April 18, 1933. A. E. WEINGARTNER 1,904,182.

TUBULAR FLUID COOLED WALLS

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Fig. 1.

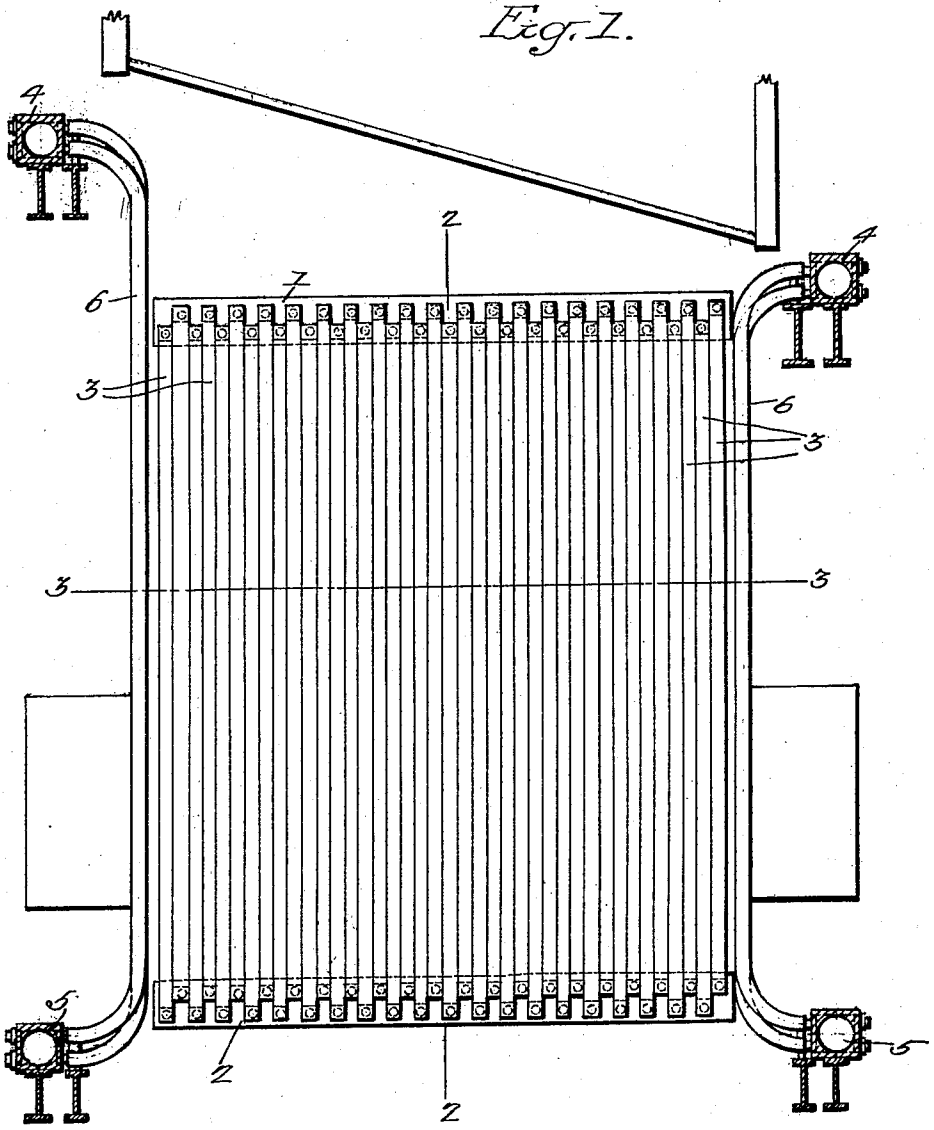
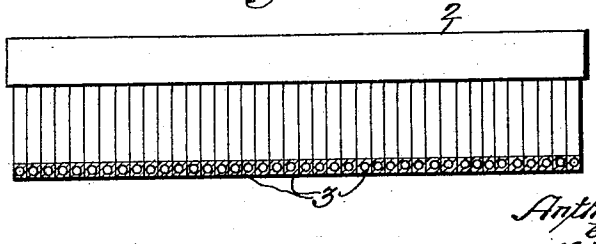


Fig. 3.



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Fig. 2.

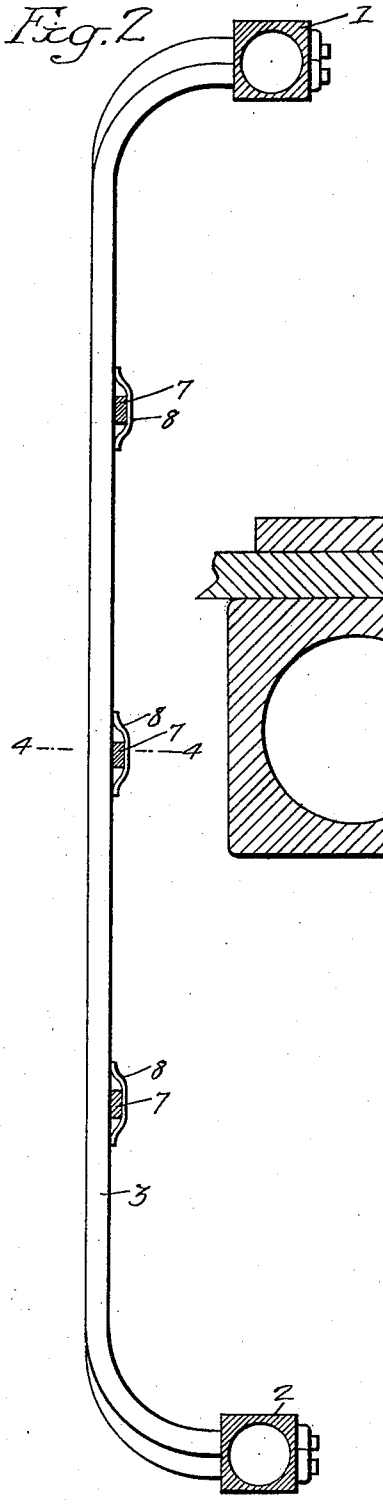
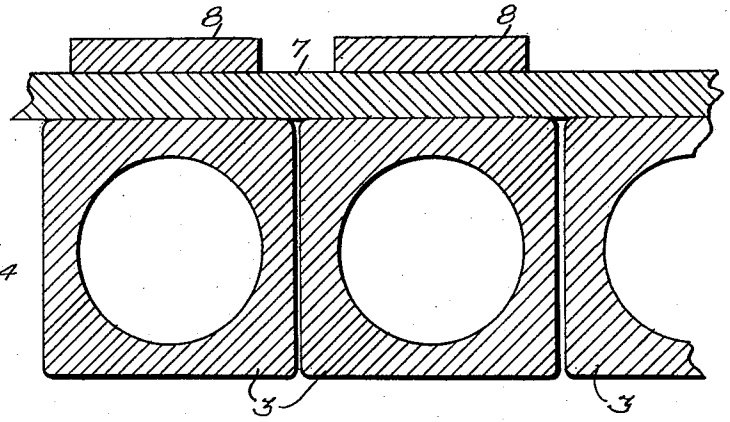


Fig. 4.



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Fig. 5.

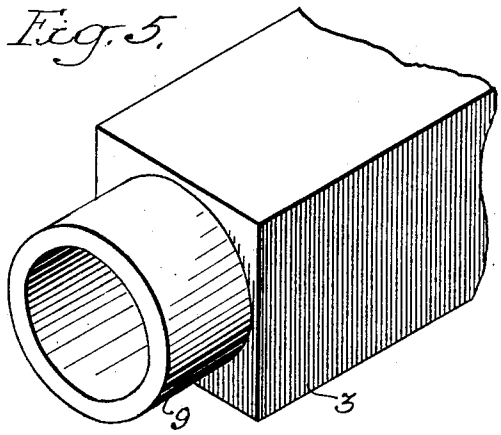
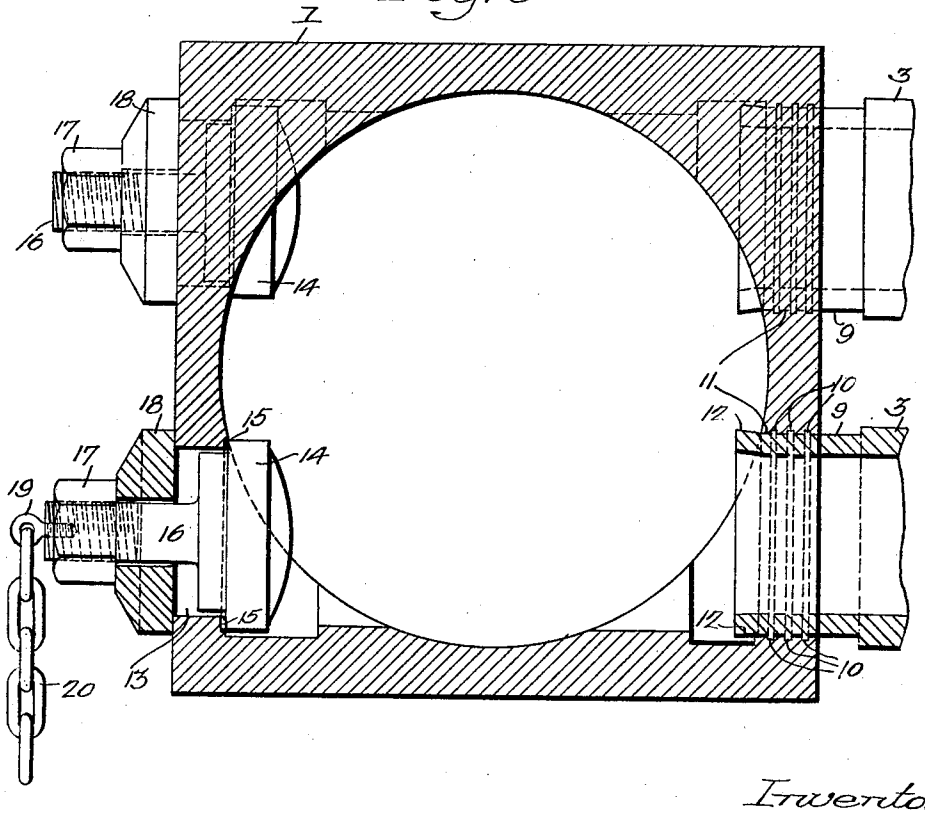


Fig. 6



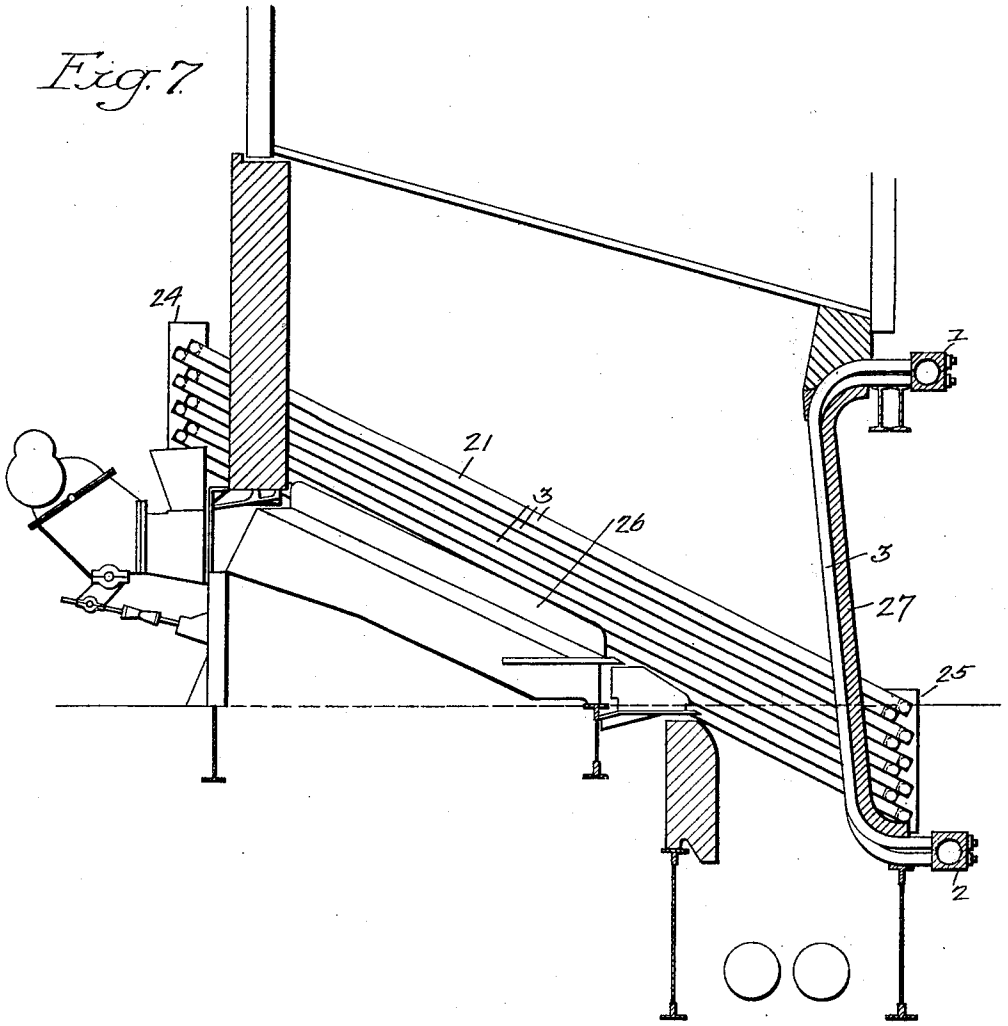
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Fig. 7



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Fig. 8

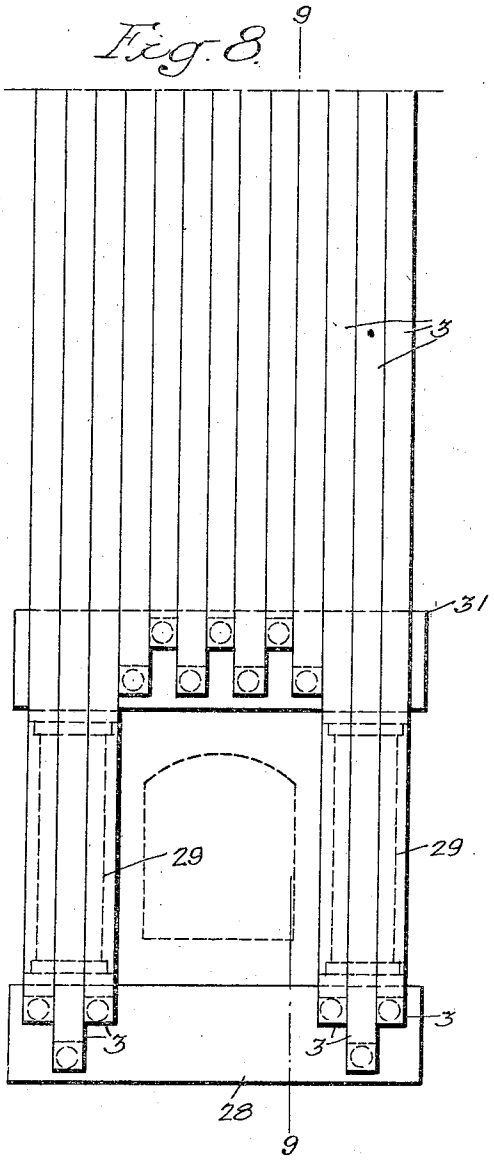
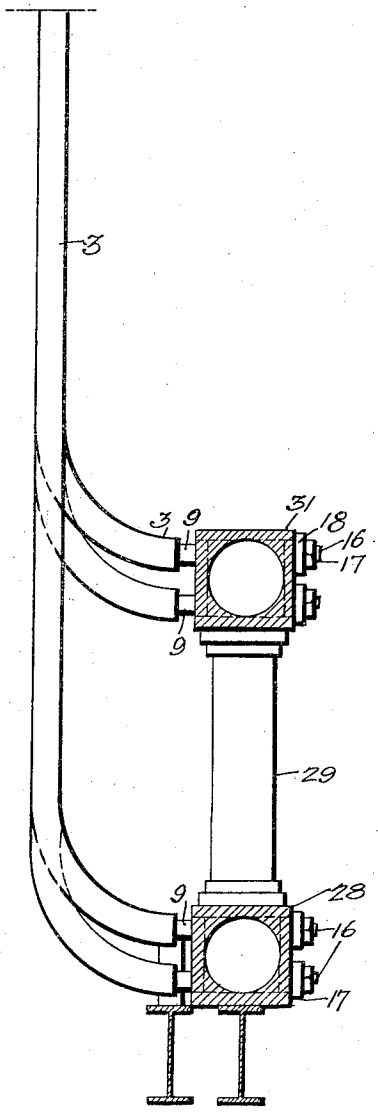


Fig. 9



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UNITED STATES PATENT OFFICE

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TUBULAR FLUID-COOLED WALLS

Application filed August 8, 1930. Serial No. 474,033.

This invention relates to improvements in tubular fluid-cooled walls of a type adapted for use in furnaces, retorts, and the like, and a principal object of the invention is to provide a wall of the stated character that shall have a generally higher efficiency and be more durable than walls of a like type as made in accordance with the prior practice.

Another object of the invention is to provide a wall of the stated character which shall be relatively simple in form and in which all tube-protecting accessories, such as facing blocks, bolts and clamps, may be eliminated.

A specific object of this invention is to provide a furnace wall of the stated character, comprising a series of tubes of substantially rectangular exterior cross-sectional form which terminate in headers also of substantially rectangular exterior cross-sectional form.

Other and further objects will become apparent as the description of the invention progresses.

In the attached drawings:

Figure 1 is a diagrammatic sectional view illustrating a fluid-cooled furnace wall construction made in accordance with my invention;

Fig. 2 is a section on the line 2—2, Fig. 1;

Fig. 3 is a section on the line 3—3, Fig. 1;

Fig. 4 is a fragmentary sectional view on the line 4—4, Fig. 2;

Fig. 5 is a fragmentary view in perspective illustrating an extremity of one of the tubes of the fluid system as made in accordance with my invention;

Fig. 6 is a sectional view illustrating structural details of a wall construction made in accordance with my invention;

Fig. 7 is a diagrammatic side elevational view illustrating a further typical installation in accordance with my invention;

Fig. 8 is a fragmentary elevational view illustrating a structural modification within the scope of my invention, and

Fig. 9 is a section on the line 9—9, Fig. 8.

In the construction of certain types of fluid-cooled walls, such for example as the water walls of furnaces, retorts and the like, it has been customary to employ metal tubes of standard outside and inside cylindrical form. These tubes, by reason of their form and inability to stand high temperatures, have required the use therewith of liner blocks both as a means for forming flat and solid wall surfaces and also as a protective means for the tubes themselves. In order to facilitate transfer of heat from the effective wall surface to the fluid cooling medium circulating within the tubes, it has been proposed to make these protective blocks of metal, such as cast iron or of a material having a like relatively high factor of conductivity, and these blocks are commonly secured in contact with the tubes by means of bolts, clamps and the like.

I have discovered that a material improvement in cooling efficiency and many other practical advantages hereinafter set forth are obtainable by employing in the formation of fluid-cooled walls of the stated type tubes which while preferably maintaining the usual cylindrical form in the inner surface are formed rectangular on the outside or are given other external form affording equivalent advantages as hereinafter set forth. These tubes preferably are made of metal and may be produced by pressing, rolling, drawing or in any other commercial and practicable manner.

The many advantages of a wall made in accordance with my invention will become more apparent by reference to the attached drawings, in which I have illustrated fluid-cooled wall structures made in accordance with my invention. Thus in Fig. 1, showing a typical water wall construction suitable for furnaces and the like, 1 and 2 indicate upper and lower headers in which are secured the ends of a plurality of tubes, which in accordance with my invention are made cylindrical

in the inner surface and rectangular in the outer. These tubes 3 are placed side by side in a continuous vertical series forming a substantially flat solid wall, the inner surface of which is exposed to the relatively high combustion temperatures of the furnace. Similarly constructed front and rear furnace walls may be employed each comprising an upper header 4 and a lower header 5, together with wall-forming tubes 6 extending between the headers and arranged contiguously in series similar to the tubes 3. With reference to the latter, it will be noted that the adjacent tubes enter the headers 1 and 2 in different planes or in staggered relation, this arrangement permitting the close assembly of this particular form of tube required for the formation of an adequately continuous wall surface.

As illustrated in Fig. 2, the tubes of the various series may be united and reinforced by means of one or more cross bars 7 on the outside of the wall, which in a preferred embodiment are connected with the individual tubes by straps 8, which at their ends may be welded to the outer surfaces of the tubes and which embrace the bars 7 as illustrated. This arrangement has been found desirable by reason of the relative ease of disconnecting the individual tubes from the wall-forming bank by simply removing the straps 8 attached to the particular tube, which permits withdrawal of the tube following release of the terminal ends from the headers to which they are attached. The bars 7 with the straps 8 afford a highly unified structure in which the tube elements are prevented from individual displacement by expansion or by reason of the various operating conditions.

Also, as illustrated in the drawings, I prefer to employ headers, such as 1 and 2, of the same internal and external forms as the tubes 3, and in Fig. 6, I have illustrated a preferred method of attaching the tubes in the headers. In this connection, I prefer to form the said tubes 3 as illustrated in Fig. 5 with cylindrical terminal ends 9 which in assembly and as illustrated in Fig. 6 are fitted in cylindrical openings 11 in the header with which the tubes are to be attached, and are expanded therein in well known manner in order to effect a secure and water-tight connection. Also as shown in Fig. 6, I prefer to form the surfaces of the cylindrical openings 11 of the headers with recesses 10, preferably extending continuously around the circumference of said openings, into which the material of the tube extensions is forced in the expanding operation. These recesses with the flared inwardly projecting extremities 12 of the inserted tubes 3 afford a completely tight and secure joint between the tubes and the headers.

In order to afford access to the interior of the headers for the tools employed in the tube-attaching operations set forth above, I provide the opposite walls of the headers with openings 13 arranged preferably in alignment with the tube-receiving openings 11, these handholes 13 normally and during the periods of furnace operation being closed by means of covers 14 which may be inserted into the interior of the headers through a master hole or holes (not shown), seats 15 for the covers being provided in the interior of the header, and said covers having threaded stems 16 which project outwardly through the openings 13 and afford means through the medium of nuts 17 and interposed washers 18 for drawing the covers up tightly upon the said seats to thereby effectively close the openings 4. To facilitate replacement of the covers 14 following removal for the purpose of cleaning the tubes and headers, I preferably attach to the outer end of the stems 16 small eye bolts 19 and chains 20.

Many advantages accrue to a wall construction such as described above. The rectangular tubes 3 assembled as illustrated provide a substantially solid wall having a flat and substantially continuous inner or effective wall surface and a continuous and uninterrupted path between this surface and the fluid cooling medium circulating through the tubes. Since the efficiency of the wall depends in large part upon the efficiency of the heat transfer operation from the heated surface of the wall to the cooling medium, it will be apparent that the continuous or uninterrupted character of the path of transfer effects a material improvement over prior walls of the type which require the use of a separate liner block in association with the tubes carrying the cooling medium.

The effectiveness of a wall made in accordance with my invention is still further increased by the fact that elimination of the necessity for liner blocks makes it possible to materially decrease the distance between adjacent tubes whereby the number of tubes in any given area of the wall structure, and in the structure as a whole, is materially increased, with a consequent corresponding increase in the cooling action. In practice a wall constructed as described herein shows an increase in the fluid circulating system per unit wall area of as much as 50% over the prior types of tubular fluid-cooled walls employing liner blocks. My construction has the advantage further of relative simplicity, all accessories, such as the liner blocks, bolts, clamps, etc., being eliminated, and the tubes by reason of their simplicity of form presenting no complication either in manufacture or in assembling. The inner cylindrical bore of the tubes provides maximum strength for resisting high pressures resulting from high temperature conditions to which the wall may be exposed, and with the added advantages resulting from the external form as set

forth above the wall is therefore particularly well adapted for high pressure furnace installations using natural gas, oil, pulverized fuel, or stoker firing, and may be used in such installations not only for maintaining relatively low temperatures in the wall itself, but also for the purpose of feed water preheating or even steam generation. A tube made in accordance with my invention is as readily bent for fitting as the all-cylindrical standard tubing. It will be apparent, therefore, that my invention not only provides a fluid-cooled wall of high efficiency but one which by reason of simplicity of form and ease of assembly and manufacture, and by reason further of the desirable structural and operating features set forth above, recommends itself highly, and represents a material improvement over this type of wall as manufactured in accordance with the prior practice.

In Fig. 7, I have illustrated in a sectional diagrammatic view a stoker-fired furnace incorporating my invention. In this instance, the fluid cooling member takes the form of a wall panel 21 consisting of a plurality of the aforedescribed pipes 3 connected at opposite ends with vertically arranged headers 24 and 25. The header 24 is mounted in a plane above the header 25 so that the effective wall-forming portions of the panel have an inclination corresponding substantially to the inclination of the stoker grate 26. In accordance with the known practice, the panel 21 is arranged to form a side bounding wall for the stoker grate. A water-cooled wall construction of this character and as made in accordance with my invention is particularly desirable for use in stoker-fired furnaces by reason of the fact that the high cooling efficiency of the wall creates a substantial immunity against slag formation. Also for this same reason, my wall is highly useful for feed water preheating or even steam generation, since the efficiency of the wall for that purpose remains substantially unimpaired over extended periods of use. It will be noted also by reference to Fig. 7 that the furnace installation therein illustrated comprises a rear wall 27 also made in accordance with my invention.

In Figs. 8 and 9, I have illustrated an assembly affording admission to the interior of a furnace utilizing a construction in accordance with my invention. In this instance, the tubes 3 are shown extending upwardly from a lower header 28. At spaced points longitudinally thereof, the header is provided with upwardly extending branches 29—29 whose outer ends are joined by an offset header section 31, in which a number of the tubes 3 of the wall terminate, thereby leaving an opening in the wall bounded by the lower header 28, the offset header section 31 and the two branch sections 29 through which access may be had to the interior of the furnace.

It will be understood that the invention in its broader aspects is not limited to tubes of rectangular outer form, since the invention may be practiced with other shapes, the essential feature residing in the provision of a fluid-cooled wall composed of a plurality of tubes so shaped as in contiguous arrangement to provide a substantially continuous wall surface of desired conformation.

I claim:

1. A fluid cooled wall structure comprising a plurality of tubes of substantially rectangular exterior cross sectional form, and a header also of substantially rectangular exterior cross sectional form in which said tubes terminate, alternate tubes entering the header at spaced points longitudinally of the tubes to thereby permit contiguous arrangement of the intermediate portions.

2. In a fluid-cooled wall, the combination with a header of rectangular exterior form, of a plurality of tubes also of rectangular exteriors contiguously arranged in a row to afford a continuous wall surface and each having a cylindrical terminal portion entering an aperture in a face of said header, said apertures being staggered and forming a plurality of rows extending longitudinally of the header, and said header having series of access ports in the opposite face in effective alignment with the inwardly projecting tube ends and corresponding in position with the said rows of apertures, and removable closures for said ports.

3. A fluid-cooled wall structure comprising a plurality of tubes of rectangular exterior cross section disposed in contiguous face-to-face relation to afford a continuous wall surface, and a header also of rectangular exterior cross-sectional form in which said tubes terminate, the points of juncture of said tubes with the header being staggered to permit of said contiguous relation while affording ample space between the ends of the tubes for securing them in the header.

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