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(54) **Showerhead with means of illumination**

Beleuchteter Brausekopf

Pomme de douche avec moyens d'éclairage

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Description

[0001] The present invention relates to a showerhead and specifically to a showerhead fitted with a means of illumination able to illuminate the jet of water erogated.

[0002] Showerheads fitted with a means of illumination which at least partially illuminate the flow of water erogated are known of in the state of the art.

[0003] The known showerheads in the state of the art usually foresee bulb or LED systems situated inside the body of the showerhead, insulated from the water collection chamber. The state of the art means of illumination known do not ensure uniform illumination of the jet of water; in addition they require complex assemblage to ensure electric and fluid insulation of the means of illumination. Such assemblage often makes the body of the showerhead extremely large and heavy. See for example DE 10 2004 001256 A1.

[0004] The problem of the present invention is to produce a showerhead which resolves the problems mentioned with reference to the technical note.

[0005] Such problems and limitations may be resolved by a showerhead made according to claim 1.

[0006] Other forms of embodiment of the showerhead according to the invention are described in the subsequent claims.

[0007] Further features and advantages of the present invention will appear more clearly from the following description of preferred embodiment realisations, made by way of an indicative and non-limiting example, wherein:

[0008] figure 1 shows a perspective view in separate parts of a showerhead according to a form of embodiment of the present invention;

[0009] figure 2 shows a lateral view of the showerhead in figure 1, in an assembly configuration;

[0010] figure 3 shows a view of the showerhead of figure 2, from the side of the arrow III in figure 2;

[0011] figure 4 shows a partial cross-section view of the showerhead in figure 2 according to a form of embodiment of the present invention;

[0012] figure 5 shows a partial cross-section view of the showerhead in figure 2 according to a further form of embodiment of the present invention;

[0013] figure 6 shows a perspective view in separate parts of some of the components of the showerhead in figure 1;

[0014] figure 7 shows a cross-section view of some of the components of figure 6;

[0015] figure 8 shows a view of the showerhead in figure 7, from the side of the arrow VIII in figure 7;

[0016] figure 9 shows a lateral view of a showerhead according to a further form of embodiment of the present invention;

[0017] figure 10 shows a cross-section view of the showerhead in figure 9;

[0018] figure 11 shows a diagram of the electrical connections of a showerhead according to a form of embodiment of the present invention.

[0019] The elements or parts of elements common to the forms of embodiment described below will be indicated by the same numerical references.

[0020] With reference to the aforesaid figures, reference numeral 4 globally denotes a showerhead comprising an erogation plate 8 with at least one hole for the erogation 12 of water and a closure plate 16 fluidly connected with a water supply 20.

[0021] For example the showerhead 4 comprises the anti-limescale nozzles 21 suitable for inserting at least partially into the holes 12 of the erogation plate 8.

[0022] According to one form of embodiment, said nozzles 21 are made of a piece with a membrane.

[0023] The erogation 8 and closure plates 16 define a collection chamber 24 of the water delimited by watertight seals 28 so as to receive the water from the water supply 20 and deliver it to the said erogation holes 12.

[0024] According to a form of embodiment, the watertight seals 28 of the collection chamber 24 comprise a perimetral seal 29 directly pinched between the closure 16 and erogation plates 8.

[0025] According to a further possible form of embodiment, the watertight seals 28 of the collection chamber 24 comprise a welded and/or glued portion 30, situated between said closure 16 and erogation 8 plates.

[0026] Advantageously, the showerhead 4 comprises a perimetral element 32 mechanically distinct from said closure 16 and erogation 8 plates and fitted externally to the collection chamber 24, preferably around it.

[0027] The perimetral element 32 comprises one lodging 36 and at least one means of illumination 40 housed in such lodging 36 so as to emit a beam of light from the side of the erogation plate 8.

[0028] Advantageously, the means of illumination are arranged inside the perimetral element 32, in an area outside the erogation holes 12.

[0029] According to one form of embodiment, the showerhead 4 comprises a cover plate 44 which defines with said perimetral element 32 a housing chamber 48, fluidly separate from the said collection chamber 24, and able to house means of electrical connection 52 for the power supply of the means of illumination 40.

[0030] According to one form of embodiment, the showerhead 4 presents an axis of symmetry X-X, and preferably has a disc-shaped configuration. Specifically, the closure 16 and erogation plates 8 are circular and the perimetral element 32 is a ring fitted around the plates 8,16, coaxial to the plates and to axis of symmetry X-X.

[0031] According to one form of embodiment, the perimetral element 32 is axially fixed between the cover plate 44 and at least one of the said closure 16 and erogation plates 8.

[0032] For example, the perimetral element 32 is fixed axially between the cover plate 44 and the erogation plate 8.

[0033] According to one form of embodiment, the perimetral element 32 comprises a collar 56, for example perimetral, suitable for inserting in an axial meatus 60

between the closure plate 16 and the erogation plate 8.

[0034] According to one form of embodiment, the showerhead 4 comprises a primary threaded connection 64, passing through the closure 16 and erogation 8 plates and suitable for binding said plates 8,16. together axially.

[0035] According to a further form of embodiment, the showerhead comprises a secondary threaded connection 68 passing through the cover plate 44 and at least one of the said closure 16 and erogation plates 8.

[0036] The showerhead may comprise spacer elements 72 suitable for distancing said cover 44, erogation 8 and closure 16 plates from each other and for guiding the first and second threaded connections 64,68.

[0037] Preferably, the erogation plate 8 comprises a plurality of illumination holes 76 aligned with the lodgings 36 and means of illumination 40 so as to allow the passage of the beam of light emitted by the means of illumination 40.

[0038] According to one possible form of embodiment, the erogation plate 8 comprises a transparent or translucent portion in the area of the means of illumination 40, able to allow the passage of the beam of light emitted by the means of illumination 40.

[0039] According to one form of embodiment, at least one lodging 36 of the perimetral element 32 comprises a ledge 80 suitable for enabling the axial blockage of the means of illumination 40 preventing removal from the side of the erogation plate 8.

[0040] Preferably the means of illumination 40 comprise a plurality of LED's 84 arranged on relative printed circuits or terminal boards 88.

[0041] Preferably, the perimetral element 32 comprises sealing and attachment means 92 able to hermetically seal the interstices between the LED's 84 and the relative lodgings 36 and mechanically fix the LED's 84 into their relative lodgings 36.

[0042] For example, the means of attachment 92 comprise a water-resistant resin 96 able to ensure electric insulation.

[0043] According to one form of embodiment, said resin 96 is two-component resin applied in a liquid state and subsequently solidifying.

[0044] According to one form of embodiment, the showerhead 4 comprises a collar cover 100 fitted around the perimetral element 32 so as to connect with said cover 44 and erogation 8 plates.

[0045] Preferably, the showerhead 4 comprises a power supply channel 104 passing through the housing chamber 48, said power supply channel 104 comprising a power supply which supplies said means of illumination 40.

[0046] The power supply comprises for example a transformer and a control circuit for managing the power supply to the LED's.

[0047] Preferably, said means of illumination comprise a diode 112 or a transistor or current stabiliser 116 to prevent inversion of polarity and/or current overload.

[0048] For example, the transformer provides continuous 18V voltage. The control circuit is composed of a microprocessor to manage the programmes alternating the colours of the LED's and of a protection transistor against inversion of polarity and /or overload.

[0049] According to one form of embodiment, these electronics are contained in a control panel wherein there is, for example, a button for turning on and off and two buttons to select the programmes.

[0050] The control circuit can power LED's of different colours, preferably, red, green and blue (figure 11).

[0051] The entire circuit is protected against polarity inversion by the diode 112.

[0052] According to a possible form of embodiment of the present invention, a showerhead 4 fitted with means of illumination 40 is inserted into a containment body 120 (figure 9,10).

[0053] The containment body 120 is surmounted by a translucent cylinder 124 fitted with secondary means of illumination 128, such as LED's 84, able to emit a luminous beam onto the flow of water erogated.

[0054] This way light is emitted onto the flow of water and, through the translucent cylinder 124, also into the area above.

[0055] As can be appreciated from the description, the showerhead according to the invention makes it possible to overcome the problems presented in the technical note.

[0056] Specifically, the showerhead permits a uniform and diffuse illumination of the entire flow of water erogated.

[0057] The means of illumination are, in fact, arranged around an external periphery of the showerhead in relation to the erogation holes of the water.

[0058] Advantageously, the perimetral element is fitted coaxial to the erogation and closure plates so that the axial thickness of the perimetral element is contained in the axial thickness of the said plates. In other words, the presence of the perimetral element does not entail an increase in the axial thickness of the showerhead.

[0059] The showerhead is of an extremely limited dimension thanks to the internal structure of the said showerhead.

[0060] The means of illumination are insulated fluidly from the water without requiring the use of cumbersome and complex means of sealing.

[0061] The showerhead is simple and cheap to assemble, and is of a reduced size and compact.

[0062] Advantageously it is possible to apply the present invention to a showerhead lacking means of illumination.

[0063] In fact a perimetral element can be applied to a showerhead, on the outside perimeter of the erogation and closure plates, and cover the showerhead with the cover plate again, inserting the means of illumination in the perimetral element and the electrical power supply in the housing chamber delimited by the cover plate and closure plate.

[0064] A technician skilled in this area may make nu-

merous modifications and adjustments to the showerheads described above so as to satisfy contingent and specific requirements, all moreover contained within the sphere of the invention defined by the following claims.

Claims

1. Showerhead (4) comprising

- an erogation plate (8) with at least one erogation hole (12) for the erogation of water,
- a closure plate (16) fluidly connected to a water supply (20),
- said erogation (8) and closure (16) plates enclose a collection chamber (24) of the water delimited by watertight seals (28) so as to receive water from the water supply (20) and channel it to the said erogation holes (12),
- the showerhead (4) comprises a perimetral element (32) mechanically distinct from said erogation (8) and closure (16) plates and fitted externally to said collection chamber (24), the perimetral element (32) comprises at least one lodging (36) and at least one means of illumination (40) lodged in such lodging (36) so as to emit a beam of light from the side of the erogation plate (8), the means of illumination (40) being arranged in an area external to said erogation holes (8),

characterised by the fact that
the showerhead (4) comprises a cover plate (44) which defines with said perimetral element (32) a housing chamber (48), fluidly separated from said collection chamber (24), and able to house means of electrical connection (52) for the power supply of the means of illumination (40),
the showerhead (4) comprises secondary threaded connections (68) passing through the cover plate (44) and at least one of said erogation and closure plates (8,16),
the showerhead (4) comprises spacer elements (72) able to distance from each other said cover (44), erogation (8) and closure (16) plates and to guide said secondary threaded connections (64,68).

2. Showerhead (4) according to claim 1, wherein the showerhead (4) comprises primary threaded connections (64) passing though the erogation (8) and closure plates (16) able to axially bind such plates (8,16) and said spacer elements (72) guide said primary threaded connections (64).

3. Showerhead (4) according to claim 1 or 2, having an axis of symmetry (X-X).

4. Showerhead (4) according to any one of the previous claims, in which said plates (8,16) are circular and said perimetral element (32) is a ring fitted around the plates (8,16).

5. Showerhead (4) according to any one of the claims from 2 to 4,wherein said perimetral element (32) is axially bound between the cover plate (44) and at least one of said erogation (8) or closure (16) plates.

6. Showerhead (4) according to any one of the claims from 2 to 5, wherein said perimetral element (32) is axially bound between the cover plate (44) and the erogation plate (8).

7. Showerhead (4) according to any one of the previous claims, wherein the perimetral element (32) comprises a collar (56) suitable for fitting into an axial meatus (60) situated between the closure plate (16) and the erogation plate (8).

8. Showerhead (4) according to any one of the previous claims, wherein the erogation plate (8) comprises a plurality of illumination holes (76) aligned with the lodgings (36) and with the means of illumination (40) so as to allow the passage of the beam of light emitted by the means of illumination (40).

9. Showerhead (4) according to any one of the previous claims, wherein the erogation plate (8) comprises a transparent or translucent portion in the area of the means of illumination 40, able to allow the passage of the beam of light emitted by the means of illumination (40).

10. Showerhead (4) according to any one of the previous claims, wherein at least one lodging (36) of the perimetral element (32) comprises a ledge (80) able to axially block the means of illumination (40) preventing it from coming out from the erogation plate (8). side

11. Showerhead (4) according to any one of the previous claims, wherein said means of illumination (40) comprise a number of LED's (84) arranged on relative printed circuits (88).

12. Showerhead (4) according to any one of the previous claims, wherein said perimetral element (32) comprises means of sealing and attachment (92) able to hermetically seal off the interstices between the LED's (84) and the relative lodgings (36) and mechanically attach the LED's (84) in their relative lodgings (36).

13. Showerhead (4) according to claim 12, wherein said means of sealing and attachment (92) comprise a resin (96) resistant to water and able to guarantee electrical insulation.

14. Showerhead (4) according to any one of the previous claims, wherein the watertight seal (28) of the collection chamber (24) comprises a perimetral seal (29) directly pinched between the closure (16) and erogation (8) plates.

15. Showerhead (4) according to any one of the previous claims, wherein the watertight seal (28) of the collection chamber (24) comprises a welded and /or glued portion (30), fitted between the closure (16) and erogation (8) plates.

Patentansprüche

1. Brausekopf (4), der umfasst:

- eine Abgabeplatte (8) mit wenigstens einem Abgabeloch (12) für die Abgabe von Wasser,
- eine Verschlussplatte (16) mit einer Fluidverbindung zu einer Wasserversorgung (20),
- wobei die Abgabe- (8) und Verschluss- (16) Platten eine Sammelkammer für das Wasser (24) umschließen, die von wasserdichten Dichtungen (28) begrenzt ist, um Wasser von der Wasserversorgung (20) aufzunehmen und es zu den Abgabelöchern (12) zu kanalisieren,
- der Brausekopf (4) ein Umfangselement (32) umfasst, das mechanisch unterschiedlich von den Abgabe- (8) und Verschluss- (16) Platten ist und außen an die Sammelkammer (24) montiert ist, wobei das Umfangselement (32) wenigstens eine Unterbringung (36) und wenigstens ein Beleuchtungsmittel (40), das in einer derartigen Unterbringung (36) untergebracht ist, umfasst, um einen Lichtstrahl von der Seite der Abgabeplatte (8) zu emittieren, wobei das Beleuchtungsmittel (40) in einem Bereich außerhalb der Abgabelöcher (8) angeordnet ist, **gekennzeichnet durch** die Tatsache, dass

der Brausekopf (4) eine Abdeckplatte (44) umfasst, die mit dem Umfangselement (32) eine Gehäusekammer (48) definiert, die fluidmäßig von der Sammelkammer (24) getrennt ist und fähig ist, Mittel zur elektrischen Verbindung (52) für die Stromversorgung des Beleuchtungsmittels (40) aufzunehmen,
der Brausekopf (4) sekundäre Gewindeanschlüsse (68) umfasst, die **durch** die Abdeckplatte (44) und wenigstens eine der Abgabe- und Verschlussplatten (8, 16) gehen,
der Brausekopf (4) Abstandshalterelemente (72) umfasst, die fähig sind, die Abdeck- (44), Abgabe- (8) und Verschlussplatten (16) voneinander zu beabstanden und die sekundären Gewindeanschlüsse (64, 68) zu führen.

2. Brausekopf (4) nach Anspruch 1, wobei der Brausekopf (4) primäre Gewindeanschlüsse (64) umfasst, die durch die Abgabe- (8) und Verschlussplatten (16) gehen, die fähig sind, derartige Platten (8, 16) axial zu verbinden, und wobei die Abstandshalterelemente (72) die primären Gewindeanschlüsse (64) führen.

3. Brausekopf (4) nach Anspruch 1 oder 2 mit einer Symmetrieachse (X-X).

4. Brausekopf (4) nach einem der vorhergehenden Ansprüche, wobei die Platten (8, 16) kreisförmig sind und das Umfangselement (32) ein Ring ist, der um die Platten (8, 16) herum eingepasst ist.

5. Brausekopf (4) nach einem der Ansprüche 2 bis 4, wobei das Umfangselement (32) axial zwischen der Abdeckplatte (44) und den Abgabe- (8) und/oder Verschluss- (16) Platten eingebunden ist.

6. Brausekopf (4) nach einem der Ansprüche 2 bis 5, wobei das Umfangselement (32) axial zwischen der Abdeckplatte (44) und der Abgabeplatte (8) eingebunden ist.

7. Brausekopf (4) nach einem der vorhergehenden Ansprüche, wobei das Umfangselement (32) eine Manschette (56) umfasst, die geeignet ist, in einen Axialgang (60), der zwischen der Verschlussplatte (16) und der Abgabeplatte (8) gelegen ist, montiert zu werden.

8. Brausekopf (4) nach einem der vorhergehenden Ansprüche, wobei die Abgabeplatte (8) eine Vielzahl von Beleuchtungslöchern (76) umfasst, die mit Unterbringungen (36) und mit dem Beleuchtungsmittel (40) ausgerichtet sind, um den Durchtritt des Lichtstrahls, der von dem Beleuchtungsmittel (40) emittiert wird, zuzulassen.

9. Brausekopf (4) nach einem der vorhergehenden Ansprüche, wobei die Abgabeplatte (8) einen transparenten oder transluzenten Abschnitt in dem Bereich des Beleuchtungsmittels (40) umfasst, der fähig ist, den Durchgang des von dem Beleuchtungsmittel (40) emittierten Lichtstrahls zuzulassen.

10. Brausekopf (4) nach einem der vorhergehenden Ansprüche, wobei wenigstens eine Unterbringung (36) des Umfangselements (32) eine Leiste (80) umfasst, die fähig ist, das Beleuchtungsmittel (40) axial zu blockieren, wobei verhindert wird, dass es von der Seite der Abgabeplatte (8) herauskommt.

11. Brausekopf (4) nach einem der vorhergehenden Ansprüche, wobei das Beleuchtungsmittel (40) eine Anzahl von LEDs (84) umfasst, die auf jeweiligen gedruckten Schaltungen (88) angeordnet sind.

12. Brausekopf (4) nach einem der vorhergehenden Ansprüche, wobei das Umfangselement (32) Dichtungs- und Befestigungsmittel (92) umfasst, die fähig sind, die Zwischenräume zwischen den LEDs (84) und den jeweiligen Unterbringungen (38) hermetisch abzudichten und die LEDs (84) in ihren jeweiligen Unterbringungen (36) zu befestigen.

13. Brausekopf (4) nach Anspruch 12, wobei die Dichtungs- und Befestigungsmittel (92) ein Harz (96) umfassen, das wasserfest ist und fähig ist, die elektrische Isolierung sicherzustellen.

14. Brausekopf (4) nach einem der vorstehenden Ansprüche, wobei die wasserdichte Dichtung (28) der Sammelkammer (24) eine Umfangsdichtung (29) umfasst, die direkt zwischen die Verschluss- (16) und Abgabe- (8) Platten geklemmt ist.

15. Brausekopf (4) nach einem der vorhergehenden Ansprüche, wobei die wasserdichte Dichtung (28) der Sammelkammer (24) einen geschweißten und/oder geleimten Abschnitt (30) umfasst, der zwischen die Verschluss- (8) Platten montiert ist.

Revendications

1. Pomme de douche (4) comprenant :

- une plaque d'érogation (8) avec au moins un trou d'érogation (12) destinée à l'érogation de l'eau,
- une plaque de fermeture (16) reliée de manière fluidique à une alimentation en eau (20),
- lesdites plaques d'érogation (8) et de fermeture (16) enferment une chambre de collecte (24) de l'eau délimitée par des joints imper-méables à l'eau (28) de manière à recevoir l'eau en provenance de l'alimentation en eau (20) et la canaliser vers lesdits trous d'érogation (12),
- la pomme de douche (4) comprend un élément périmétrique (32) distinct de manière mécanique desdites plaques d'érogation (8) et de fermeture (16) et ajusté à l'extérieur de ladite chambre de collecte (24), l'élément périmétrique (32) comprend au moins un logement (36) et au moins un moyen d'éclairage (40) logé dans ledit logement (36) de façon à émettre un faisceau de lumière à partir du côté de la plaque d'érogation (8), le moyen d'éclairage (40) étant disposé dans une zone extérieure auxdits trous d'érogation (8), **caractérisée par le fait que**:
- la pomme de douche (4) comprend une plaque formant couvercle (44) qui définit avec ledit élément perimétrique (32) une chambre de logement (48), séparée de manière fluidique de ladite chambre de collecte (24), et capable de loger un moyen de connexion électrique (52) destiné à alimenter le moyen d'éclairage (40),
- la pomme de douche (4) comprend des raccordements filetés secondaires (68) qui passent à travers le couvercle (44) et l'une au moins desdites plaques d'érogation et de fermeture (8, 16),
- la pomme de douche (4) comprend des éléments d'entretoise (72) capables de maintenir écartées les unes des autres lesdites pla-ques formant couvercle (44), d'érogation (8) et de fermeture (16) et de guider lesdits raccordements filetés secondaires (64, 68).

2. Pomme de douche (4) selon la revendication 1, dans laquelle la pomme de douche (4) comprend des raccordements filetés primaires (64) qui passent à travers les plaques d'érogation (8) et de fermeture (16) et capables de relier de manière axiale ces plaques (8, 16) et lesdits éléments d'entretoise (72) guident lesdits raccordements filetés primaires (64).

3. Pomme de douche (4) selon la revendication 1 ou la revendication 2, présentant un axe de symétrie (X - X).

4. Pomme de douche (4) selon l'une quelconque des revendications précédentes, dans laquelle lesdites plaques (8, 16) sont circulaires et ledit élément périmétrique (32) est un anneau ajusté autour des plaques (8, 16).

5. Pomme de douche (4) selon l'une quelconque des revendications 2 à 4, dans laquelle ledit élément périmétrique (32) est fixé de manière axiale entre la plaque formant couvercle (44) et au moins l'une desdites plaques d'érogation (8) ou de fermeture (16).

6. Pomme de douche (4) selon l'une quelconque des revendications 2 à 5, dans laquelle ledit élément périmétrique (32) est fixé de manière axiale entre la plaque formant couvercle (44) et la plaque d'érogation (8) .

7. Pomme de douche (4) selon l'une quelconque des revendications précédentes, dans laquelle l'élément périmétrique (32) comprend un collier (56) approprié de manière à s'ajuster dans un méat axial (60) situé entre la plaque de fermeture (16) et la plaque d'érogation (8).

8. Pomme de douche (4) selon l'une quelconque des revendications précédentes, dans laquelle la plaque d'érogation (8) comprend une pluralité de trous d'éclairage (76) alignés avec les logements (36) et avec le moyen d'éclairage (40) de façon à laisser passer le faisceau de lumière émis par le moyen d'éclairage (40).

9. Pomme de douche (4) selon l'une quelconque des revendications précédentes, dans laquelle la plaque d'érogation (8) comprend une partie transparente ou translucide dans la zone du moyen d'éclairage (40), capable de laisser passer le faisceau de lumière émis par le moyen d'éclairage (40).

10. Pomme de douche (4) selon l'une quelconque des revendications précédentes, dans laquelle au moins un logement (36) de l'élément périmétrique (32) comprend un rebord (80) capable bloquer de manière axiale le moyen d'éclairage (40) en l'empêchant de sortir du côté de la plaque d'érogation (8).

11. Pomme de douche (4) selon l'une quelconque des revendications précédentes, dans laquelle ledit moyen d'éclairage (40) comprend un certain nombre de LED (84) disposées sur des circuits imprimés associés (88).

12. Pomme de douche (4) selon l'une quelconque des revendications précédentes, dans laquelle ledit élément périmétrique (32) comprend un moyen d'étanchéité et de fixation (92) capable de sceller de manière hermétique les interstices entre les LED (84) et les logements associés (36) et de fixer de manière mécanique les LED (84) dans leurs logements associés (36).

13. Pomme de douche (4) selon la revendication 12, dans laquelle ledit moyen d'étanchéité et de fixation (92) comprend une résine (96) qui résiste à l'eau et qui est capable de garantir une isolation électrique.

14. Pomme de douche (4) selon l'une quelconque des revendications précédentes, dans laquelle le joint imperméable à l'eau (28) de la chambre de collecte (24) comprend un joint périmétrique (29) pincé directement entre les plaques de fermeture (16) et d'érogation (8).

15. Pomme de douche (4) selon l'une quelconque des revendications précédentes, dans laquelle le joint imperméable à l'eau (28) de la chambre de collecte (24) comprend une partie soudée et/ou collée (30), ajustée entre les plaques de fermeture (16) et d'érogation (8).

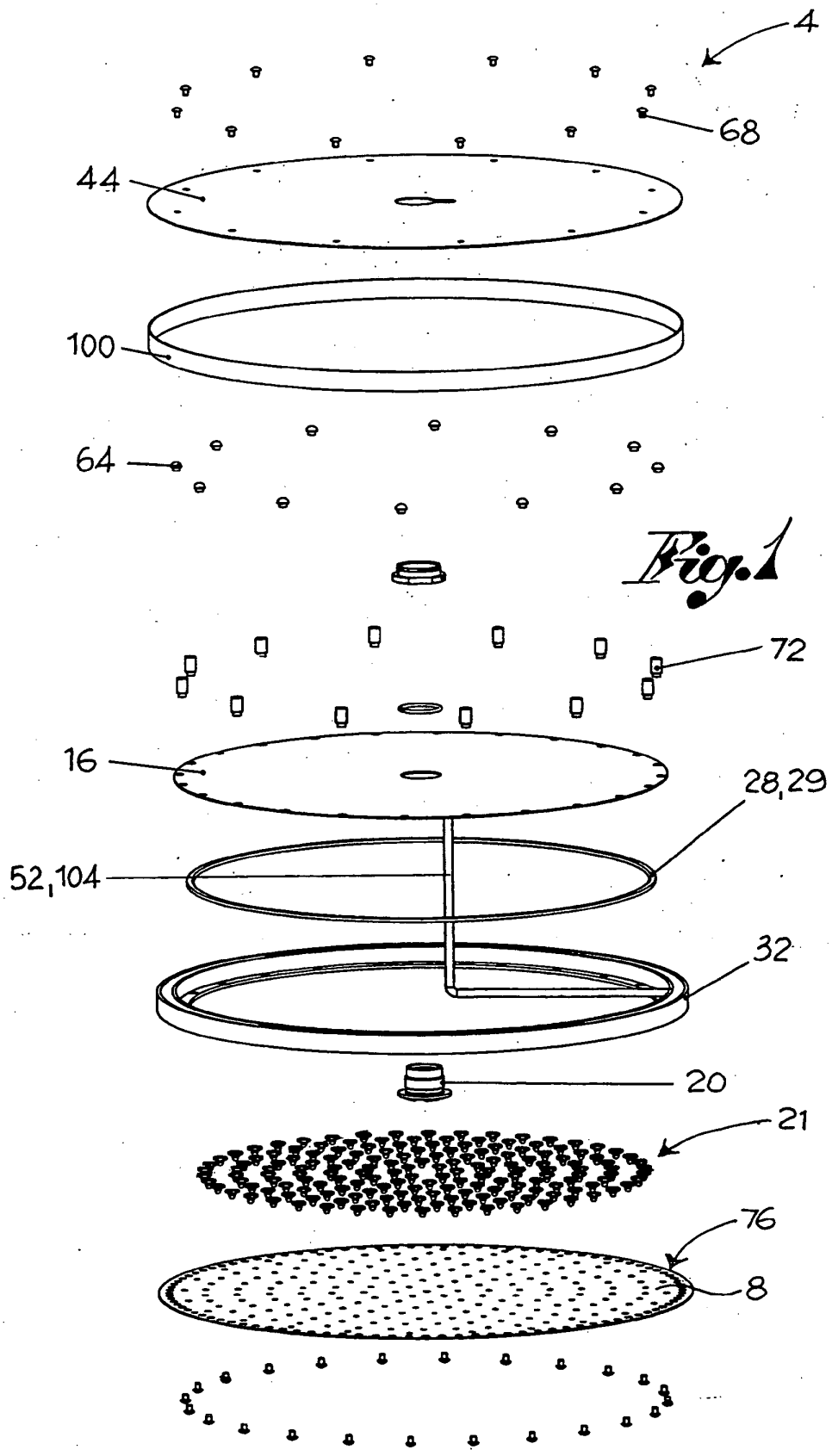


Fig.1

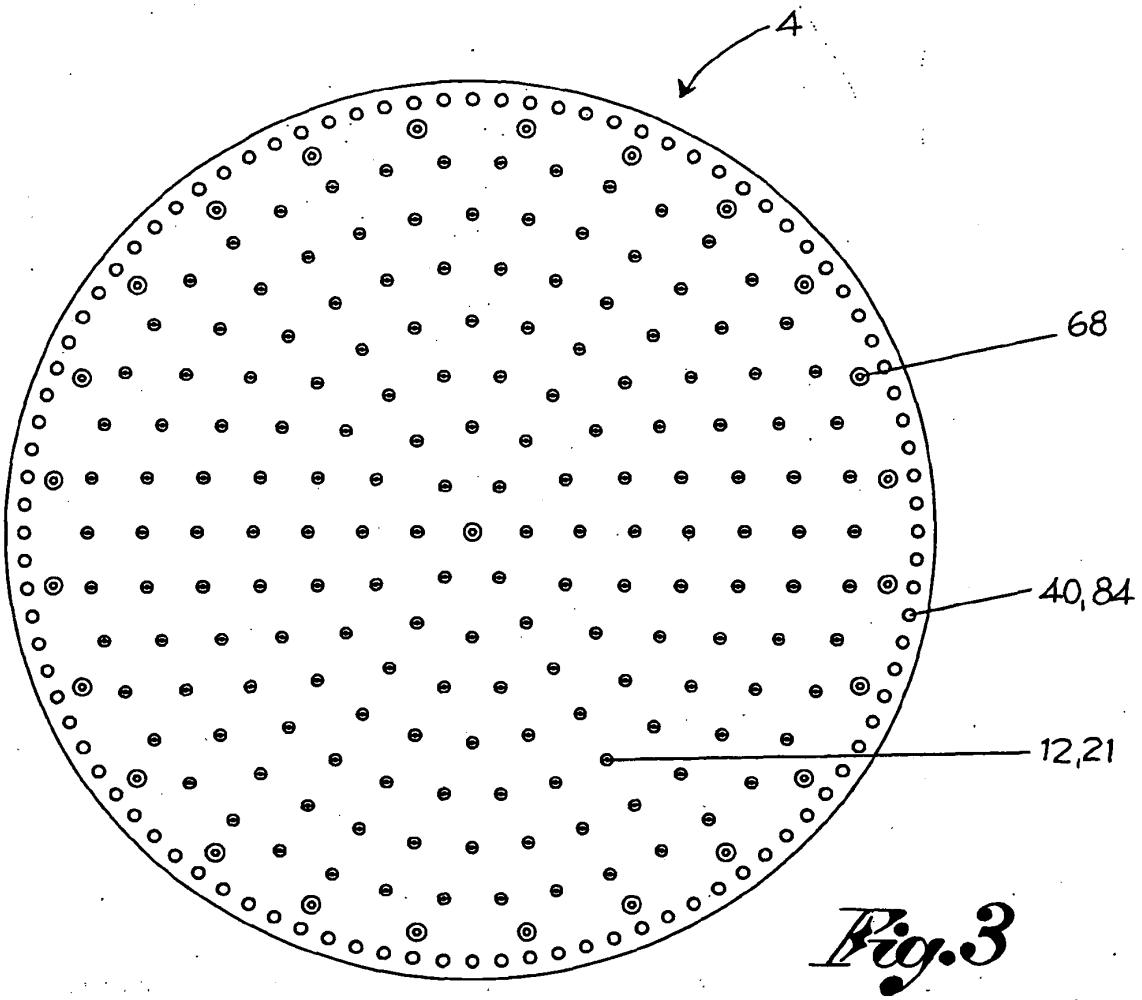


Fig.3

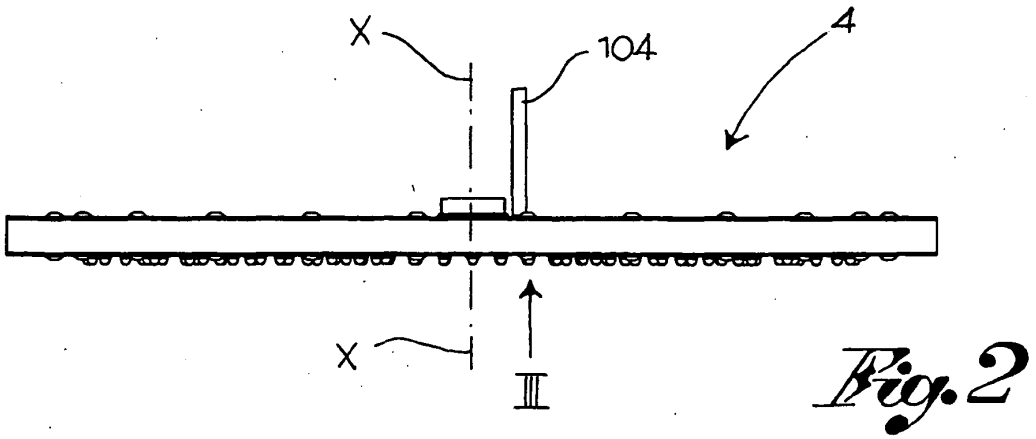


Fig.2

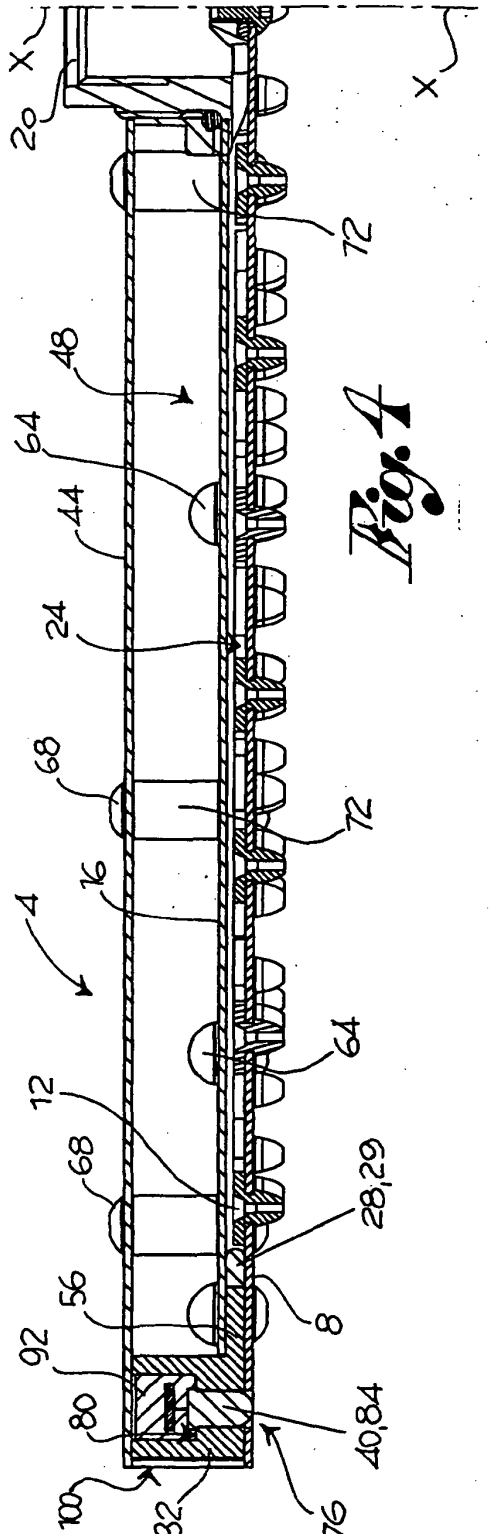

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X
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48
64
44
24
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64
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56
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40,84
100
32
76

Fig. 4

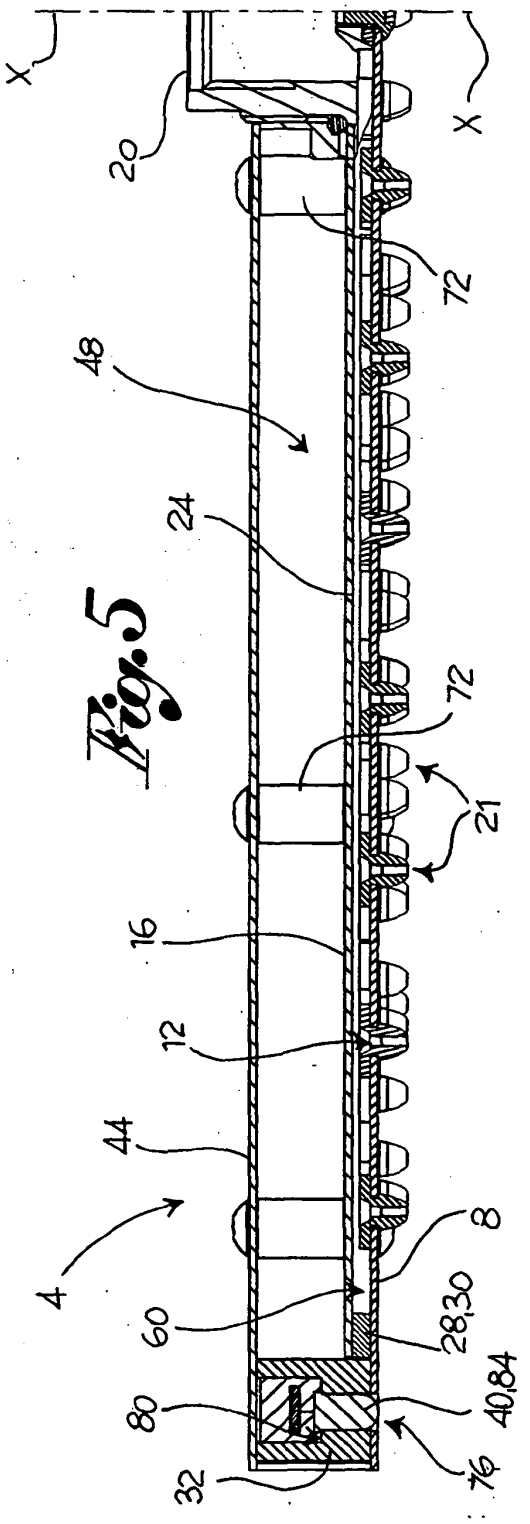

X
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76

Fig. 5

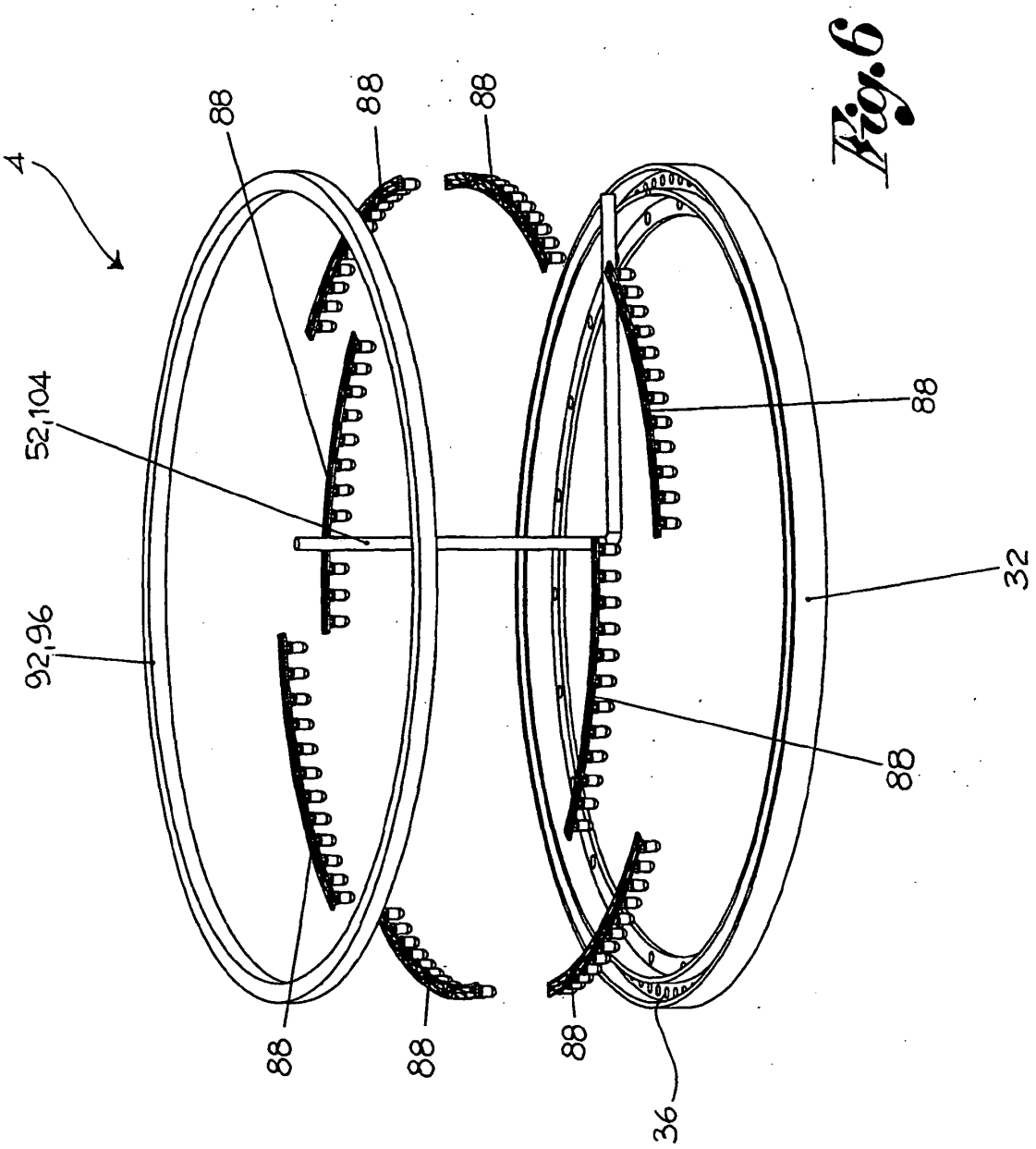
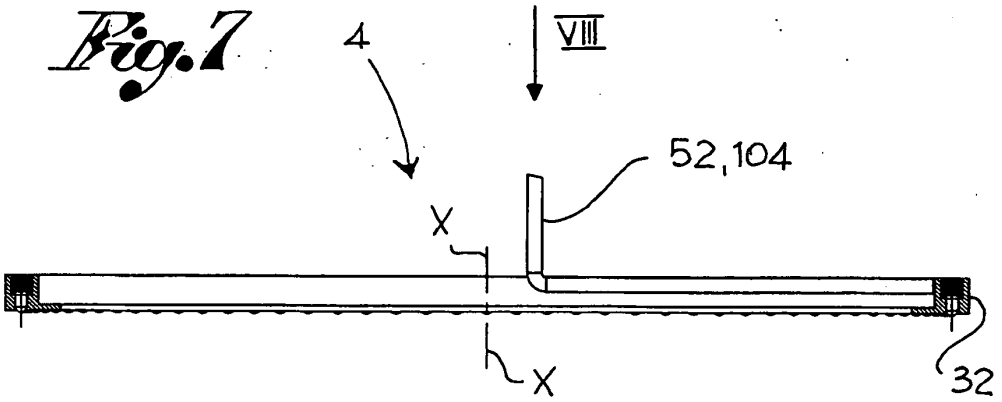


Fig.6

Fig.7



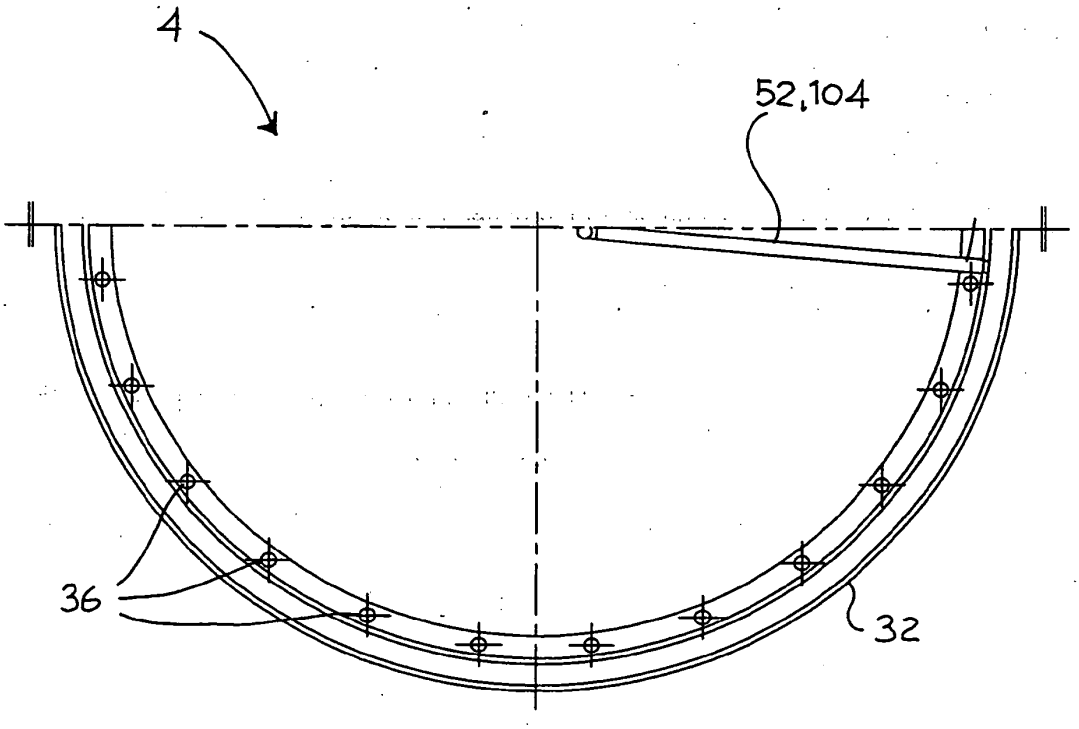


Fig.8

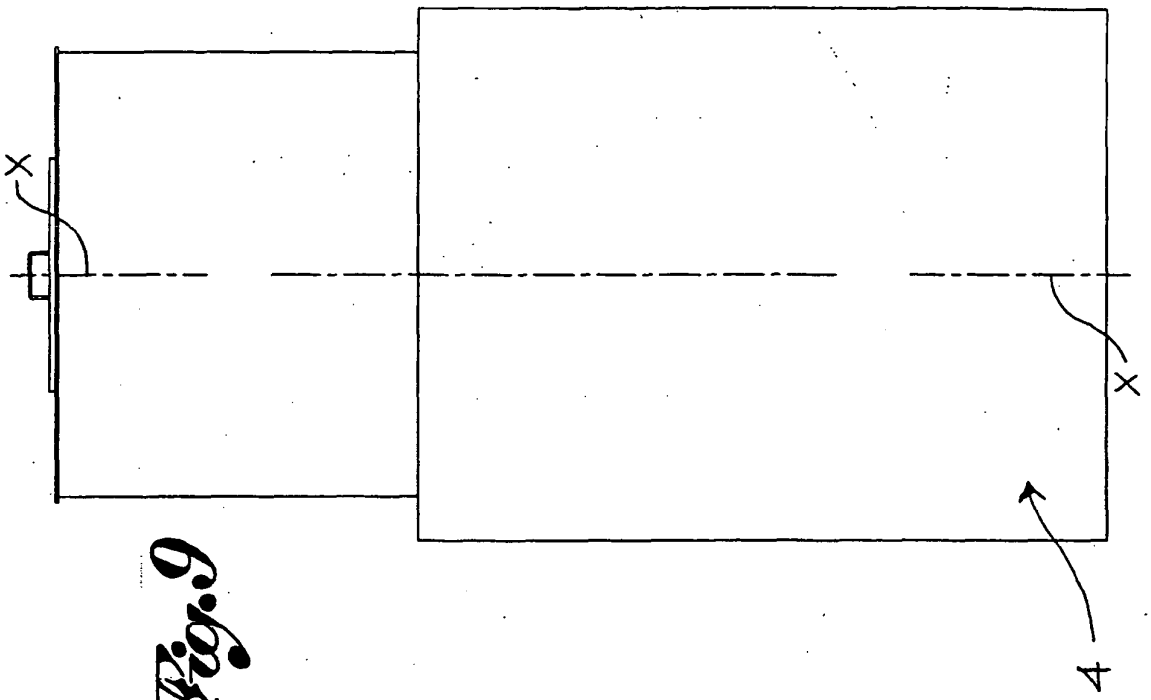


Fig.9

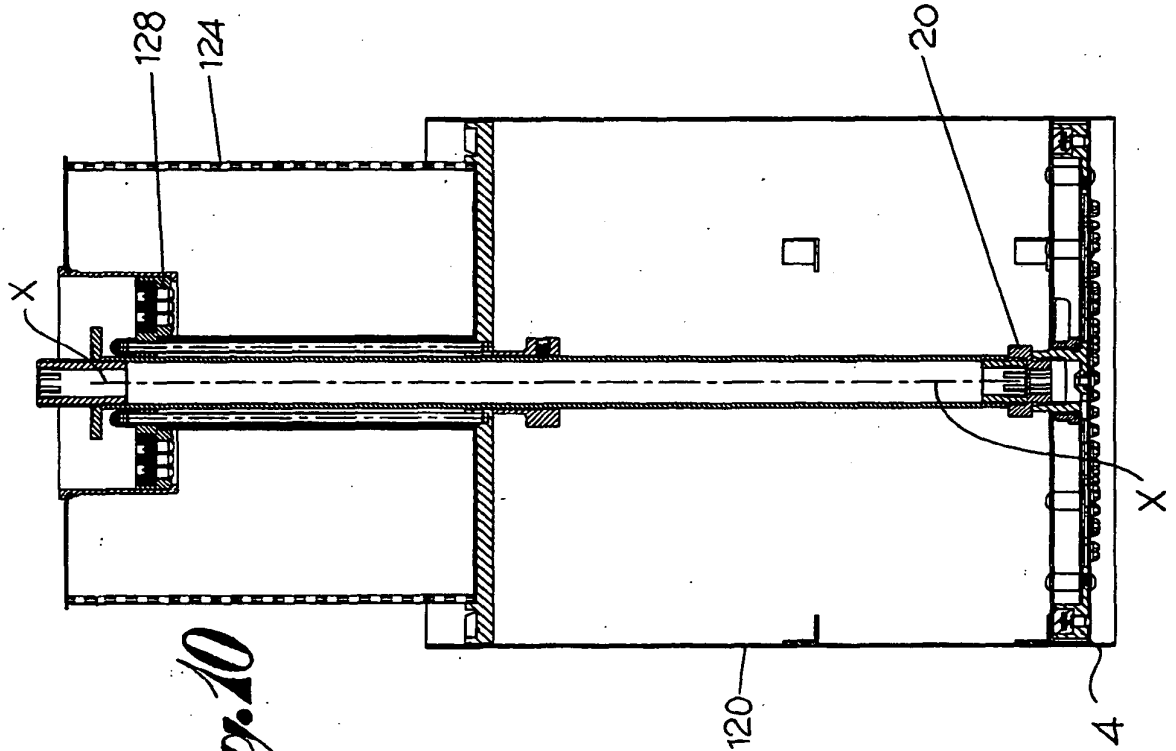


Fig.10

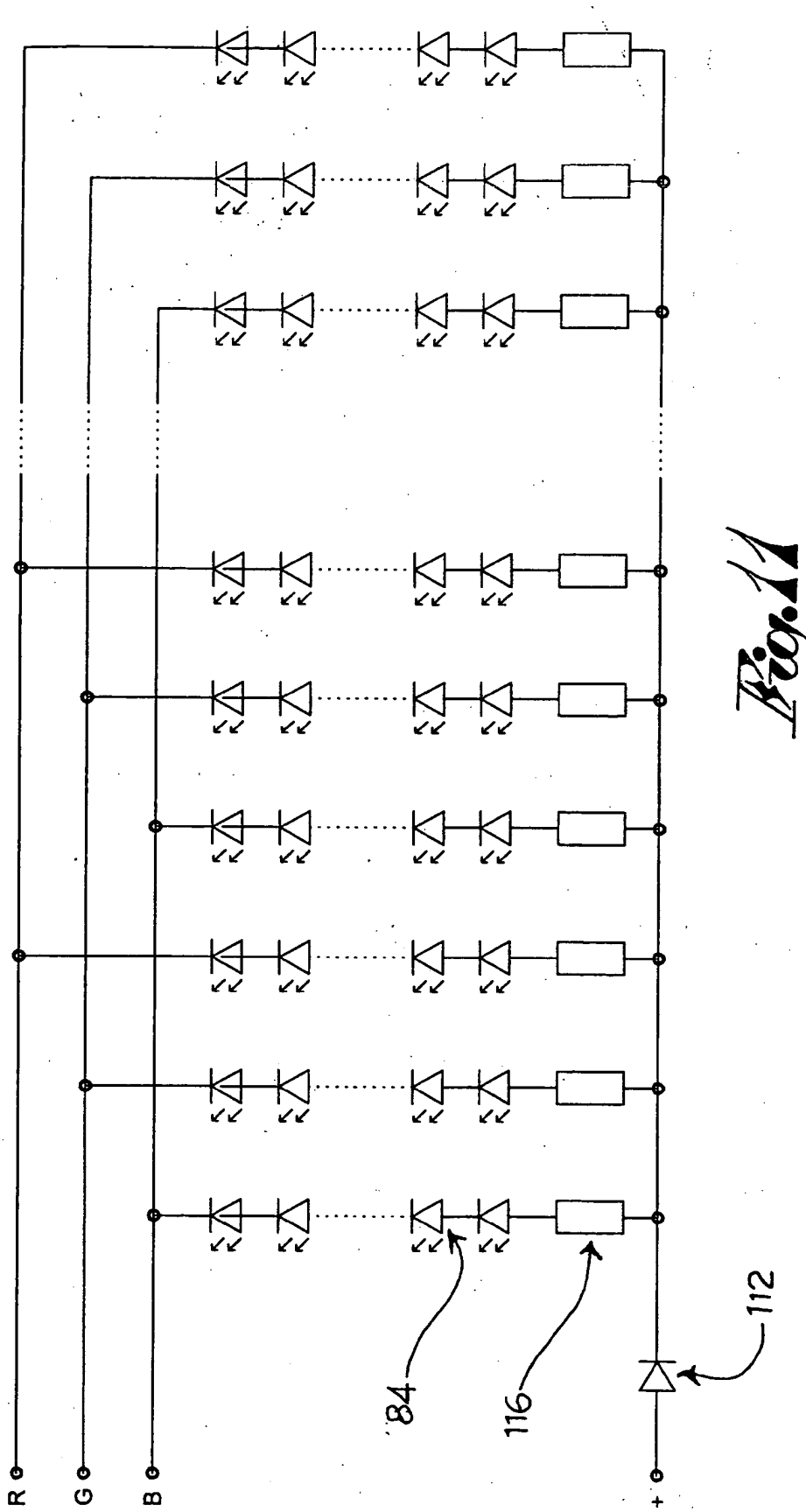


Fig.11

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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