July 4, 1950 J. W. CORRISTON 2,513,626

WATER COOLED FURNACE DOOR

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Fig. 1

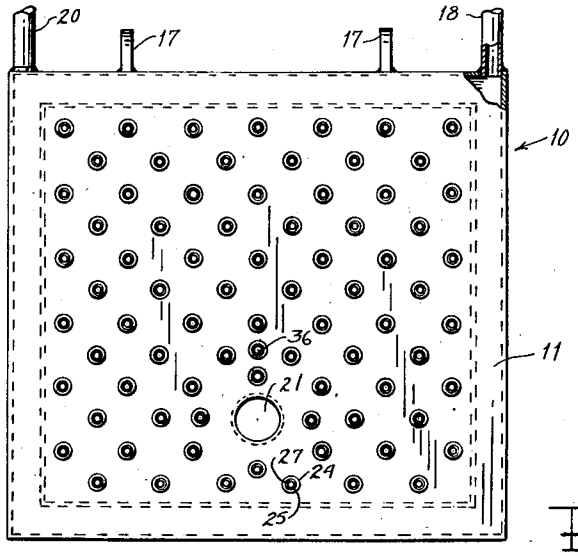


Fig. 2

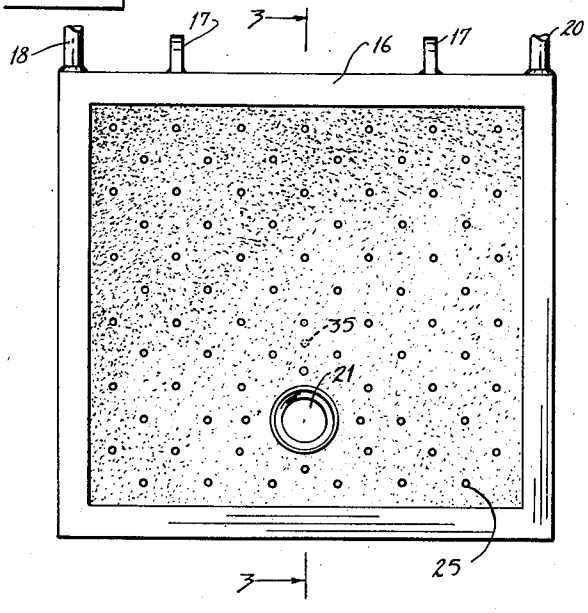
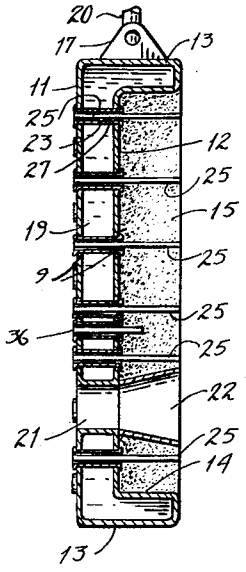


Fig. 3



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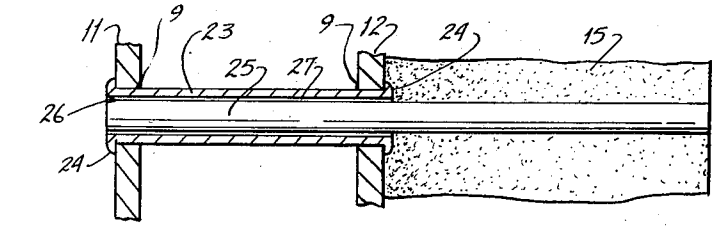


FIG. 4

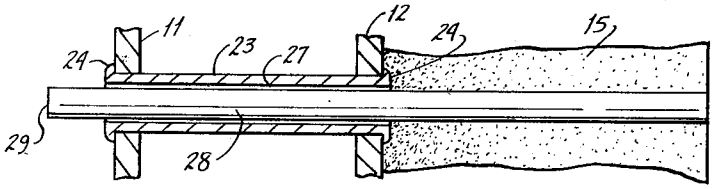


FIG. 5

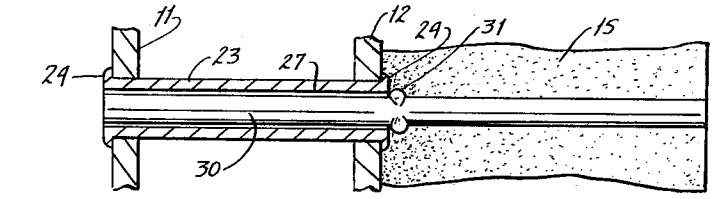


FIG. 6

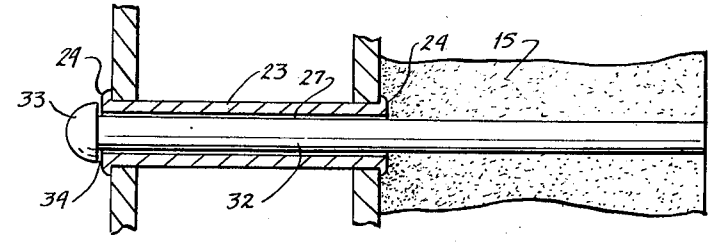


FIG. 7

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WATER-COOLED FURNACE DOOR

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Application September 16, 1947, Serial No. 774,399

4 Claims. (Cl. 122—498)

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The present invention relates in general to water cooled furnace doors of the industrial type and is directed to improvements therein over those shown in my co-pending application, Serial Number 612,067, filed August 22, 1945 for "Water Cooled Furnace Door."

As described in my above-referred to co-pending application, a number of factors are responsible for the comparatively short useful life of industrial type furnace doors; among these factors being the comparatively brief lining life of the refractory material and the erosion or progressive destruction of the studs or weldings used both to cool and support the refractory lining.

In accordance with the present invention, the heretofore costly stud welding operation is eliminated and the door is provided with comparatively heavy walled stay tubes in which are inserted removable studs which provide for the safe escape of moisture from the new linings while also obtaining better thermal contact between the removable studs and the circulating water than obtained in the usual manner by welding the studs to the inner plate. The restudding operation heretofore frequently required, and often rendered impractical by the extent of the damage to the door plates occasioned during the process of burning or knocking off the old welded studs, made essential the replacement of the inner plate or at times even an entire new furnace door.

An object, therefore, of this invention is the provision of an improved industrial type furnace door of the water colled type and of a design and reinforced construction particularly adapted to obviate the necessity of stud welding, pre-drying and operations hitherto required in maintenance and repair of conventional type furnace doors, while assuring a longer life and a more efficient transmission of heat from the lining to the cooling water.

Another object is to provide an industrial furnace door that may be installed immediately, without the necessity of pre-drying and preventing of the lining; that may be quickly assembled and reconditioned without expert supervision; that will assure a longer life for the refractory lining and the heat transmitting studs, and that will indicate externally possible leaks so that impairment of or damage to the component parts may be forestalled.

A further object is the provision of a door of the general characteristics indicated which will afford a structurally stronger door than constructions hitherto available and which will attain a desirable balance among the factors of long lining life, low maintenance cost and minimum cooling effects on the furnace.

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With these and other objects which will appear as the description proceeds, the invention resides in the combination and arrangement of parts and in the details of construction hereinafter described and illustrated and will be best understood by referring to the attached drawings; wherein:

Figure 1 is a front elevational view of a furnace door embodying the invention, as seen exteriorly of the furnace;

Fig. 2 is a rear elevational view of the door as seen from the interior of the furnace;

Fig. 3 is a traverse sectional view, taken on the line, and as seen in the direction of the arrows 3—3 of Fig. 2;

Fig. 4 is a fragmentary, sectional detail view, partly in elevation, and depicting the cooperative association of the heat conducting studs with the hollow stay bolts which secure the inner and outer walls of the furnace door together;

Fig. 5 is a view similar to Fig. 4, but showing a heat conducting stud of greater length and having a portion protruded exteriorly of the door for convenience in disassembling and replacement; also for added air cooling and for estimating the remaining length of the stud by the temperature of the protruding end.

Fig. 6 is a view similar to Fig. 4, showing a heat conducting stud provided with means for preventing axial movement of same outwardly of the stay bolt and;

Fig. 7 is a view similar to Fig. 6, showing a modified form of heat conducting stud.

Referring now to the drawings wherein similar characters of reference indicate corresponding parts in the several views of the preferred form of the invention, 10 designates generally a furnace door embodying the present invention and comprising an outer metal wall or plate 11 preferably of a heat-resistant type of ferrous alloy or a high heat conducting metal, such as copper; and an inner wall or plate 12 of similar material. The outer wall 11 is inwardly directed, as at 13, into welded engagement with the inner wall 12, the latter defining a re-entrant recess or space 14 for the accommodation of a plastic refractory material or lining 15 which is tamped or sprayed into position while moist. The upper marginal portion 16 of the door is equipped with lifting eyes or lugs 17 and has an inlet pipe 18 for circulating water which flows through the chamber or water jacket 19 formed by the walls 11 and 12 and thence outwardly via the outlet 20.

A wicket opening or peephole 21 adjacent the lower central portion of the door 10, is aligned with a frustonical sleeve or member 22 secured to the inner periphery of the wall 12, so that the

interior of the furnace may be inspected during operation, when desired.

As best shown in Fig. 3, and as depicted in detail in Fig. 4 and the ensuing figures, it will be observed that similar aligned openings 9 are provided in the opposed walls 11 and 12 to accommodate stay tubes indicated generally at 23, the outer ends of which are rolled or welded over as at 24 into sealing engagement with the outer adjacent portions of the said walls 11 and 12. Through these stay tubes, which pass through and are cooled by the water in the chamber 19, and in accordance with the present improved form of the invention, heat conducting studs 25, of a suitable metal or a ferrous or non-ferrous alloy, are passed, it being observed that the outer end of each stud, in the form shown in Fig. 4, has a shear burr or other non-encircling projection or deformation as at 26, which is effective to fasten the said studs within their respective stay tubes and against axial movement therein; while permitting, as hereinafter described, the removal of the studs, when desired, by a moderate tap of a hammer.

The crevices or interstices designated generally at 27 between the inner wall of the stay tube and the outer wall of the stud are designed and adapted to play an important function in the operation of the improved form of the device, particularly upon the initial operation of the furnace, since they permit the escape of steam from the moist refractory lining outwardly of the door and on the external side thereof. By this design and construction, the loss of time in reconditioning, hitherto essential in view of the pre-drying of the refractory insulation before actual use of the furnace door, is obviated, since my furnace door can be utilized while the refractory lining is moist without detriment. As described in my above-alluded to co-pending application, the studs 25 are preferably made of a metal or alloy having high heat conducting and heat resisting properties.

In the modified form of the invention illustrated in Fig. 5, the stay tube 23 accommodates a longer type of heat-conducting stud 28, whose outer end is protruded, as at 29, from the external end of the stay tube. This form likewise provides crevices or interstices 27 in order to permit the issuance of steam from the refractory lining, while new and moist, for the reasons described above.

While the furnace is in operation, the extended end of this stud 28 will permit convenient application of a tool for its temporary removal for furnace inspection, etc. as described in my co-pending application alluded to.

In Fig. 6, a modified form of heat conducting stud 30 having deformations or burrs 31 to prevent axial movement in the stay tube and outwardly of the furnace door, is shown. Here again, crevices or interstices are provided for escape of steam.

In Fig. 7, a heat conducting stud 32 having a flared or bolt type head 33 is shown. In addition to the crevices 27, the inner flat side of the head 33 is withdrawn sufficiently from the peened outer end of the stay tube 23, to provide a narrow space 34 for steam escape.

As disclosed in Figures 1, 2 and 3, one or more inspection recesses, as at 35, may be provided for the purpose of determining the condition of the refractory lining material 15. Each of these may include an open stay tube wherein a comparatively short stud or plug 36 is temporarily

placed. These last-mentioned studs or plugs may project slightly from the external side of the furnace door, and may be removed when the door is put on the furnace. All of the studs illustrated in Figs. 4 and 7 inclusive serve not only as means for supporting the refractory lining in the reentrant recess 14 of the door, but also as a means for the cooling of the lining by the normal process of conduction. These studs, in turn, are cooled by the process of radiation and convection of heat from their periphery to the adjacent portions of the stay tubes and across the crevices 27 hereinbefore mentioned.

Although the crevices are depicted in the drawings, by way of example, as a measurable and exaggerated symmetrical annular space encompassing the periphery of the studs, it is to be understood that the actual space or crevices are generally minute and defined generally by the position the stud assumes at the time of its initial entrance into its respective stay bolt. It will be recognized that with the diameter of each stud slightly less than the diameter of the bore of the stay tube in which it is received, a crevice 27 will be defined. This crevice, under practical conditions, will not be the symmetrical space illustrated, as its shape will depend on the relation of the stud and stay tube. The means for fixing the studs in the stay tubes has been indicated generally at 26 as a shear burr, by way of example, and has been described above. I have also found it feasible, with the same end in view, to either nick the stud adjacent its end for the purpose of protruding a burr, or to produce a slight deformation at the other end by a moderate blow of a light hammer.

The refractory and heat conducting studs which I prefer to have a diameter of about ¾" to ⅞" and a length of approximately 8", in view of the high furnace temperatures, enjoy a life which is dependent upon the extent to which their exposed surface is cooled. In the present invention, the mode of cooling, as indicated above, is by radiation and convection within the stay tubes, the latter being preferably arranged in rows with approximately 3" staggered spacing. The method employed obviates the insertion of the heat conducting studs directly in the water of the water jacket 19, yet the mechanical efficiency, in view of their number and comparatively large radiating stud surface is such as to assure long life to refractory lining material by reason of their heat conducting properties. The life of the studs in turn is correspondingly increased.

Among the advantages accruing to the design and construction employed are the elimination of the pre-drying internal steam treatment for the refractory lining hitherto deemed essential after relining a door, but which sometimes consumed several days in order to avoid damage to the lining by a too sudden conversion of steam of the moisture within. By the present design and method, the door can be installed on the furnace immediately after reconditioning and put into operation. The crevices or space mentioned above between the stay tubes and the heat conducting studs will permit the escape of steam from the wet refractory lining, which is generated immediately after the furnace is put into operation on a hot furnace.

Hitherto, it was found that upon any attempt to utilize a furnace door without dehydrating of same to permit the escape of steam, developed a

species of case hardening of the outer part of the lining behind which the steam suddenly generated and trapped, exerted destructive influence and peeled off layers of the lining of various thicknesses. In addition, the trapped steam was found to be a source of internal disintegration of the lining physically and chemically. Such factors are obviated in the instant construction which permits the escape of moisture, through the stay tubes, in the form of steam, at low pressure, instead of through the lining surface.

In the manufacture of the studs, I have found it preferable to cut the stock to length and then to upset one end and with a tap of a light hammer to provide the slight deformation alluded to above for the purpose of fixing the stud in the stay tube and against axial movement while providing the steam venting space or crevice alluded to. In many cases, the shear burr formed on stock but the cutting of same to the desired length will suffice to fix the stud in the stay tubes. By the provision of studs that are fast in the stay tubes for normal use, yet easily detachable from the same by a tap of a hammer, furnace doors may be reconditioned whenever necessary or desirable, in a matter of minutes. By the methods hitherto employed the removal of the old studs and their replacement with new studs either by cutting torch or hammer methods caused damage to the door, frequently beyond repair.

It will, therefore, be seen that the improved method and construction illustrated and described affords outstanding advantages since it permits the immediate installation of a furnace door without loss of time as heretofore, and also gives a visual indication that the steam in the lining has been or is being dissipated. After considerable usage, it provides a tell-tale warning of corrosion or impairment of the water jacket by the issuance of steam from the crevices alluded to. The further convenience of faster reconditioning when required, longer life, stronger construction and advantages associated therein have been alluded to above.

While I have described and illustrated preferred embodiments of the invention, it is to be understood that the invention is susceptible to variation and modification without departing from the spirit or essential attributes thereof, and I accordingly wish to avail myself of all variations falling within the purview of the appended claims.

What is claimed is:

1. A water cooled industrial furnace door of the character described comprising outer and inner walls defining a water containing chamber therebetween, a plurality of aligned openings formed in said outer and inner walls, stay tubes arranged in the aligned openings and fixed to said walls, initially plastic refractory material arranged in one of the said walls, and a plurality of heat conducting studs arranged in said stay tubes with the studs in heat conductive engagement with said tubes and extending into the refractory material, there being a space opening through said outer wall between each stud and adjacent stay tube, each of said spaces having a length coextensive with that of the stay tube in which it is formed to establish communication between said refractory lining and the exterior surface of the wall spaced therefrom.

2. An industrial water cooled furnace door of the character described and including outer and inner walls arranged in spaced relation and defining a water containing chamber therebetween,

a plurality of aligned openings in the outer and inner walls, a plurality of stay tubes fastened in said openings, a re-entrant recess formed in said inner wall, a plastic refractory lining material operatively arranged in the recess, a plurality of studs removably fastened in said stay tubes and protruding substantially through said lining material with the studs in heat conductive engagement with said tubes, and passages arranged between the stay tubes and the studs and extending the entire length of said stay tubes, said passages being effective to permit the escape of moisture and steam from said lining to the exterior of said outer wall.

3. An industrial water cooled furnace door of the character described and including outer and inner walls defining a water containing chamber therebetween, means on one of said walls operatively receiving initially plastic refractory lining material, a plurality of studs protruding into said refractory material, a correspondent plurality of stay tubes arranged between said outer and inner walls and operatively receiving said studs with the studs engaging said stay tubes throughout the major portion of the circumferential extent thereof, each stay tube having an internal diameter slightly greater than that of the stud received therein and a passage extending the entire length of each stay tube and located between each stud and an adjacent stay tube whereby moisture and steam is permitted to escape from said lining material and through stay tubes, said passage being defined by the relative diameters of said stay tube and stud, and a burr maintaining said stay tubes and studs in spaced relation.

4. An industrial water cooled furnace door of the character described and including outer and inner walls defining a water containing chamber therebetween, means on one of said walls to operatively receive initially plastic refractory lining material, a plurality of studs within the refractory material and effective to support and cool said material, a corresponding plurality of stay tubes arranged between the said outer and inner walls and operatively receiving said studs with the studs in heat conductive engagement with the stay tubes throughout the major portion of the circumferential extent thereof, and passages coextensive in length with the stay tubes and located within the stay tubes to permit the escape of steam therethrough from said refractory material to the exterior of said outer wall.

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