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(54) **Incandescent Lamp and Filament Support Therein**

(57) A filament support wire (10) for an incandescent lamp (1) is disclosed, wherein one end of the filament support wire (10) is looped over to form a hook portion (11). At the inner curved section (12) of the hook portion (11) there is provided a groove (20), this groove (20) running parallel with the normal to the plane defined by the hook portion (11) and filament support wire (10). The groove (20) is approximately the same size as the filament wire (2) or coiled filament wire (3) making up the incandescent filament of the incandescent lamp (1). The filament wire or primary coiled filament is preferably fixed within the groove by slightly bending the hook of the support wire, which decreases the width of the groove.

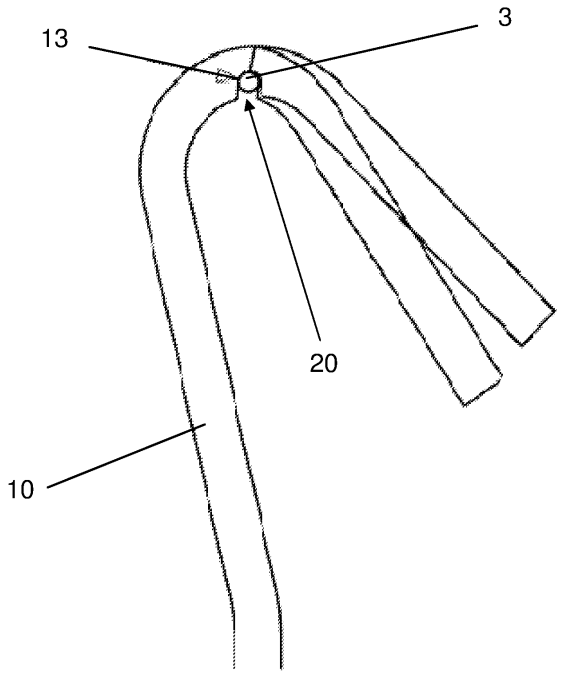

Figure 4

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Description

[0001] Incandescent lamps in which a filament is held between two electrode wires, provide a convenient and straightforward way of generating light. In particular, it is possible to make filament lamps in an extremely compact form, as the main requirements are that the filament is suspended between the two electrodes in a controlled atmosphere. Typically, the incandescent lamp will be provided with a glass, quartz or ceramic bulb, which houses a specific atmosphere allowing the filament to glow and produce light, but without causing damage thereto.

[0002] In high Volt, low wattage tungsten halogen lamps (e.g. 230V & 35W) the filament wire is long and thin and has to be coiled (primary coiling) and even coiled-coiled (secondary coiling) to create a compact form. A coiled-coiled filament of this type however, is very flimsy and has to be supported at one or more points to prevent sagging during operation. For example, the filament structure in the form of an M or a W is well known, as this allows for four sections of the filament to be light producing. Typically, in the bulb of the incandescent lamp, the two ends of the filament will be attached to lead wires, wherein these lead wires are fixed within the lamp and can provide electricity along the length of the filament. At appropriate points along the filament, this is held in place by filament support wires, such support wires being electrically isolated, and being used to position sections of the filament in order to allow for the desired filament trace. In the example described above with the W, each end of the filament is held high with the lead wires, and two lower filament support wires will hold the filament at positions near the end of the filament and lower, and a final third middle filament support wire will again hold the filament approximately in the middle and higher than the two outer filament support wires. This would clearly lead to the W structure of the filament, and the desired four incandescent sections between each of the lead wires and filament support wires.

[0003] An example of a prior known incandescent lamp showing the W filament structure, is seen in Figure 1. Figure 1 shows also the major drawback with such incandescent lamps, in particular that the filament is difficult to position reliably by means of the filament support wires. If the filament slips through the filament support wires, it is possible for the support wires to make contact with the incandescent portions, which will lead to a short circuit (highlighted in the figure). The number of secondary windings which are short circuited by the support wire, as seen in prior art constructions, will vary from lamp to lamp. This variation (see Wiebull diagrams of Figure 5) results in different coil temperatures, variation in the lumen per watts of the lamp (for example: 13 ± 0.5 for the prior art, ss. 13 ± 0.2 for the invention) and life difference.

[0004] It is further important for the filament support wires to fix the filament without causing damage thereto. For example, it is not appropriate to tightly grip the filament at the filament support wire points, as this will also lead to damage of the filament and a reduction in its lifetime. In this regard, a need exists for a reliable and simple mechanism of fixing the non-incandescent sections of the filament at the filament support wires or points, which also does not damage the delicate nature of the wire or coiled wire making up the filament itself.

[0005] US 2,145,186 has addressed this problem by means of hooks making up the filament support portions or wires. The hooked portions for holding the filament in place are provided with threads on the interior hook side, wherein these threads are intended to interact with a coiled filament wire. As is described in this document, the internal threads within the hooks are not intended to match entirely with the coil of the coiled filament wire, rather they will tend to gently grip the coiled wire making up the filament. This is a relatively complex design, and will of course only function appropriately for filaments comprising coiled wires as a primary coil.

[0006] US 3,780,333 also considers the clamping of filament wires at the end of the filament to the lead wires. In this document, the coiled filament wire making up the filament wraps around a central stub, which projects from the lead wire of the lamp, and which is also held in place by holding this projection in a looped portion of the lead wire. Whilst this gives an elegant solution to the problem, this is a technically difficult one. In particular, it is necessary to thread the support bar into the end of the filament and then grip this by means of the hook in the lead wire. Additionally, wrapping this around the lead wire in order to ensure appropriate connection, is a non-trivial matter.

[0007] In light of the above concerns, the present disclosure relates to a simple and reliable mechanism for gripping or fixing the non-incandescent sections of a filament within an incandescent lamp. Further, this is done in a manner which does not cause damage to the delicate wire or primary coiling making up the filament.

Summary

[0008] According to the present disclosure, the abovementioned problems, as well as others, are addressed by means of the filament support wire defined in claim 1. Additional advantageous aspects of this support wire are defined in the dependent claims there-from. Further, a method of wiring a filament within an incandescent lamp by means of the filament support wire of claim 1 is defined in claim 11. Again, advantageous aspects of this method are defined in the dependent claims there-from.

[0009] In particular, the present disclosure relates to a filament support wire or portion, which is intended for use within an incandescent lamp. One end of this support wire or means is fixedly attached within the incandescent lamp, and the

other free end is used to interact with the filament itself. In particular, the support is intended for fixing to the filament at non-incandescent sections of the filament. For holding the filament in position, the support is provided with a bent or hooked portion at the free end, and this holds the filament wire in the desired position. Within the hooked section, and indeed the inner portion defining the hook itself, is provided a groove. This groove running parallel with the normal to the plane defined by the hook portion and filament support wire. The wire making up the filament is intended to slot within this groove thus fixing the position of the wire making up the filament at the hooked or bent portion. In particular, the size of the groove will be chosen to be approximately the same size as the wire or primary coiling making up the filament. With the size of this groove approximately matching the size of the wire of the filament, it is clear that the wire and the groove will be in good close contact. Additionally, with this increased level of contact comes increased frictional forces, which will tend to stop the wire and filament from slipping through the hooked or bent portion of the support.

[0010] A preferred location of the groove, is at the very apex of the bend or hook in the support. By structuring and positioning the groove at essentially the highest point of the interior or inner curved section of the bend, the filament will naturally slide up and be held within the groove.

[0011] The groove preferably extends along the entire width of the filament support wire, and can take a variety of cross-sectional shapes. One particularly advantageous cross-section shape is circular, as this will tend to match the circular nature of the wire making up the filament. It is also possible to structure the cross section as an oval, wherein the oval extends along the length of the groove and it is the longer less bent side of the oval which extends into the support.

[0012] With provision of the groove being either a circular cross-section groove, or an oval or elliptical cross-section groove, it is possible to define the size thereof by means of the wire making up the filament. Obviously, it is desirable to have the groove being only slightly larger than the wire or primary coil making up the filament, as this will lead to the greatest interaction between the surface of the groove and the wire itself. In particular, the diameter of the groove when this has a circular cross-section, or the minor axis if the groove has an oval or elliptical cross-section, would be equal to the diameter of the filament wire of coiled filament wire plus between 5 and 20%. A more preferable range would be the diameter of the filament wire or coiled filament wire plus between 7 and 15% or simply most preferably plus 10%. That is:

$$1.05\ \text{Ø}_{\text{Primary Outer Coil Dia}} \leq \text{Ø}_{\text{Groove}} \leq 1.2\ \text{Ø}_{\text{Primary Outer Coil Dia}}$$

$$(\text{preferably: } \text{Ø}_{\text{Groove}} = 1.1\ \text{Ø}_{\text{Primary Outer Coil Dia}}).$$

[0013] Structuring the groove with this similar size to the filament wire or primary coil, will ensure that the wire is properly held within the groove, and that the filament will generally not slip with respect to the support.

[0014] In addition to providing the size of the groove with respect to the filament, it is also possible and important to select the size of the groove with regard to the size of the support wire. In particular, it is expected that these two will interplay with each other, and thus when the size of the filament is known, this leads to the size of the support wire. That is, a small support wire would be inappropriate for use with a large diameter filament wire or coiled filament wire, and likewise a large diameter support would be unnecessary for a very small diameter filament.

[0015] The diameter of the circular groove or minor axis of the oval or elliptical groove lies between 0.1 and 0.6 times the diameter of the support wire. It is also more appropriate and preferable to have the range of sizes of the groove lying between 0.27 and 0.45 times the diameter of the wire making up the support. Further preferably, the diameter of the groove lies between 0.3 and 0.35 times the diameter of the wire making up the support. That is:

$$0.1\ \text{Ø}_{\text{Support wire}} \leq \text{Ø}_{\text{Groove}} \leq 0.6\ \text{Ø}_{\text{Support Wire}}$$

$$(\text{more preferably: } 0.27\ \text{Ø}_{\text{Support wire}} \leq \text{Ø}_{\text{Groove}} \leq 0.45\ \text{Ø}_{\text{Support Wire}})$$

[0016] It is also possible to provide the support from a material which is plastically deformable; that is, a material which after bending will retain its new shape, rather than springing back to an original form. In this case, the support can be used to actually grip the filament wire placed within the groove. For example, if the filament wire is within the groove, the hook or bent portion can be further bent round. This additional bending will lead to a reduction in the size of the groove, which will tend to lightly grip the filament wire or primary coil, thus holding the filament in place. This is particularly

advantageous, as it provides a repeatable and simple mechanism for lightly gripping the wire or primary coil, without damaging this or the filament.

[0017] The support or support wire is intended for integration into an incandescent lamp, and will be used to define the shape of the filament as it traverses its path within the lamp. The lamp will be provided with two connections or lead wires which provide electrical contact to the outside of the lamp, and can be used to pass current through the filament attached thereto. Each end of the filament is attached to one of these lead wires, thus allowing current to pass through the filament. In the lamp, at least one of the above defined supports is positioned therein, and will hold the wire or primary coil making up the filament in the groove of the hooked or bent section. In this manner, an incandescent lamp can be fabricated wherein the filament is fixed appropriately by the support means, such that the filament will not slide through the support and the incandescent sections of the filament can be maintained without short circuit.

[0018] In particular, the filament will be structured with at least one non-incandescent portion, wherein this non-incandescent portion is provided by a skip section in the filament wire or primary coil. This non-incandescent section will be positioned at the point of the filament which will be held by the support, and there-between will have sections which will form the incandescent section. Clearly, the position and number of the non-incandescent sections will be chosen to coincide with the position and number of supports. The support wires need to be positioned precisely at the centre of the skips in the filament.

[0019] A variety of shapes is possible for the filament within the lamp, and by way of example these can include a: W, or V, or M, or N, or A shape.

[0020] As has also been discussed above, the non-incandescent sections of the filament can be held within the groove by positioning the non-incandescent section within the groove of the hook portion in a partially bent form, and then once the incandescent section is within the groove, further bending the hook or bent portion to lightly clamp the filament wire or coiled filament wire. This then leads to a clamped or gripped filament within the groove of the support.

[0021] A method of creating a connected filament in an incandescent lamp involving the support as defined above, is quite straightforward. The two ends of the filament are appropriately connected to the lead wires of the incandescent lamp, and then the filament is threaded into the hook or bent portion of the support. The non-incandescent section of the filament is held within the groove provided in the support, this support being as defined above, and thus the filament is fixed in the appropriate position. Again, the filament will not readily slip through the groove, as this will provide a good frictional engagement between the hook of the support and the wire making up the filament.

[0022] With the filament held in the hook or bent portion of the support, the hook can be further bent over, such that the groove is reduced in size slightly and will lightly grip the wire making up the filament. It is also possible, instead of, or in addition to, bending of the hook portion, for the non-incandescent section to be held within the groove by some fixing means. For example, these fixing means could incorporate one or more than one of a cement, a glue, a plasma or laser weld or soldering.

[0023] As defined above, the aspects of the support of the present disclosure are defined. In particular, the support provides a reliable mechanism of holding the filament in location, such that it will not slip through the holding portion or support, and will thus avoid any short circuits. It is of note that in the main the description relates to a filament wire, which is intended to encompass a single uncoiled wired, a wire with a primary coil as well as a wire with a primary coil which is coiled a second time to give a secondary coil. Further, the discussion relates to incandescent lamps, although this is intended to also cover the use of halogen or other noble gas lamps in particular at high pressure, as well as with specific metals for the filament, in particular tungsten. It is clear, for example, that the disclosure will be particularly successful with tungsten halogen lamps.

Brief Description of the Drawings

[0024]

Figure 1: A filament in an incandescent lamp according to the prior art.

Figure 2: A filament in an incandescent lamp showing the use of a support according to the present disclosure, wherein the filament is appropriately held and no short circuiting occurs.

Figure 3: The hook or bent portion at the end of the filament support.

Figure 4: The wire making up the filament held within the groove of the hook portion, wherein the hook has been further bent to likely grip the wire. The Figure shows the hook before and after bending.

Figure 5: Two figures showing the lifetimes of incandescent lamps. Figure 5a showing prior art lamps in which the filament is short-circuited; Figure 5b showing lamps in which the filament is appropriately held without short

circuit.

Detailed Description

[0025] As has been described above in relation to Figure 1, it is most undesirable for an incandescent lamp 1 to have a filament 30 poorly held by support wires 10. In particular, if the incandescent portions 32 of the filament 30 are in contact with the support wires 10, this leads to short circuiting between the incandescent portion 32 of the filament 30 and the support wire 10. In particular, this could lead to a short circuit across a variety of the coil windings 31 making up the incandescent portions 32 of the filament 30.

[0026] As can be seen in Figure 2, a properly held filament 30 according to the present disclosure is shown. In particular, it is quite clear that the incandescent portions 32 are well separated from the filament support wires 10. In this case, the filament 30 is provided by a filament wire 2 or coiled filament wire 3. It is well known in the art to use either a single filament wire 2 to make the filament 30 of an incandescent lamp 1, or to replace the single filament wire 2 with a coiled filament wire 3. A coiled filament wire 3, or primary oil 3, is a wire with a very tight coil, rather like a tightly wound spring, which is used as the wire for making up the filament 30. Indeed, a wide variety of wires are known in the art for the use in filament 30 in incandescent lamps 1, and the present disclosure is not limited in use to any particular one. The crucial aspect of the present disclosure being the positioning of the filament 30 in an accurate and desirable manner with respect to the lead wires 5 and the filament support wires 10.

[0027] As is common in incandescent lamps 1, two lead wires 5 are used as parts of the incandescent lamp 1 for providing current to the filament 30. These lead wires 5 pass through the relevant fitting of the incandescent lamp 1, and connect with the electricity supply of the lamp housing. Such lead wires 5 are well known in the art, and in the present disclosure are in no way limited to a specific form. Indeed, the lead wires 5 are used to connect to each end of the filament 30, such that a current can be passed through the filament 30. These can also comprise the same structure as described below for the filament support wires 10, in particular for holding the filament 30.

[0028] In many incandescent lamps 1, for example those shown in Figures 1 and 2, it is common that the filament 30 does not make a direct path between each of the lead wires 5. Instead, the filament 30 traverses a path between these two lead wires 5, and is held in this path by means of filament support wires 10. The filament support wires 10 are literally that, and generally are not used for providing any current to the filament 30. Indeed, the filament support wires 10 are generally wires which are held within the bulb of the incandescent lamp 1, and are electrically isolated from the electrical supply. In this manner, the filament support wires 10 can contact the filament 30 and are used to define the specific shape which the filament 30 makes within the incandescent lamp 1. In the case shown in Figures 1 and 2, the filament 30 forms a W path. That is, the filament 30 is held at each end by the two lead wires 5, and then at three roughly equidistant points along the filament 30 length they are held in position by the filament support wire 10. Obviously, the present disclosure is appropriate for any particular shape of filament 30 pattern, and is not limited to the W form shown in the figures.

[0029] As is common with filaments 30 which are to be structured in a held pattern within the incandescent lamp 1, the filament 30 is provided with a mix of wound sections, or windings 31, and skips 33. In the case of a single filament wire 2, the windings are simply sections of the filament 30 which are wound into a relatively tight spring-type coil, such that with current passing through the filament 30, these become hot and emit light. In the same way, if the filament 30 is made a primary coiled wire 3, the primary coil is made into at least one wound section 31, a secondary coil, and this secondary coil will also become hot with current passing through the filament 30 and will also emit light. This is well known in the art.

[0030] In order to be able to hold the filament 30 by means of filament support wires 10, the filament 30 has skips 33 between the wound sections 31. These skips 33 are not incandescent portions 32 like the windings 31. These skips 33 can be used as the points on the filament 30 for interacting with the filament support wires 10, thus holding the filament 30 in the appropriate manner and shape within the incandescent lamp 1. As will be clear to the skilled person, depending upon the desired shape of the filament 30 within the incandescent lamp 1, the number and positioning of the windings 31 and skips 33 will change accordingly. In the example given in Figures 1 and 2, four wound sections 31 are provided, and between these four wound sections 31 are three skips 33. As can also be seen in these figures, each of the three skips 33 is held in place by one of the three provided filament support wires 10.

[0031] In order to ensure that the filament 30 is appropriately positioned within the incandescent lamp 1, it is desirable that the skips 33 are properly held at the appropriate point by the filament support wire 10. It is not uncommon with prior known incandescent lamps of this sort, for the filament 30 to shift with relation to the filament support wires 10, such that the wound sections 31 (secondary coils) come into contact with the filament support wires 10. As has been described above, this leads to a dramatic reduction in the efficiency of the incandescent lamp 10, and also the lifetime of such. In the present disclosure, the filament support wires 10 are structured such that they will appropriately restrain the motion of the filament 30, without causing damage to the structure of the filament 30 and in particular the filament wire 2 or coiled filament wire 3.

[0032] As can be seen in Figure 3, wherein 3a shows a general view of a filament support wire 10 according to the present disclosure, the motion of the filament 30 with respect to the filament support wire 10 can be restrained by structuring the filament support wire 10 to have a groove 20. Generally, the filament support wire 10 is provided as an extended wire, which at one end is bent over to form a hook or hook portion 11. This hook 11 is used for holding the skip 33 of the filament 30, and allows for the filament 30 to be structured in the desired pattern. In the case of the incandescent lamp 1 shown in Figure 2, the two lower filament support wires, are provided with hook portions 11, which proceed to have an inner curve section 12 for holding the filament 30 in an upward orientation. That is, the wire extends upwards and then loops over and progresses generally downward to provide a simple hook portion 11 suitable for holding the filament 30 toward the lower part of the incandescent lamp 1. In the case of the hook portion 11 holding the middle section of the filament 30 as seen in Figure 2, this has a hooked portion 11 and an inner curved section 12 which progresses generally downward. That is, the filament support wire 10 progresses upward from the base of the incandescent lamp 1, is bent over a first time such that the wire heads generally downward. After this first bend in the filament support wire 10, the hooked portion 11 is formed, by bending the wire once more, so that the free end of the filament support wire 10 is again facing upward. This provides a hook portion 11 suitable for holding a middle section of the filament 30 up and away from the base of the incandescent lamp 1.

[0033] As is seen in Figure 3, the inner curved section 12 of the hook portion 11 is provided with a groove 20. The groove 20 is appropriately sized such that it will accommodate either the filament wire 2 or coiled filament wire 3 of the skip 33. This groove 20 passes all the way from one side to the other of the filament support wire 10 and may be at the inner apex 13, or approximately the inner apex 13, of the inner curved section 12. That is, the groove 20 is an extended indent in the inner side or portion of the hook portion 11, and is used to hold the filament wire or primary coil 3 in position. Because the groove 20 is approximately the same size as the filament wire 2 or primary coil 3, a good degree of friction exists which will tend to keep the portion of the filament 30 in place within the groove 20. That is, the close similarity in the sizes of the groove 20 and filament wire 2 or primary coil 3 making up the filament 30 will generally stop the filament 30, and in particular the skips 33 thereof, from slipping through the hook portion 11 of the filament support wire 10. Additionally, the hooks may be bent over, to decrease the width of the groove and fix the skipped sections of the filament.

[0034] Whilst it is has been found that the above structure shown in Figure 3 will advantageously stop the skips 33 of the filament 30 from slipping through the hook portions 11 of the filament support wire 10, it is also possible to affix the unwound sections 33 within the groove 20. For example, some form of heat resistant cement or glue can be used to properly fix the filament 30 with respect to the hook portion 11. Additionally, techniques such a welding (laser or plasma) or soldering of the filament within the groove 20 will also lead to the filament 30 not slipping with respect to the hook portion 11. Indeed, given the increased surface area of the groove 20 in contact with the skips 33 of the filament 30, a variety of techniques can be used for fixing the filament wire 2 or primary coil 3 with respect to the hook portion 11.

[0035] With regard to the size of the groove 20 within the filament support wire 10, this is determined by the choice of filament wire 10 or primary coiled wire 3 being used for the filament 30. In particular, it is expected that the size of the groove 20 will be very similar to the diameter of the filament wire 2 or primary coil 3. Indeed, if a groove 20 is being used which has a predominantly circular cross-section, the diameter of the groove 20 will be equal to the diameter of the filament wire 2 or primary coil 3 plus a value *x*. In this case, the value *x* lies between 5% and 20% of the diameter of the filament wire 2 or primary coil 3. More preferably, the value for *x* can lie between 7% and 15%, and more further preferably the value of *x* is 10%. Having the size of the groove 20 so close to the diameter of the filament wire 2 or primary coil 3, will lead to a good relative fixing of the filament 30 into the groove 20, which will generally stop the filament 30 from slipping through the groove 20 and also the hook portion 11 of the filament support wire 10.

[0036] It is conceivable that the cross-section of the groove 20 is not circular. That is, the cross-section could be formed as an oval or an ellipse. In this case, the ellipse or oval would be structured such that the shape of the groove 20 would be the broader, less curved, section of the oval or ellipse, rather than the longer more pointed section of the oval or ellipse. That is, the minor axis of the oval or ellipse would extend into the wire making up the filament support wire 10, and so the groove 20 would be wider and less deep than if a circular groove 20 were provided. In this case, the above relationship also applies, the relationship of the diameter of the groove 20 with regard to that of the filament wire 2 or primary coil 3, but in this case the minor axis of the oval or ellipse forming the groove 20 is used instead of the diameter of the circular groove 20.

[0037] It is also possible to determine the size of the groove 20 in the filament support wire 10 by consideration of the size of the wire making up the filament support wire 10. In particular, it is expected that the depth of the groove into the filament support wire 10 would be between 0.1 and 0.6 times the diameter of the filament support wire 10. In other words, the diameter of the circular groove or the minor axis of an oval or elliptical groove 20 lies between 0.1 and 0.6 times the diameter of the filament support wire 10. Preferably, this size lies between 0.27 and 0.45 times the diameter of the filament support wire 10, and further preferably the diameter of the circular groove 20 or semi-minor axis of an elliptical or oval groove 20 lies between 0.3 and 0.35 times the diameter of the filament support wire 10. The two determinations for the size of the groove 20 will preferably interact with each other, and further preferably inter-depend. That is, the size of the filament 30 will give rise to possible sizes of support wire 10.

[0038] These measurements relate to the size of the groove 20 in a filament support wire 10 wherein the hook portion 11 has been appropriately bent to form the hook portion 11, but is not bent further. As will be discussed below in relation to Figure 4, a further mechanism of fixing the filament 30 within the groove 20, is to position the skips 33 within the groove 20, and then to further bend the hook portion 11 such that the curvature of the hook portion 11 is tightened. As will be obvious to the skilled person, by further bending the hook portion 11, the size of the groove 20 will be reduced. If a filament wire or primary coil 3 is present in the groove 20 prior to the bending of the hook portion 11, the sides of the groove 20 will tend to grip or clamp the filament wire or primary coil 3. Indeed, the filament 30 can be held in this manner in a very convenient and repeatable manner, and as the size of the groove 20 will not change too dramatically, no damage is done to the filament wire 2 or primary coil 3 by such clamping.

[0039] As can be seen in Figure 4, a filament 30 has been positioned through the hook portion 11. In this figure, the skip 33 is appropriately located within the groove 20. In the first place, the skip 33 was placed within the groove 20 as shown in Figure 3, and thus the groove 20 was slightly larger than the size of the filament wire 2 or primary coil 3 making up the skip 33. In order to gently clamp the skip 33, the hook portion 11 has been further bent to tighten the curvature of the hook portion 11, and thus grip the skip 33 of the filament 30 within the groove 20. Figure 4 shows the hook portion 11 in the before and after bending state. As is further clear, as the groove 20 provides a generally thinner section to the filament support wire 10, bending of the hook portion 11 will proceed around the groove 20, and will thus repeatably and appropriately clamp the filament wire 2, or primary coil 3, of the skip 33. As will be clear, this system provides a simple and convenient mechanism for gripping the filament 30 at the appropriate point and holding this with relation to the filament support wire 10. As the skips 33 of the filament 30 will be fixed or clamped by means of the groove 20 at the filament support wire 10, the filament 30 will not slip with respect to the filament support wires 10, and thus short circuiting can be avoided as the wound sections 31 or secondary coils will not come into contact with the filament support wires 10.

[0040] In order to achieve this clamping by means of the hook portions 11 of the filament support wire 10, the filament support wire 10 may be made of an elastically deformable material. That is, the material making up the filament support wire 10 is desirably such that after bending the hook portion 11 so as to clamp the skips 33, the hook portion remains appropriately deformed, and so the clamping action also remains.

[0041] As has been discussed above, the mechanism and method of threading a filament 30 into such a structure provided in an incandescent lamp 1 is quite straightforward. The incandescent lamp 1 is provided with the lead wires 5 which will make electrical contact to the lamp housing (these can be structured in the same way as the support wires 10). Depending upon the desire shape of the filament 30, a variety of filament support wires 10 are also positioned within the bulb region 4 (not shown in the Figures) of the incandescent lamp 1. In the example shown in Figures 1 and 2, obviously three filament support wires 10 are provided, two lower wires 10 at either side of a central higher filament support wire 10. This will allow the filament 30 to be threaded into a W form, and thus will allow for four separate incandescent portions 32 formed by windings 31. The filament 30 is then attached at each end to the lead wires 5, and then the filament 30 is appropriately wound and connected between the three filament support wires 10. In this case, the filament 30 is obviously provided with three appropriately positioned skips 33, and these will be positioned within the hook portions 11. In particular, the skips 33 will each be positioned within the grooves 20 provided in each hook portion 11. This will then lead to a structure as shown in Figure 2.

[0042] Given that the size of the groove 20 is so close to that of the filament wire 2 or primary coil 3, the filament 30 is held in the appropriate position with regard to the filament support wires 10, and no slipping of the filament should occur. If the incandescent lamp 1 is to be used in a particularly unstable environment, it is possible at this stage to go about fixing the skips 33 within the grooves 20 of the hook portions 11. As has been discussed above, a variety of fixing techniques are well known, for example the use of a cement or glue, or by some form of heat resistant soldering or welding (laser or plasma). This will clearly stop any translation or motion between the filament 30 and the filament support wire 10, and in particular will stop the skips 33 from slipping through the groove 20 and avoid any short circuit.

[0043] A further technique for holding the filament 30 in the appropriate position with regard to the hook portions 11, is to thread the filament 30 as defined above. With the skips 33 within the grooves 20 of each of the filament support wires 10, the hook portions 11 can be further bent to tighten the loop of the hook portion 11. With this additional bending, the groove 20 will be reduced in size, and a clamping will be exerted on the filament wire 2 or coiled filament wire 3. This clamping force will be enough to stop translational motion and slipping of the filament 30 through the hook portion 11, and thus avoid any short circuits. This can be used instead of, or in addition to, the above fixing techniques (use of cement etc.)

[0044] As has been discussed above, the use of a groove 20 in a filament support wire 10 allows for the holding of a filament 30 in an incandescent lamp 1. Whether the skips 33 of the filament 30 are held in position by friction alone, or other means, the incandescent portions 32 provided by windings 31 (primary or secondary coils) can be held away from the filament support wires 10, thus stopping any short circuits.

[0045] Figure 5 shows two graphs of the lifetimes of incandescent lamps 1. In Figure 5a, we see six lamps have been graphed and these refer to known lamps as shown in Figure 1. In particular, in each of these lamps the incandescent portion 32 of the filament 30 is in contact in one or more places with the filament support wires 10. As can be seen from

this, the spread in lifetimes of the bulbs is very wide. Looking at Figure 5b by contrast, we have twelve lamps which have been produced according to the present disclosure, and are those shown in Figure 2. In these lamps, the incandescent portions 32 are not in contact with any of the filament support wires 10, and so no short circuiting occurs. As can be seen from Figure 5b, there is a dramatic improvement in the spread of the lifetime of the bulbs. In other words, structuring the incandescent lamp 1 such that the filament 30 suffers from no short circuits, leads to a dramatic improvement in the lifetime spread of incandescent lamps 1.

[0046] Whilst the above features for the incandescent lamp 1, filament support wire 10 and filament 30 have been presented, it is not intended that any specific combination of features is considered as preferable or disclosed. Indeed, the skilled person would be well aware that each of the aspects defined above relating to the filament support wire 10, groove 20 and filament 30 can be interchanged in a variety of different manners, in order to form the desired filament 30 structure for an incandescent lamp 1.

1: Incandescent lamp
2: Filament wire
3: Primary coil
4: Bulb (Not shown in Figures)
5: Lead wires
10: Filament support wires
11: Hook portion
12: Inner curved section
13: Inner apex
20: Groove
30: Filament
31: Windings
32: Incandescent portion
33: Skips
34: Holding portions.

Claims

1. A filament support wire (10) for an incandescent and/or halogen lamp (1), wherein one end of the filament support wire (10) is looped over to form a hook portion (11), wherein
the inner curved section (12) of the hook portion (11) is provided with a groove (20) which runs parallel with the normal to the plane defined by the hook portion (11) and filament support wire (10), and wherein further
the groove (20) is approximately the same size as the filament wire or primary coil (3) making up the incandescent filament of the incandescent lamp (1).

2. The filament support wire (10) according to claim 1, wherein the groove (20) is provided at the inner apex (13) of the hook portion (11).

3. The filament support wire (10) according to either of claims 1 or 2, wherein the groove (20) is either circular or oval or elliptical in cross section, wherein
when the groove (20) is oval or elliptical in cross section, the oval or elliptical cross section is preferably aligned along the axis of the groove (20) such that one of the sides of lower curvature defines the shape of the groove (20) within the filament support wire (10).

4. The filament support wire (10) of any one of the preceding claims, wherein the diameter of the circular groove (20), or the minor axis of the oval or elliptical groove (20), is equal to the diameter of the filament wire or the primary coil (3) plus *x*,
wherein *x* lies between 5% to 20% of the primary coil diameter, more preferably x lies between 7% and 15% and even more preferably x is equal to 10%.

5. The filament support wire (10) of any one of the preceding claims, wherein the diameter of the circular groove (20), or the minor axis of the oval or elliptical groove (20), is between 0.1 and 0.6 times the diameter of the filament support wire (10), preferably
the diameter of the circular groove (20), or the minor axis of the oval or elliptical groove (20), is between 0.27 and 0.45 times the diameter of the filament support wire (10), further preferably

the diameter of the circular groove (20), or the minor axis of the oval or elliptical groove (20), is between 0.3 and 0.35 times the diameter of the filament support wire (10).

6. The filament support wire (10) of any one of the preceding claims, wherein the filament support wire (10) is made from an deformable material, such that when the filament wire (2) or primary coil (3) is placed within the groove (20), the hook portion (11) can be bent further round and the groove (20) will become smaller thus gripping and clamping the filament wire (2) or primary coil (3).

7. An incandescent lamp (1) comprising a bulb (4) for housing an electrically connected filament (30), the filament (30) electrically connected at each end to lead wires (5) for supplying electrical current to the filament (30), wherein the filament (30) passes through at least one filament support wire (10) according to any one of the previous claims, and is fixed by means of the groove (20).

8. The incandescent lamp (1) according to claim 7, wherein the filament is provided by a single filament wire (2) or primary coil (3) which comprises windings (31) making up one or more incandescent portions (32) of the filament (30), and one or more skips (33) making up non-incandescent and
holding portions (34), wherein the holding portions (34) are clamped by means of the groove (20).

9. The incandescent lamp (1) of either of claims 7 or 8, wherein the filament (30) is shaped as one of the following: a W; or a V; or an N; or an M; or a A, and the filament support wires (10) are provided at each of the bends therein.

10. The incandescent lamp (1) of any one of claims 7 to 9, wherein the filament (30) is held in the groove (20) by threading the filament (30) through the hook portion (11), and into the groove (20), and then by bending the hook portion (11) further round such that the groove (20) portion preferentially bends and grips or clamps the filament (30).

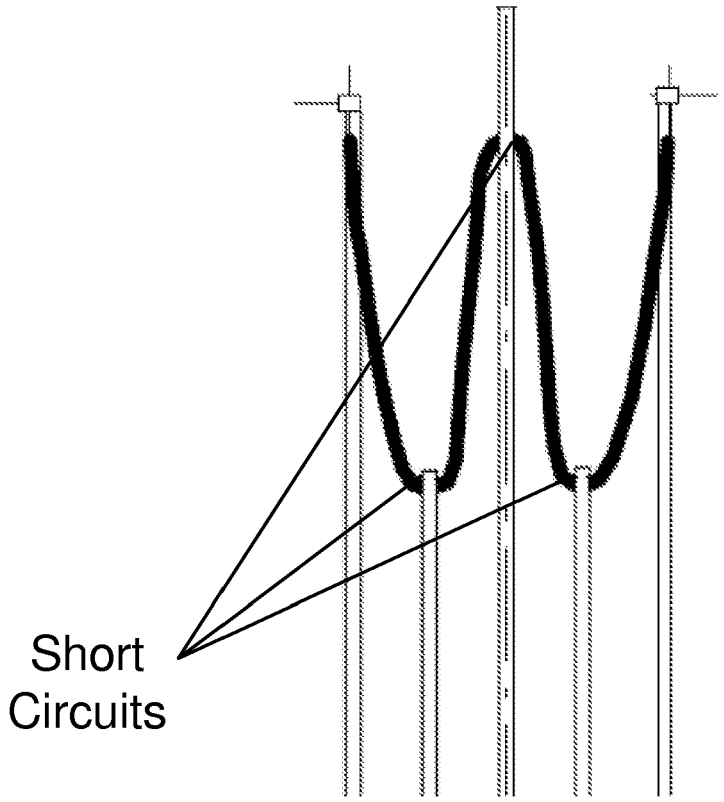
11. A method of providing a connected filament (30) for an incandescent or halogen lamp (1), comprising the steps:

connecting the two ends of the filament (30) to two lead wires (5), wherein the lead wires (5) are for providing the electrical current to the filament (30);
providing one or more filament support wires (10) according to any one of the preceding claims;
positioning the filament (30) in the hook portion (11) and fixing the filament (30) into position by locating the filament (30) into the groove (20).

12. The method according to claim 11, wherein the fixing of the filament (30) is achieved by positioning the filament (30) within the groove (20) in the filament support wire (10), and then further bending the hook portion (11) round to further close the gap (14) between the hook portion (11) and the filament support wire (10), thus causing the groove (20) to close and clamp the filament (30).

13. The method according to either of claims 11 or 12, wherein the fixing of the filament (30) is achieved by positioning the filament (30) within the groove (20) in the filament support wire (10), and then attaching this filament to the groove by fixing means, these preferably comprising one or more of a cement, glue, welding, soldering, laser welding, plasma welding.

14. The method according to any one of claims 11 to 13, wherein the filament (30) comprises a single filament wire or a primary coil (3), and further the filament (30) has additional windings (31) making up one or more incandescent portions (32) with at least one skip (33) there-between making up a non-incandescent portion holding portion (34), and the filament (30) is located such that the holding portions (34) are located in the grooves (20) of the one or more filament support wires (10).



Prior Art

Figure 1

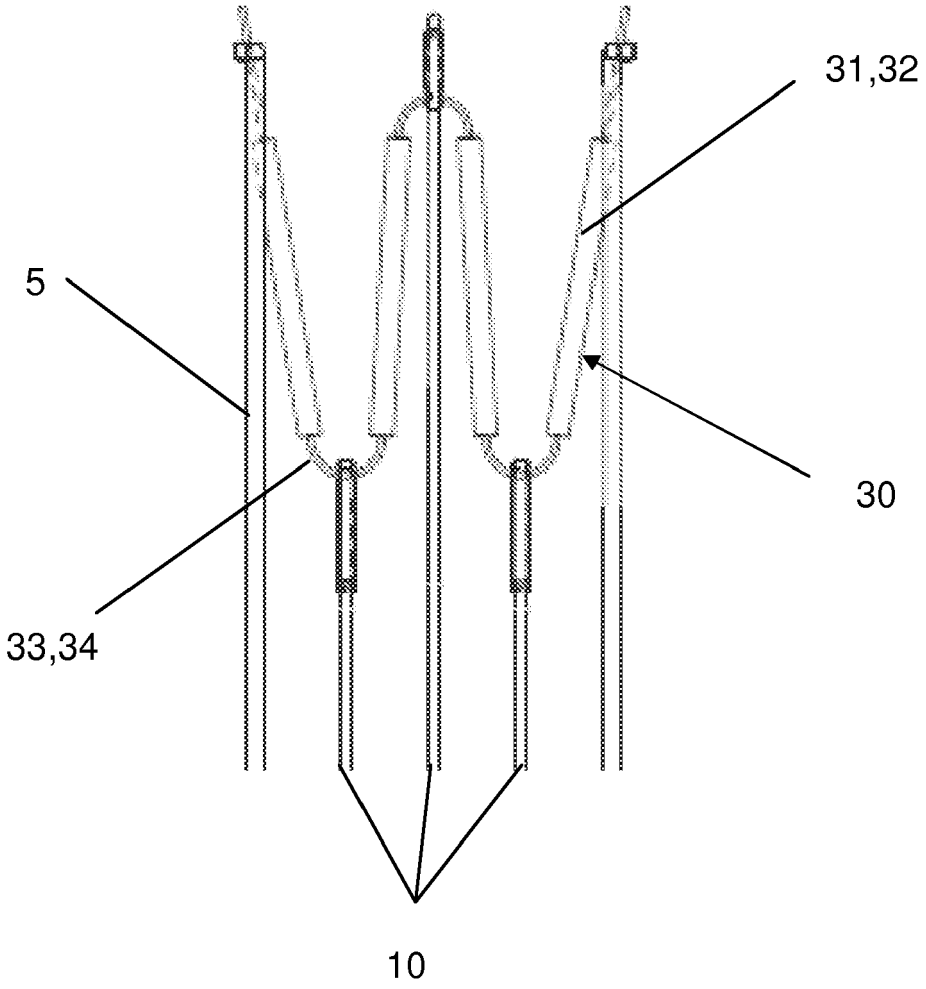


Figure 2

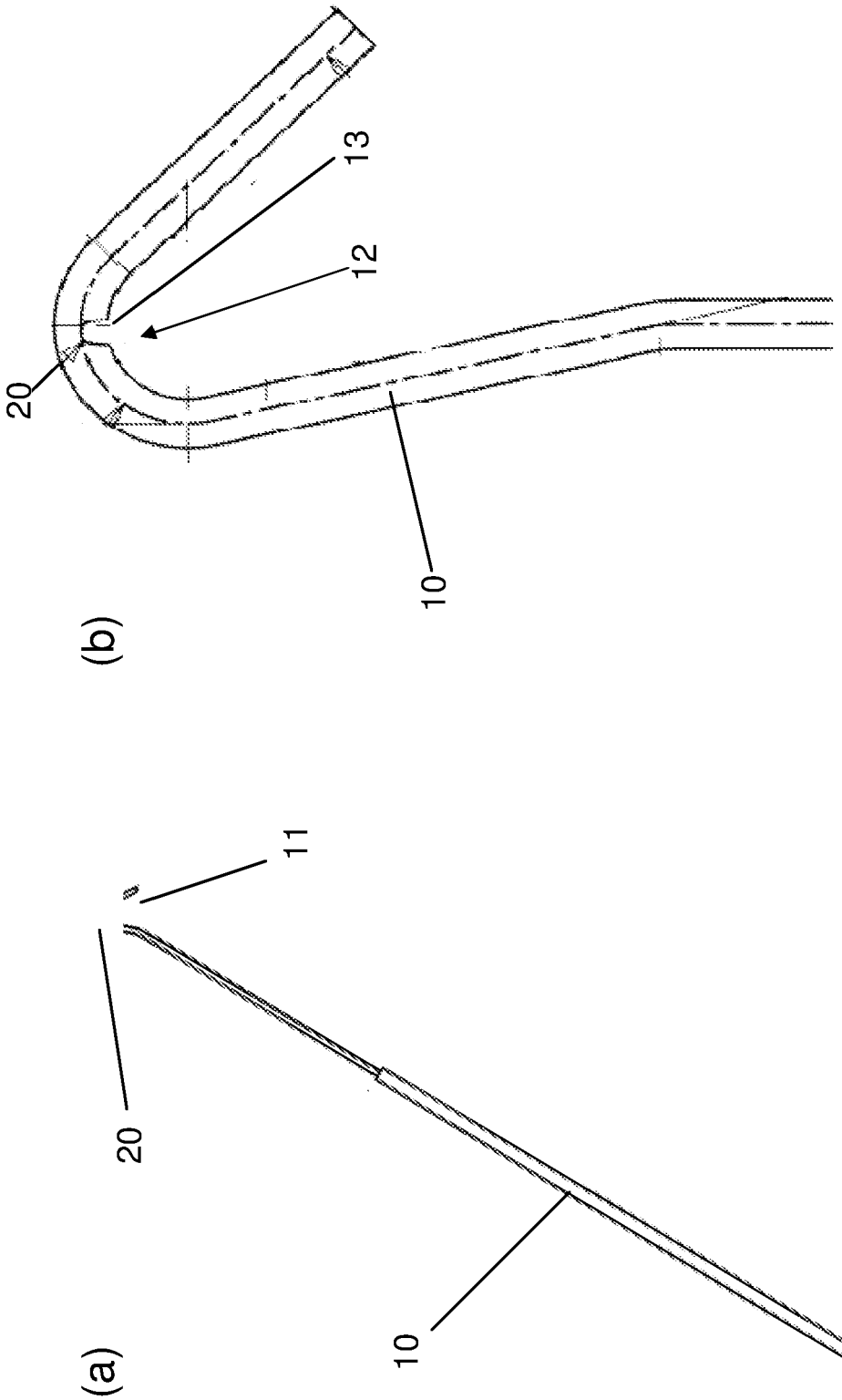


Figure 3

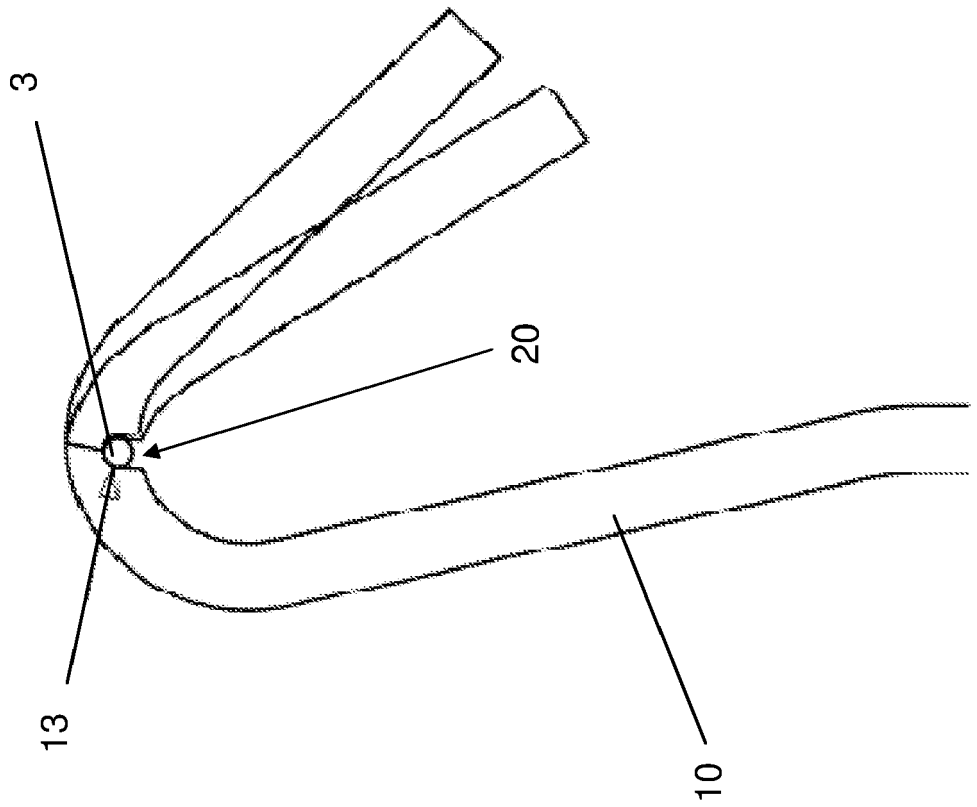
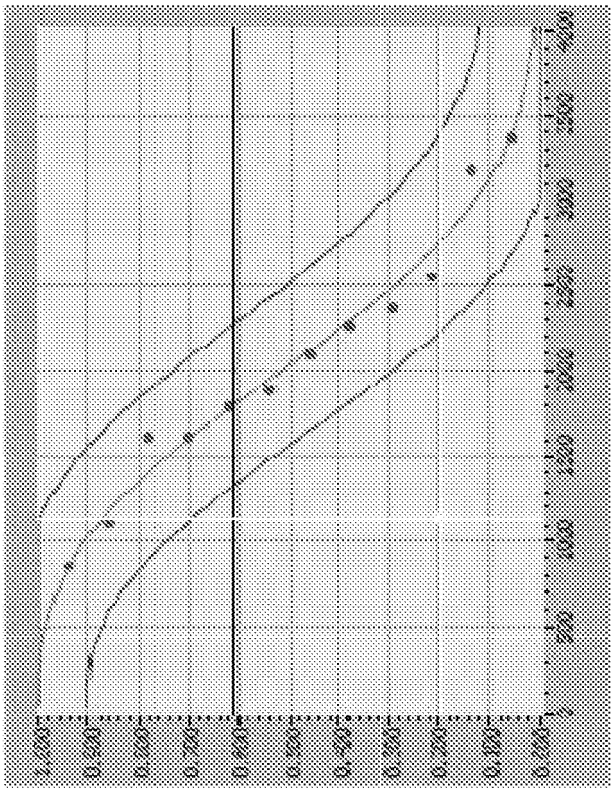
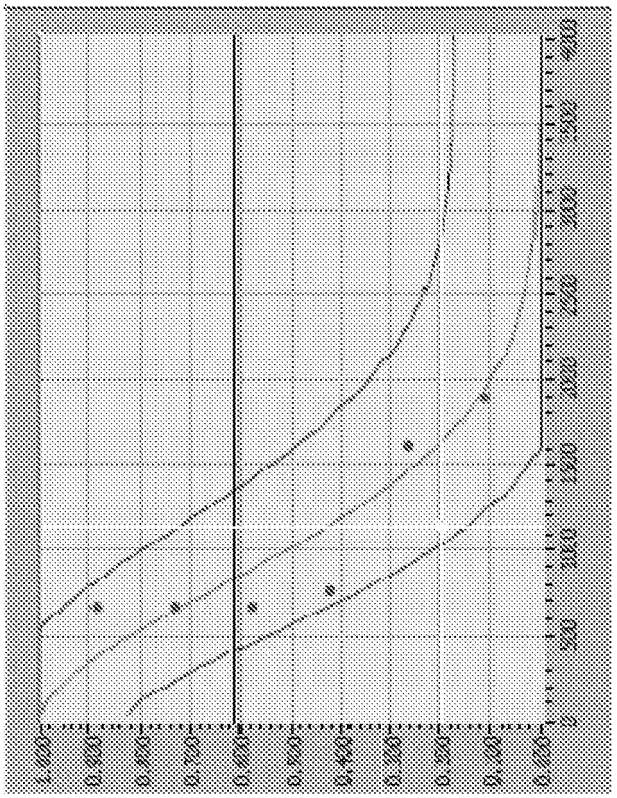


Figure 4



(b)



(a)

Figure 5

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EUROPEAN SEARCH REPORT

Application Number
EP 08 17 2807

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	15 October 2009	But, Gabriela-Ileana

CATEGORY OF CITED DOCUMENTS

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REFERENCES CITED IN THE DESCRIPTION

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