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APPARATUS FOR EFFECTING HEAT TRANSFER

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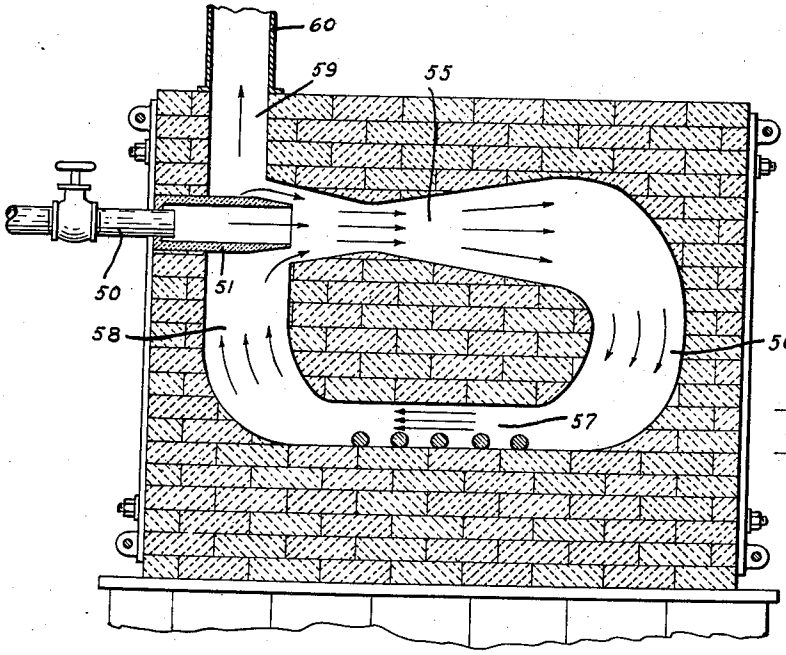


Fig. 2.

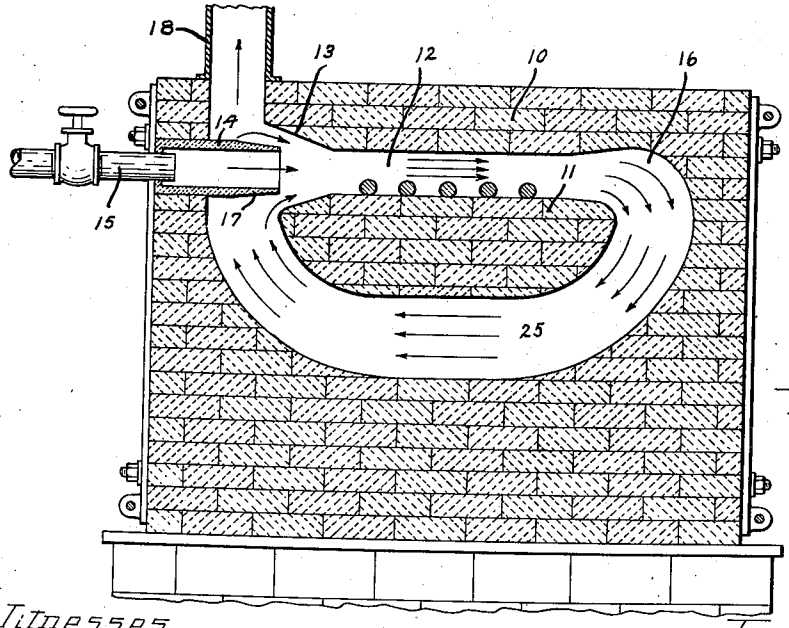


Fig. 1.

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APPARATUS FOR EFFECTING HEAT TRANSFER.

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This invention relates to furnaces.

One of the principal objects of the invention is to provide a method of heat interchange, applicable to furnaces, and the like, which is efficient and simple in operation; and apparatus adapted for the carrying on of that method.

Other objects and advantages of the invention will be apparent from the description set out below when taken in connection with the accompanying drawing.

In the transfer of heat from a gas, or a mixture of gases, to a body, the rate of heat transfer is dependent upon the differential temperature which exists between the heated gases and the body to be heated, and the quanity of heated gases which are brought in contact with the body to be heated. For a given temperature differential, therefore, the transfer of heat is dependent upon the quanity of the heated gases passed over the body to be heated. The greater the actual weight of the gas passing over the body to be heated during a given time interval, the greater will be the amount of heat transferred into that body.

The conventional furnace practice heretofore has been to burn the fuel to attain the highest flame temperature possible, and to pass the resulting hot products of combustion into the furnace, on one side of the hearth and out of the furnace on the other side of the hearth, this construction being such that the hot products of combustion pass across the hearth and the material resting thereon giving up heat to that material on the way. In this conventional construction the temperature immediately adjacent the point of ingress of the hot products of combustion is much higher than the temperature immediately adjacent the point of egress, and the material is, therefore, not uniformly heated.

In the invention forming the subject matter hereof, the furnace is provided with a heating chamber of small capacity, means being provided for forcing the hot products of combustion through this chamber and over the hearth at a comparatively high velocity, so that for a given time interval, a large weight of the heated gases will be brought into contact with the material to be heated. Since such a large quantity of the hot products of combustion is brought into contact with the body being heated it is not necessary, or desirable, that the temperature of the products of combustion be extremely high, inasmuch as the same heat transfer can be secured without a very high temperature differential, as would be secured where the temperature of the hot gases is much higher but a smaller weight of gases is brought into contact with the material being heated. In practicing the method of heat transfer, according to this invention, the heating chamber of the furnace is so arranged that considerable quantities of the hot products of combustion will be mixed with the incoming heated products of combustion and the mixture caused to circulate at high velocity through the heating chamber, and over the hearth.

In the drawing, herewith, in which like characters of reference designate like parts throughout the several views thereof,

Fig. 1, is a sectional view through a furnace constructed in accordance with this invention, the furnace being shown constructed of suitable brick, or analogous material; and

Fig. 2, is a slightly modified form of construction.

Considering first the modification shown in Fig. 1, the numeral 10 designates the top wall of the furnace. Spaced from the top wall a suitable distance is an arch or cross wall 11, which serves as the hearth to receive the material to be heated, the space between the member 11 and the top 10 constituting a heating chamber 12. The material to be heated is introduced into the heating chamber through a suitable door, or opening, not shown. Extending into the heating chamber 12, is a hollow refractory member 14, within which is positioned the end of the pipe 15, adapted to supply a mixture of air and gas, or other suitable fuel, under pressure. The construction of the top wall 10 and the hearth member 11 is such that the side of the heating chamber which receives the refractory member 14 is flared, as shown at 13 the other side of the chamber being correspondingly flared, as shown by the numeral 16, the heating chamber being thus in the nature of Venturi shape in cross section, as clearly shown in the drawing. The refractory member 14 has its end suitably tapered, as shown at 17 to correspond with the shape of the flared portion 13 of the heating chamber 12. The heating

chamber also has opening therefrom an exhaust or vent pipe, 18.

Beneath the arch 11 is a passage 25, preferably of considerably greater capacity than the chamber 12, which is connected at one end to the inlet side 13 of the chamber 12, and at the other end to the outlet side of said chamber. The refractory member 14 is so positioned that it extends across one end of the passage 25, the construction being such that as the hot products of combustion issue from the member 14 under high velocity and sweep across the hearth 11, through the chamber 12, they will tend to entrain and draw with them, through the passage 25 the gases within that chamber. This construction constitutes in effect a jet pump. During operation the passage 25, therefore, will be under suction at one end while its other end will be under pressure, and there will be a circulation of a part of the hot products of combustion sweeping through the chamber 12 down through the passage 25 into the flared end 13 of the chamber, where these products of combustion will mix with the incoming highly heated products of combustion resulting from the burning of the mixture escaping from the pipe 15. All of the hot products of combustion, of course, will not be recirculated through the passage 25 and heating chamber 12, but during operation a certain proportion of the gases within the furnace will escape through the pipe 18 the amount of gas escaping through that pipe being just equivalent to the amount of fresh products of combustion introduced into the furnace as a result of the burning of the fuel introduced through the pipe 15.

By means of this construction, when the combustible mixture is fed through the pipe 15 under pressure, the resulting hot products of combustion passing out of said refractory member 14 under high velocity, will entertain considerable quantities of gases within the passage 25 and will cause the resulting mixture to flow very rapidly through the Venturi shaped chamber 12 thus bringing a large weight of heated gases per unit of time into contact with the material upon the hearth 11. Of course when the furnace is first started the gases within the passage 25 may be cold, but as the operation continues the walls of this chamber will be very highly heated, so that during continued operation the temperature at the inlet side 13 of the chamber 12 will be very little higher than the temperature at the outlet side 19. Consequently a uniform heating will be secured throughout the furnace and in addition, because of the large weight of gas that is brought into contact with the material to be heated, a very rapid heating will be secured. It should be noted that because of the small volumetric capacity of the heating chamber, substantially all the heated gases passing therethrough are brought into heat transferring contact with the material upon the hearth. Passing the gases through the chamber under high velocity, therefore, will insure bringing a large quantity, or large weight, of these gases into contact with the material being heated.

The refractory member 14 is preferably made of such length that combustion of the fuel is practically completed within that member so that only hot products of the combustion will issue from that member to mix with the products of combustion within the furnace; but of course this is not essential.

In Fig. 2 is shown a slightly modified form of construction, which differs from the form shown in Fig. 1 primarily in that the heating chamber and hearth carrying the material to be heated are so positioned that the hot products resulting from the combustion at the burner do not pass directly into the heating chamber.

In this construction a combustible mixture under pressure is introduced through the pipe 50 into the refractory member 51, where it is burned to substantially complete combustion. The refractory member has the outer end thereof tapered, as shown, and extends into one end of the passage 55, which is shaped to form a Venturi tube, this passage and the cooperating refractory member constituting an injector or jet pump. The end of the passage into which the refractory member 51 extends has the walls thereof inclined at substantially the same angle as the tapered end of the refractory member. The other end of the passage 55 opens into the passage 56, which in turn opens into the one side of the heating chamber 57. The other side of the heating chamber 57 has connected thereto a passage 58, substantially the same in construction as the passage 56, which opens into the passage 59, which in turn is connected to the atmosphere and serves as a vent or exhaust passage. Preferably a suitable flue 60, which may be of any desired construction, is associated with the outer end of the passage 59 to carry off the products of combustion escaping therethrough. The passage 55 is connected at one end to the passage 58 and the vent passage 59, the refractory member extending across these passages. By means of this construction as products of combustion under considerable velocity issue from the end of the refractory member 51 they will entrain and draw with them some of the gases within the passage 58. As a result there will be a circulation of the hot products of combustion through the passage 55, the passage 56, the heating chamber 57 and the passage 58 back into the passage 55 for recirculation. Part of the hot products of combustion will pass out through the vent

passage 59, the amount escaping, as is the case with the modification shown in Fig. 1, being governed by the quantity of fresh products of combustion introduced from the burner.

In this construction, as in that described above in connection with Fig. 1, the combustible mixture being introduced under considerable pressure, a considerable velocity of flow is attained by the ingoing and recirculating products of combustion and, because of the comparatively small capacity of the heating chamber, this considerable velocity of flow is maintained within the heating chamber. Consequently a large weight of hot gases is brought into contact with the material to be heated, for a given interval of time, and rapid heating of the material on the hearth of the heating chamber is therefore secured; substantially uniform temperature conditions being also attained within the heating chamber, as set out above.

While the method herein described, and the forms of apparatus for carrying this method into effect, constitute preferred embodiments of the invention, it is to be understood that the invention is not limited to this precise method and forms of apparatus, and that changes may be made in either without departing from the scope of the invention which is defined in the appended claims.

What is claimed is:

1. In a furnace construction of the character described, a heating chamber, adapted to receive material to be heated, said chamber being of small capacity, the opposite sides of said chamber being flared so that said chamber constitutes in effect a Venturi tube, a nozzle extending into one side of said heating chamber, a vent pipe connected to said heating chamber, and a passage connecting the opposite sides of said heating chamber, said passage at one end terminating in cooperative relation with said nozzle, the construction being such that as hot products of combustion are introduced through the said nozzle, into said heating chamber, under high velocity, to pass through said heating chamber, a part of the previously formed products of combustion will be caused to recirculate through the said passage back into the combustion chamber, another part of the products of combustion passing off through the vent pipe.

2. A furnace, of the character described, comprising a heating chamber of small capacity, a flared inlet opening at one side of the heating chamber, a flared outlet opening at the other side of the heating chamber; a passage connecting the flared outlet opening and the flared inlet opening; a vent pipe connected to said chamber; and a nozzle, through which products of combustion under pressure are introduced, positioned within said flared inlet opening, the construction being such that as the products of combustion pass from the said nozzle into the inlet opening and thence to the heating chamber, previously formed products of combustion will be entrained and drawn through the flared inlet opening into the heating chamber for admixture with the newly-introduced hot products of combustion.

3. A furnace, of the character described, comprising a heating chamber of small volumetric capacity, an inlet passage opening into the heating chamber at one side thereof, an outlet passage opening from the heating chamber, said outlet passage being connected to the said inlet passage and also to a vent pipe; and a nozzle opening into said inlet at its place of connection with the said outlet passage, the construction being such that as products of combustion under high velocity are introduced through said nozzle previously formed products of combustion will be entrained from the outlet passage and admixed with the newly formed hot products of combustion to be passed through the heating chamber.

In testimony whereof I hereto affix my signature.

HARRY F. SMITH.