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(54) **Simulated fireplace assembly**

Kunstkamin

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(56) References cited:
WO-A-97/41393 **GB-A- 1 024 047**
GB-A- 1 443 772 **GB-A- 2 298 073**
US-A- 4 026 544 **US-A- 4 965 707**

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Description

FIELD OF THE INVENTION

[0001] The present invention relates to components for electric or gas fireplaces and in particular to a simulated fuel bed, see, for instance, WO-A-9741393.

BACKGROUND OF THE INVENTION

[0002] Simulated fuels beds are well known for use with electric or gas fireplaces. The fuel beds typically simulate combustible fuel, such as wood logs or lumps of coal, positioned upon an ember bed.

[0003] For electric fireplaces, simulated fuel beds are typically moulded from plastic, fibreglass and/or ceramic materials that are coloured or painted to resemble a combustible fuel arranged on a bed of embers. The appearance of glowing embers is provided by transmitting light from beneath the simulated fuel bed through coloured translucent panels on the body of the simulated fuel bed.

[0004] For gas fireplaces, the simulated fuel beds are typically formed from cast concrete, ceramics or other suitable flame retardant materials that are painted to resemble a combustible fuel arranged on an ember bed. Rock wool is disposed on parts of the combustible fuel and the ember bed. The wool is heated to incandescence by the gas flames in order to simulate burning embers on the ember bed and on the combustible fuel.

[0005] While the use of translucent panels or rock wool provides a reasonably realistic simulated effect of glowing embers, there is a continuing need to improve the effect.

SUMMARY OF THE INVENTION

[0006] The invention provides a fireplace assembly according to claim 1.

[0007] Advantageously, the reflector allows for embers to be simulated, in a cost-effective manner, on portions of the fuel bed that are not translucent (for instance, on solid ceramic logs).

DESCRIPTION OF THE DRAWINGS

[0008]

Figure 1 is a front perspective view of an electric fireplace incorporating a simulated fuel bed in accordance with the present invention;
Figure 2 is a partial side view of the fireplace of Figure 1;
Figure 3 is an enlarged view of the portion of the fireplace indicated by arrow 3 in Figure 1 showing a first embodiment of reflector arrangement;
Figure 4 is an enlarged view of the portion of the fireplace indicated by arrow 3 in Figure 1 showing

a second embodiment of reflector arrangement;
Figure 5 is a partial side view of a second embodiment of the fireplace of Figure 1; and
Figure 6 is a partial side view of a third embodiment of the fireplace of Figure 1.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0009] A simulated fuel bed in accordance with the present invention is shown generally at 10 in Figs. 1-6. The fuel bed 10 is shown incorporated within an electric fireplace 12.

[0010] The preferred electric fireplace 12 produces a simulated image 14 of flames between the fuel bed 10 and a reflected image 10' of the fuel bed 10. The electric fireplace 12 includes a translucent screen 16 having a partially reflecting surface 18 located immediately behind the fuel bed 10 for producing the reflected image 10' of the fuel bed 10. The simulated image 14 of flames is created by reflecting light from a flicker element 20 located behind the screen 16 and transmitting the reflected light through a diffusing region 21 on the screen 16. More detail concerning the structure of the preferred embodiment of electric fireplace 12 is provided in U.S. Patents 4,965,707 and 5,642,580. It should be understood however that the invention is intended to be used, with necessary modifications, with other types of electric fireplaces as well as with gas fireplaces.

[0011] Referring to Figs. 1 and 2, it may be seen that the fuel bed 10 has a simulated combustible fuel 22, a simulated ember bed 24 and a real or simulated grate 26. The combustible fuel 22 is preferably formed from an expanded polystyrene material and coloured to resemble wood logs. The ember bed 24 is preferably formed from a plastic material having red, orange or yellow coloured translucent portions 28 to resemble an ember bed for the logs. The grate 26 is preferably formed from a metal or ceramic material and coloured if necessary to resemble the metallic material of a real fireplace grate. The grate 26 is optional and the fuel bed 10 may be only made up of the combustible fuel 22 and ember bed 24. It will be understood that the elements 22, 24 and 26 of the fuel bed 10 may be constructed from any materials that accurately simulate the element in a cost effective and functionally practical manner.

[0012] As shown in Figure 2, a light source 30 such as one or more light bulbs is positioned underneath the simulated fuel bed 10. Light from the light source 30 is transmitted through the coloured translucent portions 28 of the ember bed to give the illusion of burning embers. Light from the light source is also transmitted toward the flicker element 20 where it is reflected toward the rear of the screen 16 to produce the simulated image 14 of flames. The flicker element 20 is preferably rotatable about its centre axis 31 so that the simulated flames 14 appear to flicker (as described in more detail in U.S. Patent 5,642,580). In the case where the fuel bed 10 is in-

corporated within a gas fireplace, the light source 30 could simply comprise the gas flames produced by the fireplace.

[0013] A plurality of reflectors 34 are disposed in an ember pattern 33 on parts of the combustible fuel 22 of the fuel bed 10 to reflect light that is transmitted from the light source 30. The reflection of light from the reflectors 34 gives the illusion of burning embers on the combustible fuel. The reflectors 34 may also be disposed on parts of the ember bed 24 where it is otherwise difficult to give the illusion of hot embers by transmitted light through coloured translucent portions 28. For instance, red coloured reflectors 34 may be mounted to an upwardly facing surface of the ember bed 24 to reflect light from a light source located at the top of the fireplace (not shown).

[0014] The reflectors 34 are mounted to the fuel bed 10 using a pressure sensitive glue (such as double-sided tape), a hot melt glue or any other suitable fastener that withstands the temperature associated with the electric or gas fireplaces. It has been found that double-sided tape allows a plurality of reflectors 34 to be applied at one time to a desired portion of the fuel bed 10. A transfer decal (not shown) is formed with the reflectors arranged in an ember pattern 33 as described further below. The sticky side of the decal is then peeled off so the decal can be mounted to the fuel bed 10. The remaining portion of the decal that does not form the reflectors 34 is then peeled away so that all that remains is the reflectors 34 arranged in the ember pattern 33. This allows the reflectors to be mounted to the fuel bed 10 in a cost effective manner with a precise arrangement of reflectors 34 in the ember pattern.

[0015] Referring to a first embodiment depicted in Figure 3, it can be seen that a plurality of reflectors 34, each polygonal in shape, are arranged in the ember pattern 33 with two opposing sides 36 of each reflector 34 extending generally parallel to the simulated grain 38 for the simulated combustible fuel 22. The reflectors 34 are arranged relative to each other such that they follow the grain 38. Wood logs for instance have a grain that extends longitudinally along the log. Lumps of coal also include a grain, although its direction is not apparent from the shape of the lump of coal. The ember pattern 33 of reflectors 34 includes non-reflecting spaces 40 between reflectors 34 to simulate cracks that would be found between embers on a burning fuel. The spaces 40 are generally uniform in width. The size and shape of the reflectors 34 varies however although most of the reflectors 34 will be generally trapezoidal in shape.

[0016] Referring to a second embodiment of reflector 34' depicted in Figure 4, it can be seen that a single reflector 34' is provided which includes a plurality of reflective regions 41 and non-reflective regions 43. The shape and size of the respective regions 41 and 43 corresponds to the shape and size of the individual reflectors 34 and spaces 40 described in Figure 3 above. The non-reflective regions 43 of the reflector 34' are formed

by etching or by applying a paint, ink or other suitable non-reflective materials to the surface of a reflector 34.

[0017] It will be noted in Figure 2 that the reflectors 34 are positioned in a number of distinct locations on the combustible fuel 22. Reflectors 34a are positioned along a downwardly facing front surface 37 of a foreground log 39. Reflectors 34b are positioned along a downwardly facing rear surface 45 of the foreground log 39. Reflectors 34c are positioned along an upwardly facing rear surface 42 of a background log 44. The background log 44 is split such that it will appear as an entire log when combined with its reflected image 44' observed in the reflective surface 18 of screen 16. The foreground log 39 similarly has a reflected image 39'.

[0018] As shown in Figure 2, depending upon their location, reflectors 34a, 34b and 34c each function differently in reflecting light from light source 30 to produce an illusion of embers. Reflectors 34a and 34b reflect light 46 that has been coloured by passing through the translucent portions 28 of the ember bed 24. Light from reflectors 34a is directly observable by a viewer 48 located in front of the fireplace. Light from reflectors 34b is indirectly observable since the light must first be reflected again on the reflecting surface 18 of screen 16 before reaching the eye of the viewer. Reflectors 34c reflect light 50 that is transmitted through the diffusing region 21 of the screen 16. Light from reflectors 34c is indirectly observable by the viewer 48 since the light must first be reflected by the reflecting surface 18 of screen 16 before reaching the eye of the viewer. Any flickering of the simulated flame 14 that is reflected by the reflector 34c gives the enhanced illusion of corresponding changes of heat intensity for the simulated ember.

[0019] The reflectors 34 are each formed from a suitable reflective material such as a highly reflective metallic foil. A thin foil of chromed MYLAR™ or metalised polyester has been found to be a suitable material. A red, orange or yellow coloured reflective foil is preferred for reflectors 34c to enhance the colour of the reflected light. A silver coloured reflective foil is preferred for reflectors 34a and 34b where the incident light has already been coloured. While foil is currently preferred for forming the reflectors 34, it is also contemplated that reflective glass or other reflective materials may be substituted. For instance, in gas fireplace applications, it may be necessary to utilise a heat resistant mirrored glass for the reflectors 34 where it is found that a foil is affected by the high temperatures. The fuel bed 10 for gas fireplaces of course would also be required to be made from suitable heat resistant materials as known in the art.

[0020] In addition to the reflectors 34, it has been found that an enhanced fuel bed effect is generated by randomly sprinkling minute flecks 60 of reflective material on the combustible fuel 22 and ember bed 24. The flecks 60 are formed of a similar reflective metallic foil as is preferred for forming the reflectors 34. The flecks 60 are sufficiently minute in size (two millimetres or less

in width) to give the illusion of a sparkling ash. Due to the minute size and random distribution of the flecks (which are disposed in a variety of different angular orientations on the fuel bed 10 to reflect light from different angles above and below the flecks 60), the viewer 48 observes random sparkles of light from the fuel bed 10 for brief instances of time (since the sparkle will disappear when the viewer 48 moves slightly such that the angle of observed reflected light changes). The flecks 60 may be treated with a glue before being sprinkled upon the fuel bed 10 or the fuel bed 10 may be sprayed with a clear adhesive substance prior to sprinkling of the flecks 60.

[0021] Referring to Figure 5, a second embodiment of simulated fuel bed 10 is shown. For convenience, corresponding elements from the embodiment described above are assigned the same reference numerals.

[0022] In the second embodiment of fuel bed 10, a flicker element 20' is located beneath the ember bed 24 for reflecting light from a light source 30'. The flicker element 20' has a similar construction to the flicker element 20 located behind the screen 16 as described above, and as described in US 4,965,707 and US 5,642,580. The flicker element 20' includes a plurality of reflective strips 62 extending from an axis 31'. The flicker element 20' is caused to rotate about the axis 31' by means of an electric motor (not shown). The rotation of the flicker element 20' produces moving beams of light from a light source 30' that are subsequently transmitted to and reflected by reflectors 34a, b to give the impression of burning embers of differing heat intensity.

[0023] Referring to Figure 6, a third embodiment of the fuel bed 10 is shown. Again, for convenience, corresponding elements from the embodiments described above are assigned the same reference numerals.

[0024] In the third embodiment of fuel bed 10, a flicker element 20' and a static reflector 70 are located beneath the ember bed 24. Light from the light source 30' may be transmitted to the reflectors 34a, b directly or by reflection by the flicker element 20' further by the static reflector 70. By virtue of its rotation, the flicker element 20' produces moving beams of light which, when reflected in reflectors 34a, b provide the observer with the impression of glowing embers and ashes, the appearance of which is constantly changing, with different areas constantly becoming more and less intensely illuminated.

[0025] The ember bed 24 also includes a plurality of light transmitting apertures 72. The apertures 72 will generally have a diameter (if generally circular) or a width of between 4 and 20mm, preferably between 6 and 12mm and especially about 8mm. The reflectors 34a, b are of a size generally equivalent to the size of apertures 72.

[0026] The combustible fuel 22 and the ember bed 24 are so arranged that light reflected from the flicker element 20' may pass (via the static reflector 70) through the apertures 72 onto the reflectors 34a, b.

[0027] The apparatus of the invention will desirably in-

clude a transparent or translucent front screen 80 which may be of glass or other suitable material such as a plastic. Preferably, the front screen 80 will be tinted (or "smoked") so that when the light source 30' is not switched on, the interior of the apparatus is not visible to the observer.

[0028] In order to enhance the visual effect provided by the apparatus of the invention, the depth of the simulated hearth may be increased by providing an additional simulated fuel bed 24' and at least one additional simulated combustible fuel piece 22' with reflectors 34d and 34e in front of the screen 80. An additional static reflector 70' is then provided to reflect light directly from the light source 30' and from the flicker element 20' onto the reflectors 34d and 34e.

Claims

1. A fireplace assembly (10) having:

a substantially vertical translucent screen (16) having a partially reflective front surface and a diffusing back surface;

a simulated fuel bed positioned in front of the screen (16), the simulated fuel bed having a partially translucent simulated ember bed (24) including translucent portions (72) and simulated combustible fuel (22) disposed over the simulated ember bed (24);

a light source (30') disposed underneath the simulated fuel bed (10);

a first flicker element (20) disposed behind the screen (16) for reflecting light from the light source (30') to the diffusing back surface of the screen (16) such that an image of flames is visible in the screen (16);

a plurality of reflectors (34) disposed on the simulated combustible fuel (22); and

a second flicker element (20') disposed beneath the simulated ember bed (24) for reflecting light from the light source (30') upwardly through the translucent portions (72) to the reflectors (34) to simulate a plurality of burning embers.

2. A fireplace assembly (10) as claimed in claim 1 additionally comprising a grate (26) disposed above the simulated ember bed (24), the simulated combustible fuel (22) being disposed over the grate.

3. A fireplace assembly (10) as claimed in claim 1 or 2 wherein the translucent portions of the simulated ember bed (24) include a plurality of light transmitting apertures (72).

4. A fireplace assembly (10) as claimed in claim 3 wherein the apertures (72) have a width of from

about 4mm to about 20mm.

5. A fireplace assembly (10) as claimed in claim 3 or 4 wherein the reflectors (34) are disposed adjacent to the apertures (72) and the respective widths of the reflectors (34) are substantially the same as the corresponding respective widths of the apertures (72).

6. A fireplace assembly (10) as claimed in claim 3 or 4 further comprising at least one static reflector (70) for reflecting light from the light source (30') directly or from the flicker element (20') upwardly through the translucent portions (72) of the simulated fuel bed (22).

7. A fireplace assembly (10) as claimed in any preceding claim further comprising:

a substantially vertical translucent second screen (80) disposed in front of the simulated fuel bed;

a second simulated fuel bed positioned in front of the second screen (80) and having a second partially translucent simulated ember bed (24') including translucent portions (72') and second simulated combustible fuel (22') disposed over the second simulated ember bed (24');

a plurality of second reflectors (34) disposed on the second simulated combustible fuel (22'); and

a second static reflector (70') positioned beneath the second simulated ember bed (24')

whereby light from the light source (30') is reflected by the second flicker element (20') to the second static reflector (70') and further reflected from the second static reflector (70') through the translucent portions (72') to the second reflectors (34) to simulate a plurality of burning embers.

8. A simulated fuel bed (10) as claimed in claim 7 wherein the translucent portions of the second simulated ember bed (24') include a plurality of light transmitting apertures (72').

9. A simulated fuel bed (10) as claimed in claim 8 wherein apertures (72') have a width of from about 4mm to about 20mm.

10. A simulated fuel bed (10) as claimed in claim 8 or 9 wherein the reflectors (34) are disposed adjacent to the apertures (72') and the respective widths of the reflectors (34) are substantially the same as the corresponding respective widths of the apertures (72').

Patentansprüche

1. Feuerstellen-Anordnung (10) mit:

einem im wesentlichen vertikalen lichtdurchlässigen Schirm (16), der eine teilreflektierende vordere Oberfläche und eine streuende hintere Oberfläche aufweist;

einem simulierten Brennstoffbett, welches vor dem Schirm (16) angeordnet ist, wobei das simulierte Brennstoffbett ein teilweise lichtdurchlässiges simuliertes Glutbett (24), welches lichtdurchlässige Abschnitte (72) enthält, und einen simulierten brennbaren Stoff (22) aufweist, der über dem simulierten Glutbett (24) angeordnet ist;

einer Lichtquelle (30'), welche unter dem simulierten Brennstoffbett (10) angeordnet ist;

einem ersten Flackerelement (20), welches hinter dem Schirm (16) angeordnet ist, um Licht von der Lichtquelle (30') zu der streuenden hinteren Oberfläche des Schirms (16) zu reflektieren, derart, daß ein Flammenbild auf dem Schirm (16) sichtbar ist;

einer Vielzahl von Reflektoren (34), die auf dem simulierten brennbaren Stoff (22) angeordnet sind;

und

einem zweiten Flackerelement (20'), welches unter dem simulierten Glutbett (24) angeordnet ist, um Licht von der Lichtquelle (30') aufwärts durch die lichtdurchlässigen Abschnitte (72) zu den Reflektoren (34) zu reflektieren, um eine Vielzahl von brennenden Glutpartikeln zu simulieren.

2. Feuerstellen-Anordnung (10) nach Anspruch 1, zusätzlich mit einem Rost (26), welcher über dem simulierten Glutbett (24) angeordnet ist, wobei der simulierte brennbare Stoff (22) über dem Rost angeordnet ist.

3. Feuerstellen-Anordnung (10) nach Anspruch 1 oder 2, wobei die lichtdurchlässigen Abschnitte des simulierten Glutbettes (24) eine Vielzahl von lichtdurchlässigen Öffnungen (72) enthalten.

4. Feuerstellen-Anordnung (10) nach Anspruch 3, wobei die Öffnungen (72) eine Breite im Bereich von ca. 4 mm bis ca. 20 mm aufweisen.

5. Feuerstellen-Anordnung (10) nach Anspruch 3 oder 4, wobei die Reflektoren (34) benachbart zu den Öffnungen (72) angeordnet sind und die jeweiligen Breiten der Reflektoren (34) im wesentlichen die gleichen sind wie die entsprechenden jeweili-

gen Breiten der Öffnungen (72).

6. Feuerstellen-Anordnung (10) nach Anspruch 3 oder 4, ferner mit mindestens einem statischen Reflektor (70), um Licht direkt von der Lichtquelle (30') oder von dem Flackerelement (20') aufwärts durch die lichtdurchlässigen Abschnitte (72) des simulierten Brennstoffbetts (22) zu reflektieren. 5
7. Feuerstellen-Anordnung (10) nach einem der vorangehenden Ansprüche, ferner mit: 10
 - einem im wesentlichen vertikalen lichtdurchlässigen zweiten Schirm (80), der vor dem simulierten Brennstoffbett angeordnet ist; 15
 - einem zweiten simulierten Brennstoffbett, welches vor dem zweiten Schirm (80) angeordnet ist und ein zweites, teilweise lichtdurchlässiges simuliertes Glutbett (24'), welches lichtdurchlässige Abschnitte (72') enthält, und einen zweiten simulierten brennbaren Stoff (22') aufweist, der über dem zweiten simulierten Glutbett (24') angeordnet ist; 20
 - einer Vielzahl von zweiten Reflektoren (34), die auf dem zweiten simulierten brennbaren Stoff (22') angeordnet sind; und 25
 - einem zweiten statischen Reflektor (70'), der unter dem zweiten simulierten Glutbett (24') angeordnet ist, 30

wobei Licht von der Lichtquelle (30') durch das zweite Flackerelement (20') zu dem zweiten statischen Reflektor (70') reflektiert wird und von dem zweiten statischen Reflektor (70') weiter durch die lichtdurchlässigen Abschnitte (72') zu den zweiten Reflektoren (34) reflektiert wird, um eine Vielzahl von brennenden Glutpartikeln zu simulieren. 35

- 8. Simuliertes Brennstoffbett (10) nach Anspruch 7, wobei die lichtdurchlässigen Abschnitte des zweiten simulierten Glutbetts (24') eine Vielzahl von lichtdurchlässigen Öffnungen (72') enthalten. 40
- 9. Simuliertes Brennstoffbett (10) nach Anspruch 8, wobei die Öffnungen (72') eine Breite im Bereich von ca. 4 mm bis ca. 20 mm aufweisen. 45
- 10. Simuliertes Brennstoffbett (10) nach Anspruch 8 oder 9, wobei die Reflektoren (34) benachbart zu den Öffnungen (72') angeordnet sind und die jeweiligen Breiten der Reflektoren (34) im wesentlichen die gleichen sind wie die entsprechenden jeweiligen Breiten der Öffnungen (72'). 50

Revendications

1. Ensemble de cheminée (10) comportant :

un écran translucide sensiblement vertical (16) comportant une surface avant partiellement réfléchissante et une surface arrière diffusante ; une imitation de lit de combustible positionnée devant l'écran (16), l'imitation de lit de combustible comportant une imitation de lit de braises (24) partiellement translucide comprenant des parties translucides (72) et une imitation de combustible (22) disposée sur l'imitation de lit de braises (24) ; une source de lumière (30') disposée au-dessous de l'imitation de lit de combustible (10) ; un premier élément scintillant (20) disposé derrière l'écran (16) pour réfléchir la lumière provenant de la source de lumière (30') vers la surface arrière diffusante de l'écran (16) de sorte qu'une image de flammes soit visible dans l'écran (16) ; une pluralité de réflecteurs (34) disposés sur l'imitation de combustible (22) ; et un deuxième élément scintillant (20') disposé au-dessous de l'imitation de lit de braises (24) pour réfléchir la lumière provenant de la source de lumière (30') vers le haut à travers les parties translucides (72) vers les réflecteurs (34) afin de simuler une pluralité de braises brûlantes.

2. Ensemble de cheminée (10) selon la revendication 1, comprenant de plus une grille (26) disposée au-dessus de l'imitation de lit de braises (24), l'imitation de combustible (22) étant disposée sur la grille.
3. Ensemble de cheminée (10) selon la revendication 1 ou 2, dans lequel les parties translucides de l'imitation de lit de braises (24) comprennent une pluralité d'ouvertures de transmission de lumière (72).
4. Ensemble de cheminée (10) selon la revendication 3, dans lequel les ouvertures (72) ont une largeur d'environ 4 mm à environ 20 mm.
5. Ensemble de cheminée (10) selon la revendication 3 ou 4, dans lequel les réflecteurs (34) sont disposés adjacents aux ouvertures (72) et les largeurs respectives des réflecteurs (34) sont sensiblement identiques aux largeurs respectives correspondantes des ouvertures (72).
6. Ensemble de cheminée (10) selon la revendication 3 ou 4, comprenant en outre au moins un réflecteur statique (70) pour réfléchir la lumière provenant de la source de lumière (30') directement ou à partir de l'élément scintillant (20') vers le haut à travers les parties translucides (72) de l'imitation de lit de combustible (22).
7. Ensemble de cheminée (10) selon l'une quelconque des revendications précédentes comprenant

en outre :

un deuxième écran translucide sensiblement vertical (80) disposé devant l'imitation de lit de combustible ; 5
 une deuxième imitation de lit de combustible positionnée devant le deuxième écran (80) et comportant une deuxième imitation de lit de braises (24') partiellement translucide comprenant des parties translucides (72') et une 10
 deuxième imitation de combustible (22') disposée sur la deuxième imitation de lit de braises (24') ;
 une pluralité de deuxièmes réflecteurs (34) disposés sur la deuxième imitation de combustible 15
 (22') ; et
 un deuxième réflecteur statique (70') positionné au-dessous de la deuxième imitation de lit de braises (24'),
 moyennant quoi la lumière provenant de la 20
 source de lumière (30') est réfléchiée par le deuxième élément scintillant (20') vers le deuxième réflecteur statique (70') et réfléchiée en outre du deuxième réflecteur statique (70') 25
 à travers les parties translucides (72') vers les deuxièmes réflecteurs (34) afin de simuler une pluralité de braises brûlantes.

8. Imitation de lit de combustible (10) selon la revendication 7, dans laquelle les parties translucides de la deuxième imitation de lit de braises (24') comprennent une pluralité d'ouvertures de transmission de lumière (72'). 30
9. Imitation de lit de combustible (10) selon la revendication 8, dans laquelle les ouvertures (72') ont une largeur d'environ 4 mm à environ 20 mm. 35
10. Imitation de lit de combustible (10) selon la revendication 8 ou 9, dans laquelle les réflecteurs (34) sont disposés adjacents aux ouvertures (72') et les largeurs respectives des réflecteurs (34) sont sensiblement identiques aux largeurs respectives correspondantes des ouvertures (72'). 40

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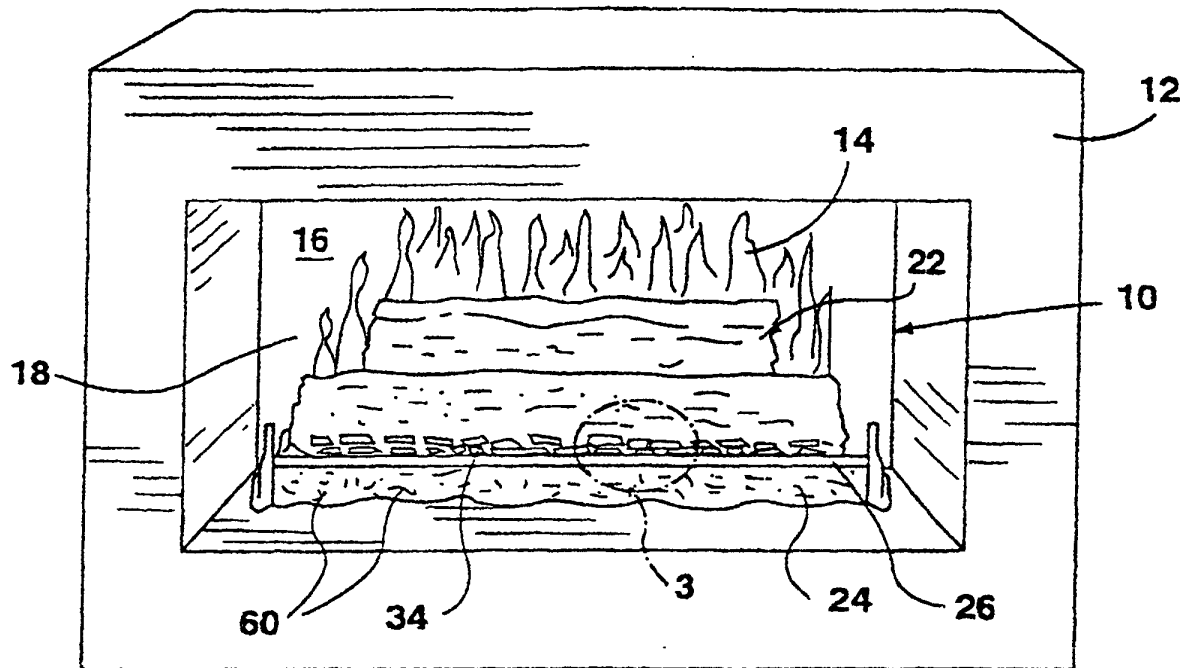


FIG. 1

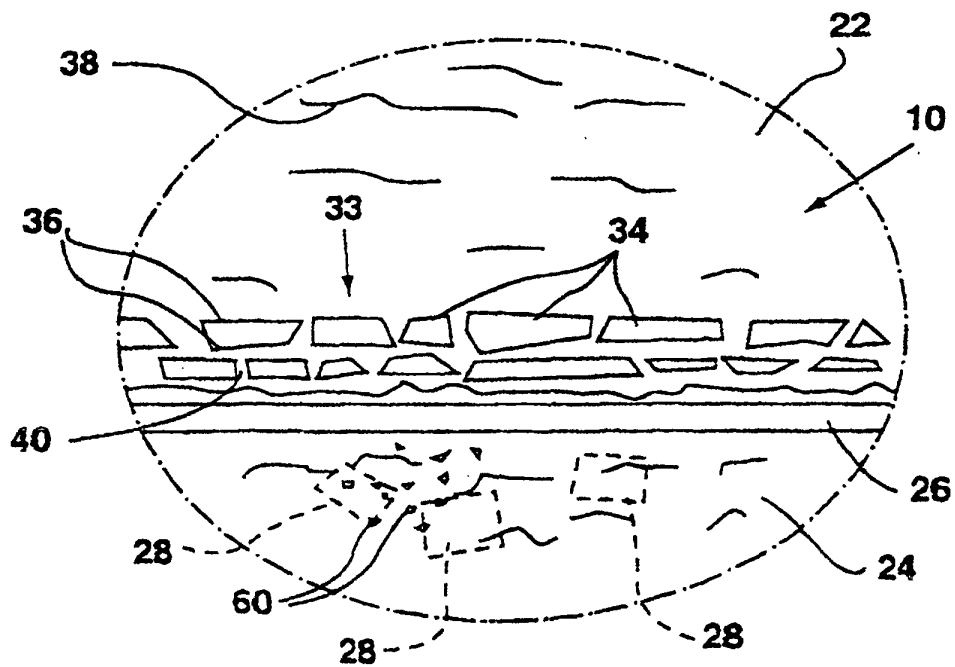


FIG. 3

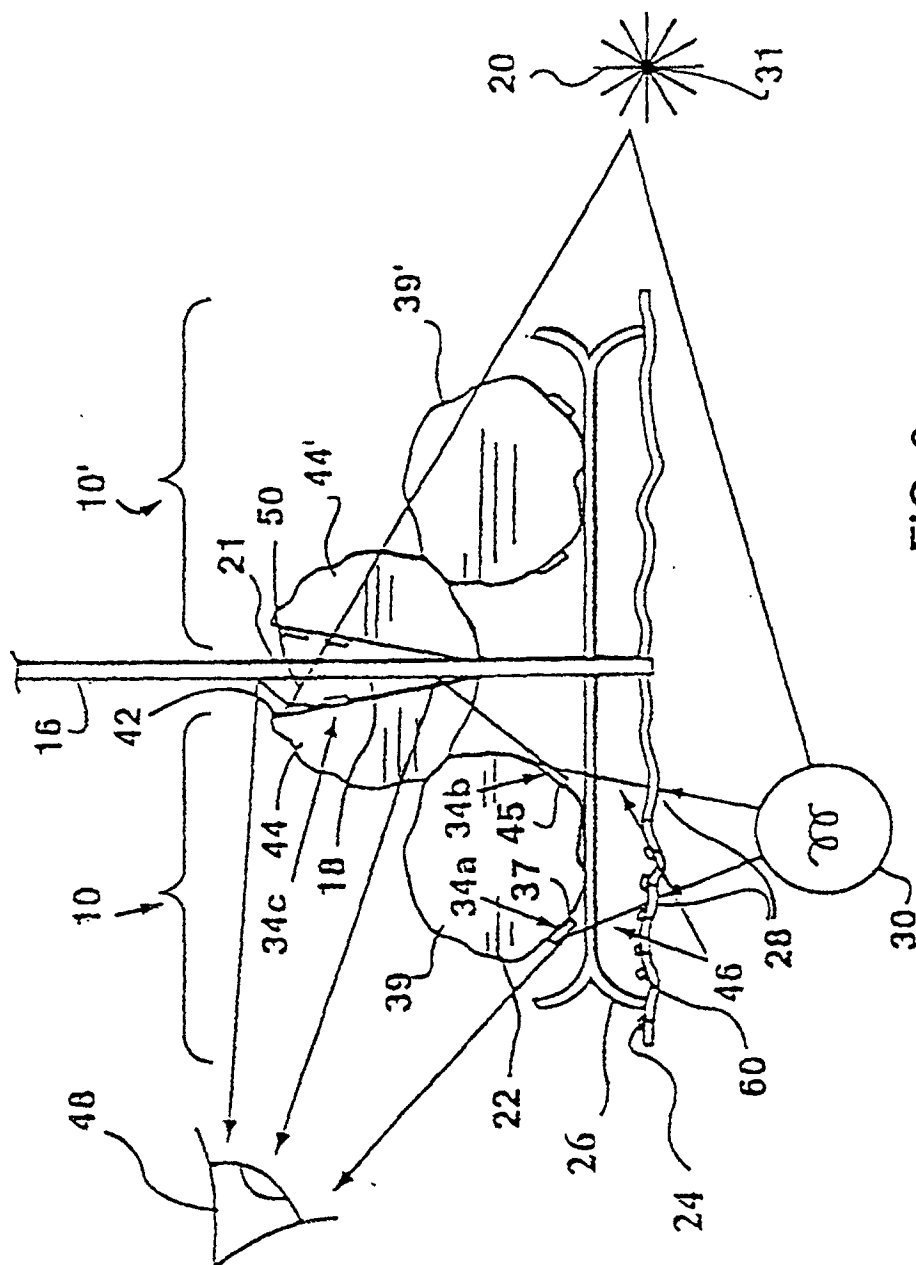


FIG. 2

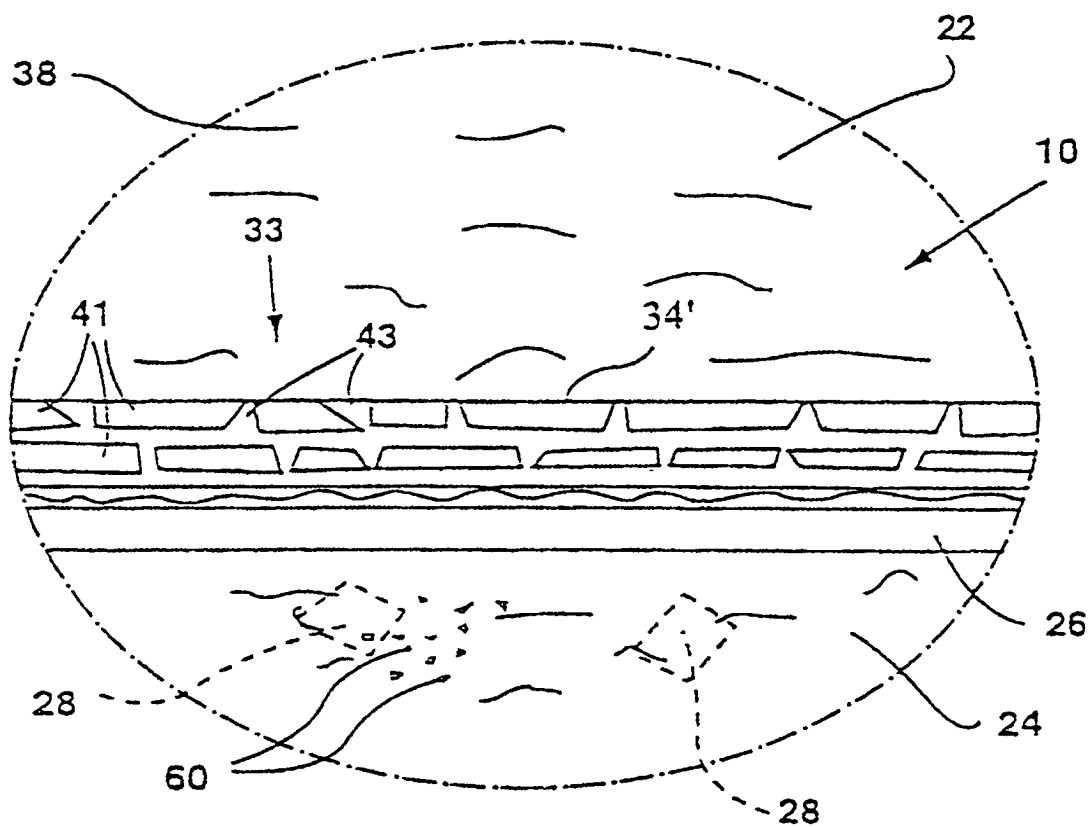


FIG. 4

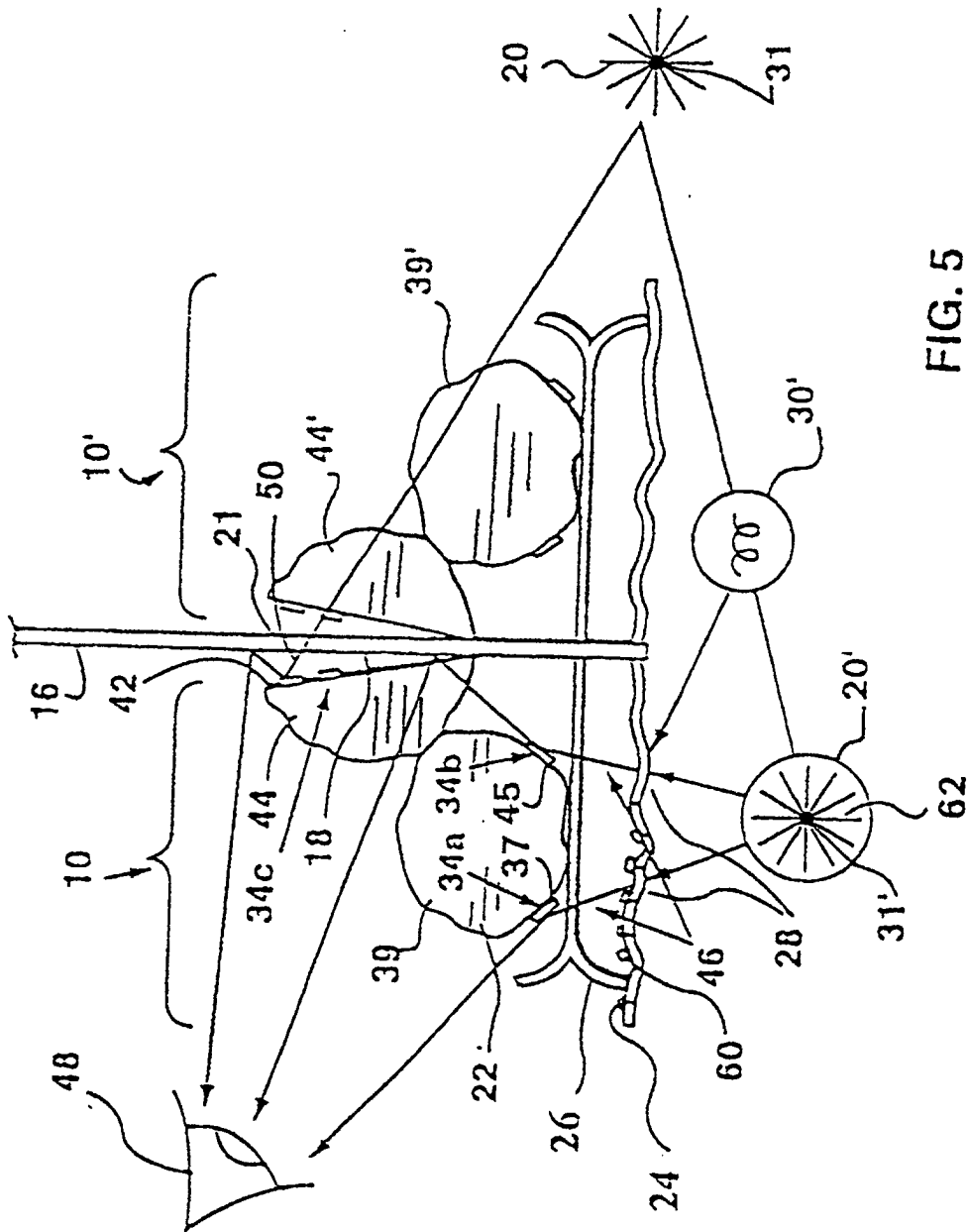


FIG. 5

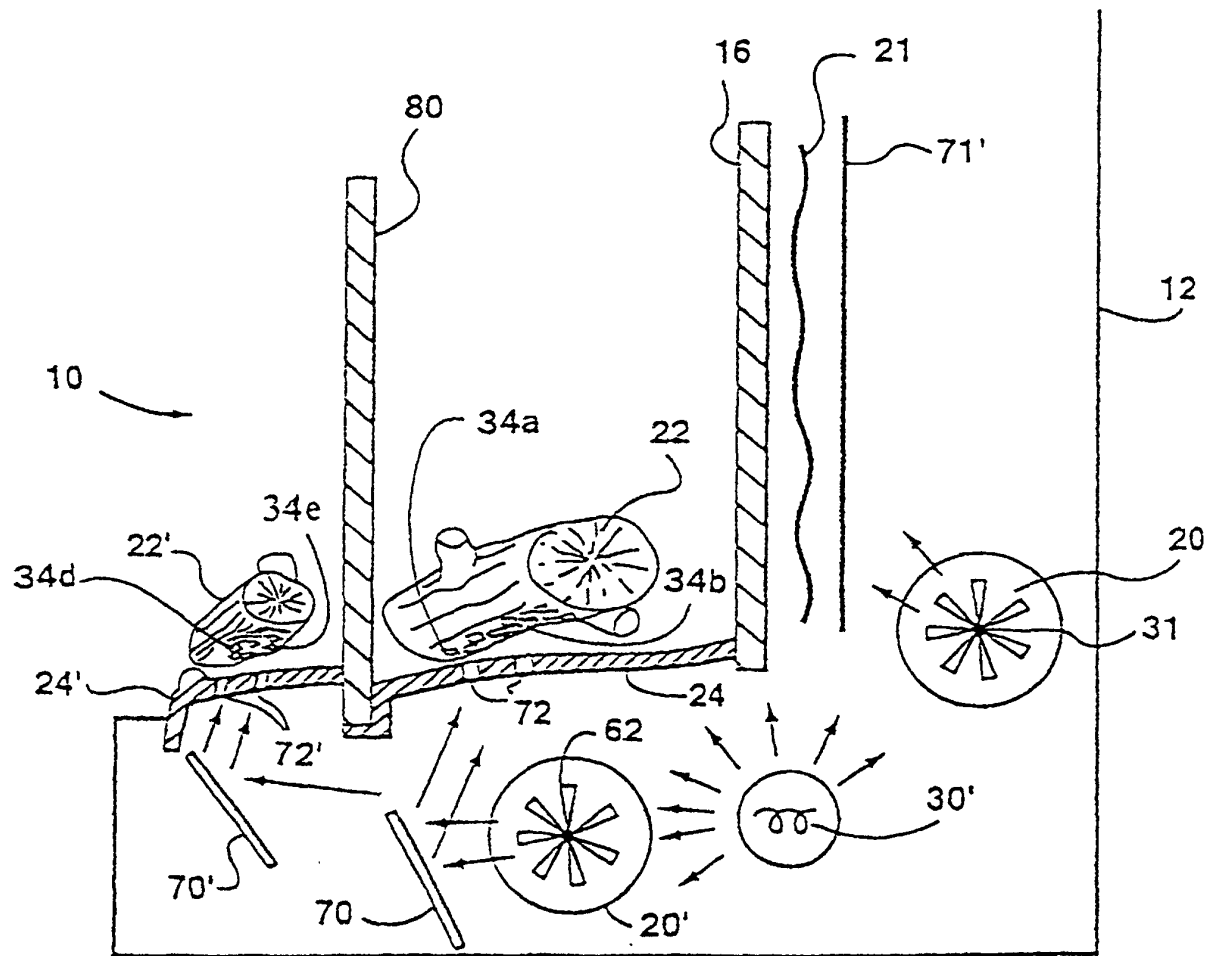


FIG. 6