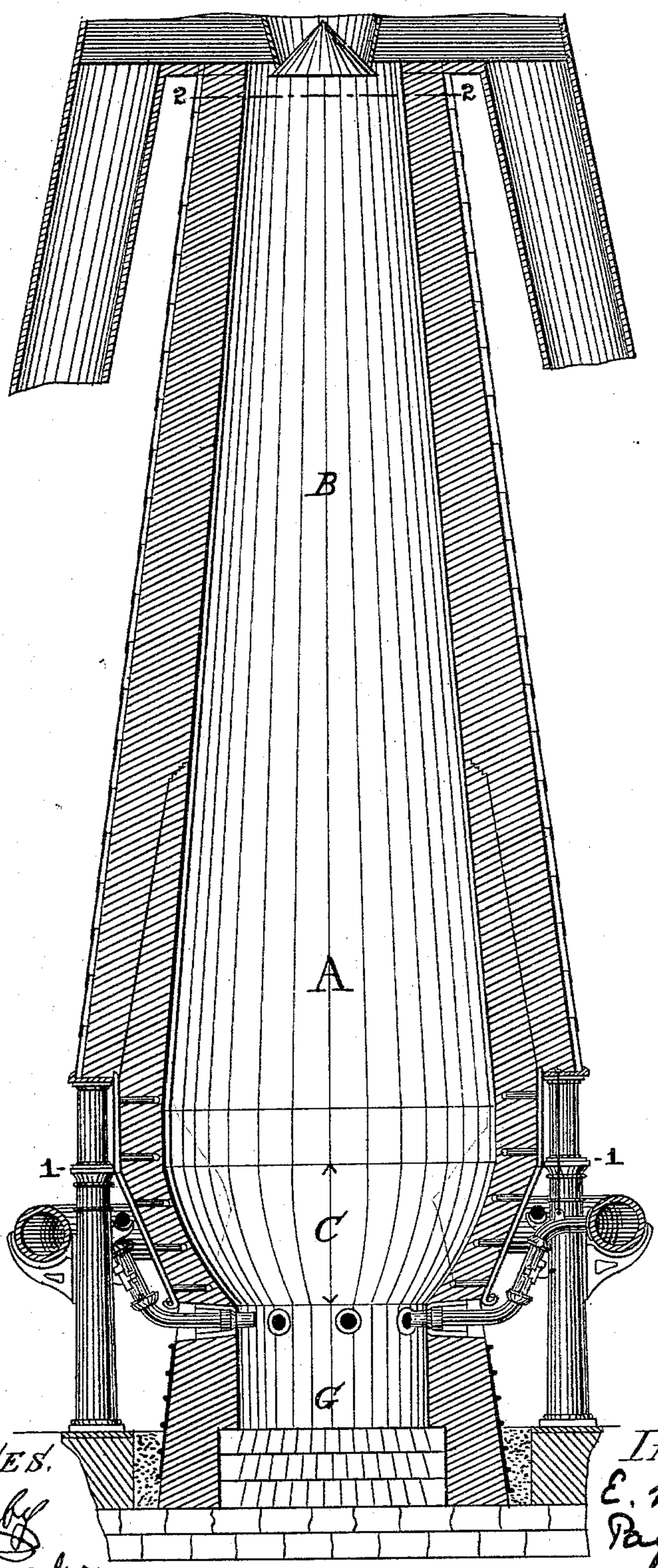
(No Model.)

E. WALSH, Jr.

BLAST FURNACE.

No. 401,395. Patented Apr. 16, 1889.



WITNESSES.
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UNITED STATES PATENT OFFICE.

EDWARD WALSH, JR., OF ST. LOUIS, MISSOURI.

BLAST-FURNACE.

SPECIFICATION forming part of Letters Patent No. 401,395, dated April 16, 1889.

Application filed May 26, 1888. Serial No. 275,207. (No model.)

To all whom it may concern:

Be it known that I, EDWARD WALSH, Jr., a citizen of the United States, residing at the city of St. Louis, in the State of Missouri, have invented a certain new and useful Improvement in Blast-Furnaces, of which the following is a full, clear, and exact description.

My invention relates to improvements in furnaces having a bosh well down within the zone of fusion, such as shown and described in my patent, No. 366,282, dated July 12, 1887, or in any in which the bosh is similarly located.

My present invention has for its object to maintain the initial pressure of the blast as it enters the zone in the immediate vicinity of the tuyeres throughout the entire furnace, and at the same time, and to further this end, to prevent the adhesion of slag or semi-molten metal on the boshes and furnace-wall, whereby the velocity, pressure, and density of the gases on the materials to be treated will be rendered uniform at every part of the furnace, and therefore under the control of the operator—advantages hitherto unattainable.

In a blast-furnace, although the highest temperature produced by the intense incandescence of the fuel in active combustion is in the immediate neighborhood of the tuyeres, yet owing to the refrigerating influence of the entering air, which is in a comparatively-cool state, this high temperature is not immediately imparted to the gases generated from the air thus entering, and they are not, therefore, expanded to their fullest extent in this region. Repeated observations on the practical working of a furnace have demonstrated that the gases are not fully expanded until they reach the upper limit of the fusion-zone, as is plainly evident in the examination of sections of furnaces that have been in use for some time. In such furnaces it will be found that a relation exists between the hearth-area and the area of the top of the fusion limit. An invariable ratio is maintained between these two areas. Thus the temperature for fusing cast-iron is about 2,400° Fahrenheit, whereas at the upper limit of the fusion-zone the temperature required for producing a chemical combination and fusing the silicates which compose the slag is in excess of 3,000° Fahrenheit. Now, by applying the well-known formula for the expansion of gases at these two temperatures it will be seen that there is a fixed cause or law for the ratio between these two areas, the gases being expanded threefold by this increase of temperature. This accounts scientifically for the constant relation that is always found to exist between the area at the upper limit of the fusion-zone and that of the hearth in worn sections of furnaces, for if a furnace was originally made larger than that determined by the above formula at the upper limit of the fusion-zone it is found that scars of slag or fine carbonaceous matter are deposited on the sides of the furnace until the above relation between the areas is reached, and if, on the other hand, the furnace was made smaller at the limit named it is found that the brick-work, notwithstanding any artificial means adopted for cooling it, will be worn away until the said relation is established.

As a rule, the temperature of the gases issuing from the furnace at the throat or tunnel-head is between 400° and 1,000° Fahrenheit, and by applying the above formula to this decreased temperature (relatively to that required to make the slag) it will be seen that the area of the throat or tunnel-head should be between one-fifth and one-seventh the area at the upper limit of the bosh or fusion-zone.

By preserving the above constant ratios of areas according to the temperature required and obtained at any zone on horizontal plane of the furnace the proper sectional form and combined disposition of the internal parts of the furnace are accurately determined, with the result that when the furnace is in operation the initial pressure imparted by the blowing-engine to the zone in the immediate vicinity of the tuyeres is maintained throughout the entire furnace, and that, consequently, the velocity, density, and impingement of the gases on the materials to be treated are rendered uniform at every part of the furnace and are entirely under the control of the operator, which is not the case with the furnace in present use, wherein the zones have been so indifferently proportioned to the requirements of the process that, owing to the varying pressure of the blast and gases within the furnace, only irregular and more or less wasteful and imperfect results are obtained.

Now, my invention consists in forming the

interior of a blast-furnace according to the above-defined principle as discovered by me in connection with the subject, or so that the sectional areas of the hearth, upper limit of bosh or fusion-zone, throat or tunnel-head, or any intermediate zone of the furnace will have constant relations to each other, according to the volume of the gases as found by applying the well-known formula for the expansion of gases to the temperature required and obtained at each of the said parts, or at any zone of the furnace, as the case may be, and in placing the bosh C well down within the zone of fusion, in accordance with the invention described in my said patent, No. 366,282, and particularly claimed by the first claim thereof, whereby any adhesion of slag or semi-molten metal around the bosh is prevented.

It is important in the practice of my present invention that the initial pressure of the blast shall not be affected by shelves or scaffolds formed by adhesion of slag or semi-molten material to the sides of the boshes or furnace-walls, and therefore I introduce as a co-operative element the bosh well down within the zone of fusion, as aforesaid.

On the accompanying drawing is represented a vertical section of my improved blast-furnace having the furnace proper, A, furnace-shaft B, bosh C, (which is brought down well within the zone of fusion, as described in my said previous Letters Patent,) and the hearth-cylinder G.

I make the sectional area of the furnace at the upper limit, 1 1, of the bosh or fusion-zone C three times (or thereabout) the area at the hearth G, and about five to seven times the area of the throat or tunnel at 2 2, these being the fixed proportions given for these parts, respectively, by the application of the above formula to the various temperatures thereat. From the upper limit, 1 1, of the bosh C the walls D of the furnace slope gradually downward and inward to the top of the hearth-cylinder G and upward and inward to the throat or tunnel-head 2 2. This proportion of parts, as far as diameters are concerned, is necessarily fixed; but in order to insure the fullest economy in the use of various kinds of ores it will be found that the height of the furnace should be made to vary with the character of the ore—that is to say, a non-refractory and easily-smelted ore will not require for its treatment as great a height of furnace as a dense refractory ore difficult of treatment.

By my invention a stronger impingement of gases at greater density and velocity is obtained and the materials in preparation in the upper portions of the furnace are more thoroughly prepared, and therefore a minimum amount of fuel is required for the reduction and smelting of the iron ores, all the space within the furnace is utilized, the process is under control of the operator, and a uniformity of results is secured unobtainable by the most approved constructions of the day.

I claim as my invention—

A blast-furnace in which the bosh is located well down within the zone of fusion, and in which the sectional area of the upper limit of its bosh is substantially three times its hearth-area and substantially five to seven times the area of its tunnel-head, substantially as shown, and for the purposes specified.

In testimony whereof I have affixed my signature, in presence of two witnesses, this 21st day of May, 1888.

EDWARD WALSH, JR.

Witnesses:
PAUL BAKEWELL,
S. L. SCHRADER.