

March 29, 1932.

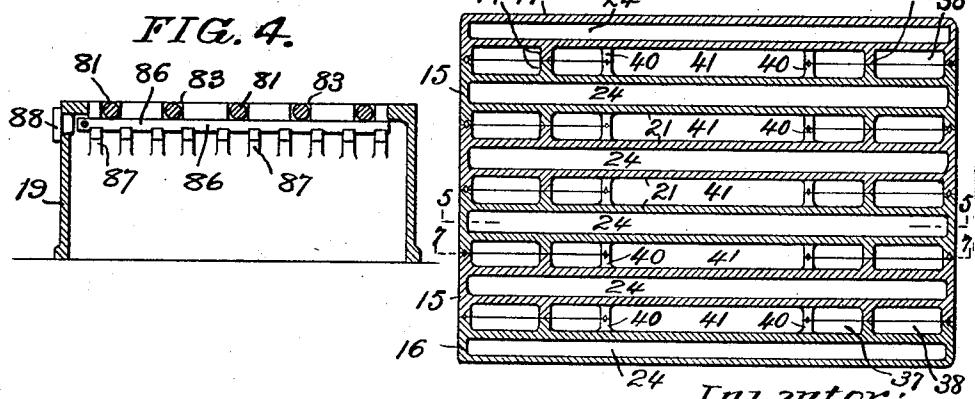
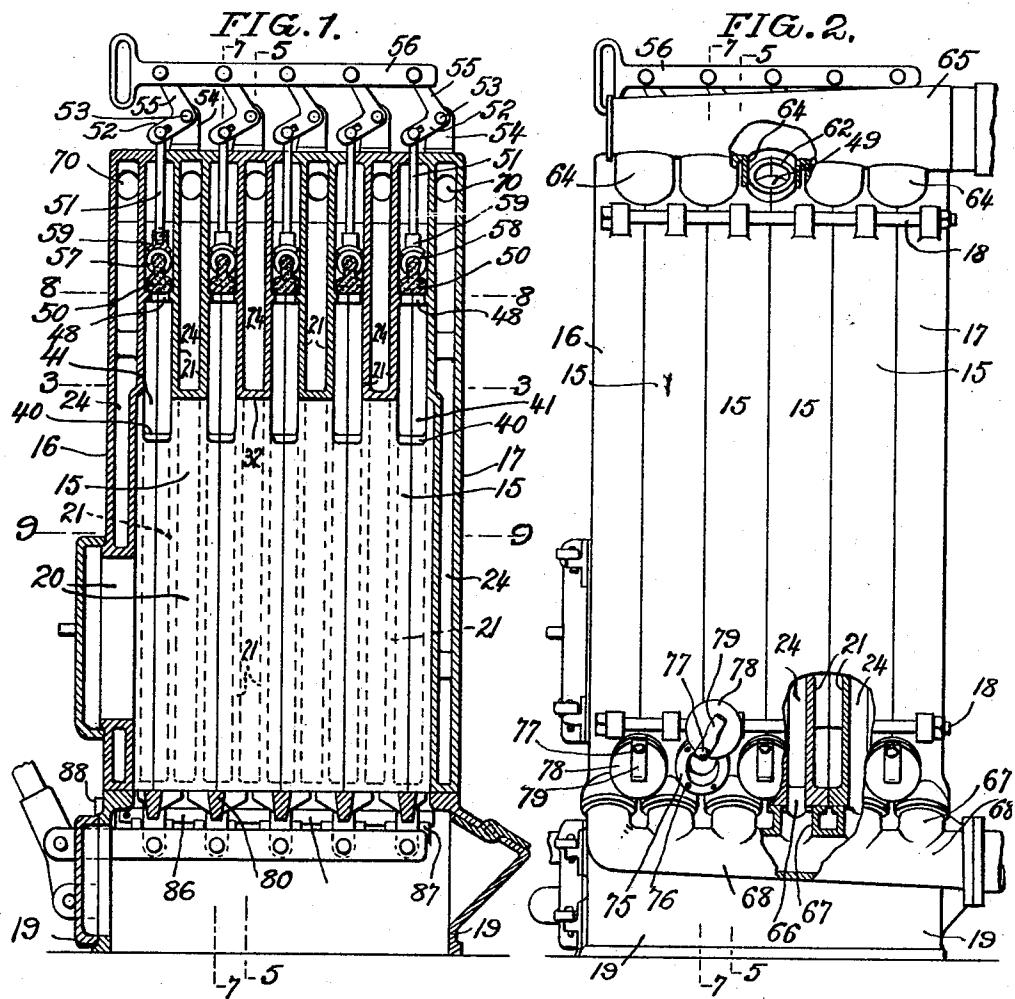
E. D. SILVER

1,851,453

## FURNACE

Filed Dec. 3, 1930

3 Sheets-Sheet 1



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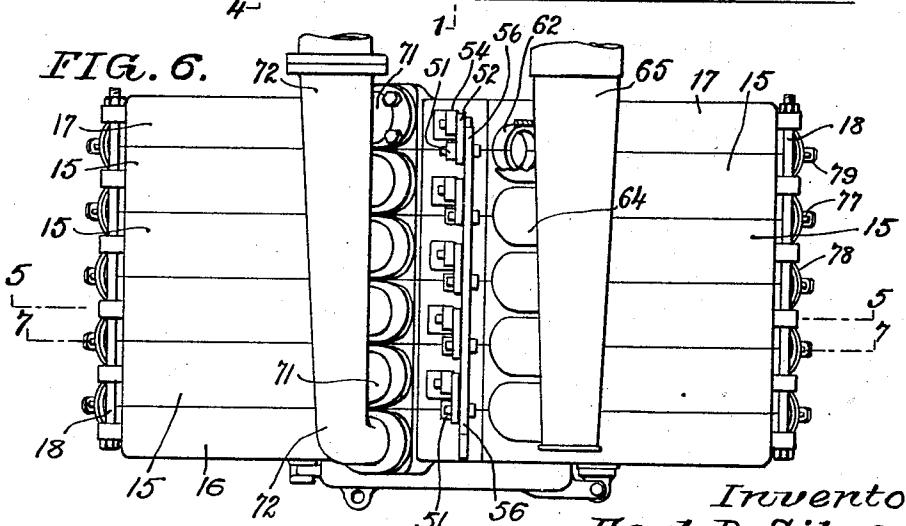
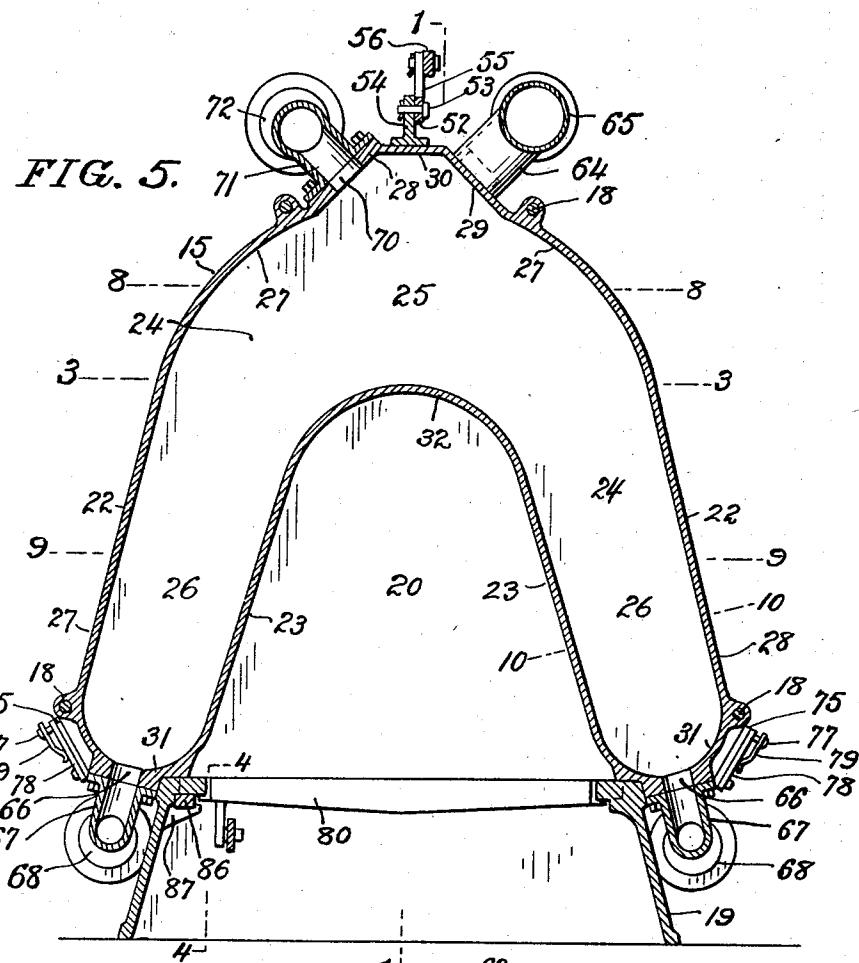
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3 Sheets-Sheet 2



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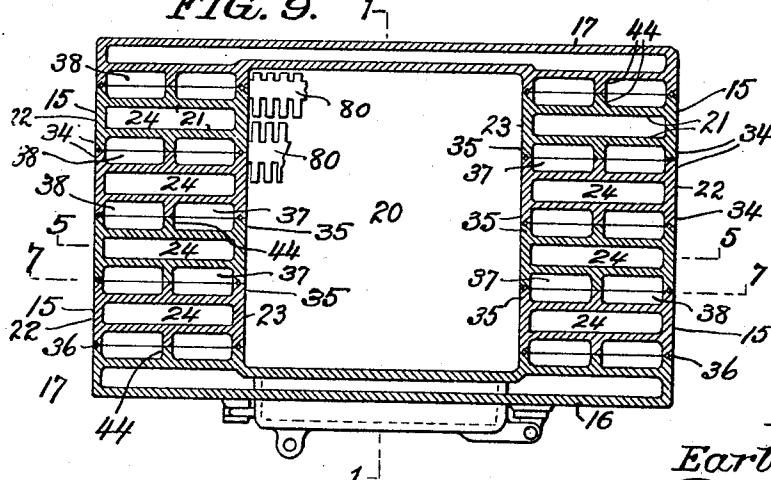
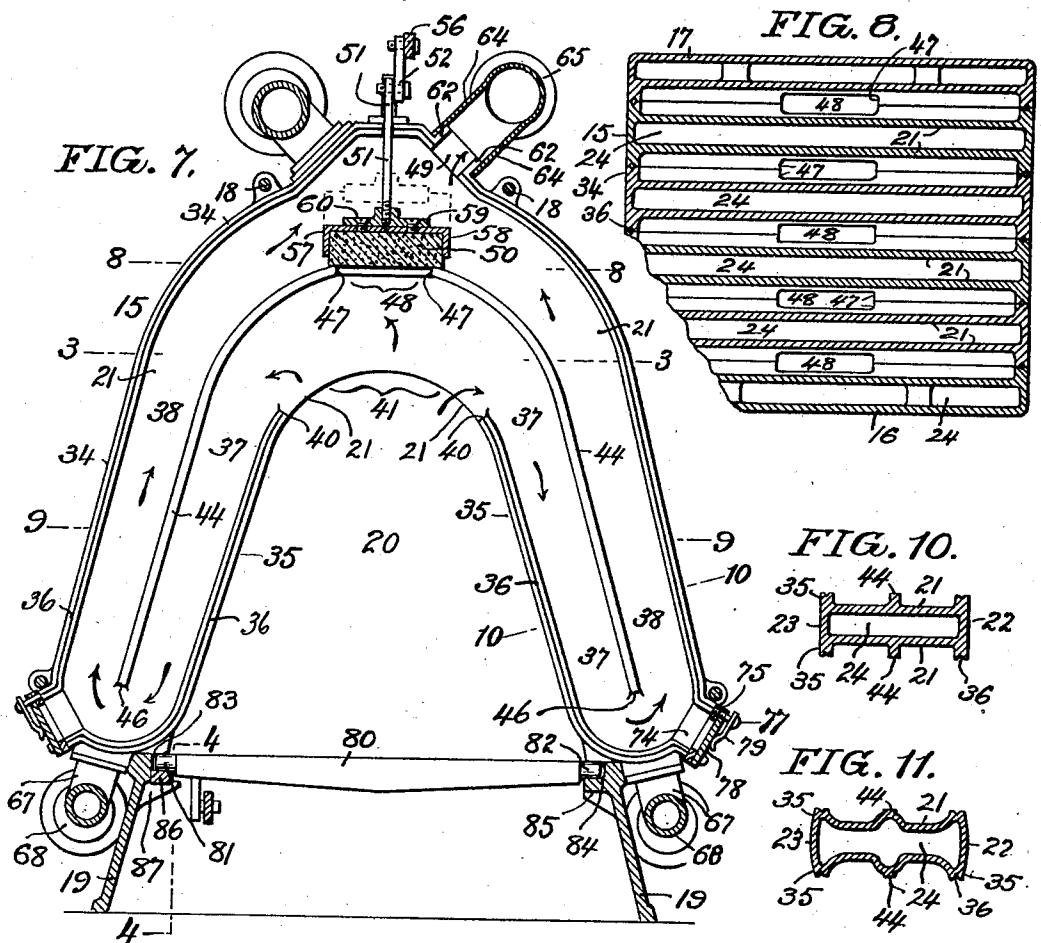
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## FURNACE

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3 Sheets-Sheet 3



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## UNITED STATES PATENT OFFICE

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## FURNACE

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My invention relates to improvements in a heater of the sectional type in which a plurality of sections may be arranged in longitudinal alignment whereby the capacity of the heater may be varied by increasing or reducing the number of sections, and particularly relates to heaters adapted for systems using steam, hot water, or air as the heating medium, and for systems using either short or long flame fuel.

The object of my invention is to construct a heater having a high ratio of heating surface relatively to the cubical capacity of the chambers containing the heating medium; a further object is to provide a heater having hollow sections, each forming a chamber for the heating elements and provide each section with individual inlet and outlet passageways, thus avoiding any intercommunication between the chambers of the different sections of the heater; a further object is to provide sections of A-shape formation, thus forming a central upper portion and symmetrical lower leg portions extending downwardly and outwardly, adapted to embrace the fire box above the line of the grate; a further object is to construct the sections with inner and outer boundary walls which are curved to eliminate all sharp corners and horizontal heating surfaces; a further object is to provide each section with substantially parallel transverse walls forming a relatively thin chamber for the heating element between said walls, and provide ribs upon the outer surfaces of the transverse walls, said ribs defining heat flues for conducting the heat, from the fire box, between the walls of the adjacent sections and in close proximity to the walls forming the chambers containing the heating medium; a further object is to provide heat flue outlets in the ribs of the adjacent sections, thus providing a heat flue outlet between the adjacent sections; a further object is to provide ribs forming division walls located centrally of the outer and inner ribs of the section for directing the heat into the flues formed in the leg portions, thereby extending the length of travel of the heat adjacent to the chambers containing the heating medium; a further

object is to provide an opening in the ribs forming the division walls and provide a novel form of damper for controlling said opening, whereby the products of combustion may be carried directly to the flue outlet when starting a new fire instead of passing through the extended heat flues or passageways before reaching the flue outlet; a further object is to provide the ribs of the adjacent sections with clean-out openings and covers located at the lower ends of the leg portions, making the entire heat flues or passageways of each section accessible for cleaning purposes; and a still further object is to provide a novel means for mounting the grate bars in the base portion of the furnace. These together with various other novel features of construction and arrangement of the parts, which will be more fully hereinafter described and claimed, constitute my invention.

Referring to the accompanying drawings Fig. 1 is a vertical, central, longitudinal sectional view of my improved heater; Fig. 2 is a side elevation partly in section of the heater shown in Fig. 1; Fig. 3 is a horizontal sectional view on line 3—3, Fig. 1; Fig. 4 is a vertical longitudinal sectional view of the base of the heater showing the novel means for detachably supporting the grate bars, as on line 4—4, Fig. 5; Fig. 5 is a transverse vertical sectional view, as on line 5—5, Figs. 1, 2, 3, 6, and 9; Fig. 6 is a plan view of my improved heater; Fig. 7 is a vertical transverse sectional view, as on line 7—7, Figs. 1, 2, 3, 6 and 9; Fig. 8 is a horizontal sectional view, as on line 8—8, Figs. 1, 5, and 7; Fig. 9 is a horizontal sectional view as on line 9—9, Figs. 1, 5, and 7; Fig. 10 is a transverse sectional view on line 10—10, Figs. 5 and 7; Fig. 11 is a view similar to Fig. 10 showing a slightly different form of the heater section; Fig. 12 is a detached view of the clean-out collar; and Fig. 13 is a detached view of the clean-out cover.

In the accompanying drawings in which like reference characters refer to like parts 15 represents the intermediate sections and 16 and 17 represent end sections secured together in longitudinal alignment by bolts 18, 100

forming the heater. Said sections are supported upon the rectangular base 19. The end sections 16 and 17 are co-extensive with the width of the heater, thus forming the 5 front and back vertical walls of the heater. The intermediate sections 15 are of A-shape formation, as shown in Figs. 5 and 7 and form an enclosed fire box 20, above the base 19, and extending longitudinally throughout 10 the length of the heater between the end sections 16 and 17.

The sections forming the heater are of relatively thin construction and extend transversely to the length of the heater. The sections 15 consist of transverse walls 21 arranged substantially parallel, as shown in Figs. 8 to 11. Said walls 21 are connected by short longitudinal outer and inner walls 22 and 23 forming relatively thin chambers 24, for the 20 heating medium, which may be water, steam or air. The A-shape sections 15 each form an upper central chamber portion 25 and symmetrical lower leg chamber portions 26 which extend downward and outwardly, as shown in Fig. 5.

The outer walls 22 of all the sections are provided with gradually upwardly inclined curved portions 27, connected by the crown walls 28, 29 and 30. The walls 22 and 23 of the leg portions of the sections 15 are connected at their lower extremities by the curved portions 31, and the inner walls 23 of the leg portions are connected by a curved dome wall 32 above the fire box 20.

35 The walls 22 and 23 are inclined upwardly and inwardly and converge with the dome walls 27 and 32, thus insuring the free circulation of the heating medium through the upper central chamber portion 25 and the lower leg chamber portions 26 of the sections, as there are no square, or abrupt corners, or flat surfaces, which would tend to retard the free circulation of the pressure medium.

40 Each section is provided with ribs 34 and 35 which project from the plane of the transverse walls 21 and abut against similar ribs formed upon the next adjacent section, thus positioning the transverse walls 21 of the adjacent sections in spaced relation to each other and forming heat flues between the chambers formed in the sections. The ribs 34 and 35 are in alignment with the walls 22 and 23 respectively. The ribs 34 follow the outer contour of the sections, and the ribs 35 follow the inner contour of the sections, as shown in Fig. 7, thus defining the heat flues 37 and 38 located between the chambers 24 of the adjacent sections. The facing surfaces of the 45 ribs 34 and 35 are provided with grooves 36 which are filled with cement or other means for sealing the joints between the sections.

The inner ribs 35 terminate at the points 50, as shown in Figs. 1, 3 and 7, thus forming an opening 41 for the heat to pass from the fire box 20 into the flues 37 and 38. Between

the ribs 34 and 35 are provided central ribs 44, as shown in Fig. 7. The central ribs 44 extend into the lower leg portions of each section, and their lower ends terminate at the points 46 in spaced relation with the outer ribs 34 and 35, thus forming long circuitous heating flues, or passageways 37 and 38, between the transverse walls 21 of the sections, as indicated by the arrows in Fig. 7.

70 The center ribs 44 terminate at their upper ends at the points 47 and form an opening 48, shown in Figs. 1, 7 and 8. Dampers 50 are provided for normally closing the openings 48, as shown in Figs. 1 and 7, so that the heat will be directed into the flues 37 and 38 of the legs of the sections by the central ribs 44 before passing out through the flue outlet 49 formed through the outer ribs 34 of the adjacent sections.

75 The damper 50 may be lifted, when starting a new fire, for allowing the heat to pass through the opening 48, directly to the flue outlet 49. Each damper 50 is provided with a rod 51 extending vertically through an opening formed in the ribs 34, at the dividing line, between the adjacent sections, as shown in Figs. 1 and 6.

80 The upper ends of the damper rods 51 are each connected with bell-crank levers 52 pivotally mounted upon shafts 53, which in turn are mounted upon bearings 54 secured upon the upper portion of each section of the heater. The arms 55 of the bell-crank levers 52 are pivotally connected with an operating bar 56 for lifting all the dampers 100 simultaneously.

85 The dampers 50 are formed of refractory material and are held in clamp plates formed of two parts 57 and 58 which embrace the dampers 50. Said parts 57 and 58 are joined together by a cap 59, with which latter the damper rod 51 is secured. The parts 57 and 58 of the plates are of circular formation 105 in cross section and embrace the enlarged upper portions of the damper 50. By removing the cap 59, the parts 57 and 58 of the clamp plates may be slid endwise upon the enlarged upper portions of the damper 50. The cap 59 is secured by screws 60 to the parts 57 and 58, thus providing means for readily assembling the dampers.

90 The flue outlets 49 are formed by semi-circular flanges 62 formed upon the outer surface of the adjacent sections, as shown in Figs. 2, 6 and 7. About the flanges 62 are fitted pipes 64 leading to a common header 65, which latter may be connected with a chimney or stack in the usual manner. By this arrangement an individual outlet 49 is provided for the heat flues 37 and 38 formed between the adjacent sections, and each outlet 49 is connected with a pipe leading to the common header.

95 The lower leg portions of the sections, in which the chambers 26 for the heating ele-

ment are formed, are provided with inlet openings 66, to each of which a branch pipe 67 from a common header 68 is connected, as shown in Figs. 2, 5, and 7. The upper central portion of each section is provided with an outlet opening 70, which is connected with a branch pipe 71 leading to a common-outlet header 72, as shown in Figs. 5 and 6, thus it will be seen that each chamber for the heating element is provided with two inlet connections 66 at the lower ends of the leg portions and with an individual outlet connection 70 at the top of the central portion of each section.

The ribs 34 of the sections are provided at the lower ends of the leg portions with openings 74 for cleaning purposes. Said openings 74 are located upon the plane between the ribs of two adjacent sections, so that the spaces forming the heat flues 37 and 38 are made accessible for cleaning purposes. Each clean-out opening 74 is provided with a collar 75, shown detached in Fig. 12, which collar surrounds the openings 74 and is fastened to the adjacent sections by means of screws 76, shown in Fig. 2. Upon the collar 75 is secured a bolt 77 upon which is pivotally mounted a cover 78, shown detached in Fig. 13, which is adapted to be held in place upon the collar 75 by means of a spring 79 carried by said bolt 77 and tending to hold the cover 78 against the collar 75.

The leg portions of the sections are adapted to embrace the base 19 upon which the sections are supported. Upon the base 19 are pivotally mounted grate bars 80 which are provided at their opposite ends with circular end shafts 81 and 82, which enter pockets 83 and 84 formed in the base 19. At one side of the base is provided a projection 85 upon which the ends 82 of the grate bars are supported, this projection may be an integral part of the base.

The opposite ends 81 of the grate bars are supported upon a removable bar 86, upon which the circular ends 81 of the grate bars are supported, as shown in Figs. 4, and 7. The supporting bar 86 is slidably mounted upon lugs 87, forming an integral part of the base 19. A vertical end wall of the base is provided with an opening having a removable plug 88, through which the supporting bar 86 may be withdrawn for allowing one end of the grate bars to drop into a position from which they may be removed from the heater. New grate bars may be inserted into the heater in a similar manner.

The operation of my invention is as follows:

The dampers 50 are opened when starting a new fire and closed when it is desired to direct the heat in full contact with the sections of the heater so that the heat will pass through the flues 37 and 38, as shown by the arrows in Fig. 7. The heat is directed by the flues in

contact with the transverse walls 21 of the sections forming the chambers for the heating medium. Said chambers are relatively thinner than the depth of the heat flues so that a large heating surface is presented to the chambers containing the heating medium, thus a high ratio of heating efficiency is obtained by directing the heat into contact with the entire transverse area of the sections adjacent to the chambers containing the heating medium.

The sections are provided with headers forming inlet and outlet connections with the chambers for the heating medium of each individual section, thus eliminating any connection between the adjacent sections liable to cause leakage. Should a leak occur in any section, the connections between the header and the section in which a leak occurs may be cut off by inserting sheets of metal, forming diaphragms between the section and the branch pipes of the headers, thus separating any one section from the connecting headers.

The heat flues provided between the sections of the heater have extremely long courses of travel from the fire box to the flue outlet formed between the ribs of the adjacent sections. Each section is provided with clean-out openings making the entire flue area accessible for cleaning purposes. The heater is of compact formation, thus occupying small floor space. It may be adapted for use in connection with any form of heating fuel and it is also adapted for use in connection with systems using steam, hot air, or hot water, as the heating medium.

I claim:

1. A heater comprising a plurality of hollow sections arranged in horizontal alignment throughout the length of the heater, each section having an upper central portion and depending symmetrical leg portions forming a chamber for a heating medium, said chamber extending transversely relatively to the length of the heater, ribs upon said sections arranged to abut against the ribs of the next adjacent section, said ribs located adjacent to the inner and outer extremities of the portions of the sections defining said chamber, said ribs terminating below said upper central portion forming a heat inlet opening, said ribs having an opening formed therein forming a heat outlet opening located at the top of said central portion, ribs upon said sections forming a division wall positioned midway between said heat inlet and outlet openings, said ribs forming the division wall extending from the upper central portion of the section into each of the leg portions, said division wall terminating in spaced relation with the lower ends of the leg portions forming heat flues for directing the heat from said inlet opening into the lower ends of the leg portions.

and thence to the outlet opening, and a base upon which the leg portions are mounted forming a fire box located below said inlet opening.

5 2. A heater comprising a plurality of hollow sections arranged in horizontal alignment, each section having an upper central portion and depending leg portions forming a chamber for the heating medium extending transversely relatively to the length of the heater, a base upon which the lower extremities of the leg portions are mounted, said base and said sections forming a fire box, ribs upon said sections arranged to abut against the ribs of the next adjacent section forming heat flues between the chambers of the adjacent sections, said ribs surrounding the heat flues and terminating immediately below said upper central portion forming inlet openings between the fire box and the heat flues, said ribs having openings formed therein forming flue outlet openings located at the upper portion of said sections, ribs upon the sections arranged to abut against similar ribs of the next adjacent section, said last mentioned ribs located midway between said inlet and outlet openings and forming a division wall for directing the heat into the downwardly depending portions of the sections.

3. A heater comprising a plurality of hollow sections arranged in horizontal alignment, each section having an upper central portion and depending leg portions forming a chamber for the heating medium extending transversely relatively to the length of the heater, a base upon which the lower extremities of the leg portions are mounted, said base and said sections forming a fire box, ribs upon said sections arranged to abut against the ribs of the next adjacent section forming heat flues between the chambers of the adjacent sections, said ribs surrounding the heat flues and terminating immediately below said upper central portion forming inlet openings between the fire box and the heat flues, said ribs having openings formed therein forming flue outlet openings located at the upper portion of said sections, ribs upon the sections arranged to abut against similar ribs of the next adjacent section, said last mentioned ribs located midway between said inlet and outlet openings forming a division wall for directing the heat into the downwardly depending portions of the sections, said last mentioned ribs of the adjacent sections having openings formed therein arranged to form direct passageways from the fire box to said flue outlet openings, dampers of refractory material, sectional clamp plates, means for securing said clamp plates upon said dampers, and a rod operatively associated with the dampers extending without said sections arranged for moving the dampers to open or close said openings formed in the last mentioned ribs.

4. A heater comprising a plurality of hollow sections arranged in horizontal alignment, each section having an upper central portion and depending leg portions forming a chamber for the heating medium extending transversely relatively to the length of the heater, a base upon which the lower extremities of the leg portions are mounted, said base and said sections forming a fire box, ribs upon said sections arranged to abut against the ribs of the next adjacent section forming heat flues between the chambers of the adjacent sections, said ribs surrounding the heat flues and terminating immediately below said upper central portion forming inlet openings between the fire box and the heat flues, said ribs having openings formed therein forming flue outlet openings located at the upper portion of said sections, ribs upon the sections arranged to abut against similar ribs of the next adjacent section, said last mentioned ribs located midway between said inlet and outlet openings forming a division wall for directing the heat into the downwardly depending portions of the sections, said last mentioned ribs having openings formed therein arranged to form direct passageways from the fire box to said flue outlet openings, dampers located between the adjacent sections arranged for opening and closing the openings formed in the last mentioned ribs, and means for operating said dampers.

5. A heater comprising a plurality of hollow sections arranged in horizontal alignment, each section having an upper central

portion and depending leg portions forming a chamber for the heating medium extending transversely relatively to the length of the heater, a base upon which the lower extremities of the leg portions are mounted, said base and said sections forming a fire box, ribs upon said sections arranged to abut against the ribs of the next adjacent section forming heat flues between the chambers of the adjacent sections, said ribs surrounding the heat flues and terminating immediately below said upper central portion forming inlet openings between the fire box and the heat flues, said ribs having openings formed therein forming flue outlet openings located at the upper portion of said sections, ribs upon the sections arranged to abut against similar ribs of the next adjacent section, said last mentioned ribs located midway between said inlet and outlet openings forming a division wall for directing the heat into the downwardly depending portions of the sections, said last mentioned ribs having openings formed therein arranged to form direct passageways from the fire box to said flue outlet openings, dampers of refractory material, sectional clamp plates, means for securing said clamp plates upon said dampers, and a rod operatively associated with the dampers extending without said sections arranged for moving the dampers to open or close said openings formed in the last mentioned ribs.

5. A heater comprising a plurality of hollow sections arranged in horizontal alignment, each section having an upper central portion and depending leg portions forming a chamber for the heating medium extending transversely relatively to the length of the heater, a base upon which the lower extremities of the leg portions are mounted, said base and said sections forming a fire box, ribs upon said sections arranged to abut against the ribs of the next adjacent section forming heat flues between the chambers of the adjacent sections, said ribs surrounding the heat flues and terminating immediately below said upper central portion forming inlet openings between the fire box and the heat flues, said ribs having openings formed therein forming flue outlet openings located at the upper portion of said sections, ribs upon the sections arranged to abut against similar ribs of the next adjacent section, said last mentioned ribs located midway between said inlet and outlet openings forming a division wall for directing the heat into the downwardly depending portions of the sections, said last mentioned ribs having openings formed therein arranged to form direct passageways from the fire box to said flue outlet openings, dampers located between the adjacent sections arranged for opening and closing the openings formed in the last mentioned ribs, rods attached to the dampers and extending to the outside of the upper portions of the

sections, and a bar operatively associated with said rods arranged for operating the dampers simultaneously.

6. A heater comprising sections of A-shape formation forming an upper central portion and depending leg portions, a base upon which the sections are supported forming a fire box above the base between the leg portions of the sections, said sections having inlet openings located at the lower ends of the leg portions, headers located outside of said sections having branch pipes connecting the inlet openings of each leg portion, said headers located outside of said sections, said sections each having an outlet opening located at the upper central portion thereof, a header located outside of said sections having branch pipes connected with each outlet opening of said sections, said sections having ribs formed thereon, means for securing the sections together with said ribs of the adjacent sections in abutting relation and forming heat flues between said sections defined by said ribs, said ribs having inlet openings formed directly above the fire box, said ribs having flue outlet openings located at the top of the central portion of each section, a header located outside of the sections having branch pipes connected with said flue outlet openings, said ribs having clean-out openings formed therein located at the lower extremities of each leg portion, removable covers upon said leg portions for closing the clean-out openings, ribs upon the sections forming division walls extending into the heat flues of said leg portions, said last mentioned ribs having openings formed therein through which the heat may be directed from the firebox directly to the flue outlet openings, dampers located in the heat flues between the adjacent sections, and means positioned without the sections for operating the dampers for opening and closing the openings formed in the ribs forming the division walls.

45 In testimony whereof I affix my signature.  
EARL D. SILVER.