Nov. 11, 1941. W. D. HEDGE 2,262,533

WATER-COOLED GRATE

Filed Dec. 9, 1939 2 Sheets-Sheet 1

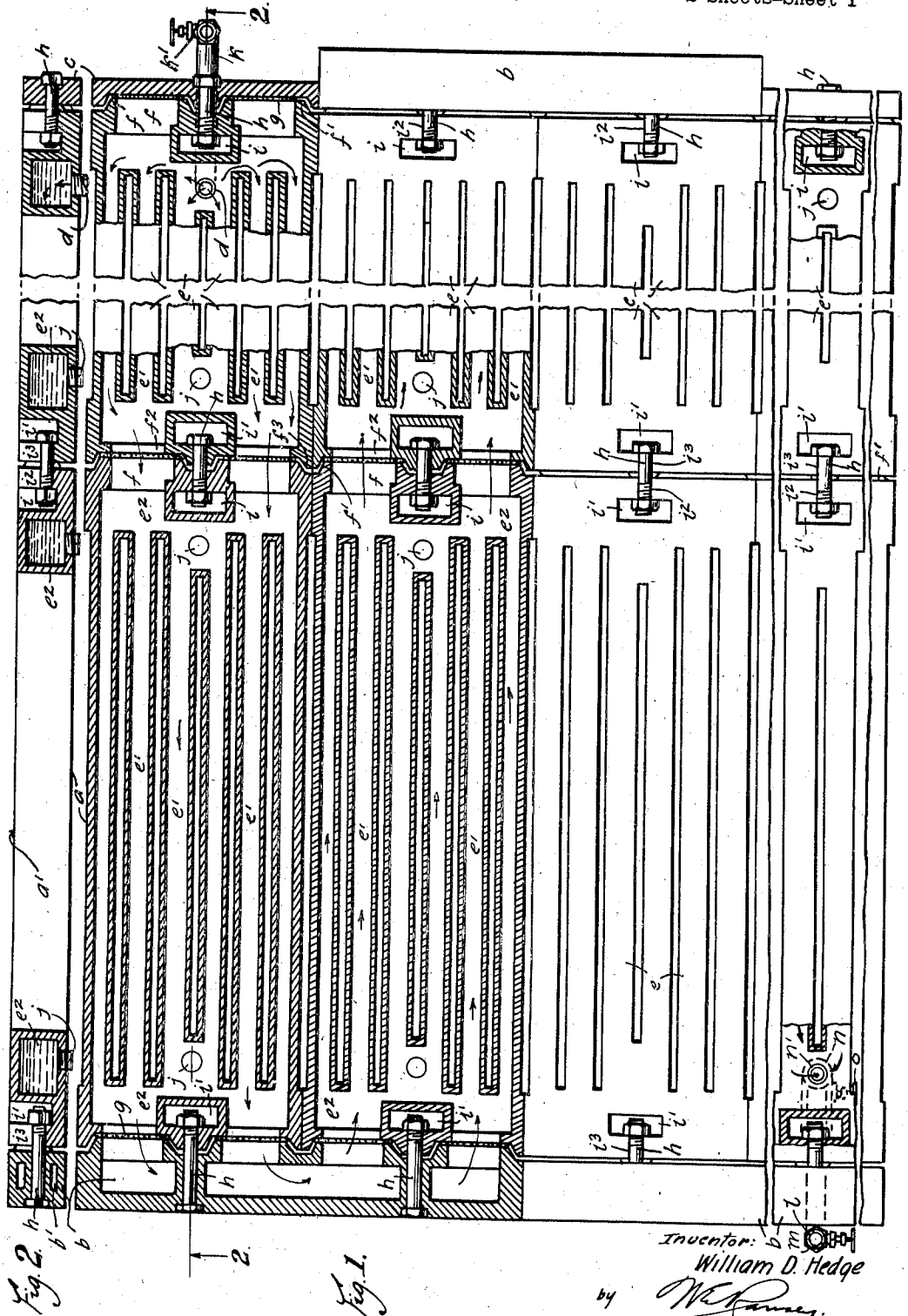

Fig. 2.

Fig. 1.

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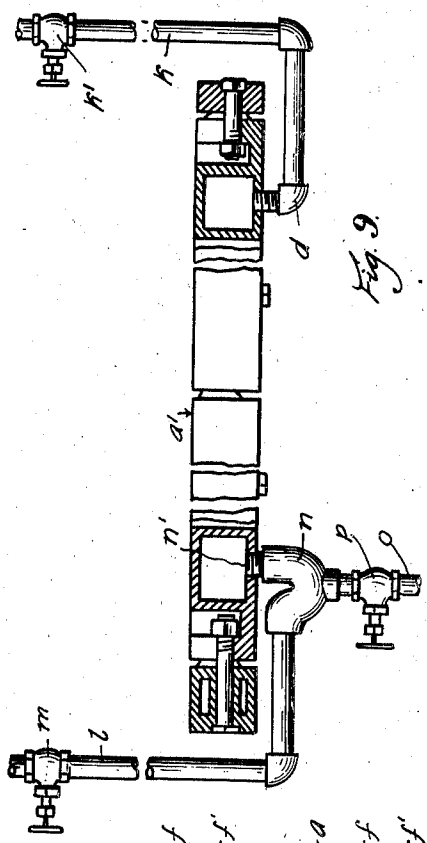

Fig. 9.

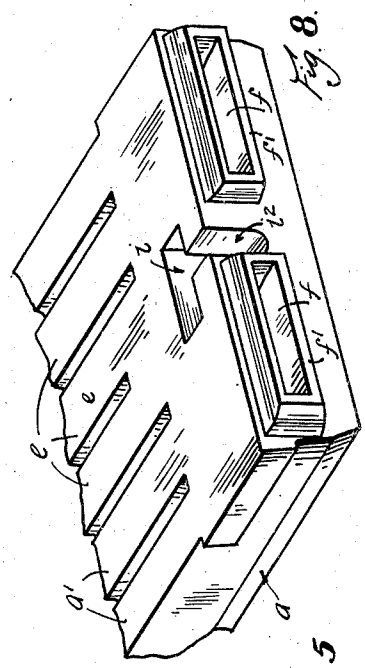

Fig. 8.

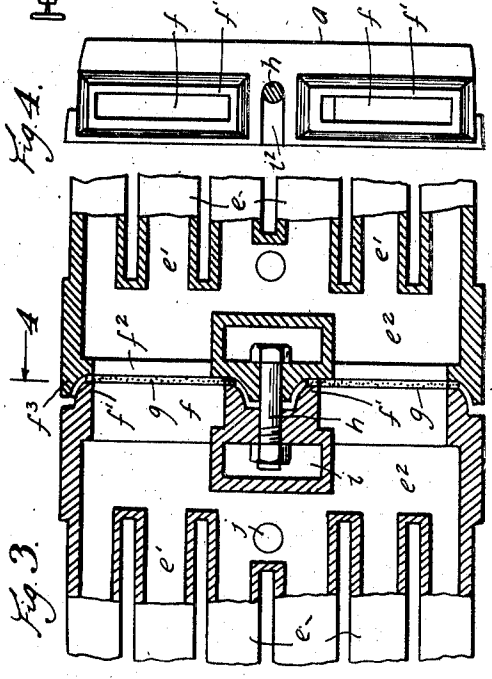

Fig. 4.

Fig. 3.

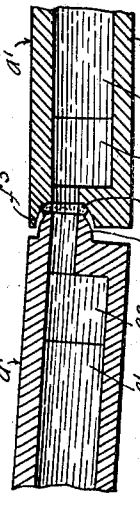

Fig. 6.

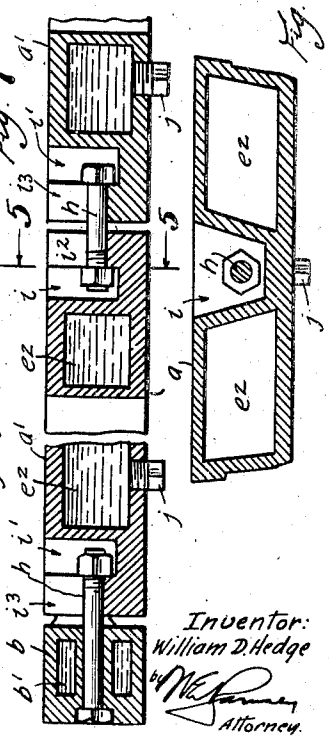

Fig. 7.

Fig. 5.

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UNITED STATES PATENT OFFICE

2,262,533

WATER-COOLED GRATE

William D. Hedge, Vancouver, Wash.

Application December 9, 1939, Serial No. 308,439

8 Claims. (Cl. 122—374)

The object of this invention is to provide a water-cooled furnace grate or grate setting comprising a plurality of uniform, hollow, cast grate bar elements joined end-to-end in longitudinally extending courses and with the courses alternately connected by headers so as to provide a continuous tortuous passageway throughout the entire grate bar setting. The further object of my invention is to provide a grate of this character in which the grate elements are secured to each other by a single bolted connection, the ends of the grate element being formed to seat one into the other to provide a water-tight joint. Said parts are constructed and arranged so that slight angular displacement may be had between elements to conform to slight irregularities in the grate bar supports, or otherwise.

A further object of my invention is to provide fastening means which may be engaged and disengaged, or adjusted from the fire surface of the grate, but which fastening means will lie wholly below the fire surface so as not readily to be burned out. To secure a good seal it is necessary to provide some elastic or plastic material for sealing the joints between the grate bar element and my invention provides structural features by which said sealing material can be completely housed within and shielded by the grate bar elements and thus be subject only to the heat conducted by said elements. The grate being water-cooled is thus maintained to a temperature below the boiling point of water and said sealing material is not subjected to high destructive temperatures, and can be maintained in proper condition.

A further object of my invention is to arrange the grate bar elements and the water supply therefor so that the grates will always be full of water as long as there is water in the cooling system. Very frequently dirt and products dissolved in the water tend to form solid deposits in the water passageways. A further object is to provide means to permit said deposits to be removed, utilizing steam generated in the grates if necessary, so that the passageways will not become clogged.

The details of my invention are hereinafter described with reference to the accompanying drawings, in which:

Fig. 1 is a foreshortened plan view of a portion of a grate bar setting, some grate bar elements being shown in section, said figure illustrating the general assembled structure of a water-cooled grate;

Fig. 2 is a transverse section taken on the line 2—2 in Fig. 1;

Fig. 3 is an enlarged fragmentary plan view, with portions shown broken away, of a joint between two grate bar elements and illustrates the sealing and connecting members;

Fig. 4 is an end elevation of one of said grate bar elements taken on the line 4—4 in Fig. 3;

Fig. 5 is a cross-sectional view of one of said grate bar elements taken on the line 5—5 in Fig. 7;

Fig. 6 is a more or less diagrammatic view indicating how the parts can be angularly displaced without breaking the water-tight seal between grate bar elements;

Fig. 7 is a slightly enlarged longitudinal section, shown foreshortened, of a header and two adjacent grate bar elements;

Fig. 8 is a perspective view of one end of a grate bar element showing the coupling elements and a recess for holding a coupling bolt; and

Fig. 9 is a foreshortened vertical view of a grate with the water conduits shown in connection therewith.

A grate bar setting or water-cooled grate embodying my invention comprises a plurality of grate bar elements *a*. Said elements are uniform and are joined end-to-end into a plurality of longitudinally extending courses. There are as many grate bar elements in a course as are necessary to extend from one end of the furnace to the other. Said elements can be of a length which is convenient to manufacture and to install, and in most cases are approximately two or three feet over all, and thus in a boiler setting twelve feet long there would be four or five grate bar elements joined into a longitudinal course.

At the ends headers *b*, which are hollow, join one end of a course to the corresponding end of an adjacent course, as is indicated in Fig. 1. The grate bar elements also are hollow and thus define passageways lengthwise through said courses and with said headers define a tortuous passageway leading from one course to the other. At the end of two courses, blank headers *c* are arranged and it is at these points that the water is either admitted or removed. The water is shown as being admitted through a pipe *d* in the upper right hand grate bar element in Figs. 1 and 2, and the arrows leading therefrom indicate the paths which the water follows as it flows through the grate elements.

Each grate element comprises a plurality of spaced longitudinal fingers *e*. Said fingers are

hollow and thus within each finger there is a branch passageway e'. Said passageways e' thus define alternate parallel passageways for the flow of water through each grate bar element. Thus, if one passageway should become clogged or the flow therefrom substantially impeded it would not prevent the flow of water through the other passageways of a grate bar element, but would only affect the particular branch in said grate bar element. At the ends of said branch passageways and within the grate bar element are transverse passageways e^2 which are common to, and join all of the passageways e' in that particular element.

The hollow bores b' of the headers b constitute transverse passageways as has been pointed out and are of large cross-sectional area. Communicating between the various grate bar units or elements and between the end elements of a course and a header are two apertures f, defined in one element by projecting box-like flanges f', and in the other apertures f^2 are defined by recess portions f^3. Said portions f' and f^2 thus constitute male and female joints which seat tightly, one within the other. To insure a water-tight seal I preferably provide heat resisting packing material g which is arranged about the registering apertures f^2 between each of the elements. Said packing material is either plastic in nature or is elastic and the pressure produced by the bolted coupling h tends to compress said material g until a good seat is had between the flanges f' and the recessed portions f^3 into which they seat.

The sides of the box-like flanges f' and the corresponding sides of the recessed portions f^3 do not coincide in angle but diverge relatively to a small degree and are preferably rounded in contour so that a limited angular displacement may be produced between coupled elements without tending to break the seal between said elements. This is diagrammatically illustrated in Fig. 6.

The bolted couplings are arranged in cup-like recesses i—i' in the adjacent abutting ends of of two grate bar elements. Said recesses are provided with slots i^2 and i^3 which are of sufficient width to pass the shank of the bolts but to prevent the passage of the head and nut thereof. Said recesses and slots permit the bolts to be dropped into place and tightened to secure a water-tight coupling, all of the operations being performed from the plane of the fire surface a' of the grate, and to be replaced without affecting the remainder of the grate. This permits easy repair and replacement as well as inspection and cleaning of the separate elements.

The bores and passageways of the various elements and headers preferably define one continuous passageway throughout a grate. The water flows through a pipe such as b into one end of one of the grate elements and passes back and forth alternately through the adjacent courses and is removed. The flow of water preferably is constant and is proportioned by manual control so that it is removed before the point of evaporization is reached and the flow is controlled so that said grates are not cooled unduly, which latter would produce an inefficient fire on said grate. A specific mode of control and the devices therefor are not shown in the accompanying drawings as this is merely common practice with any water-cooled grate structure.

Inasmuch as the grate elements are uniform, provision is made that the end of any one of said grate elements may receive a tapped coupling for inserting or removing cooling water and the openings which are not utilized are closed by plugs j.

As is illustrated in Fig. 9, the grate is composed of a plurality of sections lying substantially in a horizontal plane. Thus water admitted through the intake pipe d will tend to fill all of the sections to an equal level. To insure said grate element being constantly filled with water, I provide the water conduit with two upstanding legs, an intake leg k and a discharge leg l. The intake leg has an adjustable valve k' to regulate the flow of water through said leg k or to cut off the flow therefrom. In the discharge leg l I provide a similar valve m. Lying at a point intermediate said legs and immediately inwardly of the discharge leg l is a U-shaped trap n with a discharge pipe o leading therefrom. Said discharge pipe is opened and closed by an adjustable valve p. Said valve p normally is closed so that water flows from the leg k of the pipe d through the sections of the grate elements which form a continuous tortuous passageway therethrough. Leading from a point furthest from the point of ingress of water is a pipe n' leading to the trap n and from the latter to the upstanding discharge leg l. It is not necessary that said legs l and k be of any substantial length, only sufficient to insure the maintenance of a head of water to prevent the grate elements from being only partially filled with water. For example, it might be necessary only to have the discharge leg l extend upwardly about two or three feet above the grate so as to maintain a pound or slightly more pressure per square inch of the water in the grate section. If water does not flow sufficiently fast through the grate section, it will tend to produce steam and the steam will escape only if pressure is maintained through the discharge pipe l to the atmosphere, permitting additional water to flow into said grates.

Frequently, I find that impurities in the water and dissolved substances therein tend to form deposits in the grates. It is difficult to clean said grates although this can be done by removing the headers. I thus provide a discharge pipe o and a manually controlled valve p therefor, and thus if the water seemingly is partially clogged by deposits formed within the grates, I open the valve c and cause the water to flow out through the pipe o. This tends to discharge any foreign solids in the grate, particularly if pressure is increased in the intake pipe leading to said grate. Frequently I have found it desirable to close off both valves k' and m so that a substantial steam pressure is generated in the grate, and then if the valve p is suddenly opened, the pressure generated by said steam tends to force the water and the solids therewith outwardly through the discharge pipe o. When this has been accomplished, the valve p can be closed and the valves m and k' opened so that a normal flow of cooling water will flow through the grate. It is likewise possible to maintain a substantial pressure in the intake leg k, close the valve m, and open the valve p retarding the flow through the grate so that steam is generated and with the water contained in said grate will be discharged under pressure from the pipe o.

I claim:

1. A water-cooled furnace grate comprising a plurality of hollow, cast, grate-bar elements joined end-to-end in longitudinally extending courses, each course defining a continuous lineal passageway for cooling water, headers disposed at the ends of said courses extending in opposite directions and defining transverse conduits connecting with laterally adjacent courses, thus producing a

continuous tortuous passageway throughout the grate, each grate-bar element provided with a plurality of spaced longitudinally extending fingers, the upper surfaces of which constitute a grate fire surface, a coupling element projecting from each grate bar element joining a complementary coupling element in the longitudinally adjacent grate-bar element, and a securing member lying adjacent said coupling element and positioned to engage and hold two longitudinally adjacent grate-bar elements together and the complementary coupling elements seated one in the other.

2. A water-cooled furnace grate comprising a plurality of hollow, cast, grate-bar elements joined end-to-end in longitudinally extending courses, each course defining a continuous lineal passageway for cooling water, headers disposed at the ends of said courses extending in opposite directions and defining transverse conduits connecting with laterally adjacent courses, thus producing a continuous tortuous passageway throughout the grate, each grate-bar element provided with a plurality of spaced longitudinally extending fingers, the upper surfaces of which constitute a grate fire surface, a coupling element projecting from each end of each grate-bar element and from one face of each header joining a complementary coupling element in the longitudinally adjacent grate-bar element or header, and a threaded securing member positioned to engage and hold two longitudinally adjacent grate-bar elements or element and header, respectively, together, said securing member being proportioned and arranged to accommodate limited angular displacement of the grate elements and headers without affecting the seal between them.

3. A water-cooled furnace grate comprising a plurality of hollow, cast, grate-bar elements joined end-to-end in longitudinally extending courses, each course defining a continuous lineal passageway for cooling water, headers disposed at the ends of said courses extending in opposite directions and defining transverse conduits connecting with laterally adjacent courses, thus producing a continuous tortuous passageway throughout the grate, each grate-bar element provided with a plurality of spaced longitudinally extending fingers, the upper surfaces of which constitute a grate fire surface, and a securing member positioned to engage and hold two longitudinally adjacent grate elements together, said securing member lying in cup-like apertures arranged at the abutting ends of two adjacent grate elements and opening to the upper surface thereof.

4. A water-cooled furnace grate comprising a plurality of hollow, cast, grate-bar elements joined end-to-end in longitudinally extending courses, each course defining a continuous lineal passageway for cooling water, headers disposed at the ends of said courses extending in opposite directions and defining transverse conduits connecting with laterally adjacent courses, thus producing a continuous tortuous passageway throughout the grate, each grate-bar element provided with a plurality of spaced longitudinally extending fingers, the upper surfaces of which constitute a grate fire surface, and a two-headed securing member positioned to engage and hold two longitudinally adjacent grate elements together, said securing member lying in cup-like apertures arranged at the abutting ends of two adjacent grate elements and opening to the upper surface thereof, said apertures being slotted longitudinally to pass the shank of the securing member, but to retain the heads thereof.

5. A water-cooled furnace grate comprising a plurality of hollow, cast, grate-bar elements of uniform characteristics joined end-to-end in longitudinally extending courses each course defining a continuous lineal passageway for cooling water, headers disposed at the ends of said courses extending in opposite directions and defining transverse conduits connecting with laterally adjacent courses, thus producing a continuous tortuous passageway throughout the grate, each grate bar element provided with a plurality of spaced longitudinally extending fingers, the upper surfaces of which constitute a grate fire surface, said grate-bar elements being hollow and defining longitudinally extending parallel conduits for cooling water, and transverse passageways at, and within the confines of, the ends of each of said elements connecting said parallel conduits, and coupling elements projecting from each grate element and from one face of each header joining complementary elements in longitudinally adjacent grate elements and headers, respectively.

6. A water-cooled furnace grate comprising a plurality of hollow, cast, grate-bar elements joined end-to-end in longitudinally extending courses each course defining a continuous lineal passageway for cooling water, headers disposed at the ends of said courses extending in opposite directions and defining transverse conduits connecting with laterally adjacent courses thus producing a continuous tortuous passageway throughout the grate, each grate-bar element provided with a plurality of spaced longitudinally extending fingers, the upper surfaces of which constitute a grate fire surface, said grate-bar elements being hollow and defining longitudinally extending parallel conduits for cooling water, a pair of coupling elements projecting from each grate-bar element, joining complementary coupling elements in the longitudinally adjacent grate-bar element, and a securing member lying intermediate said coupling elements and positioned to engage and hold two longitudinally adjacent grate elements together, the complementary coupling elements seated one in the other.

7. A water-cooled furnace grate comprising a plurality of hollow-cast, grate-bar elements joined end-to-end in longitudinally extending courses each course defining a continuous lineal passageway for cooling water, headers disposed at the ends of said courses extending in opposite directions and defining transverse conduits connecting with laterally adjacent courses, thus producing a continuous tortuous passageway throughout the grate, each grate-bar element provided with a plurality of spaced longitudinally extending fingers, the upper surfaces of which constitute a grate fire surface, said grate-bar elements being hollow and defining longitudinally extending parallel conduits for cooling water, a pair of coupling elements projecting from each grate-bar element, joining complementary coupling elements in the longitudinally adjacent grate-bar element, and a securing member lying intermediate said coupling elements and positioned to engage and hold two longitudinally adjacent grate elements together, the complementary coupling elements seated one in the other, said securing member lying in cup-like apertures arranged at the abutting ends of two adjacent grate elements.

8. A water-cooled furnace grate comprising a

plurality of hollow, cast, grate-bar elements of uniform characteristics joined end-to-end in longitudinally extending courses each course defining a continuous lineal passageway for cooling water, headers disposed at the ends of said courses extending in opposite directions and defining transverse conduits connecting with laterally adjacent courses, thus producing a continuous tortuous passageway throughout the grate, each grate bar element provided with a plurality of spaced longitudinally extending fingers, the upper surfaces of which constitute a grate fire surface, said grate-bar elements being hollow and defining longitudinally extending parallel conduits for cooling water, and transverse passageways at, and within the confines of, the ends of each of said elements connecting said parallel conduits, and coupling elements projecting from each grate element and from one face of each header joining complementary elements in longitudinally adjacent grate elements and headers, respectively, and a water supply means and water discharge means for said grate, each of said latter two means including a conduit having an upstanding leg, each of said legs extending to a point substantially above the horizontal plane of the longitudinal courses of the grate.

WILLIAM D. HEDGE.