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Courier Press, Leamington Spa, England.

Description

The invention relates to a water heater according to the preamble part of claim 1.

A longstanding problem in the water heater industry is the tendency of dissolved solid particles to precipitate out of the water being heated, which particles will accumulate on the bottom of the tank, causing adverse operation and tank failure. Prior constructions directed to this problem are disclosed in US—A—4,157,077, US—A—4,257,355 and US—A—4,263,879, the last one disclosing a water heater according to the preamble part of claim 1. The latter water heater includes an agitator assembly having a circular tubular member which is positioned between the outer row of flue tubes and the tank wall with all orifices extending only in a horizontal plane, in other words, parallel to the bottom. Furthermore, there is only one venturi fitting being directed upwardly in the center of the tank, and being disposed on a straight portion which extends from a connection point to the inner side of the ring portion. Due this latter feature, the known water heater is relatively complicated structurally and, although a certain swirling and sweeping action is possible, the effect of this known arrangement is not satisfactory. Thus, the generic water heater also suffers from the before-mentioned drawback that there is a tendency for dissolved solid particles to precipitate out of the water being heated. If the scale accumulations are not periodically removed by some type of tank cleaning procedure, they will gradually build up and harden, causing an adverse effect on the heating efficiency of the unit and, in many cases, will ultimately cause a premature failure of the heater tank.

It is, therefore, an object underlying the present invention to provide a water heater according to the preamble part of claim 1 which is more effective for reducing adverse accumulations of scale than are the prior art constructions.

The solution of this object is achieved by the features of claim 1.

The dependent claims contain advantageous embodiments of the present invention.

Description of the drawings

Fig. 1 is a side elevation view (with parts broken away) of a water heater which incorporates the subject matter of the present invention;

Fig. 2 is a sectional view taken along line 2—2 of Fig. 1;

Fig. 3 is a sectional view taken along line 3—3 of Fig. 2;

Fig. 4 is a sectional view taken along line 4—4 of Fig. 2 (with orifice assembly removed);

Fig. 5 is a sectional view taken along line 5—5 of Fig. 2 (with orifice assembly removed);

Fig. 6 is a side view (partially in section) of an orifice member; and

Fig. 7 is a fragmentary side elevation view (partially in section) of a support leg for the agitator assembly.

Description of the preferred embodiment

Referring to the drawings in detail, the water heater of the present invention is comprised of a tank wall 10, a tank top member 12 and a tank bottom member 14. Top and bottom members 12 and 14 are provided with a plurality of aligned openings 16 and 18, respectively, in which flue tubes 20 are mounted (Fig. 1 does not show a complete set of flue tubes 20). Tank top and bottom members 12 and 14 are sealed to the tank wall 10 and to the flue tubes 20 by any suitable means such as welding to form a liquid tight tank having a water heating chamber 22 therein. A hot water outlet fitting 23 is provided in the top portion of the tank wall 10.

The flue tube pattern shown in Fig. 2 is typical. The flue tubes 20 are positioned in an outer row designated by numeral 24 and an inner row designated by reference number 26.

The water heater tank is mounted on a support base 28 which houses a burner 30 of conventional construction. Burner 30 is shown schematically in Fig. 1.

Mounted in the lower portion of tank chamber 22 is an agitator assembly indicated generally by reference numeral 32. Agitator assembly 32 is comprised of a circular tubular member 34 and a straight inlet tubular member 36 connected to the circular member 34 at point 38 by any suitable means such as welding. In the preferred embodiment, members 34 and 36 are made of heat and corrosion resistant material such as stainless steel.

Inlet tube 36 extends through the tank wall 10 and fits inside a sleeve 40 which, in turn, is sealed inside a nipple 42. Sleeve 40 is made of an electrically nonconductive material such as plastic. Nipple 42 is threaded into a spud 44 which is welded to the tank wall 10. Nipple 42 is connected to a source of water under pressure by any suitable means (not shown).

It should be noted at this point that circular tubular member 34 of the agitator assembly 32 is located between the outer row 24 and the inner row 26 of flue tubes 20. More specifically, member 34 is located internally of and closely adjacent the outer row 24 of flue tubes 20. The significance of this location will be explained in detail hereinafter.

Circular tubular member 34 is provided with three (3) rows of orifice assemblies 46; i.e., one row on the inner side of the member, a second row on the outer side of the member and a third row on the top of the member.

Orifice assemblies 46 are of identical construction and are mounted on member 34 in an identical manner. In the preferred embodiment, orifice assemblies 46 are mounted on member 34 by the following procedure. Referring to Fig. 3, the first step is to form an indentation in the wall of member 34 to provide a substantially flat angled wall portion 48. This can be accomplished by any suitable means such as an hydraulic press. The next step is to punch or drill an opening 50 in wall 48.

In the preferred embodiment, orifice assembly 46 is comprised of two parts, namely, a mounting

clip 52 and an orifice member 54. Clips 52 (preferably made of spring steel) are of tubular shape and dimensioned for snap engagement in openings 50. Orifice members 54 (Fig. 6) are of cylindrical shape and have a flow passageway 56 therethrough. In the preferred embodiment, orifice members 54 are made of an inorganic material such as ceramic and have an external groove 58 in one end thereof adapted for snap engagement with shoulders 60 formed in the end of mounting clips 52. It will be appreciated from the foregoing description that to install an orifice assembly 46 in tubular member 34, a mounting clip 52 is first snapped into opening 50 and then an orifice member 54 is snapped into clip 52 to complete the installation.

It is noted that the row of orifice assemblies 46 on the top of member 32 are positioned so that the axis of each assembly is directed upwardly and at an angle with respect to the verticle. As indicated in Fig. 3 in the preferred embodiment, such angle is approximately 35°.

Referring now to Figs. 2, 4 and 5, it is noted that the orifice assemblies 46 on the inner and outer sides of tubular member 34 extend substantially tangential with respect to the circular axis of tube 34, i.e. at an angle with respect to a radius line extending through orifice openings 50. Orifice assemblies also extend downwardly with respect to a horizontal plane extending through the axis of member 34. As noted in Figs. 4 and 5 in the preferred embodiment, such downward angle from the horizontal is approximately 30°. In the preferred embodiment, such tangential angle is approximately 35° with respect to a radius line through each orifice opening 50. Finally, it is noted that the orifice assemblies 46 in the inner, outer and top rows all extend in the same direction with respect to the axis of tubular member 34, i.e., either in a clockwise or counterclockwise direction with respect to the axis of tubular member 32.

Referring to Figs. 1 and 7 in the preferred embodiment, agitator assembly 32 is mounted in the lower portion of the water heater chamber 22 in a spaced relationship with respect to the bottom 14 of the water heater tank. As shown in Fig. 7, the agitator assembly is supported in such spaced relationship with the tank bottom 14 by means of a plurality of leg members 62. In the preferred embodiment, leg members 62 are of plastic material and have a groove 64 and a slot 65 therein dimensioned for snap engagement with openings 66 in the bottom of tubular member 32. The inlet tube 36 and its mounting engagement in tank wall 10 also serves to provide support for the agitator assembly 32 in its desired position in the bottom of the water heater tank. In the preferred embodiment, the bottom of agitator assembly 32 is spaced as close to the tank bottom 14 as is practicable. In the embodiment shown and described herein, the distance is approximately 1-5/8 inches (41 mm).

Operation

As previously explained, a not uncommon problem in the operation of water heaters of the type involved herein is the tendency (depending primarily on local water conditions) of certain dissolved solid materials in the water precipitating out of the water, which precipitated materials will settle out and accumulate in the bottom portion of the water heater tank. Such scale accumulations, if not periodically removed by some kind of a tank cleaning procedure, will gradually build up and harden causing an adverse effect on the heating efficiency of the unit and in many cases will ultimately cause a premature failure of the heater tank.

The water in chamber 22 will be heated by the hot gases and products of combustion passing through flue tubes 20 from burner 30 or in the case of an electric heater, the water will be heated by an electric heating element.

With the heater of the present invention, each time hot water is withdrawn from chamber 22 through outlet fitting 23 into a water system, cold water will simultaneously be drawn into the agitator assembly 32 from a source of water under pressure.

The cold water drawn into the tank each time hot water is drawn off the top will be expelled into chamber 22 through orifice members 54 in the form of a plurality of jet-like streams. The streams emanating from the outer row of orifices in member 34 will be directed somewhat downwardly at a tangential angle with respect of the flue tubes 20 in the outer row. The streams emanating from the inner row of orifices on member 34 will be directed somewhat downwardly and at a tangential angle with respect to the flue tubes 20 in the inner row 26. The streams emanating from the upper row of orifices on member 34 will be directed upwardly at an angle with respect to the axis of tubular member 34.

The combined action of the jet-like streams emanating from all three rows of orifices will agitate the water in the tank and produce a swirling action in the lower portion thereof. In the embodiment shown in Fig. 2, such swirling action will be in a counter-clockwise direction as viewed from above.

More specifically, the jet-like streams emanating from the outer row of orifices will effectively sweep the tank bottom around the base of flue tubes 20 in row 24. Similarly, the jet-like streams emanating from the inner row of orifices will effectively sweep the tank bottom around the base of flue tubes 20 in inner row 26. The jet-like streams emanating from the top row of orifices will enhance the swirling action produced by the jet-like streams emanating from the inner and outer rows of orifices and will further provide an upwardly directed flow component to the overall swirling action.

The swirling action described above will cause solid particles which have settled to the bottom or are in the process of settling to the bottom to be swept upwardly from the bottom into suspension

in the water. The normal upward circulation of the water in the tank combined with the upwardly directed streams from the top row of orifices will cause such suspended particles to be carried upwardly in the tank and eventually out through outlet 23. Such stirring and swirling action produced in the tank each time hot water is withdrawn therefrom has proven to be extremely effective in reducing harmful accumulations of scale in the bottom of the tank.

To produce the desired jet-like streams of water at the outlet of orifice members 54, the agitator assembly means 32 is dimensioned so that the aggregate size of flow passageways 56 in orifice members 54 is less than the size of the flow passageway through inlet tube 36. With such relationship, the velocity of the water flowing through the orifices 56 will be greater than the velocity of water flowing through inlet tube 36 from the source of cold water under pressure. For example, in the embodiment shown in Fig. 2, inlet tube 36 is made from 1-1/8 inch (28,6 mm) O.D. stainless steel tubing and passageways 56 in orifice members 54 have a diameter .2 inches (5,08 mm). With such dimensions, the ratio of the total area of the flow passageways 56 in the orifices 56 (total of 21 orifices) will be approximately 84% of the flow area through inlet tube 36.

Claims

1. A water heater comprising:

a watertight tank means (10, 12, 14, 16, 18) adapted to contain water under pressure;

a source of heat (30) comprising a plurality of vertical flue tubes (20) mounted in said watertight tank means (10, 12, 14, 16, 18), said flue tubes (20) arranged in an outer row (24) and an inner row (26);

a hot water outlet means (23) located in the top portion of said tank means (10, 12, 14, 16, 18);

an agitator assembly means (32) mounted in the bottom portion of said tank means (10, 12, 14, 16, 18), said agitator assembly means (32) including a circular tubular member (34) connected to a source of water under pressure;

said circular tubular member (34) having a first and second row of orifice assemblies (46), the first row being mounted around the inner side of said circular tubular member (34) and being directed towards said inner row (26) of flue tubes (20), and the second row being directed to the outer row (24) of flue tubes (20);

each of said orifice assemblies (46) including a flow passageway (56) through which a jet-like stream of water is directed into said tank means (10, 12, 14, 16, 18) each time water is drawn out of the top portion of said tank means (10, 12, 14, 16, 18) through said hot water outlet means (23), being characterized in that said circular tubular member (34) is positioned between said outer and inner row (24, 26) of flue tubes (20),

that said second row of orifice assemblies (46) is mounted around the outer side of said circular tubular member (34) and extends substantially tangential with respect to the horizontal axis of said circular tubular member (34),

that a third row of orifice assemblies (46) is mounted on top of said circular tubular member (34) and positioned so that the axis of each of its orifice assemblies (46) is directed upwardly and at an angle with respect to the vertical, and

that said first row of orifice assemblies (46) extends downwardly with respect to a horizontal plane extending through the axis of said circular tubular member (34).

2. A hot water heater according to claim 1, being characterized in that said orifice assemblies (46) in said first and second rows are directed at an angle with respect to a radius line through each of said orifice assemblies (46), said orifice assemblies (46) in said first, second and third row all directed in the same direction with respect to the axis of said tubular member (34) to produce a swirling action in the bottom portion (14) of said tank means (10, 12, 14, 16, 18) each time hot water is drawn out of said hot water outlet means (23).

3. A water heater according to claim 1 or 2, being characterized in that each of said orifice assemblies (46) includes an orifice member (54) having said flow passageway (56) extending through its cylindrical body.

4. A water heater according to one of claims 1 to 3, being characterized in that each of said orifice assemblies (46) further includes a spring clip member (52) adapted for snap engagement in an opening in said circular tubular member (34) further adapted to receive and retain one of said orifice members (54) therein.

5. A water heater according to claim 4, being characterized in that said orifice member (54) is made of an inorganic material.

6. A water heater according to one of claims 1 to 5, being characterized in that said circular tubular member (34) of said agitator assembly (32) is positioned in said tank means (10, 12, 14, 16, 18) in spaced relationship to the bottom (14) of said tank means (10, 12, 14, 16, 18), and that the spacing between said circular tubular member (34) and said tank bottom (14) is approximately 1-5/8 inches (25,4 mm to 60 mm).

7. A water heater according to one of claims 1 to 6, being characterized in that the orifice assemblies (56) of the first and second rows are directed downward from the horizontal at an angle of approximately 30°.

8. A water heater according to one of claims 1 to 7, being characterized in that said direction in which all of said orifice assemblies (46) extend, being the same with respect to the axis of said circular tubular member (34).

9. A water heater according to one of claims 1 to 8, being characterized in that said orifice assemblies (46) in said first, second and third rows are all directed in a counter-clockwise direction with respect to the axis of said circular tubular member (34) when viewed from the top portion of said tank means (10, 12, 14, 16, 18).

Patentansprüche

1. Wassererhitzer, mit:

einer wasserdichten Tankeinrichtung (10, 12, 14, 16, 18), die vorgesehen ist, um Wasser unter Druck zu enthalten;

einer Wärmequelle (30), umfassend eine Mehrzahl von vertikalen Heizgasrohren (20), die in der wasserdichten Tankeinrichtung (10, 12, 14, 16, 18) befestigt sind, wobei die Heizgasrohre (20) in einer Außenreihe (24) und einer Innenreihe (26) angeordnet sind;

einer Heißwasser-Auslaßeinrichtung (23), die im oberen Bereich der Tankeinrichtung (10, 12, 14, 16, 18) angeordnet ist;

einer Rühranordnungseinrichtung (32), die im Bodenbereich der Tankeinrichtung (10, 12, 14, 16, 18) angeordnet ist, wobei die Rührandordnungseinrichtung (32) ein kreisförmiges Rohrteil (34) enthält, das mit einer Druckwasserquelle verbunden ist;

wobei das kreisförmige Rohrteil (34) eine erste und eine zweite Reihe von Austrittsanordnungen (46) aufweist, wobei die erste Reihe rund um die Innenseite des kreisförmigen Rohrteiles (34) angeordnet ist und zu der Innenreihe (26) der Heizgasrohre (20) hin gerichtet ist und die zweite Reihe zu der Außenreihe (24) der Heizgasrohre (20) hin gerichtet ist,

wobei jede Austrittsanordnung (46) einen Strömungskanal (56) bildet, durch die ein düsenartiger Wasserstrom in die Tankeinrichtung (10, 12, 14, 16, 18) hinein gerichtet ist, und Wasser jederzeit aus dem oberen Bereich der Tankeinrichtung (10, 12, 14, 16, 18) durch die Heißwasser-Auslaßeinrichtung (23) abgezogen wird, gekennzeichnet dadurch,

daß das kreisförmige Rohrteil (34) zwischen der Außen- und Innenreihe (24, 26) der Heizgasrohre (20) angeordnet ist,

daß die zweite Reihe der Austrittsanordnungen (46) rund um die Außenseite des kreisförmigen Rohrteiles (34) angeordnet ist und sich im wesentlichen tangential im Bezug auf die Horizontalachse eines kreisförmigen Rohrteiles (34) erstreckt,

daß eine dritte Reihe von Austrittsanordnungen (46) an der Oberseite des kreisförmigen Rohrteiles (34) angeordnet ist, derart, daß die Achse jeder ihrer Austrittsanordnungen (46) nach oben gerichtet ist und winkelig in Bezug auf die Vertikale ausgerichtet ist, und

daß die erste Reihe der Austrittsanordnungen (46) sich in Bezug auf eine horizontale Ebene, die sich durch die Achse des kreisförmigen Rohrteiles (34) erstreckt, nach unten erstreckt.

2. Heißwassererhitzer nach Anspruch 1, dadurch gekennzeichnet, daß die Austrittsanordnungen (46) in der ersten und zweiten Reihe unter einem Winkel in Bezug auf eine Radiuslinie durch jede der Austrittsanordnungen (46) ausgerichtet angeordnet sind und die Austrittsanordnungen (46) in der ersten, zweiten und dritten Reihe alle in die gleiche Richtung in Bezug auf die Achse des rohrförmigen Teiles (34) ausgerichtet sind, um eine Verwirbelungswirkung im Bodenbereich (14) der Tankeinrichtung (10, 12, 14, 16, 18) zu erzeugen, wobei jederzeit Heißwasser aus der Heißwasser-Auslaßeinrichtung (23) abgezogen wird.

3. Wassererhitzer nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß jede der Austrittsanordnungen (46) ein Austrittsteil (54) enthält, das den Strömungskanal (56) durch seinen Zylinderkörper hindurch bildet.

4. Wassererhitzer nach einem der Ansprüche 1 bis 3, dadurch gekennzeichnet, daß jede der Austrittsanordnungen (46) außerdem ein Federklammerteil (52) enthält, das für einen Schnappeingriff in eine Öffnung in dem kreisförmigen Rohrteil (34) vorgesehen und außerdem vorgesehen ist, um eines der Austrittsteile (54) in sich aufzunehmen und festzuhalten.

5. Wassererhitzer nach Anspruch 4, dadurch gekennzeichnet, daß das Austrittsteil (54) aus einem anorganischen Material besteht.

6. Wassererhitzer nach einem der Ansprüche 1 bis 5, dadurch gekennzeichnet, daß das kreisförmige Rohrteil (34) der Rühranordnung (32) in der Tankeinrichtung (10, 12, 14, 16, 18) beabstandet zum Boden (14) der Tankeinrichtung (10, 12, 114, 16, 18) angeordnet ist, und daß der Abstand zwischen dem kreisförmigen Rohrteil (34) und dem Tankboden (14) ungefähr 1-5/8 inch (25,4 mm bis 60 mm) beträgt.

7. Wassererhitzer nach einem der Ansprüche 1 bis 6, dadurch gekennzeichnet, daß die Austrittsanordnungen (56) der ersten und zweiten Reihe unter einem Winkel von ungefähr 30° gegen die Horizontale nach unten gerichtet sind.

8. Wassererhitzer nach einem der Ansprüche 1 bis 7, dadurch gekennzeichnet, daß die Richtung, in der sich sämtliche der Austrittsanordnungen (46) erstrecken, in Bezug auf die Achse des kreisförmigen Rohrteiles (34) die gleiche ist.

9. Wasserheizer nach einem der Ansprüche 1 bis 8, dadurch gekennzeichnet, daß die Austrittsanordnungen (46) in der ersten, zweiten und dritten Reihe alle in Bezug auf die Achse des kreisförmigen Rohrteiles (34), gesehen vom oberen Bereich der Tankeinrichtung (10, 12, 14, 16, 18), im Gegenuhrzeigersinn ausgerichtet angeordnet sind.

Revendications

1. Chauffe-eau comprenant:

un moyen de réservoir étanche à l'eau (10, 12, 14, 16, 18) apte à contenir de l'eau sous pression;

une source de chaleur comprenant une pluralité de tubes formant carneaux (20) montés dans ledit moyen de réservoir étanche à l'eau (10, 12, 14, 16, 18) lesdits tubes formant carneaux (20) étant disposés en une rangée extérieure (24) et en une rangée intérieure (26);

un moyen de sortie d'eau chaude (23) situé dans la partie supérieure dudit moyen de réservoir (10, 12, 14, 16, 18);

un moyen d'ensemble d'agitation (32) monté dans la partie formant le fond dudit moyen de réservoir (10, 12, 14, 16, 18) ledit moyen d'ensem-

ble d'agitation (32) comprenant un organe tubulaire circulaire (34) relié à une source d'eau sous pression;

ledit organe tubulaire circulaire (34) comportant une première et une seconde rangées d'ensembles d'orifices (46), la première rangée étant montée autour du côté intérieur dudit organe tubulaire circulaire (34) et étant orientée en direction de ladite rangée intérieure (26) de tubes (20) formant carneaux, et la seconde rangée étant orientée en direction de la rangée extérieure (24) de tubes formant carneaux (20),

chacun desdits ensembles d'orifices (46) comprenant un passage d'écoulement (56) dans lequel un courant d'eau semblable à un jet est dirigé vers l'intérieur dudit moyen de réservoir (10, 12, 14, 16, 18), chaque fois que de l'eau est tirée à la partie supérieure dudit moyen de réservoir (10, 12, 14, 16, 18) dans lesdits moyens de sortie d'eau chaude (23),

étant caractérisé en ce que

ledit organe tubulaire circulaire (34) est placé entre ladite rangée extérieure et ladite rangée intérieure (24, 26) de tubes formant carneaux (20),

que ladite seconde rangée d'ensemble d'orifices (46) est montée autour du côté extérieur dudit organe tubulaire circulaire (34) et s'étend sensiblement de façon tangentielle par rapport à l'axe horizontal dudit organe tubulaire circulaire (34),

qu'une troisième rangée d'ensemble d'orifices (46) est montée au sommet dudit organe tubulaire circulaire (34) et est positionnée de façon telle que l'axe de chacun de ses ensembles d'orifices (46) est orienté vers le haut en formant un angle par rapport à la verticale,

et que ladite première rangée d'ensemble d'orifices (46) s'étend vers le bas par rapport à un plan horizontal comprenant l'axe dudit organe tubulaire circulaire (34).

2. Chauffe-eau selon la revendication 1, caractérisé en ce que lesdits ensembles d'orifices (46) des première et seconde rangées sont orientés avec un angle par rapport à une ligne de rayon traversant chacun des ensembles (46) d'orifices, lesdits ensembles (46) d'orifices des première, seconde et troisième rangées étant tous orientés dans la même direction par rapport à l'axe dudit organe tubulaire (34) afin de créer un effet de tourbillon dans la partie formant le fond dudit moyen de réservoir (10, 12, 14, 16, 18) chaque fois que de l'eau est tirée par ledit moyen de sortie d'eau chaude (23).

3. Chauffe-eau selon la revendication 1 ou 2, caractérisé en ce que chacun desdits ensembles d'orifices (46) comprend un organe d'orifice (54) comportant ledit passage d'écoulement (56) qui s'étend dans son corps cylindrique.

4. Chauffe-eau selon l'une des revendications 1 à 3, caractérisé en ce que chacun des ensembles (46) d'orifices comprend en outre un organe de pince à ressort (52) apte à s'enclencher dans une ouverture dudit organe tubulaire circulaire (34), apte en outre à recevoir et à y maintenir un desdits organes d'orifices (54).

5. Chauffe-eau selon la revendication 4, caractérisé en ce que ledit organe d'orifice (54) est fabriqué en matériau non-organique.

6. Chauffe-eau selon la revendications 1 à 5, caractérisé en ce que ledit organe tubulaire circulaire (34) dudit ensemble d'agitation (32) est placé dans ledit moyen de réservoir (10, 12, 14, 16, 18) avec un écart par rapport au fond (14) dudit moyen de réservoir (10, 12, 14, 16, 18) et que ledit espacement entre ledit organe tubulaire circulaire (34) et ledit fond de réservoir (14) est approximativement de 1 inch à 5/8 d'inch (25,4 mm à 60 mm).

7. Chauffe-eau selon une des revendications 1 à 6, caractérisé en ce que l'ensemble d'orifices (56) des première et seconde rangées sont orientées vers le bas à partir de l'horizontale avec un angle d'approximativement 30°.

8. Chauffe-eau selon l'une des revendications 1 à 7 caractérisé en ce que ladite direction dans laquelle s'étendent tous les ensembles d'orifices (46) est la même par rapport à l'axe dudit organe tubulaire circulaire (34).

9. Chauffe-eau selon l'une des revendications 1 à 8 caractérisé en ce que lesdits ensembles d'orifices (46) des première, seconde et troisième rangées sont toutes orientées dans le sens inverse de celui des aiguilles d'une montre par rapport à l'axe dudit organe tubulaire circulaire (34) lorsqu'on observe à partir de la partie supérieure dudit moyen de réservoir (10, 12, 14, 16, 18).

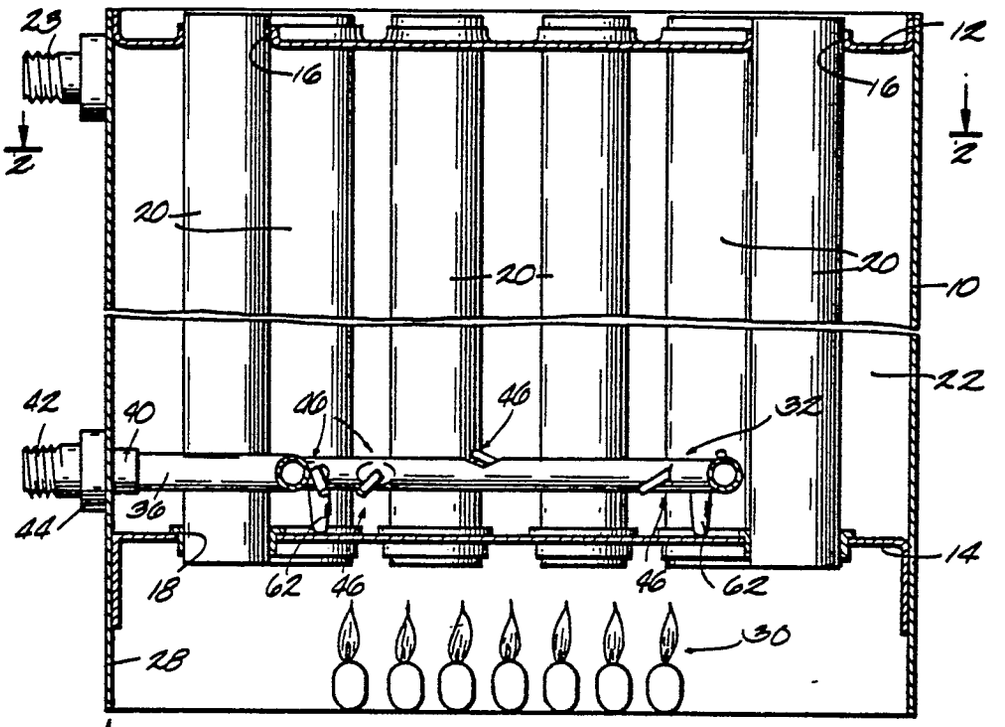
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Fig. 1

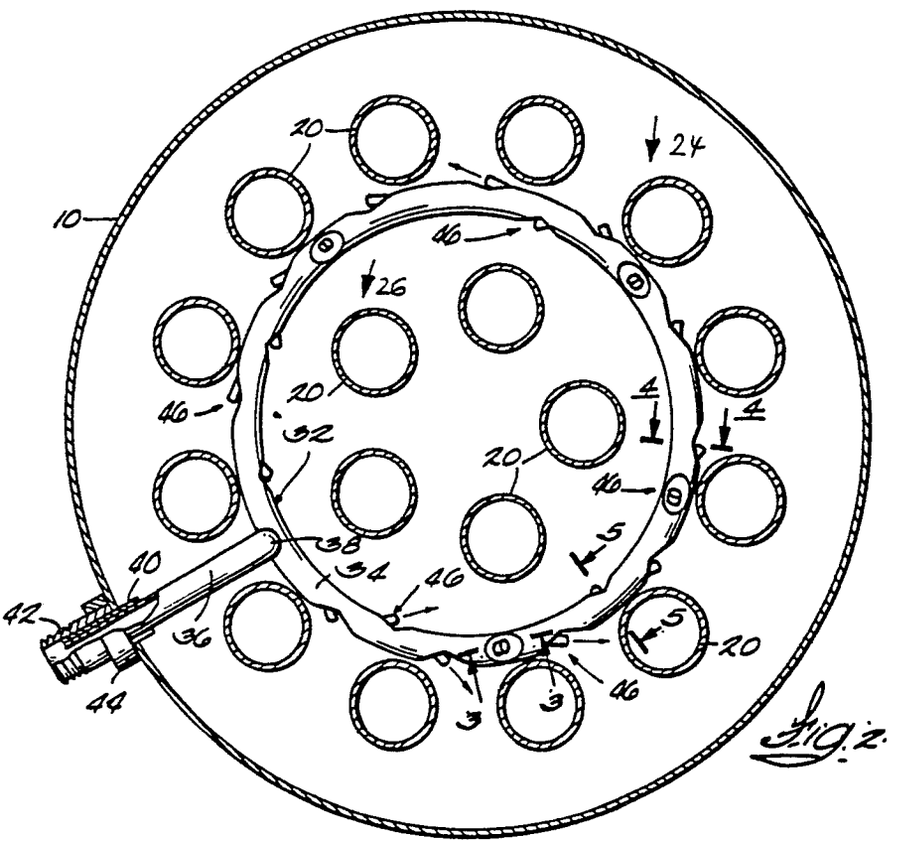
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Fig. 2

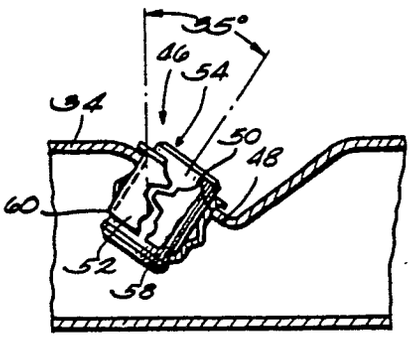

Fig. 3

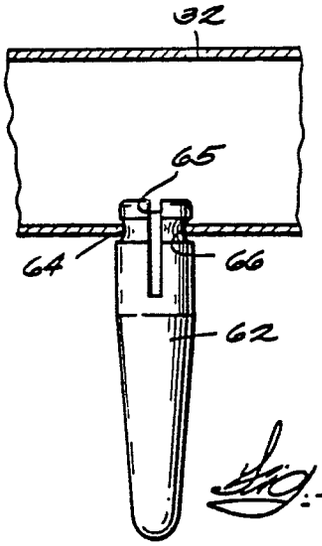

Fig. 7

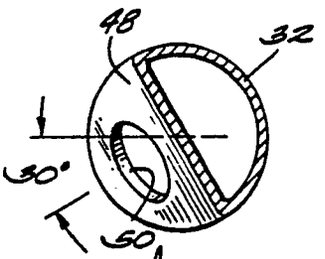

Fig. 4

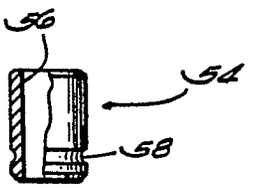

Fig. 6

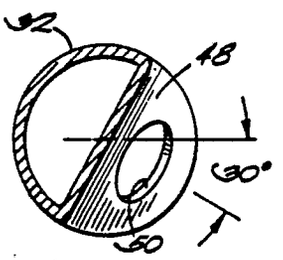

Fig. 5