METHOD OF HEATING MATERIAL

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This invention relates to the heating of metal sheets, bars, plates, and the like, generally preparatory to subsequent operations such as rolling, forging or forming, as well as to the heat treatment of metals for attainment of optimum physical properties.

For effective performance of such heating operations the material should be raised to the desired temperature in a minimum of time with the expenditure of a minimum of fuel and without extensive oxidation and scaling of the metal. To this end, it is desirable to employ a luminous flame since because of its radiant character the rate of heat transfer therefrom is higher than from a non-luminous flame of like temperature. A body may therefore be heated to a given temperature in a given time either by a luminous flame of relatively low temperature or by a non-luminous one of relatively high temperature, or may be heated to a given degree by a luminous flame in a shorter time than by a non-luminous one of the same temperature.

It is further known that it is desirable to effect the heating in a reducing atmosphere so as to reduce scaling and oxidation of the metal which generally results from the presence of an excess of oxygen in the burning gases and which, in the ordinary methods of combustion heretofore practiced, it is extremely difficult to prevent. A common method of creating such a reducing atmosphere within the furnace is to increase the proportion of gas to air supplied or to reduce the proportion of air to gas supplied, but this procedure is not only wasteful of fuel but does not result in the production of the desirable luminous or radiant flame without which, as heretofore explained, maximum efficiency of heat transfer cannot be effected.

A principal object of the present invention, therefore, is to provide a novel method of heating material in a gas fired furnace by means of which a luminous heating flame is produced and a reducing atmosphere maintained within the furnace, the method contemplating preliminary enrichment of the fuel gas by suitable treatment with a hydrocarbon and resulting in, among other things, more efficient heating conditions than have heretofore been generally obtainable, and a considerable saving in material, first, through substantial elimination of loss of the material itself by oxidation and scaling and, second, because less material is thereby rendered unfit for subsequent rolling and like operations.

A further object of the invention is to minimize the time required to heat the material to a given point.

A still further object of the invention is the production on the articles heated of a thin protective coating adapted to prevent them from sticking together in subsequent operations as, for example, when sheets after the heating are piled together preparatory to subsequent rolling, thus avoiding the necessity for the usual charcoal dipping of alternate sheets or equivalent operations required when sheets are heated by the methods commonly in vogue.

The invention further includes various other objects, novel features and operations hereinafter more particularly pointed out or which will be apparent as the description of the invention proceeds.

To enable those skilled in the art to comprehend and practice the invention, we shall now describe one manner of performing the method thereof, during which reference will be had to the accompanying drawing in which we have diagrammatically shown one form of apparatus particularly adapted for the purposes of the invention, and it will be more convenient for us to explain the apparatus and then refer to its manner of operation in the practice of the method.

Referring to the drawing, therefore, the single diagrammatic figure of which may be considered as a substantial side elevation, the apparatus is shown therein as applied to a furnace F which may be of any type suitable for the treatment of sheets, bars, plates, or other generally similar material.

Fuel gas for combustion is initially supplied from any suitable source such as a gas producer P from which a main gas conduit 1 is extended toward the furnace and suitably connected to the burner or burners thereof either directly, or when the furnace is provided with a plurality of burners, to a header extending adjacent the burners to which the latter are individually connected. For convenience we have assumed the furnace is equipped with two burners (not shown) and the conduit therefore provided with branches 2, 3 respectively extending thereto.

Leading from the source of gas supply P is another conduit 4 which may be provided with a control valve 5 and which terminates within an operatively closed receptacle or casing 6 which for convenience we may term the carburetor. This carburetor is adapted to contain a suitable hydrocarbon, desirably tar, although under certain conditions benzol, oil or various other materials may be found satisfactory, and is pro-
vided with a cover ported by a removable lid 7 through which the hydrocarbon may be introduced in quantity sufficient to partly fill the carburetor preferably about to the level indicated by the line 8. The conduit 4 is extended down into the casing so as to terminate either slightly above the level of the hydrocarbon, as shown, or else somewhat below that level, and for maintaining the material in a fluid or substantially fluid condition a steam coil 9 or other heating medium may be arranged within the casing and supplied with steam through inlet and outlet lines 10, 11.

From the upper part of the carburetor a conduit 12 is extended; as shown, this conduit is provided with branch 13, 14 respectively directed to cleaners 15, 16 conveniently which are of similar construction, and which may thus respectively comprise a closed casing within which is desirably disposed a steam coil or other heating medium 17.

As a matter of convenience, the steam or other heating medium may, as shown, be led from a supply pipe 18 upwardly through the coil 17 in the cleaner 16, thence through the intake pipe 10 to the bottom of the coil 9 in the carburetor, and thence through the outlet pipe 11 to the top of the coil 17 in the cleaner 15 and discharged from the latter through the outlet 19, a valve 20 suitably positioned in the pipe 18 being desirably provided to regulate the passage of the steam.

From a point adjacent to the top of the casing of the cleaner 15 a conduit 21, which may include a control valve 22, is led to the branch 2 of the main conduit 1, and in like manner another conduit 23, which may likewise include a control valve 24, is led from the upper part of the casing of the cleaner 16 to the branch 3 of the main conduit. Desirably, each of the cleaner casings as well as the carburetor casing is provided near its bottom with a valve controlled outlet 25 through which the hydrocarbon material contained in the carburetor and the residues collecting in the cleaners may be drawn off when and as desired.

In the practice of the method of our invention by means of an apparatus of the general character of that to which we have referred, a portion of the gas which is to be burned in the furnace is drawn from the producer or other source through the conduit 4, while the remainder passes directly to the furnace through the conduit 1 and branches 2, 3. The gas passing through the conduit 4 enters the carburetor and is there either drawn over the tar or other hydrocarbon contained therein in the conduit terminates above its level as shown, or through the hydrocarbon in case the level of the latter reaches above the lower end of the conduit; in either case, the resultant effect is to enrich the gas with hydrocarbon to a point materially in excess of its normal hydrocarbon content as it issues from the producer or other source P. From the carburetor the enriched gas passes upwardly through the conduit 12 and thence through the conduits 13, 14 respectively to the cleaners 15, 16, in each of which its velocity is diminished so that a considerable portion of the entrained particles and other impurities are released and fall to the bottom of the cleaners, from which they may be drawn off from time to time through the outlets 25. The carbonized by enriched gas then passes through the conduits 21 and 23 to the branches 2, 3 of the main conduit, where it mixes with the unenriched gas coming directly from the producer preparatory to combustion in the furnace, with resulting production of a luminous flame and a reducing atmosphere thereof.

While the form of apparatus to which we have referred is a convenient one, it is of course capable of modification in many particulars to adapt it for use with different numbers of burners and/or under variant conditions encountered in commercial installations. In many cases, the use of but one cleaner may be found desirable, and it will be apparent that the conduit leading therefrom may then be tapped directly into the main conduit 1 or into the header with which it is usually connected when a considerable number of burners are employed, the ultimate object in any case being to provide sufficient hydrocarbon enrichment of the fuel gas when delivered to the burner or burners to produce a luminous flame and reducing atmosphere within the furnace when it is burned therein. To this end it will generally be preferred to treat only a portion of the total fuel gas with the hydrocarbon as herein more particularly described, but it is within the purview of our invention to subject all of the fuel gas to such enriching treatment by passing all of it through the carburetor preparatory to delivery to the furnace, the apparatus in such case being of course suitably modified to effect this result.

It will be understood that the provision of heating means in the carburetor, and preferably in the cleaners as well, is for the purpose of maintaining their contents in fluid or substantially fluid condition, a greater or less amount of heat being utilized in accordance with the particular conditions surrounding the installation and the nature of the hydrocarbon employed.

While for convenience of illustration we have shown in the drawing the conduit 21 as considerably longer than the conduit 23, it will usually be found preferable when two or more cleaners are employed to make the delivery conduits therefrom of substantially equal length so that the draft therethrough will be similar and also to arrange the other conduits in such manner as likewise to equalize their draft to the end that, as will be readily understood by those familiar with the art, the distribution of similar amounts of fuel will be ultimately delivered to each of the furnace burners.

The practice of our invention results, among other things, in maximum heat transfer to the material being heated, thus enabling a given heat transfer to be effected thereto in a given time by the use of a flame of lower temperature than has heretofore been practical in heating operations of the character of those to which our invention relates, while the maintenance of a reducing atmosphere within the furnace and absence of excess oxygen minimize the oxidation of the material and production of scale thereon.

Moreover, it is found that a thin protective coating is produced on material heated in accordance with our method which is effective to prevent the sticking together of pieces of the material when they are later piled on each other. This is of especial advantage in the case of sheets which, after the heating, are customarily piled together preparatory to subsequent rolling in packs. Hereunto it has been necessary in order to prevent the sheets from sticking together, to dip alternate sheets in charcoal while they are being piled up, an operation which consumes considerable time and is relatively costly. Sheets heated in accordance with our method, however, and thus provided...
with the protective coating to which we have referred, do not stick when subsequently piled and rolled in packs, so that the charcoal dipping or equivalent operation can be dispensed with and the cost of production correspondingly lowered.

It will be apparent from the foregoing that our improved method of heating material is capable in practice of considerable variation without departing from the principles thereof as herein disclosed and further, that apparatus of forms other than that to which we have referred may be employed in its performance if desired, and it is therefore our intention neither to confine nor restrict ourselves to any precise details of operation in the practice of the method, nor to any particular form of apparatus for carrying it out so long as they fall within the spirit and scope of the invention as defined in the appended claims.

Having thus described our invention, we claim and desire to protect by Letters Patent of the United States:

1. The method of heating material in a gas fired furnace which comprises the steps of bringing fuel gas into contact with a hydrocarbon to enhance the normal amount of hydrocarbons contained in the gas, then mixing the gas so enriched with hydrocarbon with the other fuel gas containing a normal amount thereof, and finally burning the mixture in the furnace in such manner as to produce therein a luminous flame and a reducing atmosphere.

2. The method of heating material in a gas fired furnace which comprises the steps of increasing the normal hydrocarbon content of part of the total fuel gas prior to introduction to the furnace by bringing it into contact with a hydrocarbon in fluid condition, then mixing the gas with the remainder of the total fuel gas, and finally burning the mixture in the furnace in such manner as to produce a radiant flame and reducing atmosphere wherein during the heating of the material.

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