substantially in accordance with the square foot of the pressure. The air-blast is also expected to be forced with the usual pressure.

The cupola is charged in the usual manner with the usual quantity of fuel, but may by the use of this process be charged with a much larger proportion of scrap-iron to pig-iron than is ordinarily used in iron-founding, it being one of the advantages of the use of steam that a far larger proportion of scrap can be used, even if of an inferior quality, than can be ordinarily used with the ordinary process. After charging the fire is lighted in the usual manner and the air-blast first turned on with a twelve-ounce wind-pressure. When the iron just begins to run, steam is turned on, and in a five-ton cupola with eighty pounds of steam three nozzles or jets of one-eighth-inch opening and discharging perfectly dry superheated steam will be sufficient. This is continued as long as iron continues to melt and with the twelve-ounce wind-pressure continued.

It would not be a variation from the process to shut off the air-blast from the upper twyers during the process of heating up the cupola and until the iron began to melt; but in that case it would be necessary to enlarge the lower ones and choke them down afterward when the air-twyers above were open, nor is it absolutely essential that the air and steam both be delivered through the upper twyers, as all the air might be passed through the lower twyers; but the effect is not so marked and uniform as it is to divide the air and inject a small proportion with the steam, as it seems to assist in diffusing the latter and more thoroughly mix it with the uprising gases.

By the use of this process much less pig-iron in proportion to scrap can be used—say fifteen to twenty per cent. of pig to eighty to eighty-five per cent. of scrap properly mixed—and that a better grade of castings in strength and ease of working will be produced than can be produced without the use of steam in the man-

ner stated and that the result will be substantially uniform.

What is claimed is—

1. The herein-described process of purifying and refining iron, consisting in first charging the cupola with fuel and metal and raising the heat of the contents thereof to a high temperature by an air-blast, second, injecting steam in an angular downward direction through the mass of molten iron and incandescent fuel, said steam entering the cupola at about ten inches below the melting-point of iron, substantially as described.

2. The process of producing a cast-iron possessing some of the qualities of malleable iron, consisting in: first, charging the cupola with fuel and metal and raising the heat of the contents to the point of liquefying the metal by an air-blast, second, forcing a jet of steam angularly downward through the melted contents and incandescent fuel, said steam being delivered at a point about ten inches below the melting-point of iron and in combination with an air-blast also delivered angularly downward, substantially at the same point, substantially as described.

In testimony whereof I sign this specification in the presence of two witnesses.

HAGGERT S. COCHRAN,
Administrator of the estate of Adam Cochran, deceased.

Witnesses:
H. S. CONRAD,
EDWIN CAMACK.