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(54) **DOWNLIGHT UNIT AND ASSEMBLY METHOD**

(57) A downlight unit comprises a housing for passing through an opening in a surface and a spring assembly for holding the downlight unit in place. The spring assembly has at least two retaining springs connected by a connection element to form a single independent unit. A mounting element fixes the spring assembly to

the housing. This provides a simplified assembly method and gives a more robust design. In one example, the mounting element is a cover mounted over a back of the annular housing, to sandwich the spring assembly between the housing and the cover.

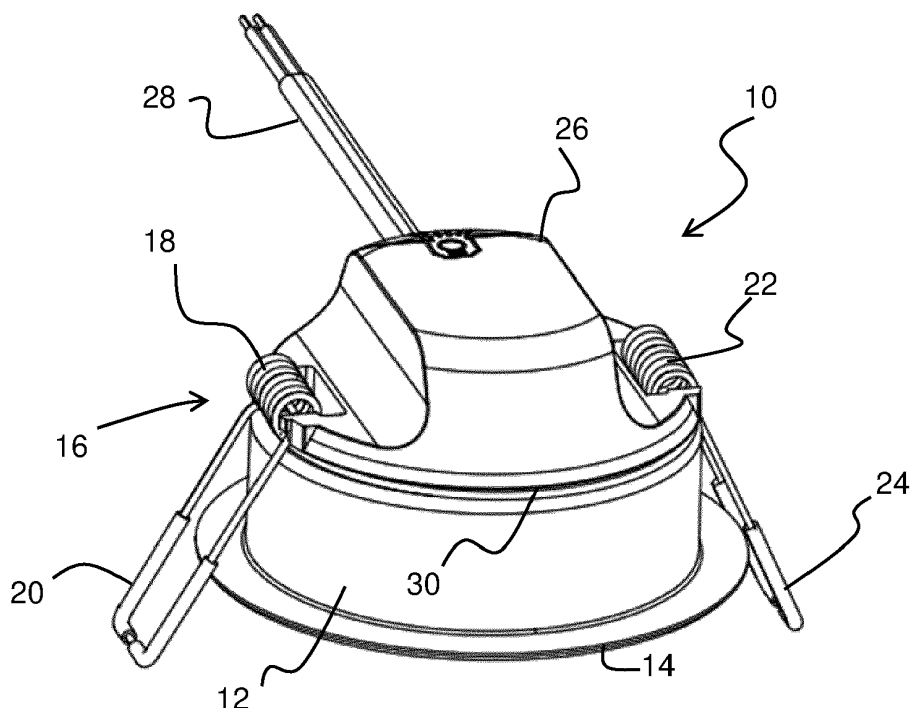


FIG. 1

Description

FIELD OF THE INVENTION

[0001] This invention relates to downlight units, in particular downlight units for fitting through an opening in a ceiling and being flush with the ceiling surface.

BACKGROUND OF THE INVENTION

[0002] Flush recessed ceiling downlights are well known. They are designed to be fitted through a hole in a ceiling from below. For this purpose, a typical design has a cylindrical body with a rim at one end. The cylindrical body is pushed through the hole in the ceiling until the rim sits against the ceiling surface.

[0003] To hold the downlight in place, a spring arrangement is typically used. The spring arrangement comprises two springs, one on each side of the unit. The springs each connect to an arm, and the spring bias pushes each arm downwardly, so they push down on the back surface of the ceiling structure (e.g. plasterboard) hence lifting and holding the downlight in position. The arms are bent back against the spring bias during installation to enable them to pass through the hole.

[0004] The springs are each fitted to a housing of the downlight during assembly for example by slotting an extension part into a dedicated slot, with each spring independently attached to the housing. This requires accurate alignment. Any misalignment can cause damage to the housing. When the downlight is fitted to a ceiling in use, there is again a risk of damage to the slots and other shape features associated with the connection between each spring and the main housing of the downlight unit.

[0005] The traditional design thus presents difficulties during manufacture and assembly and also is prone to damage in use. There is therefore a need for an improved downlight unit design.

SUMMARY OF THE INVENTION

[0006] The invention is defined by the claims.

[0007] According to examples in accordance with an aspect of the invention, there is provided a downlight unit comprising:

a housing for passing through an opening in a surface;

a front lip extending around a front of the housing;

a spring assembly comprising:

at least two retaining springs for biasing the downlight unit such that the front lip is biased against the surface; and

a connection element connecting the at least two retaining springs such that the at least two retaining springs and the connection element form a single independent unit; and

a mounting element to mount the connection element of the spring assembly to the housing.

[0008] This downlight unit avoids the need to mount individual springs to the housing, which complicates the assembly and risks damage. Instead, the springs form a spring assembly unit. This unit is mounted to the housing.

[0009] Note that the downlight unit does not necessarily include a light source - it may simply have a terminal for connection to a light source such as an LED bulb. The term "downlight unit" should be understood accordingly.

[0010] The retaining springs each preferably comprise a coil portion and an arm portion extending from the coil portion. The coil portion delimits an inner cavity extending along a coil axis. The arm portions are for bearing down on a back face of the surface (e.g. ceiling) through which the downlight unit is to be mounted.

[0011] The mounting element may be any suitable arrangement for securing the spring assembly to the housing. In one example, the mounting element comprises a cover for mounting over a back of the annular housing, to sandwich the spring assembly between the housing and the cover. The assembly can then be achieved by a simple vertical stacking assembly operation.

[0012] The cover for example comprises a respective recess for receiving each coil portion. Thus, the alignment of the spring assembly relative to the housing is easy to achieve, in that the coil portions of the springs are simply aligned with their corresponding recesses.

[0013] At least one of the recesses may comprises a spring holding element at one side of the recess for projecting into the inner cavity of the coil portion.

[0014] At least one spring holding element is then used to retain the coil portion of the spring in place. A spring holding element is only needed at one end of one coil portion, or there may a spring holding element for each coil portion.

[0015] By having a spring holding element, a stable assembly is provided with at least three fixed points; one at each end of the connection element and one at the spring holding element. If there is only a single spring holding element, it is for example placed at the coil spring end opposite to the coupling to the connecting element.

[0016] The spring holding element thereby limits the rotation of the spring assembly about an axis perpendicular to the coil axis. In particular, with three stable points, the spring assembly is not able to rotate out of its intended plane.

[0017] The (or each) spring holding element may comprise a ramp surface. The ramp surface enables an axial stacking operation to be used to fit the end of the coil spring over its respective spring holding element. The ramp surface makes the axial stacking easier by providing a self alignment function and a smooth assembly operation.

[0018] The connection element for example comprises:

a curved arm or arms which follow the outer shape of the housing between the at least two retaining springs; or
a straight arm or arms which extend between the at least two retaining springs.

[0019] Thus, different connections between the retaining springs are possible.

[0020] There are preferably exactly two retaining springs. They are for example diametrically opposite each other. This is a standard design feature for downlights, although more retaining springs may be used if desired, for example for large designs.

[0021] The housing is preferably cylindrical. This means a circular orifice through which the downlight is to be fitted is easy to form by drilling. However, the same design approach may be applied to other shapes of housing, e.g. square or rectangular.

[0022] The spring assembly is for example adapted to fit to the cover to form a cover assembly for mounting as a unit to the housing. This is one assembly option, by which the cover and the spring assembly become a single module before the cover is mounted to the housing.

[0023] The spring assembly may instead be adapted to fit over the housing and the cover is adapted for mounting over the spring assembly and the housing. This is an alternative assembly option, by which the cover, the spring assembly and the housing are connected together in a shared, vertical assembly, operation.

[0024] In all examples, the downlight unit may further comprise:

a light source in the housing; or
a light source socket extending into the housing for connection to a bulb.

[0025] The downlight may have an integrated light source or it may have a socket enabling fitting of a bulb to the downlight unit.

[0026] The invention also provides a method of assembly of a downlight unit comprising a housing for passing through an opening in a surface and a front lip extending around a front of the housing, the method comprising:

providing a spring assembly comprising:

at least two retaining springs for biasing the downlight unit such that the front lip is biased against the surface; and
a connection element connecting the at least two retaining springs; and

mounting the connection element of the spring assembly to the housing.

[0027] The mounting may involve sandwiching the spring assembly between a back of the housing and a cover.

[0028] The method may comprise positioning the spring assembly over the back of the housing, and fitting the cover over the spring assembly and housing.

[0029] Alternatively, the method may comprise fitting the spring assembly to the cover, and fitting the cover and spring assembly to the housing.

[0030] These and other aspects of the invention will be apparent from and elucidated with reference to the embodiment(s) described hereinafter.

BRIEF DESCRIPTION OF THE DRAWINGS

[0031] For a better understanding of the invention, and to show more clearly how it may be carried into effect, reference will now be made, by way of example only, to the accompanying drawings, in which:

Figure 1 shows a first example of a downlight unit in accordance with the invention;

Figure 2 shows an exploded view of the design of Figure 1;

Figure 3 shows the spring assembly more clearly; Figure 4 shows a side view of the downlight unit with the spring assembly removed;

Figure 5 shows a side view of the cover;

Figure 6 shows an assembly operation;

Figure 7 shows alternative design in a first exploded view;

Figure 8 shows the alternative design in a second exploded view;

Figure 9 shows the design of Figures 7 and 8 when assembled and in perspective view;

Figure 10 shows the assembled design of Figures 7 and 8 when assembled and viewed from above and from the side; and

Figure 11 shows an alternative way to secure the spring assembly to the housing.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0032] The invention will be described with reference to the Figures.

[0033] It should be understood that the detailed description and specific examples, while indicating exemplary embodiments of the apparatus, systems and methods, are intended for purposes of illustration only and are not intended to limit the scope of the invention. These and other features, aspects, and advantages of the apparatus, systems and methods of the present invention will become better understood from the following description, appended claims, and accompanying drawings. It should be understood that the Figures are merely schematic and are not drawn to scale. It should also be understood that the same reference numerals are used throughout the Figures to indicate the same or similar parts.

[0034] The invention provides a downlight unit which comprises a housing for passing through an opening in

a surface and a spring assembly for holding the downlight unit in place. The spring assembly has at least two retaining springs connected by a connection element to form a single independent unit. A mounting element fixes the spring assembly to the housing. This provides a simplified assembly method and gives a more robust design. In one example, the mounting element is a cover mounted over a back of the annular housing, to sandwich the spring assembly between the housing and the cover.

[0035] Figure 1 shows a first example of a downlight unit in accordance with the invention.

[0036] The downlight unit 10 comprises a cylindrical housing 12 for passing through a circular opening in a surface, with a front lip 14 extending around a front of the housing. Note that in this document "front" refers to the part of the downlight unit with a light output face and "back" refers to the opposite part facing into the cavity behind the surface against which the downlight unit is to be mounted. Note that other opening shapes and corresponding shapes of the housing may be used.

[0037] A spring assembly 16 comprises first and second retaining springs for biasing the downlight unit such that the front lip is biased against the surface.

[0038] The first retaining spring comprises a first coil portion 18 and a first arm portion 20 extending from the coil portion. The second retaining spring comprises a second coil portion 22 and a second arm portion 24 extending from the coil portion.

[0039] The arm portions 20, 24 are biased by the coil portions 18, 22 to bear down on a back face of the surface (e.g. ceiling) through which the downlight unit is to be mounted, in known manner. This lifts the downlight unit so that it is held with the front lip held flush against front face of the surface, e.g. ceiling.

[0040] A cover 26 is mounted over a back of the annular housing 12. An electric supply cable 28 is routed through the cover to the inside of the downlight unit. It may terminate at a terminal to which a bulb can be connected, or it may connect to an integrated light source such as an LED bulb (and the downlight unit may then be replaced as a whole unit).

[0041] To the extent described above, the general construction is conventional. In the conventional construction, the spring assembly 16 comprises separate and independent spring units, each of which is mounted to the cover or the housing by a dedicated coupling feature. The housing and the cover may be a single piece in conventional designs.

[0042] According to the invention, there is a connection element 30 connecting the two retaining springs to form a single independent unit. The coil portions are then simply retained in openings in the cover and do not need to be rigidly attached to the cover 26.

[0043] These features are most clearly shown in the exploded view of Figure 2.

[0044] This design avoids the need to mount individual springs to the cover 26 (or to the housing), which complicates the assembly and risks damage. Instead, the

springs form a shared spring assembly unit 16. This unit is sandwiched between the cover 26 and the housing 12, which can be achieved by a simple vertical stacking assembly operation.

[0045] The cover 26 has a first recess 40 for the first coil portion 18 and a second recess 42 for the second coil portion 22. In a most simple design, there is no active coupling between the coil portions and the recesses. Instead, the recesses simply serve to locate the coil portions. The coil portions cannot come out of their respective recesses because the connection element 30 keeps them in place. The alignment of the spring assembly 16 relative to the housing 12 is easy to achieve, in that the coil portions of the springs are simply aligned with their corresponding recesses.

[0046] The spring assembly in this example comprises a curved arm which follows the outer shape of the housing 12 between the two spring elements.

[0047] The spring assembly is shown more clearly in Figure 3. It may comprise a single bent metal wire which forms both coil portions, both arm portions and the connection element.

[0048] An advantage of a curved arm is that there is no single axis of rotation defined by the arm. Thus, by clamping the arm between the housing and the cover (as shown in Figure 1), the clamping of the arm resists any movement of the coil portions out of their intended plane. Thus, the curved arm resists rotation of the coil portions of each spring about an axis perpendicular to the coil axis (e.g. rotation about a horizontal diagonal axis). This therefore resists the coil portions moving away from their intended orientations within the recesses. The correct orientation of the coil portions defines the intended rotation axis for the arm portions 20, 24, and this rotation axis is intended to be in a plane parallel to the plane of the lip 14 (i.e. parallel to the plane of the surface through which the downlight unit is to pass).

[0049] It is however additionally possible to provide one or more spring holding elements, at one side of the recess. A spring holding element is for projecting into the inner cavity of the coil portion.

[0050] Figure 4 shows a side view of the downlight unit with the spring assembly removed, to show a spring holding element 50. It extends into the central core of an associated coil portion to retain the coil spring in place. A spring holding element may be provided at one end of only one recess, for one associated coil portion, but there may be one in each recess.

[0051] Figure 5 shows a side view of the cover 26 to show the spring holding element 50 more clearly in its recess 40.

[0052] It is desired that the assembly does not require any mechanism to compress the coil portions before assembling the downlight unit.

[0053] In one assembly process, a simple vertical stacking operation is performed, so that the three parts shown in Figure 2 are simply vertically moved together relative to each other. The spring assembly is positioned

over the housing and the cover is mounted over the spring assembly and the housing. The cover, the spring assembly and the housing are then connected together in a shared, vertical assembly, operation.

[0054] This requires the coil portion of a spring to be able to ride over any provided spring holding element. A ramp surface at the bottom of the spring holding element 50 may allow this, such that the coil portion of the spring element snaps in place over the spring holding element. The spring holding element then has only a small dimension (for example smaller than is shown in Figures 4 and 5, as will become clear below). The ramp surface also makes the axial stacking easier by providing a self-alignment function. For example, the width of the recess may then be larger than the length of the coil portion, so facilitating alignment.

[0055] By having a spring holding element, a stable assembly is provided with at least three fixed points; one at each end of the connection element, and one at the spring holding element itself. The spring holding element is for example placed at the coil spring end opposite to the coupling to the connecting element so that the three fixed points form a triangular base for the overall spring assembly.

[0056] The spring holding element thereby further limits the rotation of the spring assembly, or the individual coil portions, about an axis perpendicular to the coil axis, in the same manner as explained above.

[0057] Instead of a vertical stacking operation of the three parts as mentioned above, the spring assembly 16 may first be fitted to the cover 26 to form a cover assembly. This cover assembly is then mounted as a unit to the housing 12. Thus, the vertical stacking assembly only involves two components.

[0058] Figure 6 shows this assembly operation.

[0059] In this example, each recess 40, 42 has a spring holding element 50, 52.

[0060] The spring holding elements can be longer that would be possible for a fully vertical stacking operation. The top image shows the spring assembly 16 ready to be fitted to the cover 26.

[0061] The middle image shows the first coil portion 18 about to be fitted over the first spring holding portion 50. The spring holding portion can project further into the inner core of the coil portion than would be possible for a vertical stacking operation. The first spring holding portion 50 is at the opposite side of the coil portion to the connection element 30.

[0062] The bottom image shows the second coil portion 22 fitted over the second spring holding portion. The second spring holding portion 52 is also at the opposite side of the coil portion to the connection element 30.

[0063] This final connection may be achieved by rotating the second coil portion out of the intended plane (twisting the connection element) as part of the assembly process. This twisting can easily be tolerated as elastic deformation of the connection element. At the end of the process, the spring assembly is securely fixed to the cov-

er and they can be handled as a single unit for attachment to the housing.

[0064] The example above shows a curved connection element. An alternative design may use a straight arm or arms which extend between the two spring elements.

[0065] Figures 7 and 8 show this alternative design in exploded view from two different viewing directions. The same reference numbers are used as in Figures 1 to 6.

[0066] This example of the design is based on a vertical stacking assembly. A spring holding element 50 is shown but it is small enough to enable vertical stacking without separate handling of the spring assembly 16. Also, there is only one spring holding element 50 (in only one 40 of the recesses). It may for example project by around 1.5mm. It may have ramped edges as explained above, to improve the feeling during assembly and to act as a self-alignment feature.

[0067] The spring holding element is optional, as in the design of Figures 1 to 6. It is however preferred in this example because the straight connection element 30 defines an axis of rotation about which the spring assembly, and hence the coil portions, could conceivably rotate if not restrained in some way.

[0068] There are however alternative ways to prevent the coil portions moving out of their recesses. For example, the cover may include a cap area over each recess which bears down on the upper surface of the coil portions, but without hindering rotation of the arm portions. This would provide clamping of each coil portion between the housing beneath and the cover above.

[0069] Figure 9 shows the design of Figures 7 and 8 when assembled and in perspective view and Figure 10 shows the assembled design of Figures 7 and 8 when assembled and viewed from above and from the side.

[0070] The examples above provide fixing of the spring assembly to the housing by clamping between the housing and a cover. However, the spring assembly may be secured by other means.

[0071] Figure 11 shows an example in which the spring assembly 16, of the same types as described above, is secured to the housing 12 by a clamp 60. The clamp 60 for example opens and closes, so that in the open position the spring assembly can be fitted to the housing 12, and the clamp is then closed to secure the spring assembly in position. The clamp may instead be removed for fitting the spring assembly, then attached to hold the spring assembly in place.

[0072] The invention thus relates to the general design of the spring assembly. It may be incorporated into the overall design of the downlight unit in various different ways, as will be apparent to those skilled in the art.

[0073] The invention is of particular interest for ceiling downlights, but it may be used for any light fitting which is to be mounted flush against a surface with a hollow space behind.

[0074] The spring design may be used as part of a downlight device for any type of lighting technology and any type of light bulb.

[0075] Variations to the disclosed embodiments can be understood and effected by those skilled in the art in practicing the claimed invention, from a study of the drawings, the disclosure and the appended claims. In the claims, the word "comprising" does not exclude other elements or steps, and the indefinite article "a" or "an" does not exclude a plurality.

[0076] The mere fact that certain measures are recited in mutually different dependent claims does not indicate that a combination of these measures cannot be used to advantage.

[0077] If the term "adapted to" is used in the claims or description, it is noted the term "adapted to" is intended to be equivalent to the term "configured to".

[0078] Any reference signs in the claims should not be construed as limiting the scope.

Claims

1. A downlight unit (10) comprising:

a housing (12) for passing through an opening in a surface;
a front lip (14) extending around a front of the housing;
a spring assembly (16) comprising:

at least two retaining springs (18,20;22,24) for biasing the downlight unit such that the front lip (14) is biased against the surface; and
a connection element (30) connecting the at least two retaining springs such that the at least two retaining springs and the connection element form a single independent unit (16); and

a mounting element to mount the connection element of the spring assembly to the housing.

2. The unit of claim 1, wherein the retaining springs each comprise a coil portion (18,22) and an arm portion (20,24) extending from the coil portion, wherein the coil portion delimits an inner cavity extending along a coil axis.

3. The unit of claim 2, wherein the mounting element comprises a cover (26) for mounting over a back of the housing (12), to sandwich the spring assembly (16) between the housing (12) and the cover (26).

4. The unit of claim 3, wherein the cover (26) comprises a respective recess (40,42) for receiving each coil portion.

5. The unit of claim 3 or 4, wherein at least one recess (40) comprises a spring holding element (50) at one

side of the recess for projecting into the inner cavity of the coil portion (18).

6. The unit of claim 5, wherein each spring holding element (50,52) comprises a ramp surface.

7. The unit of claim 5 or 6, wherein the spring holding element (50,52) limits the rotation of the spring assembly about an axis perpendicular to the coil axis.

8. The unit of any one of claims 3 to 7, wherein the spring assembly (16) is adapted to fit to the cover (26) to form a cover assembly for mounting as a unit to the housing (12).

9. The unit of any one of claims 3 to 8, wherein the spring assembly (16) is adapted to fit over the housing (12) and the cover (26) is adapted for mounting over the spring assembly and the housing.

10. The unit of any one of claims 1 to 9, wherein the connection element (30) comprises:

a curved arm or arms which follow the outer shape of the housing between the at least two retaining springs; or
a straight arm or arms which extend between the at least two retaining springs.

11. The unit of any one of claims 1 to 10, comprising exactly two retaining springs (18,20;22,24).

12. The unit of any one of claims 1 to 11, comprising:

a light source within the housing; or
a light source socket extending into the housing for connection to a bulb.

13. A method of assembly of a downlight unit comprising a housing for passing through an opening in a surface and a front lip extending around a front of the housing, the method comprising:

providing a spring assembly comprising:

at least two retaining springs for biasing the downlight unit such that the front lip is biased against the surface; and
a connection element connecting the at least two retaining springs; and

mounting the connection element of the spring assembly to the housing.

14. The method of claim 13, comprising positioning the spring assembly over the back of the housing, and fitting a cover over the spring assembly and housing.

15. The method of claim 13, comprising fitting the spring assembly to a cover, and fitting the cover and spring assembly to the housing.

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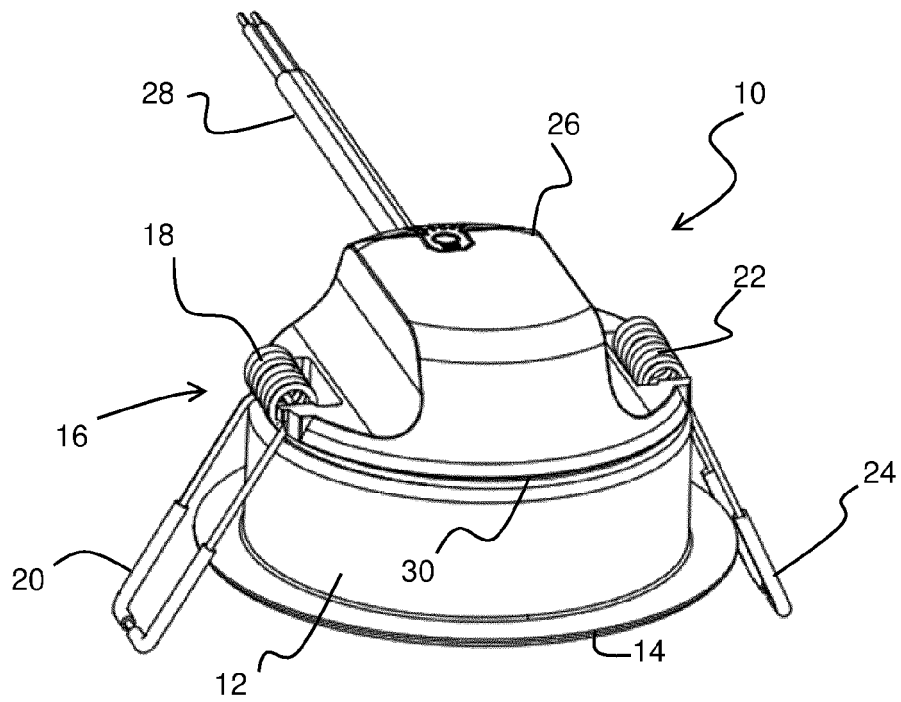


FIG. 1

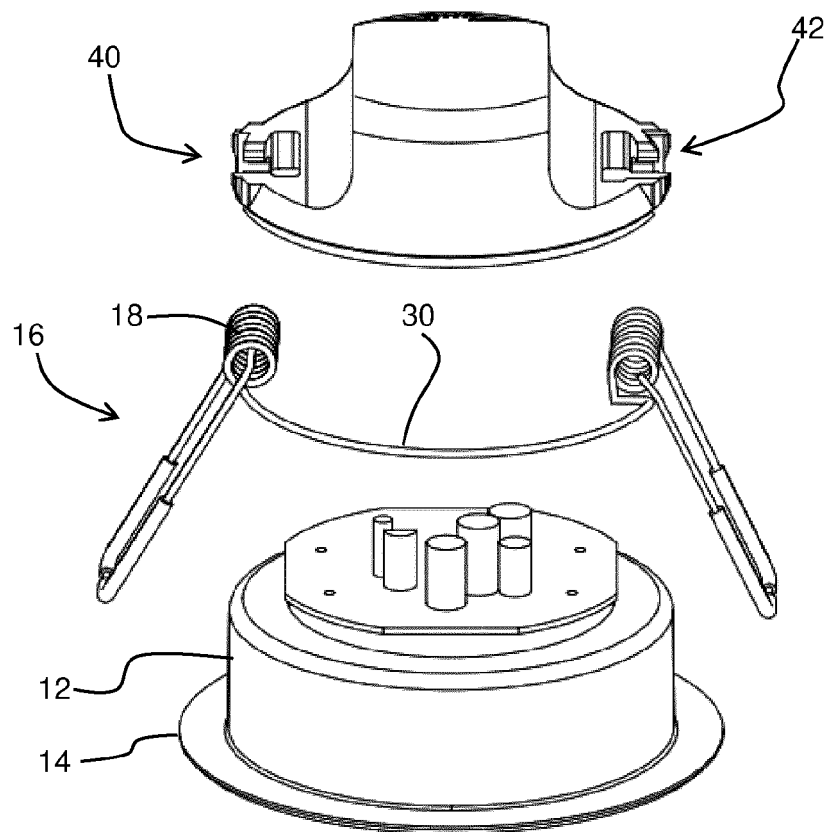


FIG. 2

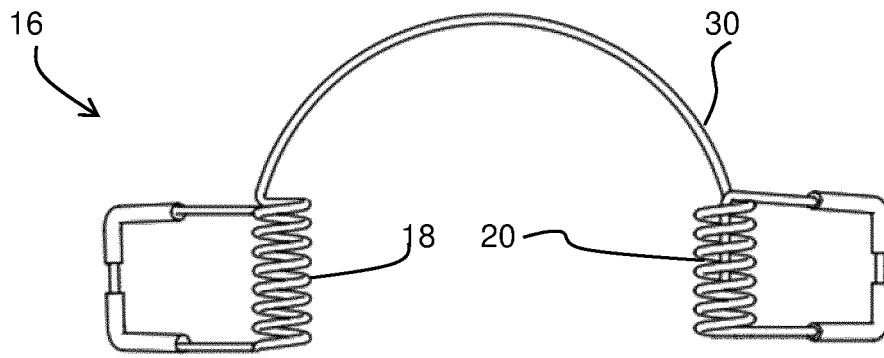


FIG. 3

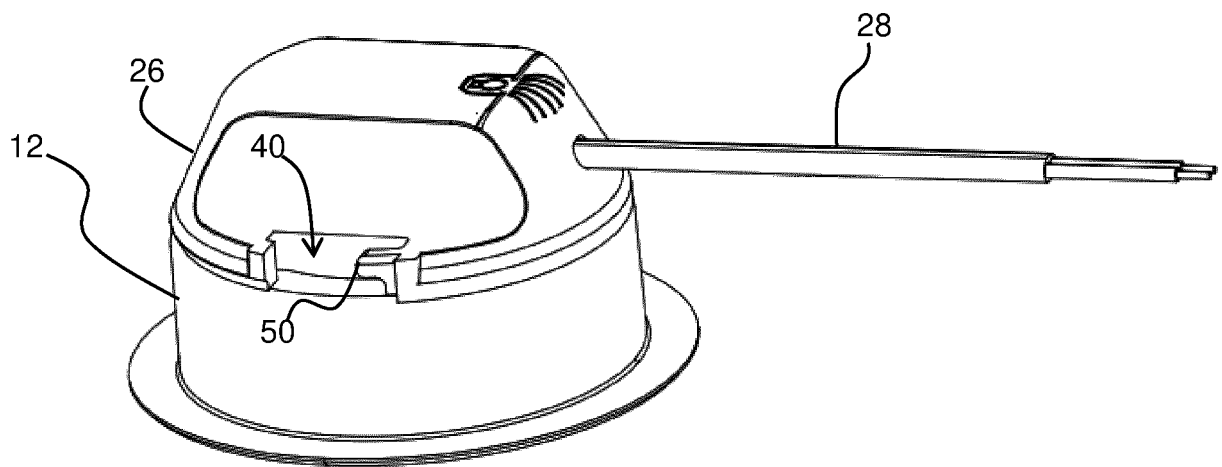


FIG. 4

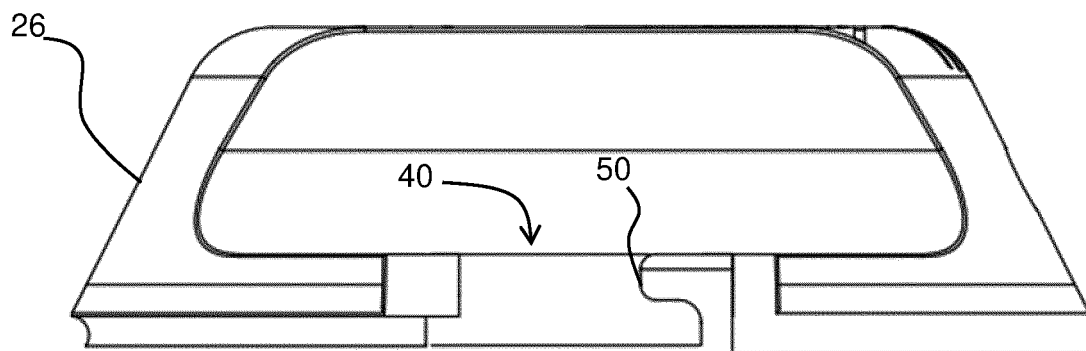


FIG. 5

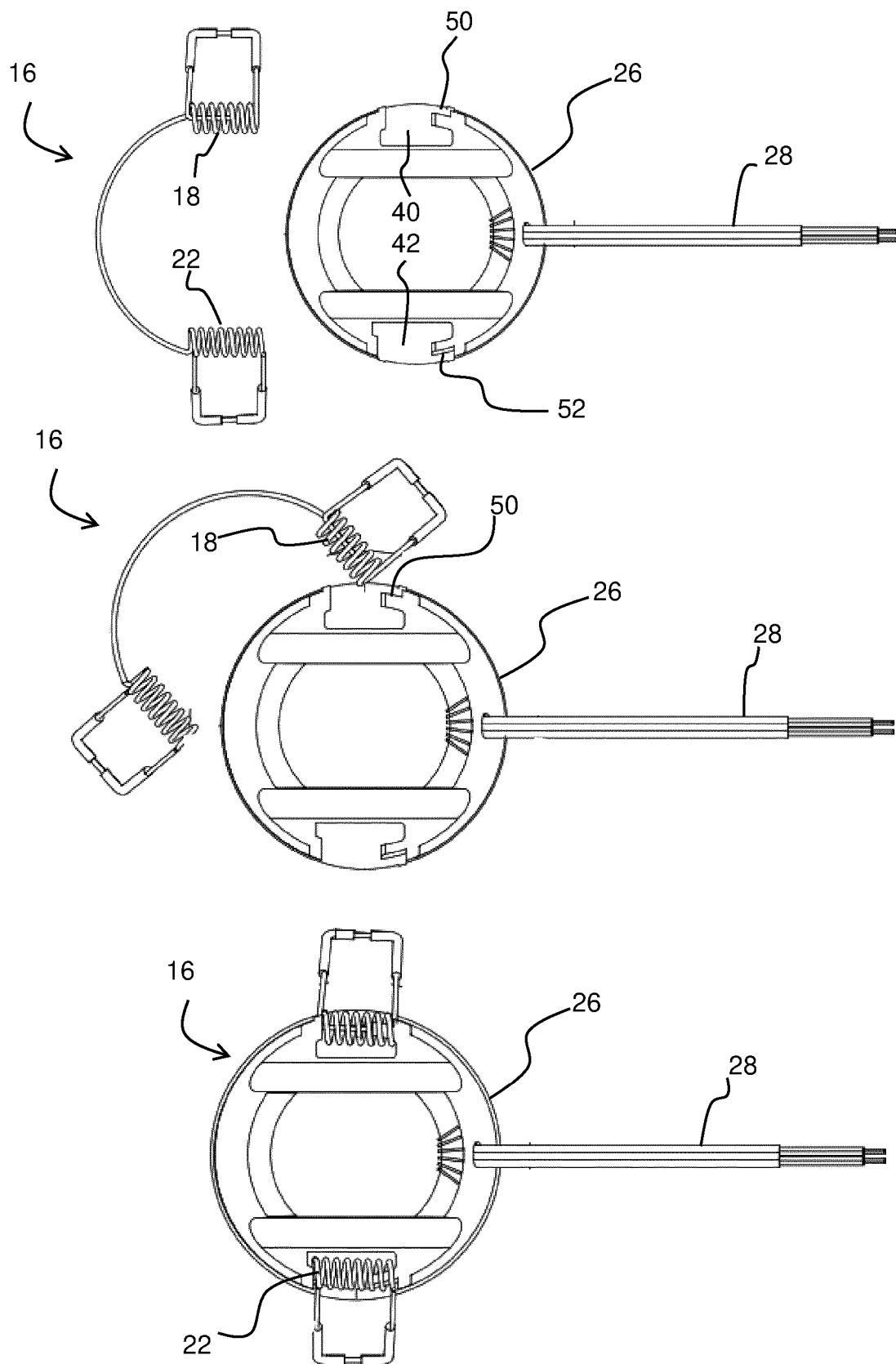


FIG. 6

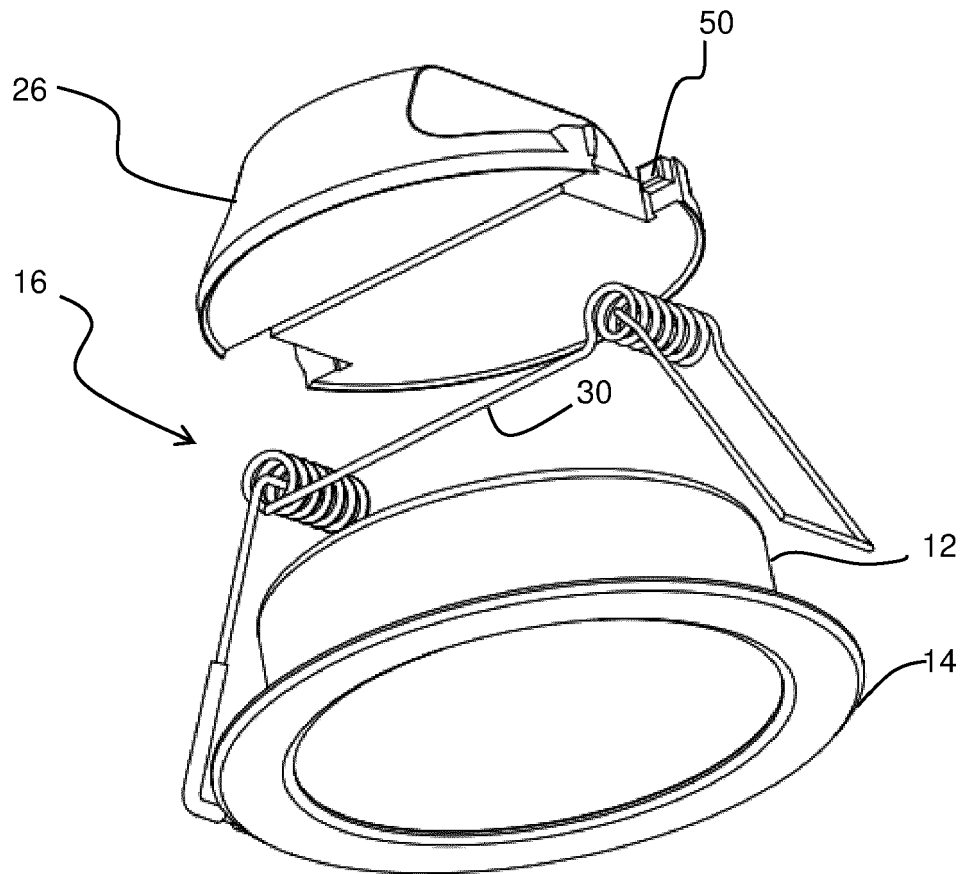


FIG. 7

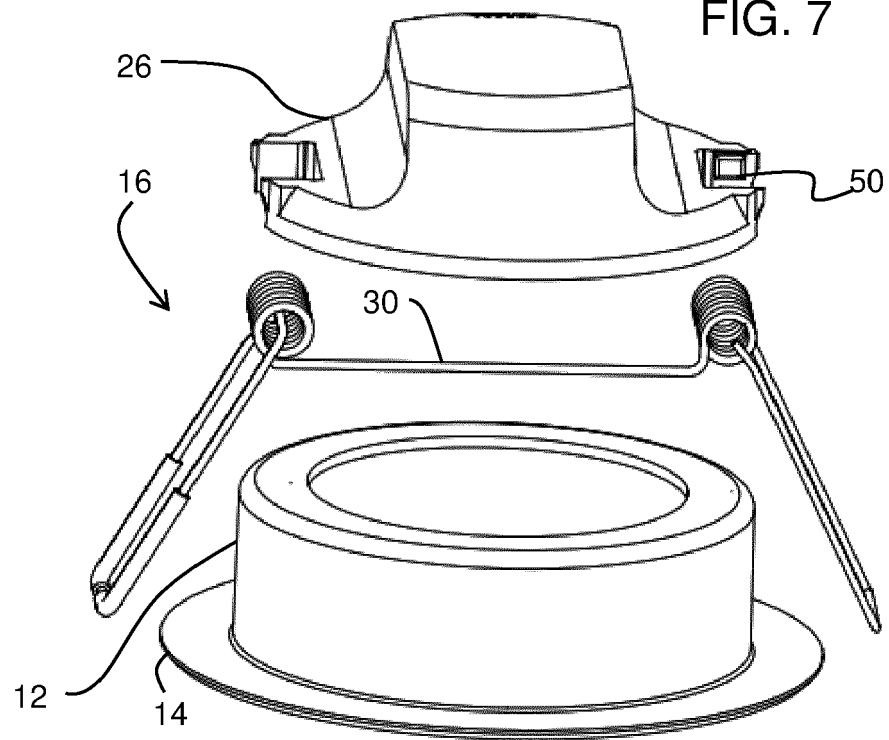


FIG. 8

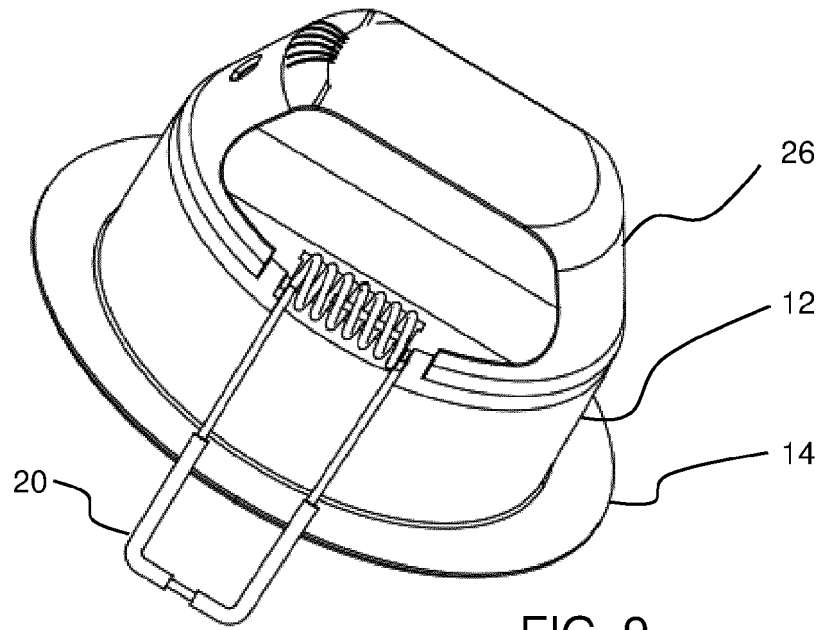


FIG. 9

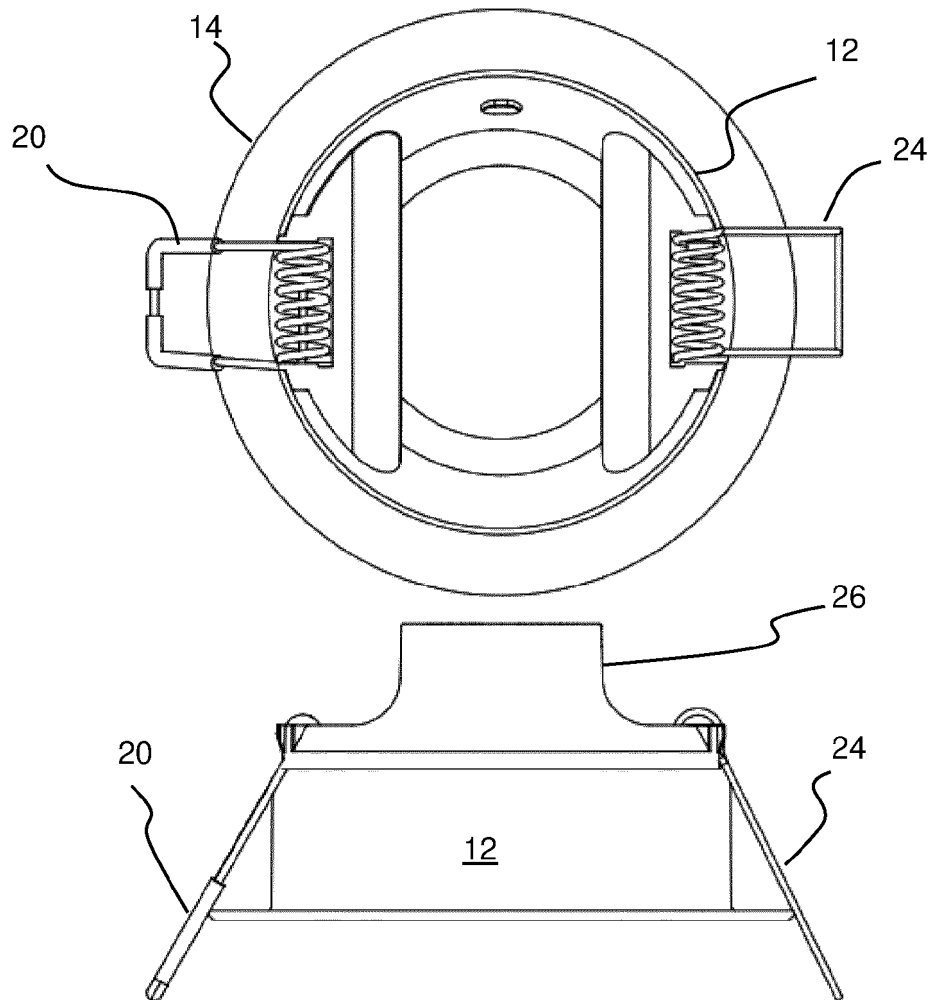


FIG. 10

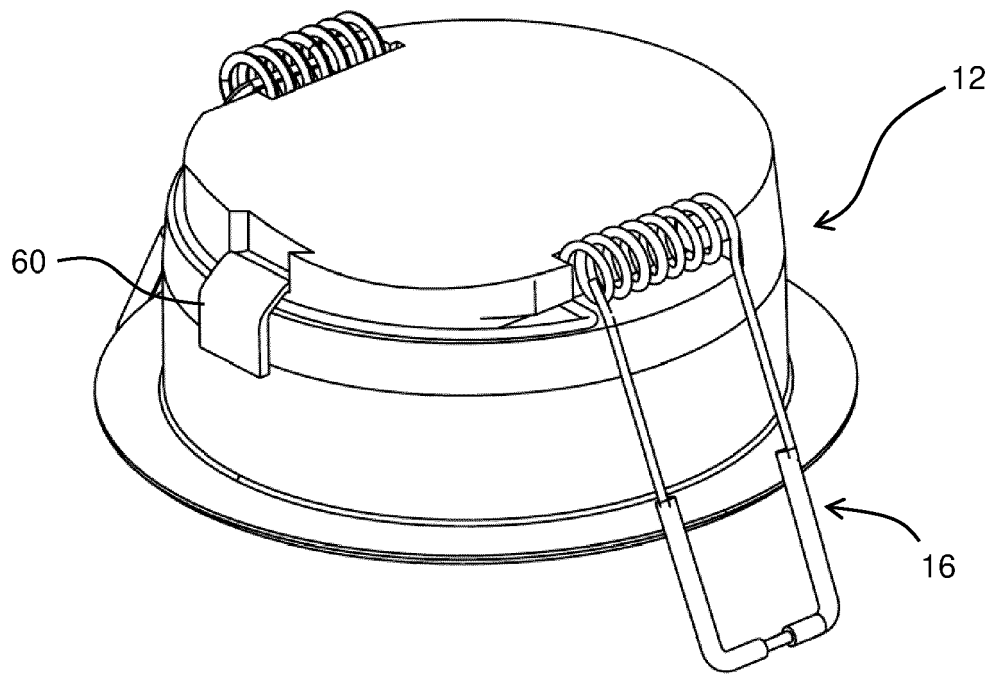


FIG. 11



EUROPEAN SEARCH REPORT

 Application Number
EP 20 20 1986

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DOCUMENTS CONSIDERED TO BE RELEVANT			
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Y	* paragraphs [0033] - [0049]; figures 1-5 *	3-9,15	

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Y	* paragraphs [0082] - [0091]; figures 1-4 *	3-9,15	

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Y	* paragraph [0036]; figures 4-5 *	3-9,15	

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	* paragraphs [0072] - [0091]; figures 1-6 *		F21S F21V

The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 26 February 2021	Examiner Thibaut, Arthur
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

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EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 20 20 1986

5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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26-02-2021

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