June 22, 1965 KINGO MIYAHARA 3,190,283

COMPACT INSTANTANEOUS WATER HEATER

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Fig. 1

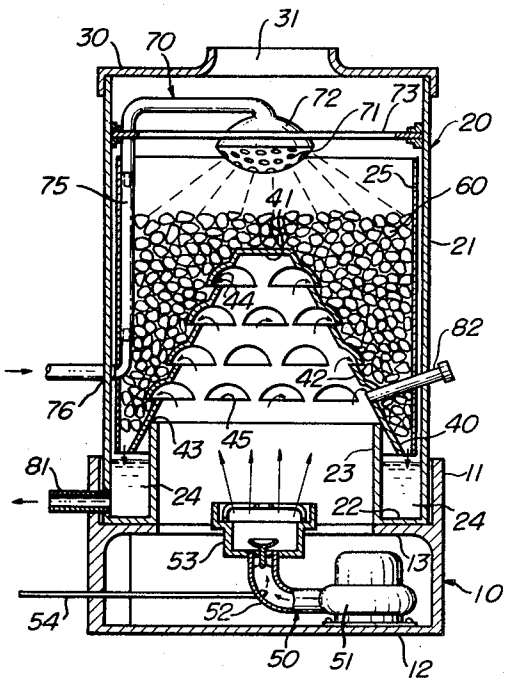


Fig. 2

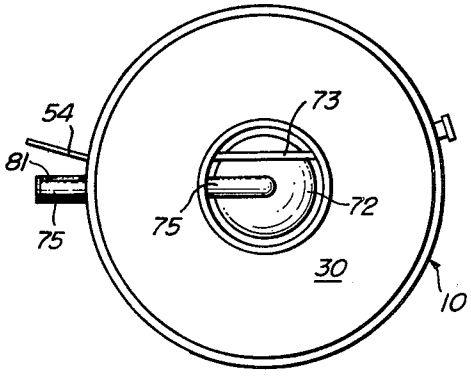


Fig. 3

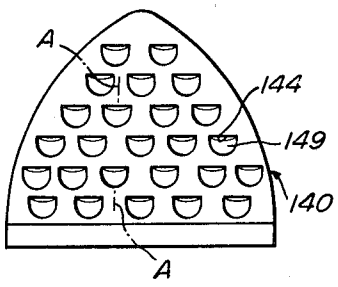
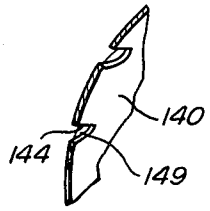


Fig. 4



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Fig. 5

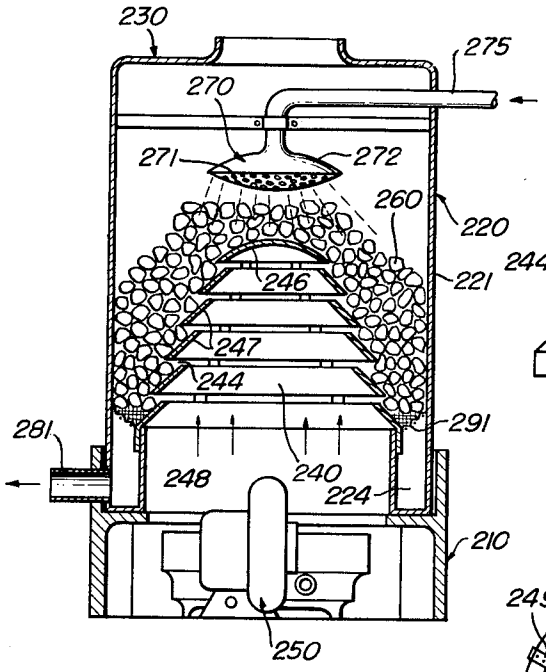


Fig. 7

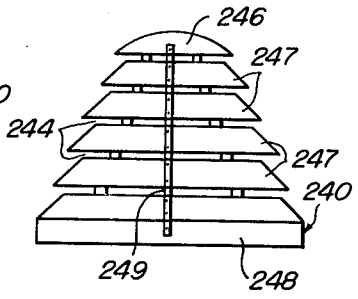


Fig. 8

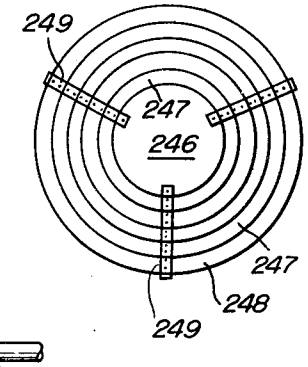
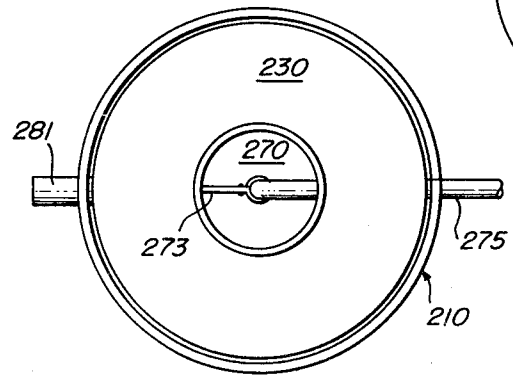


Fig. 6



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COMPACT INSTANTANEOUS WATER HEATER

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2 Claims. (Cl. 126—359)

The present invention relates to water heaters and more particularly to water heaters capable of continuously furnishing water heated to a predetermined temperature at high rate.

According to the present invention, there is provided a water heater which comprises a casing having an opening at the top, a burner arranged in said casing, a cap member mounted in said casing above the burner to define the top portion of a combustion chamber and having a wall formed with through apertures serving as outlet openings allowing burnt gases to flow exteriorly of said combustion chamber, a stack of heat-absorbing material filling a space defined between said cap member and the adjacent wall of said casing, means for sprinkling water over said stack of heat absorbing material, and means for collecting the water heated.

In the water heater according to the present invention, sprinkled water comes into direct contact with the burnt gases or the heat absorbing material heated thereby to be heated through the heat exchange effected therebetween while trickling down through the stack of heat-absorbing material and the water thus heated is collected in the water collector.

The water heater according to the present invention is a kind of flush type water heater which is highly efficient, compact and economical to manufacture. The water heater may be advantageously employed in all cases where heated water is required either for domestic or industrial use.

The present invention will now be described in detail with reference to the accompanying drawings, which illustrate a few embodiments of the invention and in which:

FIG. 1 is a vertical cross-sectional view of one embodiment of the invention;

FIG. 2 is a top plan view of the embodiment shown in FIG. 1;

FIG. 3 is a side elevational view of a modified form of cap member;

FIG. 4 is an enlarged fragmentary cross-sectional view of the cap member shown in FIG. 3;

FIG. 5 is a vertical cross-sectional view of another embodiment of the present invention;

FIG. 6 is a top plan view of the embodiment shown in FIG. 5; and

FIGS. 7 and 8 are a side elevational and a top plan view, respectively, of the cap member employed in the embodiments of FIGS. 5 and 6.

Referring to the drawings and particularly to FIGS. 1 and 2, the water heater illustrated is comprised of a base **10**, a casing **20** mounted on the base. A cover **30** is disposed on top of the casing, and a cap-like member **40** is mounted in the casing. A burner assembly **50** is arranged in the base on the bottom thereof. A stack of solid heat-absorbing refractory material **60** fills a space defined between the cap-like member **40** and the adjacent wall of the casing **20** to surround the cap-like member **40**. Water feeding means **70** is provided for sprinkling water over the stack of heat-absorbing material. The heat-absorbing material preferably takes the form of pebbles of foraminous rock such as of silica, shale or pumice or ceramic material or balls formed of sheet metal.

The base **10** is preferbly a one-piece structure of cast iron having a cylindrical side wall **11**, a bottom wall **12** and an annular flange **13** extending horizontally inwardly from the side wall **11** at a level about half of the height thereof.

The casing **20** is made of sheet metal and has a cylindrical outer shell or wall **21** connected at the bottom end with an annular bottom wall **22** along the outer periphery thereof. A relatively short cylindrical upstanding wall **23** extends upwardly from the inner peripheral edge of the annular bottom **22**. The walls **21**, **22** and **23** together form a reservoir **24** where heated water collects. Provided inside of the outer casing wall **21** is an inner shell or cylindrical heat-shielding wall **25** in slightly spaced-apart relation thereto. The heat-shielding wall **25** is secured to the wall **21** by suitable means, as will readily be understood. The casing **20** is placed on the flange **13** of the base **10** by way of the annular bottom wall **22**. The cover **30** mounted on top of the casing **20** has formed therein a central aperture **31** serving as a burnt gas discharge opening.

The cap-like member **40** is placed in the casing on top of the upstanding wall **23** thereof, as illustrated. The cap-like member **40** is also made of sheet metal and generally frustoconical including a flat horizontally extending top wall **41** and a downwardly diverging conically-shaped wall **42**, the inner surface of which engages the top edge of the upstanding wall **23** as at **43**. The conical wall **42** is formed with a multitude of apertures **44** serving as outlet passages through which burnt gases flow out. Each of the apertures **44** includes a slit having a horizontally extending straight bottom edge **45** and an outwardly expanded or bulged top edge overlying said bottom edge in spaced-apart relation thereto. The apertures in this embodiment of the invention open downwardly.

The bottom wall **12** and annular flange **13** of the base **10** define a space together with the upstanding wall **23** of the casing and the cap-like member **40**, the burner assembly **50** being arranged in the bottom portion of the space, as illustrated. The top portion of the space forms a combustion chamber where fuel ejected through the burner is burnt. The burner assembly **50** includes a blower **51**, an air delivery pipe **52** connected to the outlet of said blower, and a mixing chamber **53** communicating with the air delivery pipe **52** at the extremity thereof. Fuel gas is fed through a conduit **54** into the air delivery pipe **52** intermediate its ends and mixed with air in the mixing chamber **53**. The fuel-air mixture is ejected upwardly from the mixing chamber **53** to burn in the combustion chamber above.

In this embodiment, the stack of heat-absorbing material **60** fills the space defined between the inner wall **25** of the casing and the cap-like member **40** to surround the walls thereof reaching at the top a level higher than the top wall **41**.

The water feeding device **70** includes a sprinkler head **72** disposed above the stack of heat-absorbing material and formed with a mulitude of orifices **71** having downwardly diverging axes. The water feeding device **70** is secured at the sprinkler head **72** to the outer wall **21** of the casing **20** by means of a support bar **73**. A water conduit **75** for feeding water to the sprinkler head **72** extends downwardly along the inner surface of the inner wall **25** and further extends outwardly through the inner wall **25** and the outer wall **21** as indicated at **76** to a suitable water supply source. Water to be heated is thus fed from the supply source through the conduit **75** to the sprinkler head **72**.

For the purpose of carrying the heated water collecting in the reservoir **24** exteriorly of the heater, a conduit **81** is connected to the reservoir **24** adjacent to its bottom and extends outwardly through the side wall **11** of the base **10** to the point of use of the heated water. As

shown in FIG. 1, a window device 82 is provided for observing the state of fuel combustion in the heater exteriorly of the casing thereof.

In operation of the water heater illustrated in FIGS. 1 and 2, as apparent from the foregoing description, fuel gas fed through the conduit 54 into the air delivery pipe 52 of the burner assembly to be mixed with the air delivered from the blower 51 flows upwardly through the pipe 52 into the mixing chamber to be thoroughly mixed with the air. The mixture flows out of the chamber to burn in the space above. The burnt gases rise to flow outwardly through the mulitude of apertures 44 formed in the cap-like member 40 to be uniformly distributed into the stack of heat-absorbing material 60 and thus rises therethrough while directly heating the heat-absorbing material. Water fed through the conduit 75 into the sprinkler head 72 is ejected through the orifices 71 formed therein downwardly divergently to trickle down through the stack of heat-absorbing material 60 while making direct contact with the rising hot gases or with the surfaces of the heat-absorbing material heated thereby. The water thus heated while trickling down through the heat-absorbing material is collected in the annular reservoir 24 and led out through the conduit 81 to the point of use as required.

With this arrangement, it will be appreciated that the contact area between the trickling water and the rising gases or the heat-absorbing material is extremely large for the size of the water heater and thus the heat content of the burnt gases is substantially entirely transferred to the water. According to the present invention, therefore, an extremely highly efficient water heater is provided which may be fed with fuel and water at high rates despite of its limited size. In the embodiment described above, the provision of the inner wall 25 is effective to keep heat produced from escaping exteriorly of the casing, as will readily be appreciated.

Referring next to FIGS. 3 and 4, a modified form of cap-like member 140 is generally similar to the cap-like member 40 except that it includes apertures 144 each taking the form of a slit having a horizontally extending straight top edge and an inwardly offset bottom edge 149.

Another embodiment of the present invention shown in FIGS. 5 and 6 is generally similar in construction to the first embodiment shown in FIGS. 1 and 2 except the following features. Parts of the second embodiment corresponding to those of the first embodiment are designated in FIGS. 5 and 6 by adding 200 to the reference numerals for the first embodiment.

The casing 220 of the second embodiment has a simplified structure compared with that of the first embodiment, lacking any inner wall corresponding to the wall 25 arranged inside of the outer casing wall 21 of the first embodiment. The casing 220 also has an integral top wall 230 in place of the cover 30. The stack of heat-absorbing material 260 is supported at the bottom by an annular platform 291 provided for the purpose. A burner assembly 250 is designed for use with liquid fuel.

A further distinctive feature of the embodiment shown in FIGS. 5 and 6 is a cap-like member 240 constructed as described below.

As illustrated in FIG. 7, the cap-like member 240 includes a top roof member 246, a number of intermediate roof members 247, a bottom roof member 248, and three rafters 249 interconnecting said roof members in spaced-apart overlapping relation to each other to form a dome-like structure having annular spacings 244. Burnt gases flow through these annular spacings 244 between the adjacent roof members outwardly into the stack of heat absorbing material 260.

The general function of the water heater shown in FIGS. 5 to 8 is similar to that of the heater shown in FIGS. 1 and 2. Specifically, water is fed through the conduit 275 to the sprinkler head 272 and ejected downwardly divergently through the orifices 271 formed therein to flow down through the stack of heat-absorbing material while being heated by the burnt gases and the heat-absorbing material heated thereby. The water thus heated is collected in the reservoir 224 and subsequently led through the conduit 281 to the point of use as required.

The present invention has been described with particular reference to a few preferred embodiments thereof, but it will be apparent to those skilled in the art that various changes and modifications may be made without departing from the scope and spirit of the invention as claimed.

What is claimed is:

1. A compact water heater comprising, a casing, means defining a combustion chamber in said casing and coming a cap-like cover member defining an upper part of said combustion chamber in which combustion takes place, said cap-like member having through, elongated apertures extending in a circumferential direction for allowing hot gases of combustion to flow out of said combustion chamber, means on said cap-like cover member defining said apertures opening in a downward direction, a plurality of stacked heat-absorbing bodies disposed around and over said upper part of said combustion chamber in immediate contact therewith to be heated by said gases flowing out of said combustion chamber apertures, means to sprinkle water on the stack of said heat-absorbing bodies for heat transfer from said hot gases and said bodies to the sprinkled water percolating therethrough, means for collecting the heated water comprising means defining a hot water reservoir disposed at a level for receiving said water after percolating through said heat-absorbing bodies and disposed beneath and close adjacent to said stacked heat-absorbing bodies to hold the heated water outwardly of said combustion chamber and in contact with said combustion chamber at least partially circumferentially thereof, and a burner assembly in said combustion chamber for burning a fuel in said combustion chamber, whereby said compact water heater is of reduced dimensions and can heat relatively large amounts of water with an improved efficiency.

2. A compact water heater according to claim 1, in which said heat-absorbing bodies comprise a foraminous material.

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