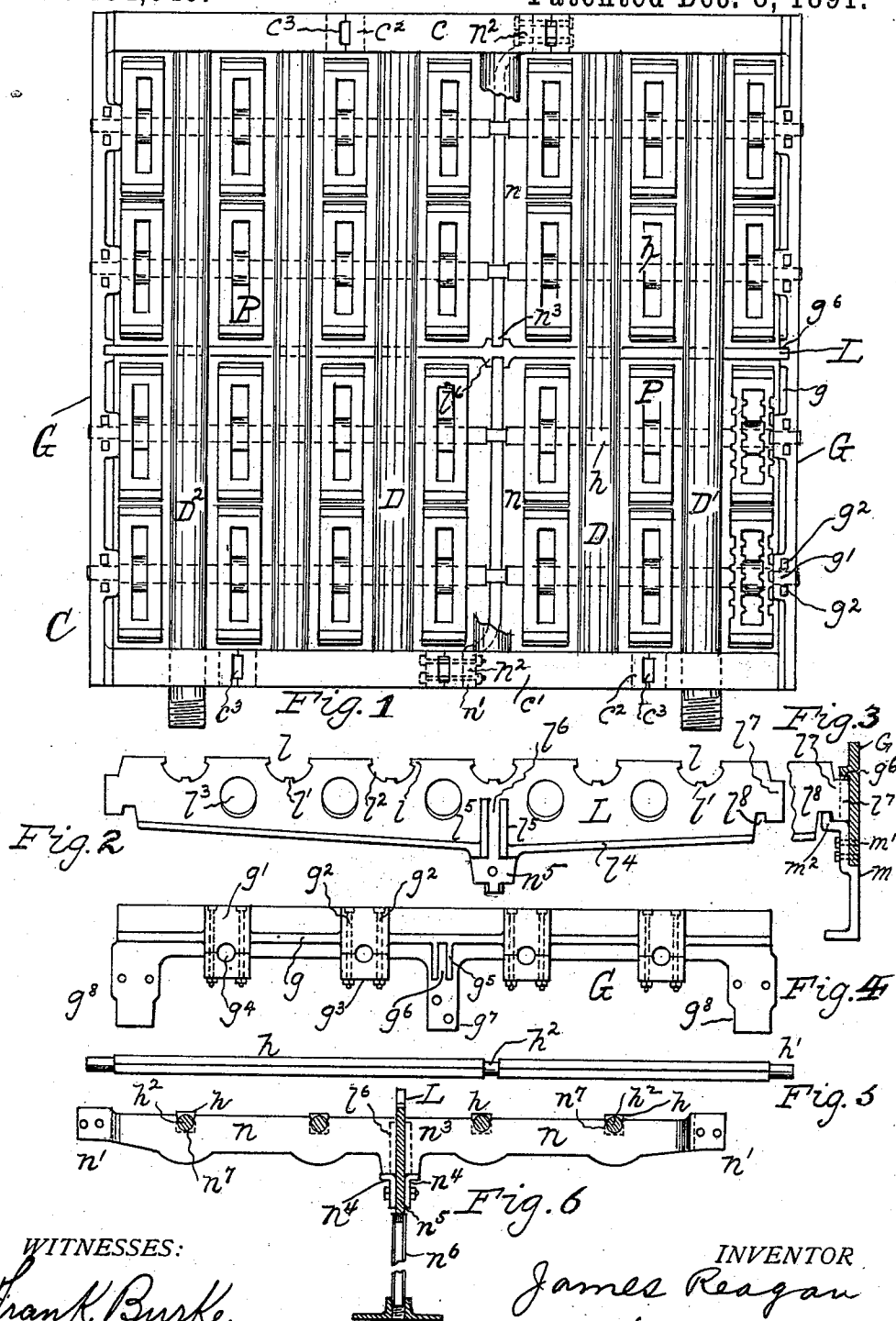


J. REAGAN.
CIRCULATING WATER BAR GRATE.

No. 464,649.

Patented Dec. 8, 1891.



WITNESSES:

Frank Burke
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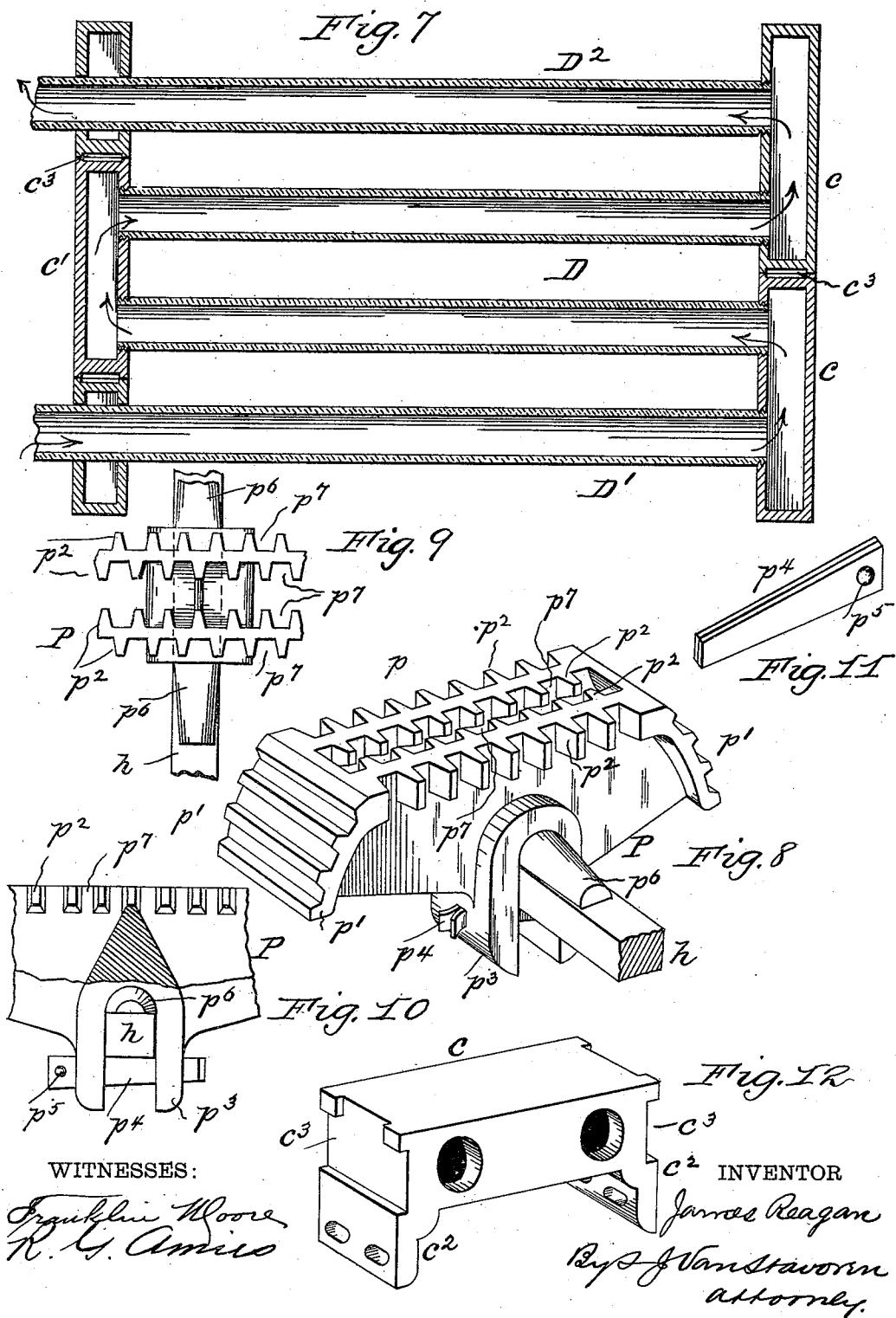
(No Model.)

3 Sheets—Sheet 2.

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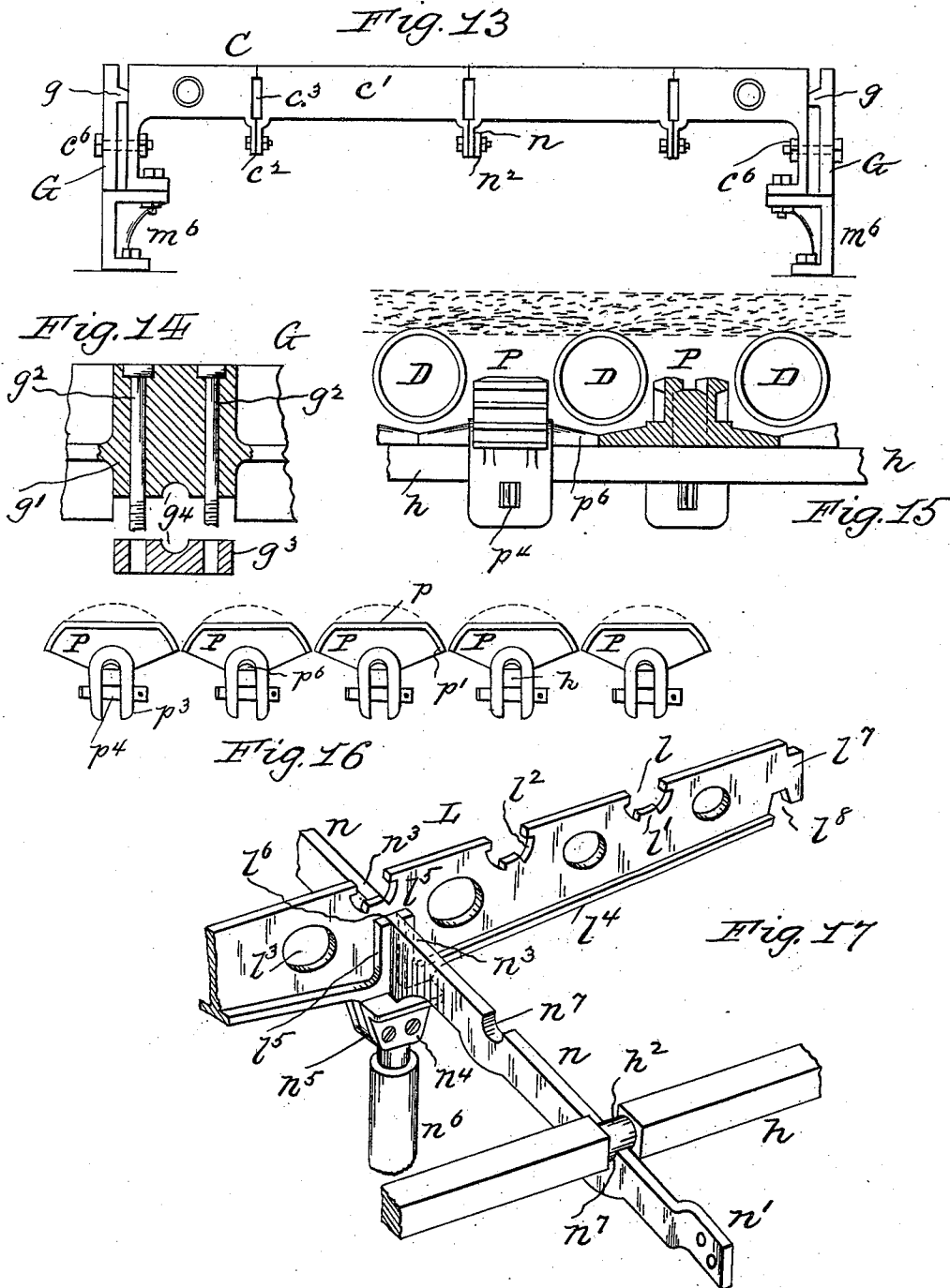
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3 Sheets—Sheet 3.

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CIRCULATING WATER BAR GRATE.

No. 464,649.

Patented Dec. 8, 1891.



WITNESSES:

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UNITED STATES PATENT OFFICE.

JAMES REAGAN, OF PHILADELPHIA, PENNSYLVANIA.

CIRCULATING WATER-BAR GRATE.

SPECIFICATION forming part of Letters Patent No. 464,649, dated December 8, 1891.

Application filed March 20, 1891. Serial No. 385,762. (No model.)

To all whom it may concern:

Be it known that I, JAMES REAGAN, a citizen of the United States, residing at Philadelphia, in the county of Philadelphia and State of Pennsylvania, have invented certain new and useful Improvements in Circulating Water-Bar Grates, of which the following is a specification.

My invention has relation, generally, to water-bar grates, and particularly to that form of the same in which the ends of alternate bars are joined by bends or hollow sections to provide a continuous water-circulation through the grate and hollow sectional end bearing-bars therefor, and wherein perforated leaves, shakers, or choppers intermediate of the water-bars are used for cleaning and dumping the fire, the perforations in said leaves, shakers, or choppers being provided for the admission of a supply of air through them to the fire.

My invention has for its object an economical, durable, efficient, and commercially or practically available construction of water-bar grate which is susceptible, with slight changes in form, of being economically applied to any type of fire-box for stationary, locomotive, or marine boiler or other furnaces, any of the parts of which, when necessary and when the grate is in position in the fire-box, can be removed and replaced by new ones without dismantling the entire grate, whereon any of the cheap grades of fine coal, coal-dust, or dirt can economically be burned equally as well as grades of a larger size and more expensive kind; which provides for the admission to the fire through the leaves, shakers, or choppers, and between the latter and the water-bars of the largest possible supply of air uniformly throughout the entire grate-surface without diminishing the area of the fuel-supporting surface of the leaves, shakers, or choppers, and water-bars; which admits of the use of cast metal—such as iron or steel—for the leaves, shakers, or choppers, as they do not melt and burn out; which admits of carrying a light fire which may be uniformly cleaned throughout without loss of fuel and without breaking through the top crust, thereby preventing cold drafts of air passing into the fire to lower the temperature of the same while being cleaned, and when

desired the fire can be entirely dumped from the grate without opening the fire-doors, and effects a very material economy in fuel and ashes or waste hauling, cost for steam-generative, heating, or analogous purposes.

To obtain an economical and durable form of water-bar grate of the kind alluded to, I so connect or bolt together the hollow sections of the end bearing-bars and the ends of the latter to side bars that these sectional end bearing and side bars form the frame or housing of the grate, and by providing this frame with feet the grate and its supports are independent of the fire-box and ash-pit. Hence by configuring the frame to correspond with the form of the fire-box and ash-pit the grate may be applied to any type of stationary locomotive, marine boiler, or other furnace fire-box. The bridge-bars, when any are used for supporting the water-bars intermediate of their ends, are also connected to or supported upon the side bars, as are also the supporting and actuating bars for the shakers or choppers. The supports and connections of all of said parts are so made that they compensate for the expansion and contraction of the grate or its parts under varying degrees of heat. By supporting or connecting the sectional end bearing-bars, bridge-bars, and shaker or chopper actuating and supporting bars on the side bars for the grate all of said parts are positively maintained in relative alignment under varying conditions of expansion and contraction and liability of warping of any of said parts independently of the others is avoided. The shaker or chopper actuating and supporting bars have their ends mounted in journal-boxes in the side bars. The lower half of each of said boxes is removable from recesses in the lower side of the side bars and are held in place by bolts which pass down through openings in the side bars and said boxes and have end nuts which screw up against the under side of the boxes to firmly hold them in place. Should one of these actuating and supporting bars break or otherwise become impaired, it can easily and quickly be withdrawn from the grate by removing the screw-nuts which hold said boxes in position, whereupon the broken or impaired bar, with its attached choppers, drop from the grate.

Its choppers are removed from it and placed on a new bar and the whole reinserted into the grate.

To provide for easy removal of a broken or impaired chopper from its actuating and supporting bar, the latter is made angular in cross-section. A correspondingly-formed recess with lower open end is formed in depending arms on the choppers to fit the bar, and said chopper-arms are fastened to the bar by split keys or wedges passing through suitably-located openings in said arms and impinging one side of the bar. By uncoupling any one of these bars from the shaking-lever device used for said bars the uncoupled bar and the choppers may be turned down to lower the choppers from the grate, whereupon by driving out the key of the damaged or impaired chopper it drops off of the bar and a new one is substituted. The bar is then turned to raise the choppers into the grate and the bar is coupled to said shaking-lever devices, the same being done while the grate is in position in the furnace.

By bolting the hollow sections of the end bearing-bars together and the ends of the latter to the side bars any one of these sections may be removed for replacement, when required, by uncoupling the water bar or bars therefrom and unscrewing its bolt-connections without taking down any other section. As the bridge bar or bars are connected to and supported upon the side bars and feet or brackets, the same can be correspondingly removed for replacement or repairs.

As all parts of the grate maintain their relative alignment, the choppers can be located close to the water-bars and the ends of the choppers close together and to the bridge and end bearing-bars, and as the ends of the choppers are close together they move past each other and adjacent to the bridge and end bearing-bars when actuated to shake or clean the fire without producing large openings between said parts for the fuel or coal to fall through, and hence fine coal, coal-dust, or dirt can be burned on the grate as well as large-sized coal.

To provide for the largest possible air-supply required for the furnace through the grate to secure thorough combustion and avoid formation of black spots or areas along the lines of the water-bars and choppers without diminishing the area of the fuel-supporting surface of the choppers, the latter are hollow from end to end with open tops and bottoms, and at the inner and outside upper edges of the long sides of each chopper are projecting ribs with intervening spaces. The inner and outer ribs of each side stagger or are out of line relatively to one another. This formation of said ribs or projections and spaces provides numerous small openings throughout the top surface of the choppers for admission of large supplies of air therethrough and secures the necessary area of fuel-supporting surface required. Furthermore, this fuel-supporting

surface for the chopper is so divided or broken up that all parts of it are exposed to free circulation of such air, and hence deposition of cinders, molten metal from the fuel, and clinkers on and their adherence to such divided or broken surfaces is prevented and melting and burning out of the choppers is avoided. As the choppers are close to the water-bars and have the air-spaces at their upper outer edges, the supply of air admitted through said spaces is directed to and follows the conformation of the water-bar to supply air to the fuel located thereon. As the configuration of the air-spaces at the top of the choppers is uniform throughout, the admission of air through them to all parts of the fire is correspondingly uniform, and black spots in the fire along the line of the choppers and water-bar are avoided.

To provide for uniformly cleaning the grate without breaking through the top crust, the choppers are made in short lengths, and preferably located with their top surfaces located below the level of the tops of the water-bars, which form bridges or supports for the upper part of the fire while the lower part is being shaken by a slight vibration or shaking of the chopper. A more extended or forcible actuation of the shakers dumps the fire from the grate when desired. Both the cleaning and dumping operations are performed with the furnace-doors closed, and escape of dust and dirt into the boiler or engine room is avoided.

By constructing the grate as described to secure a free and ample circulation of air over all parts of its fuel-supporting surface a light fire can be used and the grate frequently shaken to keep the bottom of the fire always bright to promote more thorough and perfect combustion, resulting in increased generation of steam, an economy of fuel, and a decrease in the bulk of ashes or waste from the furnace, which lessens the cost of disposal of such waste. By having the water-tubes always in contact with the bright fire the water circulating through is more quickly heated and raised in temperature to a higher degree previous to being fed to the boiler or conveyed away for use for other purposes.

My invention accordingly consists of the combinations, constructions, and arrangements of parts, as hereinafter more particularly described in the specification, and pointed out in the claims.

Reference is had to the accompanying drawings, wherein Figure 1 is a plan, partly broken away and partly in section, showing a form of water-bar grate with shakers or choppers embodying my improvements. Fig. 2 is an elevation of a form of bridge-bar detached from the grate for supporting the water-bars intermediate of their ends. Fig. 3 is an elevation, partly sectional, showing side bar and feet or bracket supports for the ends of the bridge-bar. Fig. 4 is a side elevation of the side bars for the grate. Fig. 5 is a plan

of the actuating and supporting bars for the shakers or choppers. Fig. 6 is a sectional elevation showing bridge-bar, central support for the same, and bearings on the bridge-bar and central support for the inner ends of bars for upholding the chopper actuating and supporting bars intermediate of their end bearings. Fig. 7 is a horizontal section through the water-bars and their end bearing-bars detached from the grate, the arrows showing the direction of circulation through the same. Fig. 8 is a perspective, partly sectional, of a shaker or chopper and part of an actuating and supporting bar therefor, showing the manner of fastening the chopper to said bar. Fig. 9 is a top view of the same, partly broken away and the sides of the chopper distended to more plainly show the hollow formation of the chopper and internal hub for engagement with its actuating and supporting rod. Fig. 10 is an elevation, partly sectional and one side partly broken away, of the same. Fig. 11 is a perspective view of a preferable form of split key or wedge for fastening the choppers to their actuating and supporting rods. Fig. 12 is a perspective of a bend or section for the sectional end bearing-bars of the grate. Fig. 13 is an end view of the grate with the bridge-bar removed. Fig. 14 is an enlarged sectional view of part of the side bars of the grate, showing more plainly the end bearing or journal boxes therein for the chopper actuating and supporting bars and the removal of the lower half of the journal-box therefrom. Fig. 15 is an enlarged sectional elevation of water-bars and choppers with fire-bed on the water-bars, illustrating the latter supporting the upper crust or part of the fire after its lower part has been cleaned and before being broken down by fresh or new supplies of coal thrown onto it. Fig. 16 is a side elevation of a line of choppers detached from the grate, showing more plainly their relative location for the support of the fuel between their adjacent ends. Fig. 17 is a perspective of part of bridge-bar, central support therefor, part of a chopper actuating and supporting bar, and part of the upholding-bars for the latter.

C represents the grate, comprising the hollow sectional end bearing-bars c and c' , the sections of which have solid ends with recesses therein, as more plainly shown in Fig. 12, and depending end lugs c^2 , having suitable openings through which pass bolts or other fastening devices for uniting said sections together end to end with intervening air-spaces c^3 to form the end bearing-bars c and c' .

The water-bars D , D' , and D^2 connect the sections of the end bearing-bars c and c' , so as to provide a continuous passage through said parts for the circulation of water, as more plainly shown in Fig. 7.

The water-bars D' and D^2 are respectively the inlet and outlet bars of the grate, and they project through the end sections of preferably the front end bearing-bar of the grate, said end sections forming no part of the water-

circulation way or passage through the grate, they being provided to afford supports for the front ends of the pipes or bars D' D^2 , and means of connection between the front sectional end bearing-bar c and the side bars G G of the grate.

To inlet-bar D' in practice is coupled the feed-pipe, and to the outlet-bar D^2 is coupled the pipe leading to a boiler or other appliance, as desired. The bars c and c' are bolted to the side bars G G , as shown at c^6 , Fig. 13. The inner sides of the side bars G G are shown provided with a longitudinal rib g intermediate of the top and bottom edges of said bars, (see more plainly Fig. 4,) said rib being flush with a series of journal-boxes g' at suitable intervals along said bars. These boxes have vertical openings in them for receiving bolts g^2 , which pass down through the lower removable halves or parts g^3 of the boxes, and are provided with end nuts or fastening devices impinging against the under side of parts g^3 to hold them firmly in their bearing-recesses in the side bars and provide a journal-bearing g^4 for transverse shafts or bars h , which support and actuate the leaves, shakers, or choppers P . By removing the nuts from the bolts g^2 the parts g^3 drop down to admit of withdrawal of a bar h and its attached choppers P from the grate.

Upon the inner sides of bars G G , at their middle or at other desired locations whenever needed and below the rib g , are parallel ribs g^5 g^5 , vertically arranged to form a slot g^6 , having lower open end and from which depends a foot-piece g^7 , a like foot g^8 being also provided at the ends of bars G , to the latter of which the ends of the sectional bars c c' are bolted, as above set forth.

The shafts or bars h are preferably of an angular form, having end journals h^1 , which fit the bearings g^4 in the side bars G , and an intermediate journal h^2 , which have a bearing, as hereinafter described, to prevent said bars sagging at their middle or between their ends.

L represents a preferable form of bridge-bar for supporting the water-bars intermediate of their ends to prevent sagging of the same. One or more bridge-bars may be used, as desired. Bar L is more plainly shown in Figs. 2, 3, and 17, and has on its top edge semi-circular recesses l , with lugs or seats l^1 , upon which the water-bars rest, so as to form air-spaces l^2 between the water-bars and their bearings in said recesses l for the circulation of air therethrough to the bars and thence to the fire on the bars in line with the bridge-bar. The body of the latter is formed or provided with circular or other configured openings l^3 for circulation of air through them to both sides of the bridge-bar and thence to the fire resting on the bar to prevent the formation of dark spots in the fire on the bridge-bar. Bar L has a lower flanged edge l^4 , which is cut away at its middle to form, in conjunction with the parallel vertical ribs l^5 l^5 , a slot l^6 , open at

both ends. Bar L has preferably reduced ends l' , upon the lower edge of each of which is a recess l^8 . Bar L is supported at its ends, as more plainly shown in Fig. 3. Its ends l' are inserted in slots g^6 of the side bars G G, the closed upper ends of said slots g^6 preventing bar L from rising. The lower edge of bar L rests upon a leg m , bolted at m' to the middle foot-pieces g^7 of side bars G G, and said legs m have an upwardly-projecting lug m^2 fitting the recesses l^8 in the lower edge of the ends of bar L. The latter is therefore loosely supported at its ends upon the side bars G G and legs m and are tied thereto so that it can move upwardly, downwardly, or sidewise independently of the side bars G. In the expansion and contraction of said parts all move together, so that the line of support of the bar L for the water-bars is constant from end to end, and they are prevented from sagging. Legs m^6 , corresponding in form to legs m , except that the lugs m^2 are dispensed with, are also provided for the feet g^8 of the bars G. (See Fig. 13.) The grate is therefore supported upon such legs and not upon fixtures secured to the furnace-wall, and its conformation may be changed to fit or suit different types of furnaces.

In the open end slot l^6 of bar L are inserted the inner ends of longitudinally-arranged bars n , the outer ends n' of which are bolted to the depending lugs of two meeting sections of the end bearing-bars $c c'$, as indicated at n^2 , Figs. 1 and 13, while their inner ends n^3 in slots l^6 are supported on knees n^4 , formed on or bolted to a depending lug n^5 on bar L. (See more plainly Figs. 6 and 17.) Lug n^5 has a reduced lower end, which engages with a leg n^6 to support the bars L and n at their junction. The bars n have at suitable intervals in their upper edges recesses n^7 , into which the journals h^2 of the bars h fit or have their bearings to prevent sagging of the same. Upon these bars h are secured the choppers P, which are located between the water-bars and between the latter and the side bars G. A form of such chopper is more plainly shown in Figs. 8 to 10, inclusive, and they are of preferably a short length having straight top p , with curved or flaring ends p' , which are corrugated transversely, as shown, or as desired. The choppers are hollow from end to end with open tops and bottoms, and each side of the choppers have inside and outside nicked edges or projections or ribs p^2 at their tops, between which projections or ribs are spaces or intervals p^7 . The projections or ribs on the inner and outer surfaces of each side of the choppers do not align, but have a staggered arrangement—that is, the projections on one surface are opposite the spaces p^7 on the other surface. This arrangement of said projections and spaces divides or breaks up the fuel-supporting surface of each chopper into small areas of stock or metal and numerous angularly-located intervening spaces of small size for preventing escape of fuel to the

ash-pit and for causing free and ample circulation of air through the chopper and said spaces over the entire fuel-supporting surface of the choppers, which circulation prevents the adherence of cinders, molten metal from the fire, or clinkers on the choppers, and thereby avoids melting or burning out of the choppers, which may therefore be made of any suitable cast metal to reduce the cost of the grate.

The choppers have depending lugs p^3 , with lower open end recesses, which fit the angular part of bars h , and through suitable openings in lugs p^3 are driven split keys or two part or leaf wedges p^4 , which impinge against the bars h to fasten the choppers to the latter. Fig. 11 shows a preferable form of such key or wedge, the parts of which are riveted at one end, as at p^5 . The top of the chopper-lugs p^3 extend from side to side of the choppers and are suitably configured between the sides of the choppers to prevent lodgment of ashes or dirt thereon. (See more plainly Figs. 9 and 10.)

Upon the sides of the lugs p^3 or projecting therefrom are extensions p^6 , of such length that the extensions p^6 of adjacent or parallel choppers on a bar h will abut, and thus prevent the choppers or shakers moving laterally to come into contact with the water-bars.

The choppers are made wide enough to fill the spaces between the water-bars and between the latter and the side bars G, with clearance-space for the choppers to move in when shaken, so as not to contact with the water-bars. The choppers have like clearance-space between their ends and between the latter and the end bearing-bars $c c'$ and bridge-bar L, so that there are no large openings in the grate for the fire to fall through, and hence fine coal or coal-dust can be burned on the grate as well as coal of a large size. As the choppers are below the line of the top of the water-bars, the latter form supports for bridging the upper crust or part of the fire (see Fig. 15) when the choppers are actuated to clean the fire, which is done by slightly moving them.

As the choppers do not then break through the top part of the fire and their ends do not separate from each other nor from the end bearing-bars $c c'$ and bridge-bar L, no large openings are made in the fire when it is cleaned for admission of cold drafts to the fire-box to produce black spots in the fire or lower its temperature, and escape of unburned fuel from the fire is avoided.

As the choppers are hollow from end to end and have the staggering arrangement of air-spaces p^7 , as described, the largest possible volume of air is admitted to the fire uniformly throughout its entire area to insure thorough combustion, and as the top of the fire is not broken when cleaned its bottom can always be kept bright and a light fire used for securing the best results as to the generation of steam, heating the water cir-

culating through the water-bars, economy in fuel required, and in disposing of the ashes or waste from the furnace.

Any suitable shaking-levers may be coupled to the chopper-bars h for actuating the same. These levers are not shown in the drawings, as the type of the same is well known.

No system of pipe connection between the inlet water-bar D' and the feed and between the outlet water-bar D^2 and the boiler or other source of consumption for the hot water from the grate are shown, as a preferable form of the same forms the subject-matter of another pending application filed July 16, 1891, which is a division of this application.

What I claim is—

1. In a grate, the combination of side bars, hollow sectional end bearing-bars secured at their ends to the side bars, water-bars joining the sections of the end bearing-bars, shakers or choppers between the water-bars and between the latter and the side bars, and actuating and supporting bars for the shakers or choppers, having end bearings on said side bars, substantially as set forth.

2. In a grate, the combination of side bars, hollow sectional end bearing-bars secured at their ends to the side bars, water-bars joining the sections of the end bearing-bars, shakers or choppers between the water-bars and between the latter and the side bars, actuating and supporting bars for the shakers or choppers, having end bearings in said side bars, a bridge-bar having edge recesses for the reception and support for the water-bars, and interlocking end connections with the side bars, substantially as set forth.

3. In a water-bar grate, the shakers or choppers P , hollow from end to end with open top and bottom sides and having at the upper edges of the interior and exterior surfaces of each side projections or ribs with intervening spaces, and actuating and supporting bars for said shakers or choppers, substantially as set forth.

4. In a grate, the combination of water-bars, end bearing-bars, supports for the latter, hollow choppers with open tops and bottoms, and interior and exterior serrated or corrugated surfaces at the top of the sides thereof, and actuating and supporting bars for said choppers, substantially as set forth.

5. The combination of a water-bar grate and choppers, hollow from end to end, with open tops and bottoms and inside and outside serrations or corrugations at the top of the sides of the choppers, and said choppers projecting into the space between the water-bars and having their upper sides below the top sides of the water-bars, substantially as set forth.

6. The combination of a water-bar grate, hollow choppers with open tops and bottoms and inside and outside serrated upper edges and having their upper surfaces below the level of the top of the water-bars, side pro-

jections p^6 on said choppers, and actuating and supporting bars for the choppers, substantially as set forth.

7. In a water-bar grate, the choppers P , hollow from end to end, with open tops and bottoms and inside and outside serrated upper edges and curved ends, said choppers projecting into the spaces between the water-bars and placed end to end, so that their curved ends support part of the line of fire on the choppers, and actuating and supporting bars for the choppers, substantially as set forth.

8. In a water-bar grate, the combination of sectional hollow end bearing-bars, side bars joining the end bearing-bars, a bridge-bar supported on said side bars, choppers projecting into the spaces between the water-bars, actuating and supporting bars for the choppers, having end bearings in said side bars, supporting-rods having end bearings on the sectional bearing, and bridge-bars for the chopper actuating and supporting rods intermediate of their ends, substantially as set forth.

9. In a grate, the combination of side bars G G , having vertical recesses g^5 , with closed upper ends, legs m , having projecting lugs m^2 , bridge-bar L , having ends fitting recesses g^5 , and interlocking with lugs m^2 , substantially as set forth.

10. A bridge-bar for a grate, having in its top edge recesses l , with seats l' , air-spaces l^2 , and openings l^3 in the body of said bar, substantially as set forth.

11. A bridge-bar for a grate, having on each side central parallel vertical ribs or ways l^5 , and knees n^4 on said bar below said ways, in combination with bars n and leg n^6 , substantially as set forth.

12. A grate-chopper P , hollow from end to end, with open top and bottom, projections with intervening spaces at the inner and outside top edges of each side of the chopper, depending lugs p^3 , and a two-leaf or split key or wedge p^4 , passing through openings in said lugs, substantially as set forth.

13. A hollow grate-chopper P , having open top and bottom, and a staggered arrangement of projections with intervening recesses or spaces at the inner and outer top edges of each side of the chopper, substantially as set forth.

14. A hollow grate-chopper P , having open top and bottom, a staggered arrangement of projections and intervening spaces at the inner and outer top edges of each side of the chopper, depending bottom lugs p^3 , and side extensions or projections p^6 , substantially as set forth.

In testimony whereof I affix my signature in presence of two witnesses.

JAMES REAGAN.

Witnesses:

ROBERT OSBORNE, Jr.,
S. J. VAN STAVOREN.