May 12, 1953 F. O. HESS 2,638,333

CONTINUOUS FURNACE

Filed Aug. 25, 1950

FIG. 1

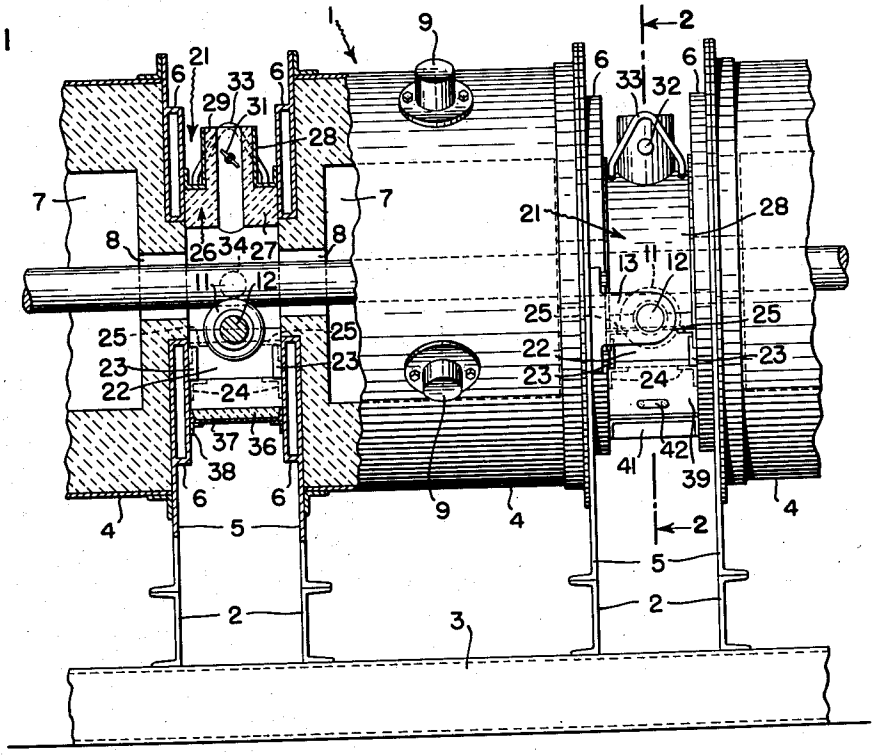


FIG. 3

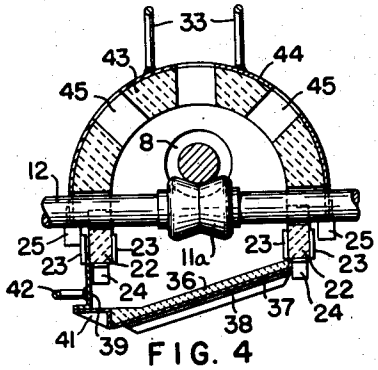


FIG. 4

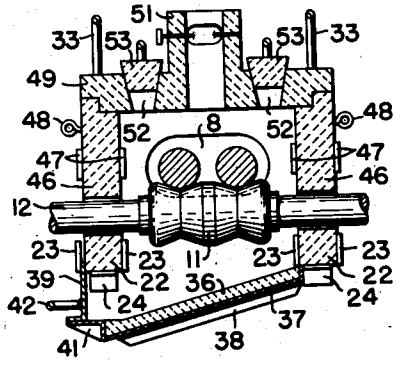
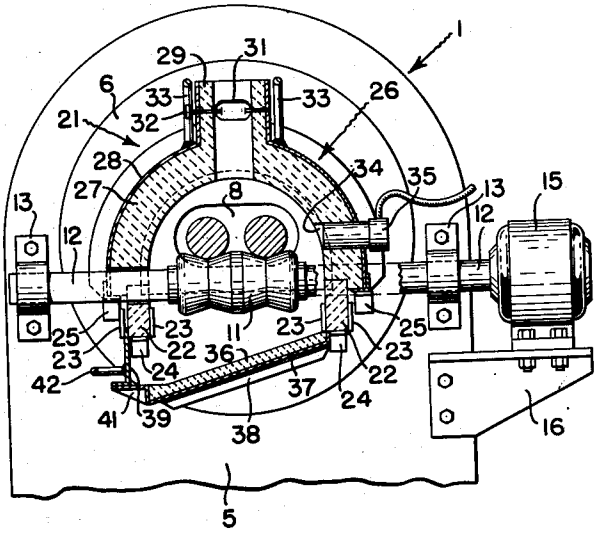


FIG. 2



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CONTINUOUS FURNACE

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Application August 25, 1950, Serial No. 181,336

3 Claims. (Cl. 263—3)

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This application is a continuation-in-part of my application Serial Number 103,371 filed July 7, 1949 and now abandoned.

The present invention relates to the heat treating of metal, and more particularly to the construction of a housing structure to be used between the furnace units of an elongated continuous heat treating furnace.

One form of continuous metal heating furnace that is in use at the present time comprises a number of small furnace units that are aligned axially with each other. Enough of these furnace units are used in each installation to raise the work being heated to the desired temperature. Each of the furnace units is cylindrical or barrel shaped and is provided with a similarly shaped chamber that is fired to a high temperature. The ends of the chamber are provided with axially aligned openings through which the work enters and leaves. The furnace units are mounted in axial alignment, and a conveying roller is placed between each unit to forward the work. In this manner the work is progressively heated as it moves from end to end of the furnace.

When in operation, the hot products of combustion are exhausted through the ends of the furnace units in what is generally called a "sting-out" to protect the heated work from the oxidizing effect of the atmosphere. As the hot gases leave the furnace units they begin to rise, so that the lower portion of the work is not covered by as thick a layer of gases as is the upper portion. This condition is augmented by the fact that the hot gases have a tendency to create an upward draft of cold air between the furnace units. This air chills the lower portion of the protective coat or sleeve of combustion gases around the work, so that the work is unevenly heated as it is passing between the furnace units. It has been found in some instances that the temperature of the work actually dropped slightly as it was passing from one furnace unit to the next. Quite frequently the "sting-out" impinges upon the conveying mechanism, usually water cooled, and at times heats up the supporting means and bearings therefor to an objectionable extent.

It is an object of the invention to provide a shield or housing around the work and its conveying mechanism between furnace units of a sectional furnace structure to protect the work from loss of heat and uneven heating due to drafts created between the furnace units by the "sting-out" and by excessive radiation to the atmosphere. This housing, in effect, provides a soaking zone between heating zones.

It is also an object of the present invention

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to provide a shield or housing between the furnace units that will control the "sting-out" so that it will protect the work being heated, but will not unduly heat up the various parts of the conveyor supporting mechanism. It is a further object of the invention to provide a shield or housing between the furnace units that will, in effect, join them into a single elongated structure that is individually fired in a plurality of zones.

The shield or housing is provided with openings so that it serves as a stack through which the products of combustion are withdrawn between the furnace units or zones. By varying the size of the openings the pressure of the gases around the work and in the furnace chambers may, to some extent, be varied. It is, therefore, a further object of the invention to provide a means for controlling the flow of exhaust gases from the furnace units to control the pressure in the furnace chambers and the space between them.

The various features of novelty which characterize my invention are pointed out with particularity in the claims annexed to and forming a part of this specification. For a better understanding of the invention, however, its advantages and specific objects attained with its use, reference should be had to the accompanying drawings and descriptive matter in which I have illustrated and described a preferred embodiment of the invention.

In the drawings:

Figure 1 is a side view showing a continuous heat treating furnace, with a portion thereof in section;

Figure 2 is a view taken on the line 2—2 of Figure 1; and

Figures 3 and 4 each are views similar to Figure 2 and show different modifications of the invention.

Referring to Figure 1, there is shown a section of a continuous heat treating furnace which is formed of a number of furnace units 1. These units are mounted on suitable supports 2, that are in turn fastened to a foundation 3. The foundation may take the form of a pair of elongated channels, or it may be the foundation of the building in which the furnaces are being used. The number of furnace units that are contained in each continuous furnace or furnace system will vary depending upon the temperature to which the work is to be heated and depending upon the size and analysis of the work. In any event, each of the furnaces includes a number of furnace units 1.

Each of the furnace units 1 is in effect a small

individual furnace. These furnace units are cylindrical in shape and are formed by a sheet metal cylindrical shell 4, that is supported at each end by plates 5 which are attached to supports 2. It is noted that the plates 5 may be of metal and serve merely as supports or they may have water-cooled heads 6 on their outer faces, as is shown in the drawing. The shell is lined with suitable refractory material that is capable of withstanding the heat to which the furnace will be fired and is provided with a chamber 7, having axially aligned openings 8, extending through each of the heads. The furnaces are fired with any suitable type of burners that are capable of maintaining the temperature to which the work is to be raised. It is preferable, however, that the burners 9 be of the type disclosed in application Serial Number 56,616, filed October 26, 1948 by A. A. Furczyk, now Patent No. 2,561,793.

In the operation of a furnace of this type, elongated work to be heated is fed by suitable conveying means into one end of the furnace and successively through the various furnace units and out the other end of the furnace. During the time that the work is passing through furnace units it is being progressively heated to bring it to the temperature which is desired. In order that the work may be forwarded through the furnace, there is provided between each of the furnace units a conveying roller 11, as is shown best in Figure 2 of the drawing. This roller may be water cooled, if desired, and in any event it is mounted on a shaft 12 that is journaled for rotation in bearings 13 which are attached to suitable blocks 14 extending forwardly from the supporting plates 5 for the furnace units. It is noted that each of the furnace units has supports on it for one conveying roll 11. Each of the conveying rolls is driven at the same speed, and for this purpose is preferably driven by an electric motor 15, that is attached to the end of shaft 12 and is mounted upon a bracket suitably secured to the end-plate 5. Each conveying roller 11 may have its axis parallel to the faces of the adjoining furnaces, or at an angle thereto. In the first case the work will be moved through the furnace without rotation. In the latter case the work will be rotated about its axis as it is being moved axially. This type of conveyor roll mounting is frequently used to insure even heating around the work.

When the furnace system is being fired the burners 9 and the walls of the chambers 7 are heated to incandescence so that radiant heat is projected against all sides of the work passing through the furnace chambers. When the burners are fired large volumes of burned gases result as the products of combustion, and these gases are exhausted at high velocity through the openings 8 at the ends of each furnace chamber. These hot products of combustion are called a "sting-out" and serve the purpose of completely enveloping the work as it is moving between a pair of the furnace units so that the surface of the work cannot become oxidized. Since the products of combustion are composed of heated gases, there is a natural tendency for them to rise. In some cases, particularly when the furnace is being fired at a low rate, the gases will tend to rise quickly enough so that the work extending between the furnace units is not entirely covered, thus resulting in uneven heating. At other times, when the furnaces are being fired at capacity the opposing blasts of these products of combustion meet each other between the furnace units and spread to both sides as well as upwardly. In either case there is a tendency to induce a draft of cold air upwardly across the conveying roll 12 and that portion of the work extending between furnace units. Not infrequently, also, the hot gases mushroom out so that the bearings in which the shaft 12 is rotatable are heated to an excessive temperature. Some means must, therefore, be devised to insure that the exhausting products of combustion will at all times completely envelop the work as it is passing between the furnace units without inducing a cooling draft across the work, but will nevertheless be prevented from impinging against the bearings in which the shaft 12 is mounted. Such a means in combination with the furnace units themselves forms the primary subject matter of this invention and will now be described in detail with particular reference to Figures 1 and 2.

By reference to Figures 1 and 2 it will be seen that there is provided a shield or housing 21 which completely surrounds the work and its supporting roller. The housing 21 is supported jointly by the end plates 5 or the water jackets 6 of adjoining furnace units and includes a pair of refractory side blocks 22 which extend downwardly below the shaft 12 of the conveyor roll. The upper surface of each of these blocks has a semi-circular cut in it to receive the ends of the shaft that extend beyond the housing. These blocks are supported by angles 24 that are welded to the faces of the furnace units and are maintained in position by plates or lugs 23 which project forwardly from each of the furnace units. The top portion of the housing comprises a semi-cylindrical member 26 which engages the top edges of blocks 22 and extends around the upper portion of the openings 8 of the furnace units. The weight of this member is supported by angles 25 that are welded to the faces of the furnace units. Each side of member 26 is provided with a semi-circular cut out portion cooperating with the similar portions of blocks 22 to form an opening through which the shaft 12 extends. Members 26 are made of suitable refractory material 27 that are backed up by metal sheet work 28 in accordance with standard furnace construction practice. The upper part of the member 26 is provided with an upwardly extending projection which forms a stack 29 through which the products of combustion are exhausted. Exhaustion of these products of combustion is controlled by a damper 31 located in the stack. The damper can be adjusted manually in the usual fashion by a handle 32 on its shaft or, if desired, can be adjusted automatically in any conventional manner in accordance with furnace pressure. This member 21 can be lifted into and out of place in order to afford access to the conveying rolls 11 by lifting lugs 33 that extend from the upper surface thereof.

One or more of the members 21 extending between the furnace units is provided with an opening 34 that is aligned with the work passing between the furnace units. In this opening there is placed a radiation responsive pyrometer 35 that can be used to measure the temperature of the work.

The bottom of the housing between the furnace units is formed by a floor that comprises a block of refractory material 36 which is backed up by suitable reinforcing metal 37. This block is supported by angle irons 38 that extend outwardly from the faces of the furnace units. As

shown herein, the block slopes downwardly at an angle to the horizontal so that any scale or dirt which may fall from the work being heated can easily be removed through the space between the lower surface of the left block **22** and the upper surface of the floor **36**. Since the opening between the floor and the lower surface of the left block **22** would permit an inflow of air that would have a cooling effect upon the work, this opening is closed by a door **39** which rests upon an extension **41** of the reinforcement **37** of the floor. The upper end of the door can be received and held in place between the block **22** and one of the lugs **23**, as is best shown in Figure 2 of the drawing. A handle **42** is provided by means of which this door can be removed for cleaning purposes when it is so desired.

The embodiment of the invention disclosed in Figure 3 is substantially the same as that described above. In this figure, however, the conveyor roller **11***a* is shown as a single conveyor instead of a double conveyor so that only one billet at a time may be heated in the furnace.

In this embodiment of the invention the upper portion of the housing **21** is constructed of refractory material **43** backed up by metal work **44** as was the previously described embodiment. In this case, however, there are provided a plurality of openings **45** through which the exhaust gases from the furnace can pass into the atmosphere. Whether a single damper controlled opening of the type shown in Figure 2 is used, or whether a number of openings of the type shown in Figure 3 are used will depend entirely upon the requirements of a particular furnace installation. This is determined somewhat by the temperature to which the billets are to be heated and also upon the volume of combustion gases that are produced. It is noted that an opening similar to opening **34** may be provided for a pyrometer if such is necessary or desired.

The embodiment of the invention shown in Figure 4 has the lower portion of the housing formed in exactly the same fashion as the lower portion of the housing of the two previously described embodiments. The upper portion of the housing, however, is formed of a number of separate blocks of refractory material. As shown herein, there are provided side blocks **46** which rest upon the blocks **22** and which are guided into position by lugs **47** extending from each of the furnace units. These blocks may be lifted into and out of position by suitable rings **48** through which hoisting apparatus can be inserted. The top closure of the housing comprises a refractory plate **49** that rests upon the upper ends of the blocks **46**. This plate has an opening in the center thereof in which is placed a stack **51** for the exhaust gases. Plate **49** is also provided with openings **52** on each side of the central opening forming the stack which openings are normally closed by plugs **53** of refractory material. In some cases it may be desirable or necessary to have a larger opening for the exhaust gases than is provided by the stack. In such a case the plugs **53** will be removed from the openings **52** and the gases can then exhaust through these openings. It is noted that the stack **51** may be provided with a damper, if desired, and one of the blocks **46** may be provided with an opening to receive a pyrometer for measuring the work temperature.

From the above description it will be seen that the continuous furnace of the invention is made up of a plurality of independent and individual

furnace units which are joined by refractory housings completely enclosing the work and the conveying mechanism between each furnace unit. The housings have been described as being removably placed between the furnace units, but they could be fastened permanently in place, if desired, so that in effect the furnace contains a plurality of chambers with every other chamber being provided with burners and every other chamber that is formed by the housing acting as a soaking chamber in which the heat imparted to the work can soak for a short period of time until additional heat is placed in the work by the next furnace unit **1**. The use of the shields or housings between the furnace units insures that the work will at all times during the heating process be enveloped by products of combustion and that the heating process will be continuous.

While in accordance with the provisions of the Statutes, I have illustrated and described the best form of embodiment of my invention now known to me it will be apparent to those skilled in the art that changes may be made in the form of the apparatus disclosed without departing from the spirit and scope of the invention, as set forth in the appended claims, and that in some cases certain features of my invention may be used to advantage without a corresponding use of other features.

What is claimed is:

1. In a furnace system, the combination of a plurality of axially aligned furnace units each having a chamber and axially aligned entrance and exit openings, conveying means including a horizontally extending shaft having a portion thereof aligned with said openings extending between each pair of furnace units and operative to move work therethrough, and housing means between pairs of furnace units including a pair of side members, means to mount said members jointly on the ends of the units between which they extend with one of said members on each side of said openings and having a portion thereof below said shaft, a floor member extending between the lower ends of said side members to close the space therebetween, and a U-shaped shield removably mounted between the ends of said furnace units adjacent to the upper ends of said side members, said shield extending around the upper portion of said openings and being provided at its ends with means through which said shaft may pass and with a vent opening in the upper portion thereof.

2. The combination of claim 1 in which one side of said floor member is lower than the other, and a normally closed door adjacent to the low portion thereof through which access may be had for cleaning said housing.

3. In a furnace system, the combination of a plurality of furnace units each having a chamber and axially aligned entrance and exit openings, conveying means between each pair of furnace units operable to move the work therethrough and including a horizontally extending shaft, and a housing between each pair of furnace units surrounding the exit opening of one and the entrance opening of the other including a side member of refractory material on each side of said openings having a portion thereof below said shaft and being supported jointly by the furnace units, a substantially U-shaped part having a refractory lining above said side members and surrounding the upper portion of said openings, means to support said part removably above said side members, and said housing also including

a floor portion extending below said openings and between said side members, said floor portion having a refractory lining, said U-shaped part being provided with an upwardly extending vent through which products of combustion discharged from said chambers may be exhausted.

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