(No Model.)

# A. L. CARLETON.

## FURNACE FOR FORMING CAST METAL.

No. 598,694. Patented Feb. 8, 1898.

*Fig. 2.*

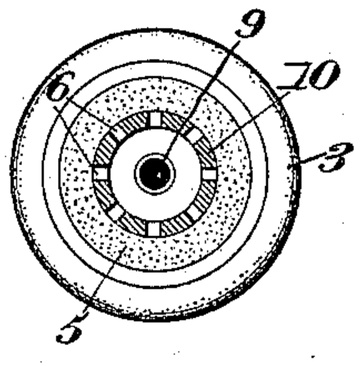



*Fig. 3.*

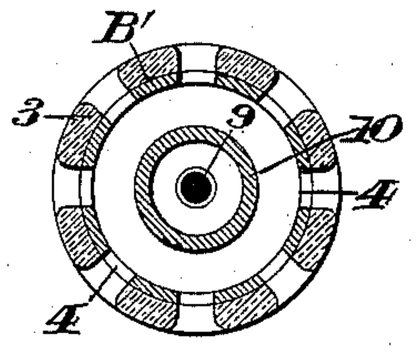
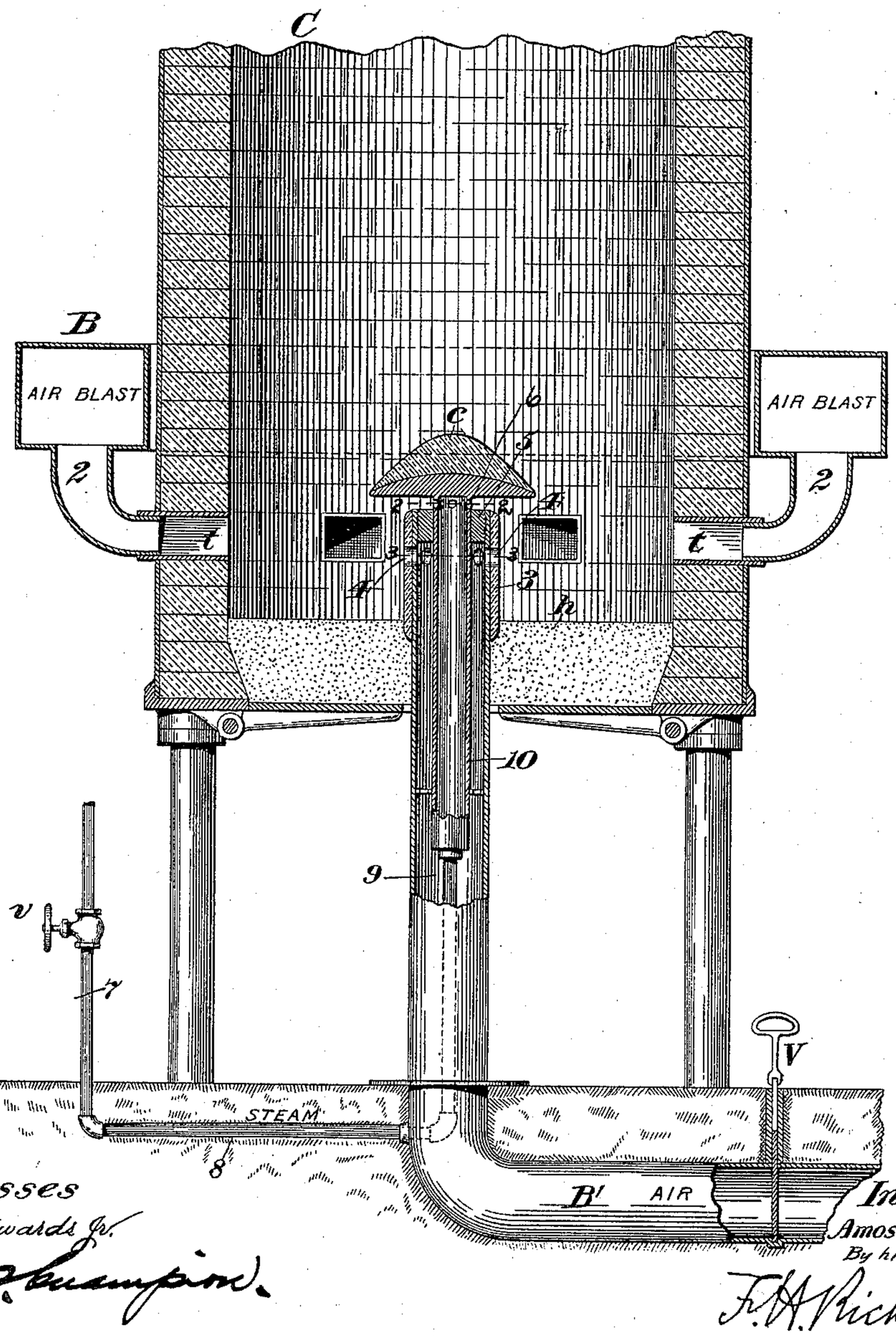



*Fig. 1.*

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# UNITED STATES PATENT OFFICE.

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## FURNACE FOR FORMING CAST METAL.

SPECIFICATION forming part of Letters Patent No. 598,694, dated February 8, 1898.

Original application filed July 10, 1897, Serial No. 644,040. Divided and this application filed October 30, 1897. Serial No. 656,921. (No model.)

*To all whom it may concern:*

Be it known that I, AMOS L. CARLETON, a citizen of the United States, residing in Hartford, in the county of Hartford and State of Connecticut, have invented certain new and useful Improvements in Furnaces for Forming Cast Metal, of which the following is a specification.

This invention relates to furnaces for forming cast metal; and it has for its main object the provision of an improved cupola for forming refined cast-iron.

This application is in the nature of a division of that filed by me July 10, 1897, Serial No. 644,040, and embraces as its subject-matter an improved cupola adapted for carrying out the process described in said prior application.

My improved apparatus is intended to constitute a means for producing from scrap and pig metal and especially from the lower and cheaper grades of these materials a refined cast-iron in the nature of a homogeneous metal containing less combined carbon than is present in ordinary cast-iron, a smaller percentage of sulfur, and possessing more of the characteristics of malleable iron and mild steel—viz., ductility, malleability, and toughness—than of cast-iron usually employed in foundry-work. In forming such a refined cast-iron I employ in connection with the usual air-blast a gas or vaporous medium which will combine with the oxygen of the air-blast and by means of which an excessively high reducing heat may be obtained and sustained within the zone of fusion of the cupola, nearly all of the sulfur and other impurities which it is found difficult to eliminate by means of the old process being burned out by this high reducing heat and the ferric oxid of the rusty scrap reduced to pure iron and not wasted in the slag, this reducing action being of such a character, moreover, as to cause the burning out from the charge of a greater proportion of the carbon than it has been possible to do heretofore.

As is well known, the oxyhydrogen-flame is the most intense heat that can be obtained by the union of elementary gases or compounds, and by reason of the large volume of hydrogen which is present during combustion it is an exceptionally good reducing-flame; and the process which I make use of for obtaining refined cast-iron having some of the properties of malleable iron and mild steel is based principally upon these facts, and embodies as its essential features the burning of the charge in the cupola and the fusing of the metal therein by means of an oxyhydrogen-blast preferably containing an excess of hydrogen or, if not an excess, as much as will combine with the oxygen of the air-blast when the latter is introduced into the cupola, as through the twyers, at the proper pressure.

In practice I have found it to be most advantageous to supply the oxygen of the air-blast for obtaining the oxyhydrogen-flame by decomposing a jet or jets of steam introduced into the zone of fusion of the furnace or cupola and impinging upon the incandescent carbon of the fuel with which the cupola is charged. The heat in the furnace is, of course, sufficient to decompose the vapor of the steam, and the nascent hydrogen as soon as it is set free unites with the oxygen of the air-blast, which is introduced through the twyers in large quantities and under pressure, the ignition of these gases producing combustion under much better conditions.

It is the principal object of my present invention to provide an apparatus in which the supply of air and steam may be utilized to the best advantage and the flow properly regulated, and in the construction shown in the drawings I have illustrated an apparatus in which the air and the steam are allowed to enter the furnace from a supply device at points near the center of the cupola, the admission-ports being so located as to facilitate commingling of the air and the steam and consequently the creation of an oxyhydrogen atmosphere, by means of which an oxyhydrogen-flame may be sustained within the walls of said cupola.

As it is obvious that the opening or openings in each of the supply-pipes through which air and steam are admitted would become clogged if the discharge ends of said pipes were so disposed as to receive the entire pressure of the mass of melted metal, ore, and flux in the charge, I have provided herein a device for protecting these discharge-openings

from the downward pressure of the superposed mass, this device being preferably in the form of a cap of refractory material of a diameter sufficient to protect the openings or perforations through which the air and the steam enter the interior of the cupola. It will be understood, of course, that such a device as this may be employed for many different purposes in connection with a furnace in which it is desired to mix two or more gaseous or vaporous media prior to ignition thereof; but it is especially applicable for use in connection with an oxyhydrogen-supply device, substantially of the type hereinbefore shown, for use in a cupola for carrying into effect the process described fully in detail in my prior application hereinbefore referred to and which has been outlined more briefly herein.

In the drawings accompanying and forming part of this specification, Figure 1 is a side elevation of the lower portion of a cupola constructed in accordance with my present invention. Fig. 2 is an enlarged horizontal section taken in line 2 2, Fig. 1, and illustrates the preferred construction of supply device through which steam is admitted to the interior of the cupola; and Fig. 3 is a similar view on line 3 3, Fig. 1, of the supply device through which the air-blast is admitted into the furnace.

Similar characters designate like parts in all the figures of the drawings.

C designates the body portion of the cupola, which, except as to the features hereinafter particularly specified, may be of the usual construction, and B designates the usual air-blast belt, to which air may be supplied at any suitable pressure, as by means of a blower. (Not shown.)

Another air-blast pipe is illustrated at B′ and enters the cupola from the under side through the hearth *h* thereof, the belt-pipe B being, however, in connection with the twyers *t* in the usual manner through connection-pipes 2. Six of these twyers and pipes are shown in the present case, although, of course, any desired number may be used. At its upper end, where the air-blast pipe B′ enters the cupola, it is covered with suitable heat-resisting material—such as a coating 3, of fire-clay—and the pipe and fire-clay are transversely perforated to form a circuit of air-supplying openings 4, through which the blast of air is admitted to the cupola, near the center thereof. These openings 4 may be somewhat flaring at the outer ends thereof, so as to prevent clogging due to an influx of molten material in the cupola. At its upper end the air-blast pipe B′ may be sealed by a heat-resisting plug 5, which may also be of fire-clay and through which in this instance will pass a pipe for delivering into the interior of the cupola a blast of steam or other gaseous medium containing hydrogen. The steam-blast may be derived from any suitable source, and in the present construction of the apparatus employed for carrying out my process it will be delivered into the cupola through transverse openings 6 in a pipe 10, passing through the plug 5 and sealed thereinto. This steam-admission pipe may be disposed entirely within the air-blast pipe B′ and will be suitably connected with a source of steam-supply—as, for instance, by means of the pipes 7, 8, and 9. The openings 6 in the pipe 10 should be of considerably smaller diameter than the internal diameter of the pipe through which steam is conveyed to the cupola from the boiler or other source of supply. The openings 6 are flared in substantially the same manner as those shown at 4 and for the same purpose. Moreover, in order to relieve the pressure of the charge at the air and steam outlet openings as far as it is possible to do so I provide, in connection with the steam and air blast device, a cap, such as *c*, located above the discharge ends of the air-blast pipe B′ and the steam-pipe 10, this cap being also of refractory material and of sufficient diameter to relieve a considerable portion of the pressure of the superposed charge, which otherwise would tend to force its way into the openings 4 and 6 and clog them.

Although the apparatus just described is sufficient for the purpose of supplying air and steam to the interior of the cupola some means should be provided for controlling the flow of air and steam into the charge, and especially the volume of steam so admitted, as if the steam were allowed to enter the furnace in large quantities uncontrolled and at full pressure the volume of hydrogen given off by the decomposition of the steam would be so great as to tend to extinguish the fire in the cupola, and hence check or stop the operation thereof. For this reason and for the further reason that, on the other hand, it is desirable to supply to the charge as large a volume of hydrogen gas (and hence of steam) as the oxygen or the air-blast can unite with, I deem it essential to control or regulate the quantity of the steam admitted into the cupola and to provide for this purpose a suitable device or devices for regulating the flow of the steam through the pipes by which it gains entrance into the furnace. Hence I have shown at *v* a regulator for controlling such flow of steam, this regulator being, in the construction shown in Fig. 1, in the form of a wheel-valve in the steam-pipe 7, although it will be obvious that any other suitable type of regulator might be employed and that it might be located at any other point so long as the same result is obtained.

I have also shown at V another valve or gate in the nature of a slide, by means of which the supply of air through the pipe B′ may be regulated.

In operating my improved apparatus the cupola is first charged in the usual manner, and after the fire has been started the air-

blast is turned on and also the steam-blast, the supply of steam being continued and properly regulated until the charge is melted and the flames above the molten iron show a distinct hydrogen color, when substantially all of the impurities will have been burned out.

Having described my invention, I claim—

The combination, with a cupola, of an air-blast pipe communicating with the interior of the cupola and having an upwardly-extending transversely-perforated discharge end; a steam-blast pipe within the air-blast pipe and also having an upwardly-extending transversely-perforated discharge end in position to permit commingling of the air and the steam; a cap above the discharge ends of said pipes and in position to relieve the pressure of the charge at such point; and means for controlling the flow of air and steam through said pipes.

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