Dec. 15, 1931. S. W. CRAWFORD 1,836,791

MELTING FURNACE

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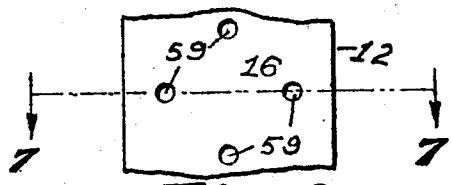


Fig. 6.

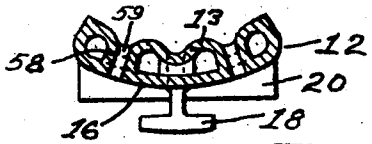


Fig. 7.

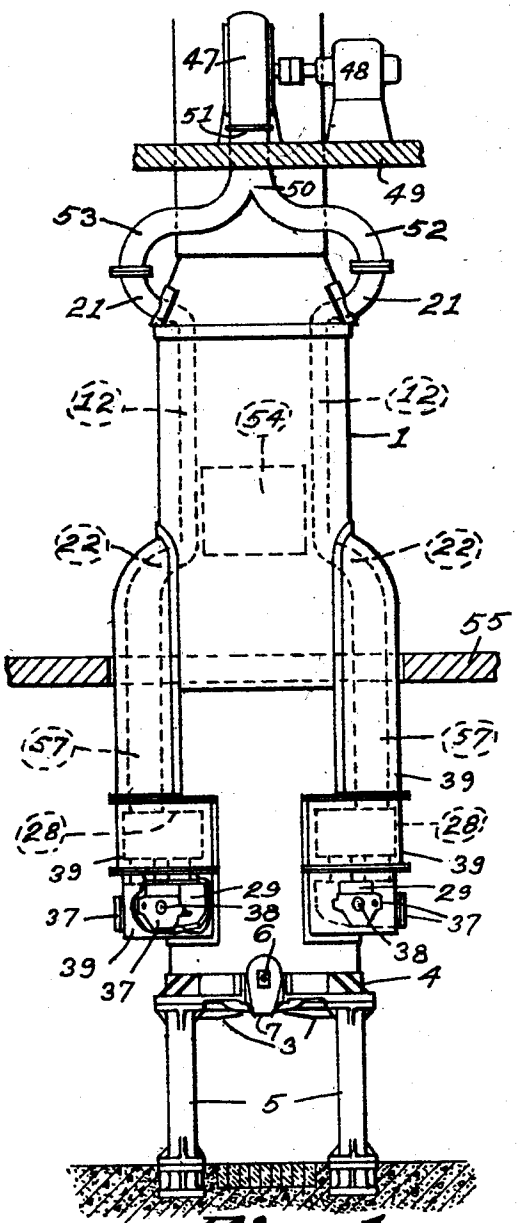


Fig. 1.

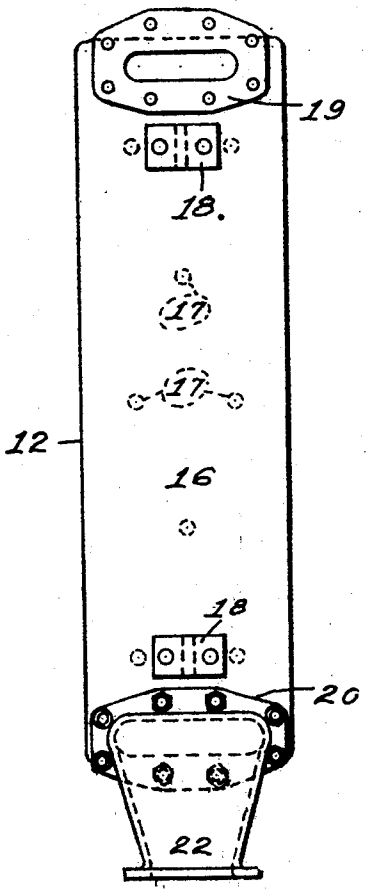


Fig. 5.

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MELTING FURNACE

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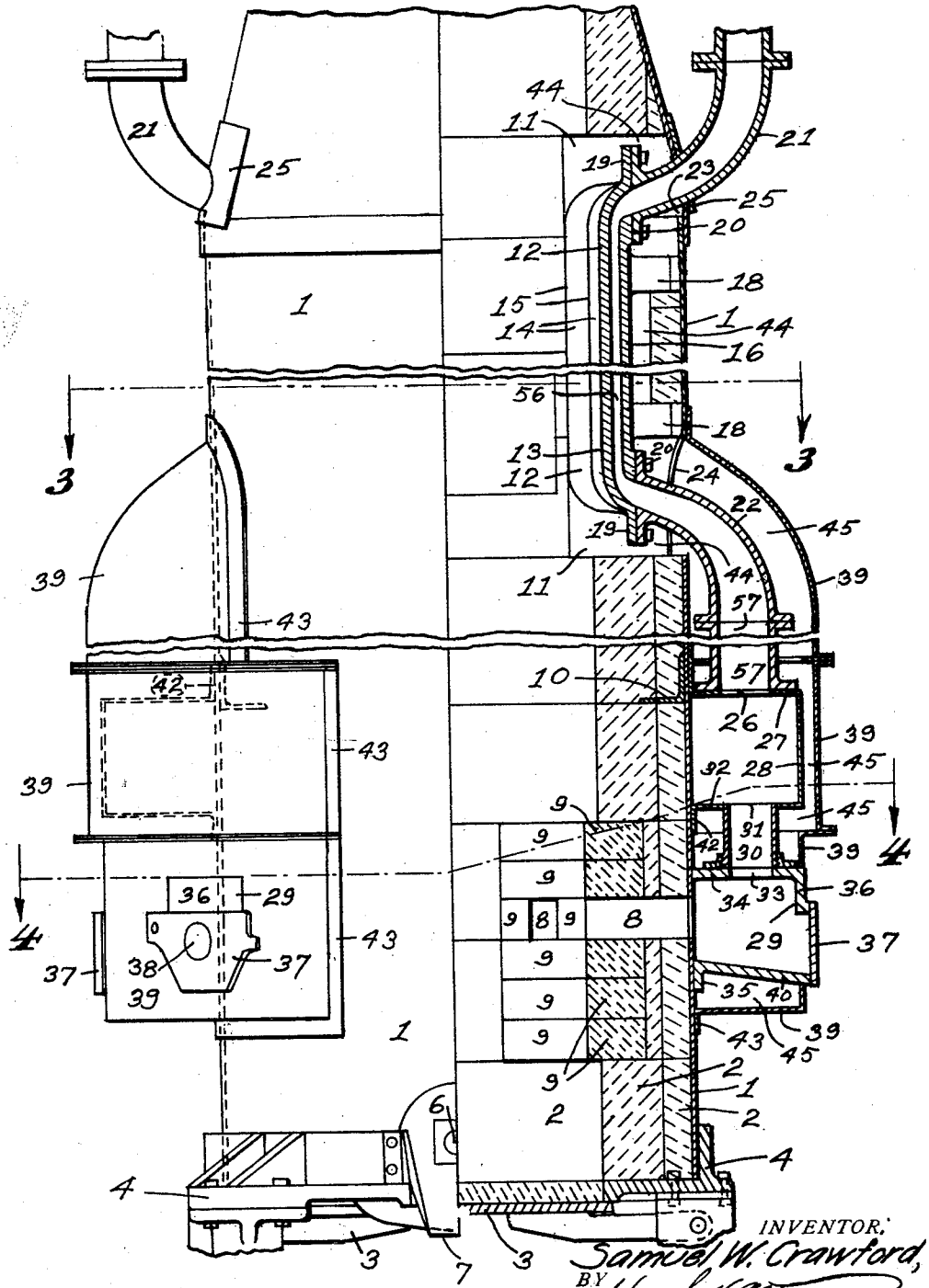


Fig. 2.

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MELTING FURNACE

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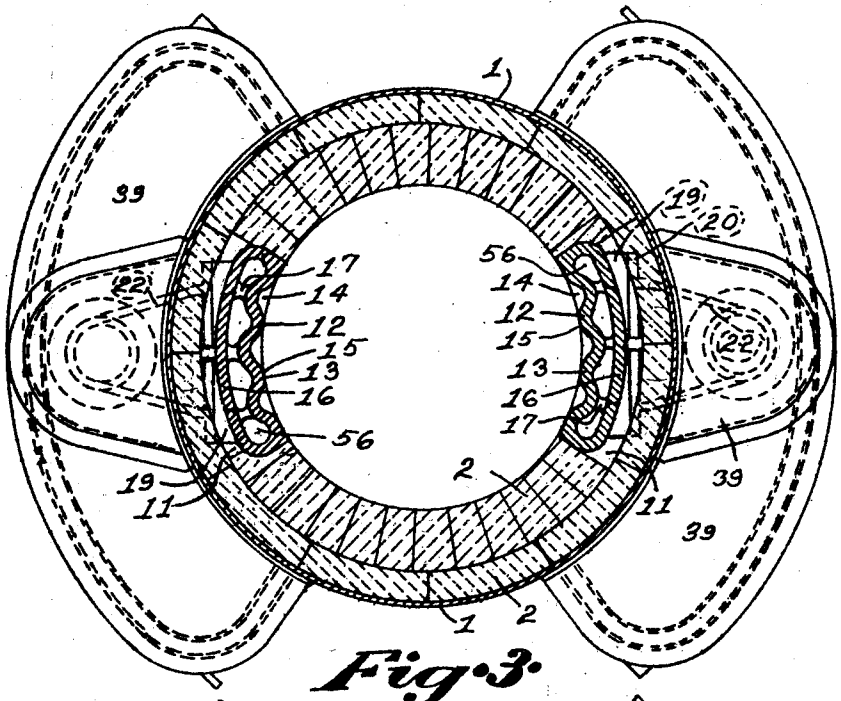


Fig. 3.

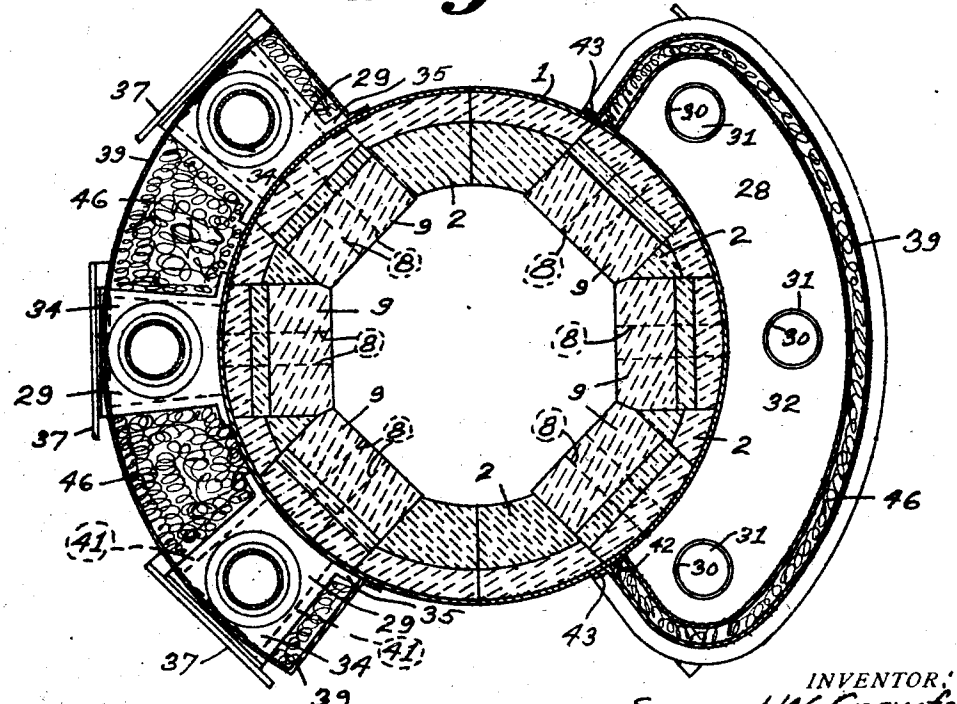


Fig. 4.

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1,836,791

UNITED STATES PATENT OFFICE

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MELTING FURNACE

Application filed January 22, 1931. Serial No. 510,478.

This invention relates generally to melting furnaces, and more particularly to an improved method and means for melting bronze or allied alloys or their metals.

One of the difficulties encountered in this art is that the admittance of air at the comparatively cold ordinary temperatures to the tuyères of the furnace tends to chill and thicken the slag so that the latter retards the distribution of the air through the fuel mass. Furthermore, the warmer the air that is admitted to the tuyères, the smaller may be the proportion of fuel to metal in charging the furnace. The time required to melt the metal is, also, reduced. Accordingly, one purpose of the present invention is to provide means for preheating the air before it enters the tuyères.

Another purpose is to preheat the air by utilizing the heat of the gases in the furnace that ordinarily passes out of the furnace with the gases into the atmosphere and is thereby ordinarily wasted.

Another object is to provide a reducing atmosphere in the furnace sufficient to prevent oxidation of the metal and the undue formation of slag.

A further object of the invention is the provision of a method of feeding the charges of metal and fuel to the furance so as to provide a continuous supply of molten metal at a desired uniform temperature.

Other objects, advantages and desirable features of the invention will appear in the course of the following description of an illustrative embodiment of the spirit thereof.

In the accompanying drawings forming part of this specification, in which like numbers of reference denote like parts wherever they occur,

Figure 1 is an elevation of a furnace embodying the features of the present invention;

Figure 2 is a fragmentary view similar to Figure 1, but on a larger scale, and with one lateral half of the view in vertical central section;

Figure 3 is a transverse sectional view taken on the line 3—3 in Figure 2;

Figure 4 is a transverse sectional view taken on the irregular line 4—4 in Figure 2;

Figure 5 is a rear elevation of the air case employed in the furance to heat the air for the tuyères, showing the case detached;

Figure 6 is a fragmentary rear elevation of a modified form of air case; and

Figure 7 is a horizontal sectional view taken on the line 7—7 in Figure 6.

The furnace shown is of the cupola type and comprises the usual outer shell 1 of wrought iron or steel plates riveted or otherwise secured together in any suitable manner, and the usual lining 2 of fire brick. The bottom may be formed as usual of two doors 3 opening downward and covered on their inner sides with refractory material, the doors 3 being hinged to the cast iron base 4, which is supported by the columns 5 and in turn supports the shell 1 and the lining 2. The tap hole 6 and spout 7 may be of any suitable or usual form. The inner lining around the tuyères 8 is preferably formed of blocks 9 of material more highly refractory than fire brick. The refractory lining 2 may be supported at intervals of its height by rings 10 of angle iron riveted to the shell 1.

A pair of diametrically opposed recesses 11 are provided in the inner face of the lining 2 to receive the air-cases 12. The air-cases 12 are arcuate in horizontal cross-section to conform to the recesses 11 in the annular lining 2, and the inner wall 13 of each case 12 is corrugated to provide alternate vertically extending grooves 14 and ridges 15. The purpose of the corrugations is to compensate for a difference of expansion between the inner wall 13 and the outer wall 16; and to expose a greater surface to the interior of the furnace, thereby increasing the heating capacity of the cases 12. The inner wall 13 and outer wall 16 of each case are secured together at intervals by stays 17. The cases 12 are secured in position by T-shaped brackets 18, formed integral with and projecting exteriorly from the wall 16, and riveted to the shell 1. The upper and lower ends of each case 12 open outwardly or rearwardly, and are surrounded by rearwardly facing flanges 19, to which are attached the inward-

ly facing flanges 20 of an elbow pipe 21 and an elbow pipe 22 at the upper and lower ends respectively of each case 12. The cases 12 and the pipes 21 and 22 are preferably formed of cast iron. The elbows 21 and 22 extend through openings 23 and 24, respectively, provided therefor in the shell 1. The opening 23 is closed around the elbow 21 by a cover 25 suitably secured to the shell 1, as shown in Figures 6 and 7.

The lower end of each elbow 22 is connected through the intermediacy of a pipe 57 to an opening 26 in the top wall 27 of a respective windbox 28, that distributes the blast from the pipe 21 to each of a plurality of tuyère boxes 29 through nipples 30 that are each connected at their upper ends to a respective opening 31 in the lower wall 32 of the windbox 28 and at their lower ends to the opening 33 in the top wall 34 of a respective tuyère box 29. Each of the tuyère boxes 29 is preferably an iron casting, and its open inner end is provided with integral flanges 35 that are suitably secured to the outer side of the shell 1 so that the interior of the box communicates with a respective one of the tuyères 8. The outer wall 36 of each tuyère box 29 may be provided with clean-out doors 37, provided with observation openings 38. A jacket 39, preferably formed of steel plate, incloses the windbox 28, the part of the pipe 22 disposed exteriorly of the shell 1, and, also, the top wall 34, bottom wall 40, and two lateral walls 41 of the tuyère boxes 29, as well as closing the opening 24 to the exterior of the furnace. The windbox 28 and the jacket 39 are preferably formed of plate steel, and are provided with suitable flanges 42 and 43, respectively, by means of which they are secured to the outer side of the shell 1 by riveting or in any other suitable manner. The spaces 44 behind the cases 12 and over and under the same form passageways for the heated ascending gases; and the spaces 45 in the jacket 39 are filled with a suitable insulating material 46, such a "silocel", for retaining the heat in the cases 12 and in the elbows 22, windboxes 28, nipples 30, and tuyère boxes 29.

The blast for the tuyères is supplied by a blower 47, driven by a motor 48. The blower and motor are mounted upon a suitable platform 49. A pipe 50 leads from the discharge end 51 of the blower 47 and divides into branches 52 and 53 that have their lower ends connected to the upper ends of the elbows 21. The cross-section of the pipe 22 exceeds that of the pipe 21 sufficiently to compensate for the expansion of the heated air.

If desired, the solid stays 17 may be supplanted by stays 58 of hollow or tubular formation, that will provide passageways 59 for conducting the heated gases from the front side to the rear side of the air-cases 12, as shown in Figures 6 and 7.

The construction of the furnace having been fully described, its mode of operation will be readily comprehended. The fuel bed is preferably built up until its top is slightly higher than the top of the lining 9, coke being the usual and preferred fuel. After the ignition and usual preliminary combustion in the fuel bed, the motor 48 is started, thereby delivering a blast through the air-cases 12 to the tuyères 8. The ascending gases in the furnace heat the air-cases 12, and thereby in a short while the air passing through the chambers 56 in the air-cases emerges from the tuyères into the furnace at a temperature ranging from three hundred to five hundred degrees Fahrenheit. When the fuel has been brought to the full or desired temperature, and not until then, the first charge of metal is put on, then fuel on top of the charge to an amount equal to that consumed per charge of metal. As soon as the first charge of metal has melted down until it is out of view of the operator, the next charge of metal and then the layer of coke on top of it is put on similarly to the manner in which the first charge was put on. These operations may be continually re-enacted to form a continuous process or supply of molten metal, since the intervals of the metal charges are such that each charge melts and merges with the previous charge before the latter has been entirely drawn out.

It has been ascertained that this process effects a twenty per cent. reduction in melting time, reducing it from about twelve to nine minutes, and furthermore effects a twenty-five per cent. saving in fuel. The temperature is governed by the depth of fuel under the metal charge; and about one hundred cubic feet of air is delivered for each pound of coke under three-fourths of an ounce to one ounce above normal atmospheric pressure. The heat absorbed by the air cases for preheating the blast is utilized between the tuyères and the melting zone, where it is most effective, instead of passing out through the stack. The higher temperature produced by the preheated blast decreases the time of melting, and thereby the oxidation, which is especially important in the melting of non-ferrous metals such as bronze or brass or their constituents. Since the metal is not charged until the furnace is at full temperature and the previous charge has melted down, there is no oxidation prior to the short time of the actual melting of each charge, in contradistinction to the oxidation that would occur if the furnace were charged with alternate layers of coke and metal proior to the ignition, as is customary in the operation of melting cast-iron. Furthermore, because of the hot blast and resulting higher temperature in the melting

zone, the percentage of carbon monoxide is materially increased, which increases the reducing character of the gases in the melting zone and thereby further tends to reduce oxidation of the heated metal. Prior to the present invention, about ten per cent. of the volume of the charge had become slag, which tends to chill and thicken and thereby retard the distribution of air through the fuel mass. When, however, the blast is preheated, the slag is materially reduced in amount, and, besides, being more highly heated, attains a greater fluidity that offers less interference to the flow of the blast.

Having thus fully described this invention, I hereby reserve the benefit of all changes in form, arrangement, order, or use of parts, as it is evident that many minor changes may be made therein without departing from the spirit of this invention or the scope of the following claims.

I claim:

1. A melting furnace having tuyères, an air-preheating chamber within the furnace, means for supplying air to the chamber from the exterior of the furnace, a pipe extending from the air chamber through the wall of the furnace, a windbox for distributing the air from the said pipe to the tuyères, and an insulating jacket inclosing the windbox and the part of the said pipe disposed exteriorly of the wall of the furnace.

2. An air-case for use on the wall of a furnace, the said case being perforated from its interiorly presented side to its exteriorly presented side without effecting communication thereat to the interior of the case.

3. A melting furnace having tuyères, an arcuate air case in the interior of said furnace, said case having a curved outer wall and a corrugated inner wall to compensate for the difference of expansion between the walls, and means for conveying air from said air case to the tuyères.

4. A melting furnace having tuyères, an arcuate air case in the interior of said furnace, said case having a curved outer wall and a corrugated inner wall to compensate for the difference of expansion between the walls, stays connecting the inner and outer walls, and means for conveying air from said case to the tuyères.

5. A melting furnace having tuyères, an arcuate air case in the interior of said furnace, said case having a curved outer wall and a corrugated inner wall to compensate for the difference of expansion between the walls, stays connecting the inner and outer walls, perforations extending through the stays, and means for conveying air from said case to the tuyères.

In testimony whereof I hereunto affix my signature.

SAMUEL W. CRAWFORD.