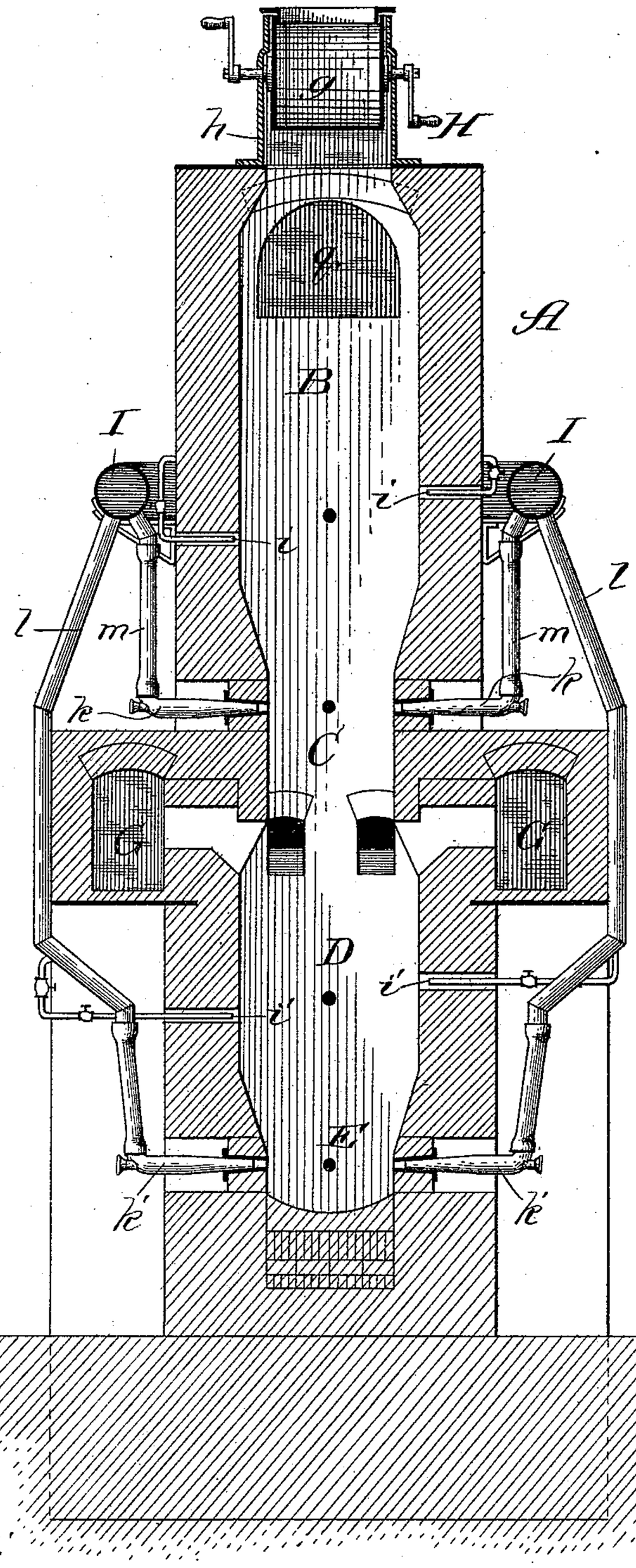
(No Model.) 2 Sheets—Sheet 1.

W. A. KONEMAN.

METHOD OF AND APPARATUS FOR RECARBURIZING METALS.

No. 485,392. Patented Nov. 1, 1892.

Fig 1.



Witnesses:
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(No Model.) 2 Sheets—Sheet 2.

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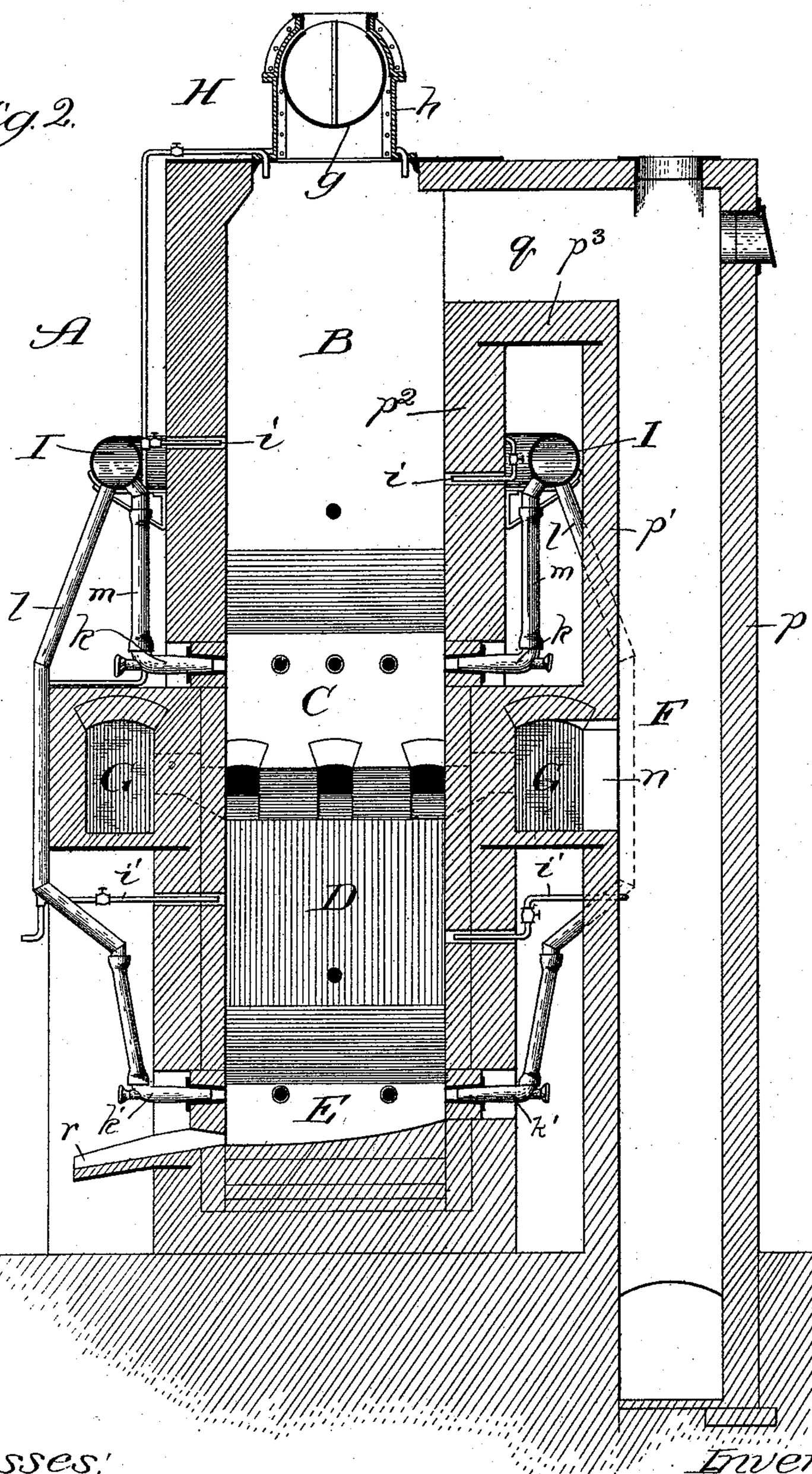
Fig. 2.



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UNITED STATES PATENT OFFICE.

WILLIAM A. KONEMAN, OF CHICAGO, ILLINOIS, ASSIGNOR OF ONE-HALF TO CHARLES G. SINGER, OF SAME PLACE.

METHOD OF AND APPARATUS FOR RECARBURIZING METALS.

SPECIFICATION forming part of Letters Patent No. 485,392, dated November 1, 1892.

Application filed September 18, 1891. Serial No. 406,113. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM A. KONEMAN, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a new and useful Improvement in Methods of and Apparatus for Recarburizing and Recovering Metals, of which the following is a specification.

Metal in the form of old iron or steel, commonly referred to by the term "scrap," commands, as very low-grade metal, but a comparatively-small price in the market, since being very low in, if not quite devoid of, carbon, after remelting for use as cast-iron it is fit to use only where weight is desired, as for sash and elevator weights and the like, and not where tensile strength, tooling, and other qualities of the higher grades of metal are required.

The object of my invention is to convert by a simple process scrap iron and steel into a highly-carburized, high grade, refined, and merchantable iron product, and to recover readily the contained metals in furnace slag and ores.

My improved apparatus is shown in the accompanying drawings, in which—

Figure 1 is a view thereof in vertical sectional elevation; and Fig. 2 is a similar view of the same, the section being taken, however, at a right angle to that presented in Fig. 1.

A is the shell of my improved apparatus, which I provide as a brick structure of considerable height, preferably thirty odd feet. Internally the shell A is divided into three sections or open-base chambers B, C, and D, below the lowermost D of which is a receptacle or crucible E for the molten metal. The first-named chamber B, which affords a preparing-chamber in the sense of heating the metal short of the melting-point, converges from two sides toward its upper end and similarly in a downward direction toward its lower end, thus forming a "bosh," and should occupy about one-third the height of the shell A. The lower chamber D resembles in form and height the chamber B and constitutes a percolating-chamber for the molten metal, reduced to a molten condition in the intermediate or melting chamber C, the width of which should correspond or approximately correspond with that of the converging lower and upper ends of the respective chambers B and D. The chamber D opens at its base into the receptacle E for the molten metal, which flows off through a spout *r*. At one outer side of the shell A, extending the full length thereof, is a downtake F, (which need only be provided, however, in case it shall be desired to save the gas product resulting from my process,) communicating at its upper end through a lateral passage *q* with the upper end of the chamber B, and formed by a wall *p* and a double wall p' p^2, provided with a cover p^3, forming the base of the gas-outlet passage *q*. A horizontal gas-channel G encircles the exterior of the shell and communicates with the interior of the shell at the upper end of the chamber D, and through a passage *n* with the downtake F.

I I represent main blast-pipes, (supplied with air from a fan, not shown,) from each of which extend air-pipes *m* and *l*, the former terminating in tuyeres *k*, leading into the chamber C near its upper end, and the latter terminating in similar tuyeres *k'*, passing through the shell at or near the base of the chamber D. Above the base of the chamber B, I introduce through the walls thereof steam-pipes *i*, preferably for superheated steam, and branches *i'* of the steam-pipes *i* lead into the chamber D, preferably about midway between its ends; but no steam is admitted through them, except when the apparatus is used solely, as it may be, for making fuel-gas.

The ordinary hopper form of device for feeding the apparatus is not desirable in the present connection, owing to the irregular or ragged form of the material, (old metal in various shapes,) which would tend to produce clogging of the feed. Accordingly, particularly when precaution is to be taken to prevent loss of gas resulting from the process, I provide for feeding the material to be converted or treated a rotary hopper H, which may also be used for feeding coal to the apparatus, and comprising a rectangular case *h*, secured at its open base over an opening in the top of the shell A, and rounded laterally toward its upper open end, and inside the case I journal a drum *g*, closed at its ends and open along one side, which when turned by

handles on the trunnions of the drum or other suitable means to coincide at its opening with the upper open end of the case permit it to be filled through the latter. The contents of the drum are readily dumped into the apparatus by turning it in either direction to bring its open side downward, the construction tending to prevent clogging of the material in the drum and access of air to the interior of the generator.

The operation is as follows: A fire is built in the shell A and blasted with air through the lower tuyeres *k'*, and coal or other solid carbonaceous fuel is supplied through the medium of the hopper H, together with a suitable flux, such as limestone, the fuel-bed being raised to incandescence and the coal being piled into the shell to fill the chambers therein to a height reaching nearly to the outlet *q*, at or about at which height the bed should be maintained throughout the operaion. Steam is admitted continuously into the bed through the pipes *i*, and air is also and similarly introduced through the uppermost set of tuyeres *k'*, no steam being supplied through the pipes *i'* while the metal conversion is being practiced, since it would tend to chill the molten metal. The object of introducing steam through the pipes *i* is twofold. When the apparatus is used as a fuel-generator, the steam is employed to absorb, by reason of its decomposition into the elements hydrogen and oxygen, as much as possible of the sensible heat contained in the apparatus, and so far as possible carry such sensible heat into the gas proper in the form of hydrogen. The second object is to have the hydrogen so generated unite with and carry off a considrable portion of the contained sulphur in the form of sulphureted hydrogen, and thereby produce a pig metal comparatively free from sulphur.

The proceeding thus far described produces, mainly, protoxide of carbon gas in the chamber D, which enters the channel G through the openings leading thereto, and thence goes into the downtake F, whence it may be taken through the passage F' at its base to the point of storage or of utilization, and in the chambers C and B gas is also produced of lesser sensible heat than that led off from below, owing to the action throughout its generation of the steam from the pipes *i*, and is led off through the passage *q* into the downtake, therein mixing with and improving the gas introduced into it from the channel G.

The gas-making action thus described is merely incidental to my process, which is proceeded with as follows: The scrap metal, furnace slag, or ore to be treated is dumped, together with a suitable amount of fuel and fluxing material, from the hopper H upon the top of the bed of incandescent fuel in the apparatus and subjected to the heat thereof. In the chamber B the metal, slag, or ore will sink with the sinking of the bed by the consumption of the fuel, becoming heated nearly to fusion by the time it reaches the top of the chamber C, wherein it is melted by the continued action of the heat, and thence percolates in comparatively-small drops through the incandescent mass of fixed carbon in the chamber D and through the protoxide of carbon gas rising therein. Thus the molten metal in thinly-divided proportions is subjected to the carburizing action of the fixed carbon and protoxide of carbon gas in the chamber D, and by the time it has reached the receptacle E the scrap metal is thoroughly recarburized and refined and constitutes a high grade of iron, and all metals contained in slags or ores are thoroughly reduced and set free by the reducing action of the carbon and protoxide of carbon gas, through which the fused mass is caused to percolate. The object of the lower blast is to maintain the fuel in chamber D in an incandescent state and at a temperature greater than the melting-point of the material percolating through it, and the quantity of air there required is much less than that required in the melting-chamber C. The amount of air admitted to chamber D is regulated either by carrying a very light blast to the tuyeres or by reducing the number of tuyeres entering that chamber, and the lightness of the blast renders it desirable to provide for leading it off through a shallow bed; hence the provision of the channel G.

As will be understood, to continue the process the charges of metal or metal-containing material with fuel and flux are repeated as frequently as may be found necessary to maintain the required height of the bed.

What I claim as new, and desire to secure by Letters Patent, is—

1. The method of carburizing iron or iron-bearing compounds, which consists in forming and confining a deep bed of carbonaceous fuel, blasting it with air near its base, introducing air or steam and air into the bed toward its upper end, leading off the generated gases, respectively, from a point between the top and base of the bed and from the top of the bed introducing the material to be treated upon the incandescent bed and allowing it to sink therewith by the consumption of fuel until the mass of said material is melted, and causing the molten mass to percolate downward through the lower portion of the incandescent bed of fixed carbon and through the protoxide of carbon gas rising therein, substantially as described.

2. In a metal recovering and recarburizing furnace, the combination of a shell A, divided into vertical chambers B and D for burning solid carbonaceous fuel and forming, respectively, a preparing and a percolating chamber having converting ends, an intermediate melting-chamber C, and a receptacle E below the chamber D, a downtake F, communicating through a passage *q* with the chamber B, an external gas-channel G below the chamber B, communicating with the interior of the furnace and with the downtake, a suitable num-

ber of tuyeres for air-blasts leading, respectively, into the base of the chamber D and into the furnace above the channel G, and a steam-supply pipe to the chamber B, the whole being constructed and arranged to operate substantially as described.

3. In a metal recovering and recarburizing furnace, the combination of a shell A, divided into vertical chambers B and D for burning carbonaceous fuel and forming, respectively, a preparing and a percolating chamber for the metal and provided with laterally-converging upper and lower ends, an intermediate melting-chamber C, and a receptacle E for the molten metal below the chamber D and provided with an outlet, the said chambers having unobstructed vertical communication with each other and with the said receptacle, a suitable feed-hopper at the upper end of the structure, a downtake F, communicating through a passage *q* with the chamber B near its upper end, an external circumferential gas-channel G, surrounding the shell at the chambers C and D and communicating therewith and with the downtake, tuyeres *k* and *k'*, leading from an air-blast supply, respectively, into the chamber C and base of the chamber D, and a steam-supply pipe leading to the chamber B, the whole being constructed and arranged to operate substantially as described.

4. A metal recovering and recarburizing furnace comprising, in combination, a shell A, divided into vertical chambers B and D for burning carbonaceous fuel and forming, respectively, a preparing and a percolating chamber for the metal and provided with laterally-converging upper and lower ends, an intermediate melting-chamber C, and a receptacle E for the molten metal below the chamber D and provided with an outlet, the said chambers having unobstructed communication with each other and with the said receptacle, a feed-hopper H, surmounting the structure and comprising a case *h*, open at top and bottom and rounded laterally toward its upper end, a rotary drum *g*, journaled therein and open along one side, an external wall p^2, forming, with the outer wall *p'* of the shell, the base of the gas-outlet passage *q*, a downtake F outside the wall *p'* and communicating at its upper end with the chamber B through outlet *q*, a gas-channel G around the adjacent ends of chambers C and D and communicating therewith and with the downtake, tuyeres *k* and *k'*, leading from an air-blast supply, respectively, into the upper part of chamber C and base of chamber D, and steam-supply pipes leading, respectively, into the chambers B and D, the whole being constructed and arranged to operate substantially as described

WILLIAM A. KONEMAN.

In presence of—
J. W. DYRENFORTH,
M. J. FROST.