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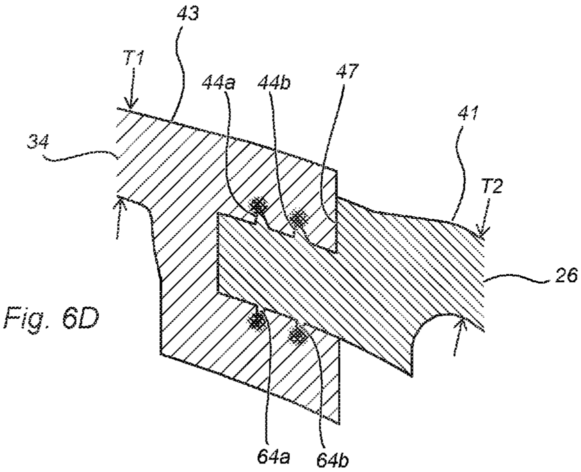

Fig. 6D

(57) Abstract: A method of producing a plastic tank for a power tool comprises: providing a moulding tool comprising a transparent inspection window (26); injecting liquefied plastic onto the moulding tool to form a tank wall (34), the liquefied plastic engaging with said inspection window (26) at an over-moulding interface; and allowing the injected plastic to solidify, thereby forming a bond with said inspection window (26), wherein said inspection window (26) comprises at least one liquefaction precursor ridge (44a, 44b, 64a, 64b) extending from a face of the inspection window (26) along the over-moulding interface, wherein said liquefied plastic is injected onto said over- moulding interface to at least partly liquefy said liquefaction precursor ridge (44a, 44b, 64a, 64b).

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INJECTION MOLDING METHOD OF PRODUCING A PLASTIC TANK WITH AN INTEGRATED INSPECTION WINDOW, A PLASTIC TANK, AND A POWER TOOL COMPRISING SUCH A PLASTIC TANK

Field of the invention

The present invention relates to a method of producing a plastic tank for a power tool, to a plastic tank, and to a power tool comprising such a plastic tank.

Background

Modern-day fuel tanks for handheld power tools are made of plastic. There are many different requirements on fuel tanks. By way of example, they need to be mechanically strong, and allow easy refilling and inspection of present fuel level. Fuel tanks also need to fulfil a number of safety standards; by way of example, they need to be leakage proof at an elevated pressure. The gas pressure may differ quite substantially between the interior of the tank and the exterior ambient air pressure; in some situations, the difference may be as high as 30-40 kPa.

Typically, the present fuel level is communicated to the operator via a transparent fuel level inspection window. The tank body is generally made of glass- or carbon fibre reinforced plastic, for mechanical strength, whereas the fuel window is made of transparent plastic. Transparent fuel level inspection windows are generally attached to the fuel tank by ultrasonic welding. In order to warrant that the window be fuel-tight, the window is kept as small as possible, and it is welded to the tank along a weld which extends substantially in a single plane. Those limitations are primarily set by the size and shape of the ultrasonic welding sonotrode, which needs to define a waveguide suitable for delivery of welding power to the entire interface between tank body and window in a single welding step. A drawback of those limitations is that lighting conditions and the posture of the handheld power tool may limit the visibility of the fuel level.

US 2008/0087080 discloses a method of manufacturing a fuel tank. However, there is a need for an improved fuel tank, as well as for an improved method of producing such tanks.

Summary

It is an object of the present invention to solve, or at least mitigate, parts or all of the above mentioned problems. To this end, there is provided a method of producing a plastic tank for a power tool, the tank comprising a tank wall and a transparent or translucent inspection window arranged in a window aperture in the

tank wall, the inspection window permitting visually inspecting a content level in the tank, the method comprising providing a moulding tool comprising one of the tank wall and the inspection window; injecting liquefied plastic onto the moulding tool to form the other of the tank wall and the inspection window, the liquefied plastic engaging with said one of the tank wall and the inspection window at an over-moulding interface of said one of the tank wall and the inspection window; and allowing the injected plastic to solidify, thereby forming a bond with said one of the tank wall and the inspection window, characterized in that said one of the tank wall and the inspection window comprises at least one liquefaction precursor ridge extending from a face of said one of the tank wall and the inspection window, along the over-moulding interface, wherein said liquefied plastic is injected onto said over-moulding interface to at least partly liquefy said liquefaction precursor ridge. The dimensions of the liquefaction precursor ridge may allow the liquefaction precursor ridge to liquefy, heated by the injected plastic, thereby enabling intermixing of the materials of the tank wall and the inspection window along the liquefaction precursor ridge. This results in an interface between the tank wall and the inspection window with a high mechanical strength and a good tightness against leakage. Such liquid tightness is particularly desirable for tanks containing combustible, volatile liquids such as chainsaw fuel. Liquefaction may be the result of e.g. melting or passing the glass transition temperature. It may be preferred that at least the liquefaction precursor ridge, and optionally said one of the tank wall and the inspection window in its entirety, be thermoplastic. However, the process provides improved tightness also for moulding thermoset resins, in particular in combination with short cycle times between consecutive moulding shots building up the tank. According to embodiments, the over-moulding interface may extend along an edge of the inspection window or of the window aperture. Alternatively, the over-moulding interface may be located at a distance from any edge of said one of the tank wall and the inspection window. The method gives a full design freedom with regard to the placement, size, and shape of the inspection window within the tank wall, which allows designing a tank which facilitates checking the liquid content level. The tank wall may be opaque; alternatively, it may be translucent or transparent. According to embodiments, the power tool may be a handheld power tool. The power tool may be portable, to be carried by one or two hands by an operator during operation, or wheeled, to be rolled on the ground by an operator during operation. The power tool may be an outdoor power tool, such as a garden or forestry tool.

According to embodiments, said one of the tank wall and the inspection window may be the inspection window. Obviously, in such an embodiment, said other of the tank wall and the inspection window is the tank wall. In an alternative embodiment, said one of the tank wall and the inspection window may be the tank wall, and said other of the tank wall and the inspection window may be the inspection window.

According to embodiments, said at least one liquefaction precursor ridge may define a closed loop about the inspection window or window aperture. Thereby, an increased liquid tightness may be obtained.

According to embodiments, said at least one liquefaction precursor ridge may be continuous. Thereby, an increased liquid tightness may be obtained. Alternatively, the ridge may be intermittent. By way of example, it may be formed by a row of closely spaced liquefaction precursor protrusions.

According to embodiments, said at least one liquefaction precursor ridge may comprise a plurality of liquefaction precursor ridges. Having more than one liquefaction precursor ridge reduces the risk that any defect in a single liquefaction precursor ridge may result in leakage. By way of example, the over-moulding interface may be provided with two, three, four, five or six liquefaction precursor ridges.

According to embodiments, said plurality of liquefaction precursor ridges may comprise a first set of ridges on a first side of said one of the tank wall and the inspection window, and a second set of ridges on a second side of said one of the tank wall and the inspection window, said second side being opposite to said first side. Said first and second sides may correspond to the inside and outside faces of the tank. Each set of ridges may comprise one, two, three, or more liquefaction precursor ridges.

According to embodiments, said second side may face towards an interior of the tank, and said first side may face towards an exterior of the tank. Such an arrangement increases the liquid tightness of the tank to a similar extent regardless of whether the tank holds an overpressure or an underpressure compared to the exterior, ambient pressure. According to embodiments, the faces carrying the ridges on said first and second sides may locally be substantially parallel to the plane of the tank wall adjacent to the over-moulding interface.

According to embodiments, injecting liquefied plastic onto the moulding tool to form the other of the tank wall and the inspection window may comprise allowing the liquefied plastic to flow onto a moulding tool having a moulding surface which is, at the over-moulding interface, substantially in register with an outer face of said one of the tank wall and the inspection window, such that an outer face of the tank wall becomes substantially in register with an outer face of the inspection window at the over-moulding interface. Such an arrangement makes the inspection window less prone to collect dirt, such as saw-dust, thereby facilitating inspection. Said moulding surface may be, at the over-moulding interface, substantially flush with the outer face of said one of the tank wall and the inspection window, such that the interface between the outer face of the tank wall and the outer face of the inspection window will be substantially free from steps.

According to embodiments, said over-moulding interface may comprise an outer over-moulding interface portion which faces towards an exterior of the tank, and which is offset towards an interior of the tank compared to an outer face of said one of the tank wall and the inspection window adjacent to the over-moulding interface. Thereby, the over-moulding may bring the outer face of the tank wall in relatively close alignment with the outer face of the inspection window. The over-moulding interface portion which faces towards an exterior of the tank may comprise one or more liquefaction precursor ridges as defined above.

According to embodiments, the tank wall and the inspection window may be joined in a tongue-and-groove joint, wherein said over-moulding interface of said one of the tank wall and the inspection window forms a tongue of said tongue-and-groove joint, and wherein said other of the tank wall and the inspection window is over-moulded onto said tongue to form a groove of said tongue-and-groove joint, said groove enclosing said at least one liquefaction precursor ridge. The method may further comprise shrinking, during solidifying, of said other of the tank wall and the inspection window. Thereby, a particularly liquid-tight joint may be obtained.

According to embodiments, said tongue may locally extend substantially parallel to the tank wall adjacent to said tongue-and-groove joint. Thereby, a similar tank tightness may be obtained regardless of whether the tank holds an overpressure or an underpressure. Moreover, a comparatively wide over-moulding interface may be employed without causing any substantial ridges around the tank window, which may further increase liquid tightness and/or reduce the inspection window’s proneness to accumulate dirt. Here, the term “locally” should be construed as each section of the tongue being substantially parallel to its nearest portion of the tank wall.

According to embodiments, the inspection window may have a substantially convex outer face and a substantially concave inner face. Such a shape is particularly well suited for handling a high interior pressure with a maintained liquid-tightness.

According to embodiments, providing a moulding tool comprising said one of the tank wall and the inspection window may comprise injecting liquefied plastic onto said moulding tool to form said one of the tank wall and the inspection window. Such an arrangement makes production simple and fast. According to an embodiment, the moulding tool may be rotated between different respective injection nozzles for injecting the respective materials for said one and other of the tank wall and the inspection window. As an alternative to moulding said one of the tank wall and the inspection window in the same moulding tool, said one of the tank wall and the inspection window can be manufactured in another tool, or using any other method, prior to being moved to said moulding tool for moulding said other of the tank wall and the inspection window.

According to embodiments, providing a moulding tool comprising one of the tank wall and the inspection window may further comprise retracting, after having formed said one of the tank wall and the inspection window, at least one core of said moulding tool to expose at least a portion of said over-moulding interface. Thereby, said other of the tank wall and the inspection window may more easily be allowed to over-mould said over-moulding interface on two opposite sides, to form a tongue-and-groove joint.

According to embodiments, said at least one liquefaction precursor ridge may extend from said face of said one of the tank wall and the inspection window to a ridge height above said face of between 0,1 mm and 1 mm. Thereby, a high degree of intermixing of the materials of the tank wall and the inspection window along the liquefaction precursor ridge is warranted. According to further embodiments, said at least one liquefaction precursor ridge extends from said face of said one of the tank wall and the inspection window to a ridge height above said face of between 0,2 mm and 0,6 mm.

According to embodiments, said at least one liquefaction precursor ridge, as seen in a cross-section perpendicular to a path followed by said ridge, may have a width, at half its height above said face of said one of the tank wall and the inspection window, of less than 0,3 mm. Thereby, a high degree of intermixing of the materials of the tank wall and the inspection window along the liquefaction precursor ridge is warranted. According to further embodiments, said ridge has a width, at half its height above said face of said one of the tank wall and the inspection window, of less than 0,2 mm.

According to embodiments, said tank wall may have a wall thickness of between 1 mm and 3 mm. Alternatively or additionally, the inspection window may have a thickness of between 1 mm and 3 mm. A ratio between the ridge height and the tank wall thickness and/or the inspection window thickness may, by way of example, be between 1:1,5 and 1:10.

According to embodiments, said at least one liquefaction precursor ridge, as seen in a cross-section perpendicular to a path followed by said ridge, may have a ridge top forming an acute angle. Thereby, a high degree of intermixing of the materials of the tank wall and the inspection window along the liquefaction precursor ridge is warranted. According to further embodiments, said ridge top forms an angle of less than 70 degrees, less than 50 degrees, or between 20 and 40 degrees. According to some embodiments, the ridge may have a triangular shape as seen in cross-section.

According to embodiments, the tank wall and the inspection window may be formed of thermoplastic materials having substantially the same glass transition temperature. According to embodiments, the tank wall and the inspection window may be formed of the same base polymer, and differ only in dye content and, optionally, any other filler materials such as fiber reinforcement etc. Typically, the material of the tank wall may be reinforced by e.g. glass or carbon fibre, whereas the material of the inspection window may be substantially non-reinforced. The base polymers may be semi-crystalline. According to other embodiments, said other of the tank wall and the inspection window may be formed of a non-thermoplastic polymer, and may, after having been injected, cure e.g. through cross-linking.

According to an example, at least one of the tank wall and inspection window, and optionally both, may be made of polyamide, such as polyamide 6. The tank wall may, for example, be made of a polyamide 6 comprising 15% by weight of glass reinforcement, such as glass fibre. An exemplary suitable temperature of the liquefied plastic during injection moulding may typically be between 200 °C and 300 °C and, for the specific example of polyamide 6, between 230 °C and 285 °C. An exemplary suitable temperature of the moulding tool during injection moulding may be between 40 °C and 100 °C.

According to a second aspect, parts or all of the above mentioned problems are solved, or at least mitigated, by a plastic tank obtainable by any of the methods defined above.

According to a third aspect, parts or all of the above mentioned problems are solved, or at least mitigated, by a power tool comprising the plastic tank obtainable by any of the methods defined above. The power tool may be handheld power tool such as a chainsaw, and/or the tank may be a fuel tank for holding fuel for a combustion engine of the power tool.

According to a fourth aspect, parts or all of the above mentioned problems are solved, or at least mitigated, by power tool tank comprising a tank wall and a transparent or translucent inspection window arranged in a window aperture in the tank wall, the inspection window permitting visually inspecting a liquid content level in the tank, the tank wall and inspection window being moulded together along a moulding interface, the moulding interface comprising a ridge of one of the tank wall and the inspection window blending into the material of the other of the tank wall and the inspection window.

It is noted that embodiments of the invention may be embodied by all possible combinations of features recited in the claims. Further, it will be appreciated that the various embodiments described for the methods are all combinable with the devices as defined in accordance with the second, third and fourth aspects of the present invention, and vice versa.

Moreover, the methods may be used for producing tanks for other applications than power tools. Hence, according to an even further aspect, and to pave the way for any further patent applications to be divided herefrom, there is provided a method of producing a plastic tank, the tank comprising a first tank wall portion and a second tank wall portion, the method comprising providing a moulding tool comprising the first tank wall portion; injecting liquefied plastic into the moulding tool to form the second tank wall portion, the liquefied plastic engaging with said first tank wall portion at an over-moulding interface of said first tank wall portion; and allowing the injected plastic to cool and solidify, thereby forming a bond with said first tank wall portion, wherein said first tank wall portion comprises at least one liquefaction precursor ridge extending from a face of said first tank wall portion, along the over-moulding interface, wherein said liquefied plastic is injected onto said over-moulding interface to at least partly liquefy said liquefaction precursor ridge. The method is combinable with any of the embodiments defined above with reference to the first aspect, wherein the first tank wall portion corresponds to said one of the tank wall and the inspection window, and the second tank wall portion corresponds to said other of the tank wall and the inspection window.

Brief description of the drawings

The above, as well as additional objects, features and advantages of the present invention, will be better understood through the following illustrative and non-limiting detailed description of preferred embodiments of the present invention, with reference to the appended drawings, where the same reference numerals will be used for similar elements, wherein:

Fig. 1 is a diagrammatic view in perspective of a chainsaw;

Fig. 2 is a side view of a tank half of the chainsaw of Fig. 1;

Fig. 3A is a perspective view of a fuel inspection window of the tank half of Fig. 2;

Fig. 3B is a perspective view of the tank half of Fig. 2, with the fuel inspection window of Fig. 3A positioned therein;

Fig. 4A is a schematic illustration of an equipment for two-shot injection moulding of the tank half of Fig. 3B, wherein the equipment is illustrated during a first process step;

Fig. 4A is a schematic illustration of an equipment for two-shot injection moulding of the tank half of Fig. 3B, wherein the equipment is illustrated in a first position;

Fig. 4B is a schematic illustration of the equipment of Fig. 4A in a second position;

Fig. 4C is a schematic illustration of the equipment of Fig. 4A in a third position;

Fig. 4B is a schematic illustration of the equipment of Fig. 4A in a fourth position;

Fig. 5A is a plan view of the fuel inspection window of Fig. 3A;

Fig. 5B illustrates a section along the line B-B of Fig. 5A;

Fig. 5C is a magnified view of a portion of the section of Fig. 5B;

Fig. 6A is a second side view of the tank half of Fig. 1;

Fig. 6B illustrates a section along the line B-B of Fig. 6A;

Fig. 6C is a magnified view of a portion of the section of Fig. 6B;

Fig. 6D is a magnified view of a portion of the magnified view of Fig. 6C;

Fig. 7A illustrates an alternative embodiment of a section along the line B-B of Fig. 6A;

Fig. 7B is a magnified view of a portion of the section of Fig. 7A; and

Fig. 8 is a flow chart illustrating a method of producing the tank half of Fig. 2.

All the figures are schematic, not necessarily to scale, and generally only show parts which are necessary in order to elucidate the embodiments, wherein other parts may be omitted.

Detailed description of the exemplary embodiments

Fig. 1 illustrates a power tool embodied as a handheld chainsaw 10. The chainsaw 10 comprises an internal combustion engine 12 configured to rotate a saw chain 14 about a guide bar 16. A fuel tank 18 of the chainsaw 10 is configured to hold fuel to be burnt in the internal combustion engine 12, which is typically a two-stroke engine, and a saw chain oil tank 20 is configured to hold saw chain oil to lubricate the saw chain 14 as it moves along the guide bar 16. The fuel tank 18 is integrally formed with a rear handle 22 of the chainsaw 10, and comprises two opaque, plastic tank halves 18a, 18b, which are fused together along a joint 24. A first tank half 18a of the tank halves 18a is provided with a transparent fuel inspection window 26, which is integrally formed with the tank half 18a in a manner which will be described in greater detail in the following. The chainsaw 10 further comprises a front handle 28, and the rear handle 22 is provided with a trigger 30 for controlling the internal combustion engine 12.

Fig. 2 illustrates the first tank half 18a as seen from its inside. The tank half is integrally formed with a rear handle portion 22a and a front bottom plate 32 of the chainsaw 10 (Fig. 1). A tank wall 34, which defines the actual fuel container wall of the tank half 18a, is provided with a refilling opening 36, which in the view of Fig. 1 is closed by a tank refill cap 38. The view of Fig. 2 also illustrates the inspection window 26, which is joined with the tank wall 34 along an attachment edge 40 extending about the inspection window 26.

The perspective views of Fig. 3A and 3B illustrate the inspection window 26, along with its position in an inspection window aperture 27 in the tank half 18a, in greater detail. The inspection window 26 comprises a transparent inspection area 42, which is enclosed by the attachment edge 40. The inspection area 42 rises above the attachment edge 40 such that the outer face 41 of the inspection area 42 is substantially flush with the outer face 43 of the tank wall 34. Two outer liquefaction precursor ridges 44a, 44b, the function of which will be elucidated further below, extend along the attachment edge 40 to define a closed loop about the inspection area 42.

Figs 4A-D schematically illustrate a method of producing the tank half 18a of Figs 1, 2, 3A and 3B by means of two-shot injection moulding. Starting with Fig. 4A, a moulding equipment 46 comprises a first resin injector 48a connected to inject resin into a first injection mould 50a, and a second resin injector 48b connected to inject resin into a second injection mould 50b. An ejector mould support 52 holds a first ejector mould 54a in a first ejector mould position and a second ejector mould 54b in a second mould position. For simplicity, only the first ejector mould 54a will be described in detail, and it will be appreciated that the second ejector mould 54b may be identical, or even left out. The ejector mould support 52 is translatable along an axis A between the position illustrated in Fig. 4A, in which mould cavities are open, and the position in Fig. 4B, in which mould cavities are closed. Moreover, the ejector mould support 52 is rotatable about the axis A such that the first ejector moulds 54a and 54b can change places with each other. Each ejector mould 54a, 54b comprises a respective fixed ejector mould portion 56, which is held in a static position relative to the ejector mould support 52, and a respective retracting core 58, which is retractable into the ejector mould support 52 to change the shape of the respective ejector mould 54a, 54b. The first ejector mould 54a is illustrated with the core 58 in a non-retracted position, whereas the second ejector mould 54b is illustrated with the core in a retracted position.

Fig. 4B illustrates a first moulding shot. In the position of Fig. 4B, the first moulds 50a, 54a have been closed to define a first moulding cavity 60, and the first resin injector 48a injects a first composition 49a of liquefied, transparent thermoplastic resin into the first moulding cavity 60 to form the inspection window 26. The inspection window 26 is allowed to cool and solidify before opening the mould.

Fig. 4C illustrates the moulding equipment 46 after having opened the moulding cavity 60 (Fig. 4B) and rotated the first ejector mould 54a to the second mould position previously held by the second ejector mould 54b. Moreover, the core 58 has been retracted to expose two opposite sides the attachment edge 40 of the inspection window 26. Thereby, the attachment edge 40 forms a double-sided over-moulding interface for the next moulding shot, which is illustrated in Fig. 4D.

In the view of Fig. 4D, the second injection mould 50b and the first ejector mould 54a have been closed to define a second moulding cavity 62, and the second resin injector 48b injects a second composition 49b of liquefied, fibre-reinforced, opaque thermoplastic resin into the second moulding cavity 62 to form the tank wall 34. As illustrated, the first resin injector 48a, and injection mould 50a can be used with the second ejector mould 54b for forming the next inspection window in the same step. After having over-moulded the tank wall 34 onto the inspection window 26, and allowed the composite tank half thus formed to cool and solidify, the tank half is removed from the equipment 46.

Fig. 5A illustrates the inspection window 26 prior to the over-moulding step of Fig. 4D, Fig. 5B is a magnified view of the cross-section B-B of the inspection window 26 illustrated in Fig. 5A, and Fig. 5C is an even further magnification of the view of Fig. 5B. Staring with the view of Fig. 5B, the outer face 41 of the inspection area 42 is slightly convex, whereas the inner face 45 of the inspection window 26 is concave to a corresponding degree. As has been described hereinabove, the outer face 41 of the inspection area 42 rises above the outer face 63 of the attachment edge 40 in an outwards direction, away from the interior of the tank 18 (Fig. 1). More specifically, the outer face 63 of the attachment edge 40 is offset towards the interior of the tank 18, compared to the outer face 41 of the inspection area 42, by an offset step 47. The inner face of the inspection window 26 presents a corresponding offset 49, such that a substantially uniform thickness of the inspection window 26 is obtained over the inspection area 42. A first set 44 of liquefaction precursor ridges 44a, 44b extend from the outer face 63 of the attachment edge 40, and rise above the face 63 of the attachment edge 40 in substantially the same direction as a surface normal of the outer face of the inspection area 42. A second set 64 of liquefaction precursor ridges 64a, 64b extend from an inner face 65 of the attachment edge 40, wherein the directions outer and inner should be construed in relation to the exterior and interior of the tank 18 (Fig. 1). In the second moulding shot illustrated in Fig. 4D, the attachment edge 40 is over-moulded on two opposite sides, to cover both sets 44, 64 of liquefaction precursor ridges, thereby forming a tongue-and-groove joint. Upon over-moulding, the second composition of resin is injected onto the over-moulding interface to at least partly melt the liquefaction precursor ridges 44, 64, thereby enabling intermixing of the materials of the tank wall 34 (Fig. 1) and the inspection window 26 along the liquefaction precursor ridges 44, 64. This results in an interface between the tank wall and the inspection window with a high mechanical strength and a good tightness against leakage. The magnified view of Fig. 5C illustrates a liquefaction precursor ridge 44a in greater detail. The liquefaction precursor ridge 44a extends from the outer face 63 of the attachment edge 40 (Fig. 5B) to a ridge height H of about 0,4 mm, and forms an acute top angle α of about 35°. At half its height H, the liquefaction precursor ridge 44a has a width W of about 0,13 mm.

Fig. 6A illustrates the first tank half 18a after the second moulding shot of Fig. 4D, and Fig. 6B illustrates the section B-B of Fig. 6A. Fig. 6C is a magnification of a portion of the view of Fig. 6B, and Fig. 6D is an even further magnification of a portion of the view of Fig. 6C. As is illustrated in Fig. 6C, the attachment edge 40 of the inspection window 26 forms a tongue, and the tank wall 34 forms a groove, of a tongue-and-groove joint. Thereby, when the tank wall 34 has been over-moulded onto the attachment edge 40 of the inspection window 26, any shrinkage occurring during solidification of the tank wall 34 will contribute to maintaining the liquid tightness of the tongue-and-groove joint. The tongue extends along a directuin which is substantially parallel to the tank wall 34.

Fig. 6D illustrates the joint between the inspection window 26 and the tank wall 34 after solidification of the tank wall 34. The liquefaction precursor ridges 44a, 44b, 64a, 64b now blend into the material of the tank wall 34, to define a liquid tight joint. Fig. 6D also schematically illustrates the sizes of the liquefaction precursor ridges 44a, 44b, 64a, 64b in relation to the tank wall thickness T1 and the inspection window thickness T2, both of which may, by way of example, be about 1,5 mm. The offset 47 between the outer face 63 (Fig. 5B) of the attachment edge 40 (Fig. 5B) and the outer face 41 of the inspection area 42 (Fig. 5B) permits over-moulding the outer face 43 of the tank wall 34 substantially in register with the outer face 41 of the inspection window 26.

Figs 7A and 7B illustrate, with increasing degree of magnification, a second embodiment of the interface between the tank wall 34 and the inspection window 26. The second embodiment is identical to the embodiment described in detail hereinbefore, except in that the interfacing edges of the tank wall 34 and the inspection window 26 do not form a tongue-and-groove joint. This may simplify the two-shot moulding process, since there is a reduced need for any retracting cores of the extractor mould.

Fig. 8 illustrates the method of producing the plastic tank half 18a described in detail hereinabove.

In a first step 801, the inspection window 26 is moulded by injecting a first composition of liquefied plastic onto the first ejector mould 54a (Fig. 4B).

In a second step 802, the tank wall 34 is moulded by injecting a second composition of liquefied plastic onto the first ejector mould 54a (Fig. 4D), thereby over-moulding and partly liquefying the liquefaction precursor ridges 44, 64 (Fig. 5B).

In a third step 803, the second composition of injected plastic is allowed to solidify together with the partly liquefied liquefaction precursor ridges 44, 64, thereby forming a bond between the tank wall 34 and the inspection window 26.

The invention has mainly been described above with reference to a few embodiments. However, as is readily appreciated by a person skilled in the art, other embodiments than the ones disclosed above are equally possible within the scope of the invention, as defined by the appended patent claims. By way of example, according to the embodiments described hereinabove, the tank wall is over-moulded onto the inspection window. As an alternative, the inspection window may be over-moulded onto the tank wall. In such an embodiment, an attachment edge along the inspection window aperture of the tank wall may be provided with liquefaction precursor ridge(s). Furthermore, according to the method described in detail hereinabove, the inspection window is moulded in the same tool as the tank wall. Clearly, this is not necessary. The inspection window may first be moulded in a first mould. Thereafter, the inspection window can be picked from the first mould and placed in a second mould for over-moulding with the tank wall. This may be done manually, or in an automated manner by a robot.

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.

Claims

1. A method of producing a plastic tank (18) for a power tool (10), the tank (18) comprising a tank wall (34) and a transparent or translucent inspection window (26) arranged in a window aperture in the tank wall (34), the inspection window (26) permitting visually inspecting a content level in the tank (18), the method comprising

   providing a moulding tool (54a) comprising one (26) of the tank wall (34) and the inspection window (26);

   injecting liquefied plastic (49b) onto the moulding tool (54a) to form the other (34) of the tank wall (34) and the inspection window (26), the liquefied plastic (49b) engaging with said one (26) of the tank wall (34) and the inspection window (26) at an over-moulding interface of said one (26) of the tank wall (34) and the inspection window (26); and

   allowing the injected plastic (49b) to solidify, thereby forming a bond with said one (26) of the tank wall (34) and the inspection window (26),

   characterized in that said one (26) of the tank wall (34) and the inspection window (26) comprises at least one liquefaction precursor ridge (44a, 44b, 64a, 64b) extending from a face (63, 65) of said one (26) of the tank wall (34) and the inspection window (26), along the over-moulding interface, wherein said liquefied plastic (49b) is injected onto said over-moulding interface to at least partly liquefy said liquefaction precursor ridge (44a, 44b, 64a, 64b).

2. The method according to claim 1, wherein said one (26) of the tank wall (34) and the inspection window (26) is the inspection window (26).

3. The method according to any of the preceding claims, wherein said at least one liquefaction precursor ridge (44a, 44b, 64a, 64b) defines a closed loop about the inspection window (26) or window aperture (27).

4. The method according to any of the preceding claims, wherein said at least one liquefaction precursor ridge (44a, 44b, 64a, 64b) is continuous.

5. The method according to any of the preceding claims, wherein said at least one liquefaction precursor ridge (44a, 44b, 64a, 64b) comprises a plurality of liquefaction precursor ridges (44a, 44b, 64a, 64b).

6. The method according to claim 5, wherein said plurality of liquefaction precursor ridges (44a, 44b, 64a, 64b) comprises a first set of ridges 44 on a first side (63) of said one (26) of the tank wall (34) and the inspection window (26), and a second set of ridges 64 on a second side (65) of said one (26) of the tank wall (34) and the inspection window (26), said second side (65) being opposite to said first side (63).

7. The method according to claim 6, wherein said second side (64) faces towards an interior of the tank (18), and said first side (63) faces towards an exterior of the tank (18).

8. The method according to any of the preceding claims, wherein injecting liquefied plastic (49b) onto the moulding tool (54a) to form the other (34) of the tank wall (34) and the inspection window (26) comprises allowing the liquefied plastic (49b) to flow onto a moulding tool having a moulding surface which is, at the over-moulding interface, substantially in register with an outer face (41) of said one (26) of the tank wall (34) and the inspection window (26), such that an outer face (43) of the tank wall (34) becomes substantially in register with an outer face (41) of the inspection window (26) at the over-moulding interface.

9. The method according to any of the preceding claims, wherein said over-moulding interface comprises an outer over-moulding interface portion (63) which faces towards an exterior of the tank (18), and which is offset towards an interior of the tank (18) compared to an outer face (41) of said one (26) of the tank wall (34) and the inspection window (26) adjacent to the over-moulding interface.

10. The method according to any of the preceding claims, wherein the tank wall (34) and the inspection window (26) are joined in a tongue-and-groove joint, wherein said over-moulding interface of said one (26) of the tank wall (34) and the inspection window (26) forms a tongue of said tongue-and-groove joint, and wherein said other (34) of the tank wall (34) and the inspection window (26) is over-moulded onto said tongue to form a groove of said tongue-and-groove joint, said groove enclosing said at least one liquefaction precursor ridge (44a, 44b, 64a, 64b).

11. The method according to claim 10, wherein said tongue locally extends substantially parallel to the tank wall (34) adjacent to said tongue-and-groove joint.

12. The method according to any of the preceding claims, wherein the inspection window (26) has a substantially convex outer face (41) and a substantially concave inner face (45).

13. The method according to any of the preceding claims, wherein providing a moulding tool (54a) comprising said one (26) of the tank wall (34) and the inspection window (26) comprises injecting liquefied plastic (49a) onto said moulding tool (54a) to form said one (26) of the tank wall (34) and the inspection window (26).

14. The method according to claim 13, wherein providing a moulding tool (54a) comprising one (26) of the tank wall (34) and the inspection window (26) further comprises retracting, after having formed said one (26) of the tank wall (34) and the inspection window (26), at least one core (58) of said moulding tool (54a) to expose at least a portion (64, 65) of said over-moulding interface.

15. The method according to any of the preceding claims, wherein said at least one liquefaction precursor ridge (44a, 44b, 64a, 64b) extends from said face (63, 65) of said one (26) of the tank wall (34) and the inspection window (26) to a ridge height (H) above said face ((63, 65) of between 0,1 mm and 1 mm.

16. The method according to any of the preceding claims, wherein said at least one liquefaction precursor ridge (44a, 44b, 64a, 64b), as seen in a cross-section perpendicular to a path followed by said ridge (44a, 44b, 64a, 64b), has a width (W), at half its height (H) above said face (63, 65) of said one (26) of the tank wall (34) and the inspection window (26), of less than 0,3 mm.

17. The method according to any of the preceding claims, wherein said tank wall (34) has a wall thickness (T1) of between 1 mm and 3 mm.

18. The method according to any of the preceding claims, wherein said at least one liquefaction precursor ridge (44a, 44b, 64a, 64b), as seen in a cross-section perpendicular to a path followed by said ridge (44a, 44b, 64a, 64b), has a ridge top forming an acute angle (α).

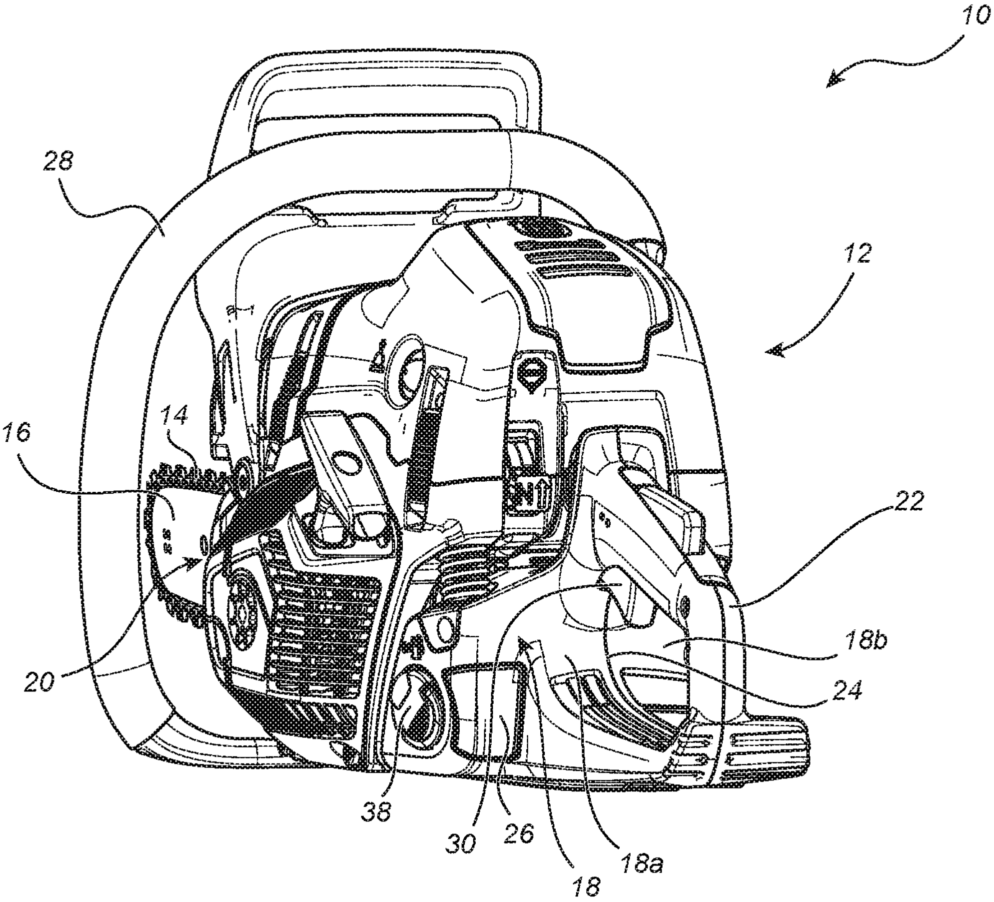
19. The method according to any of the preceding claims, wherein the tank wall (34) and the inspection window (26) are formed thermoplastic materials having substantially the same glass transition temperature.

20. A plastic tank (18) obtainable by the method according to any of the preceding claims.

21. A power tool (10) comprising a plastic tank (18) according to claim 20.

22. A power tool tank (18) comprising a tank wall (34) and a transparent or translucent inspection window (26) arranged in a window aperture (27) in the tank wall (34), the inspection window (26) permitting visually inspecting a liquid content level in the tank (18), the tank wall (34) and inspection window (26) being moulded together along a moulding interface, the moulding interface comprising a ridge (44a, 44b, 64a, 64b) of one (26) of the tank wall (34) and the inspection window (26) blending into the material of the other (34) of the tank wall (34) and the inspection window (26).

Fig. 1



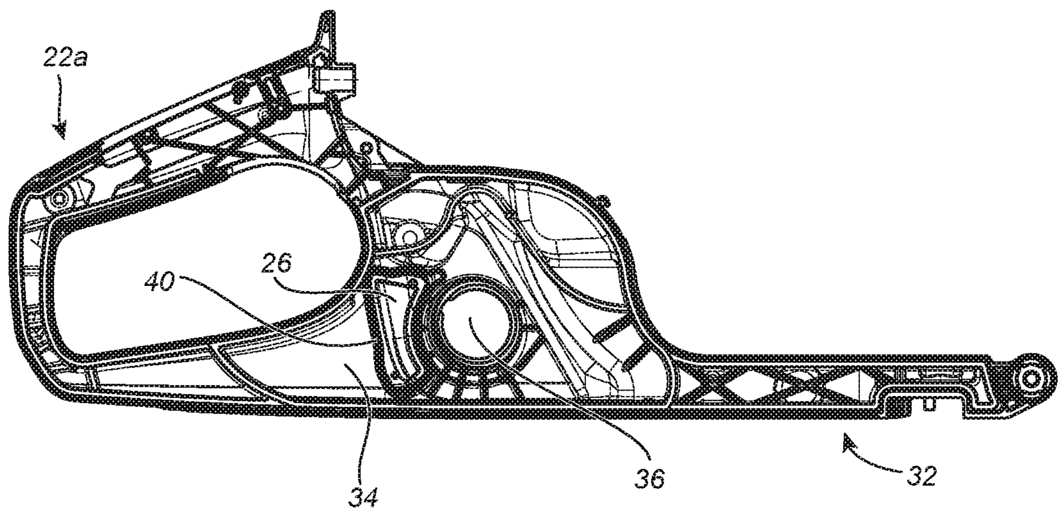


Fig. 2

Fig. 3A

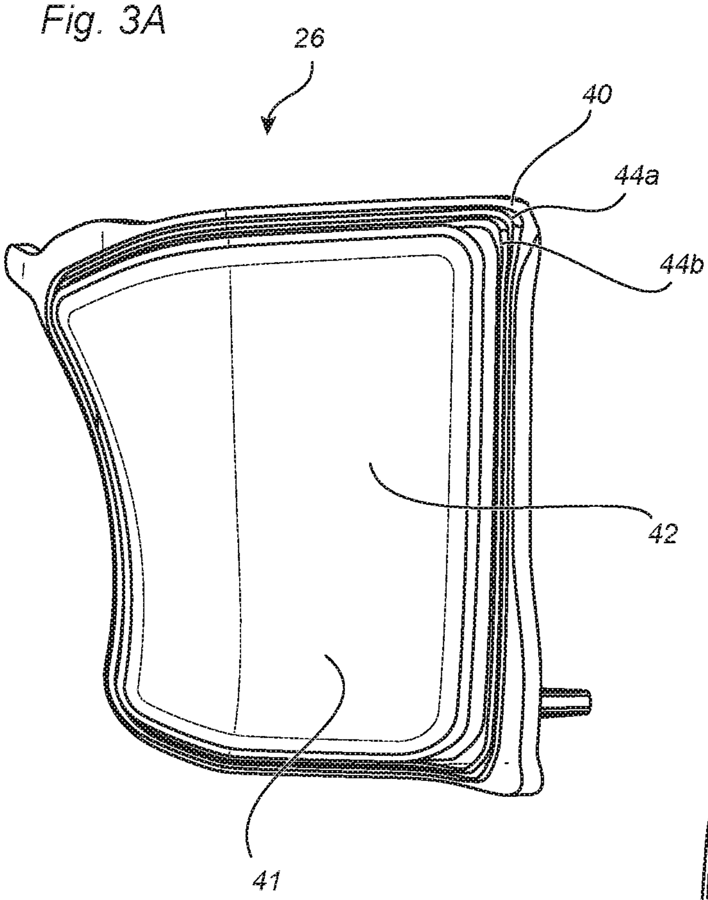


Fig. 3B

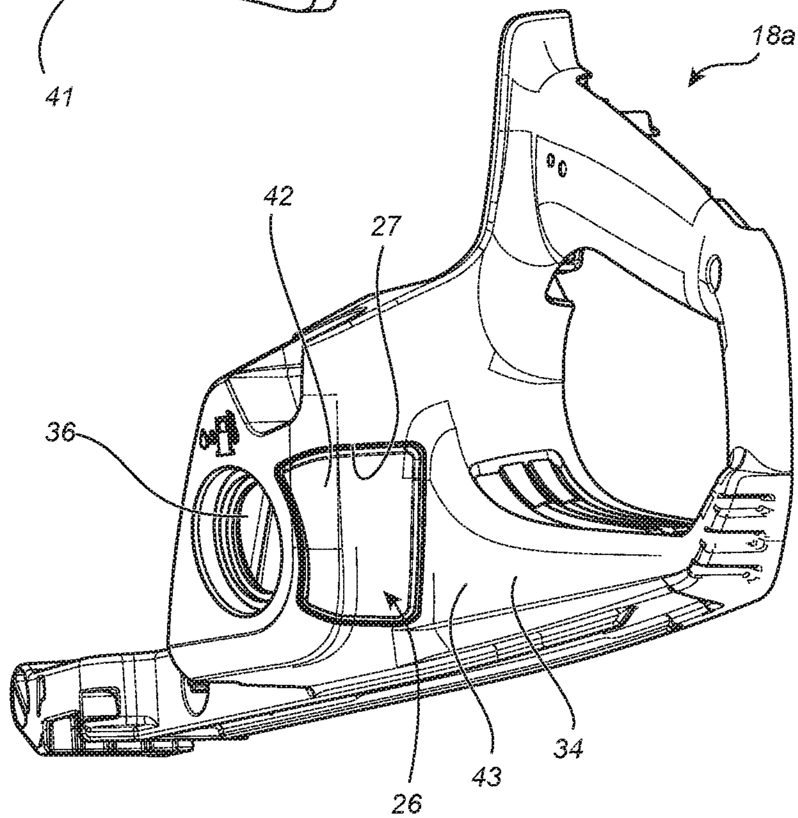


Fig. 4A

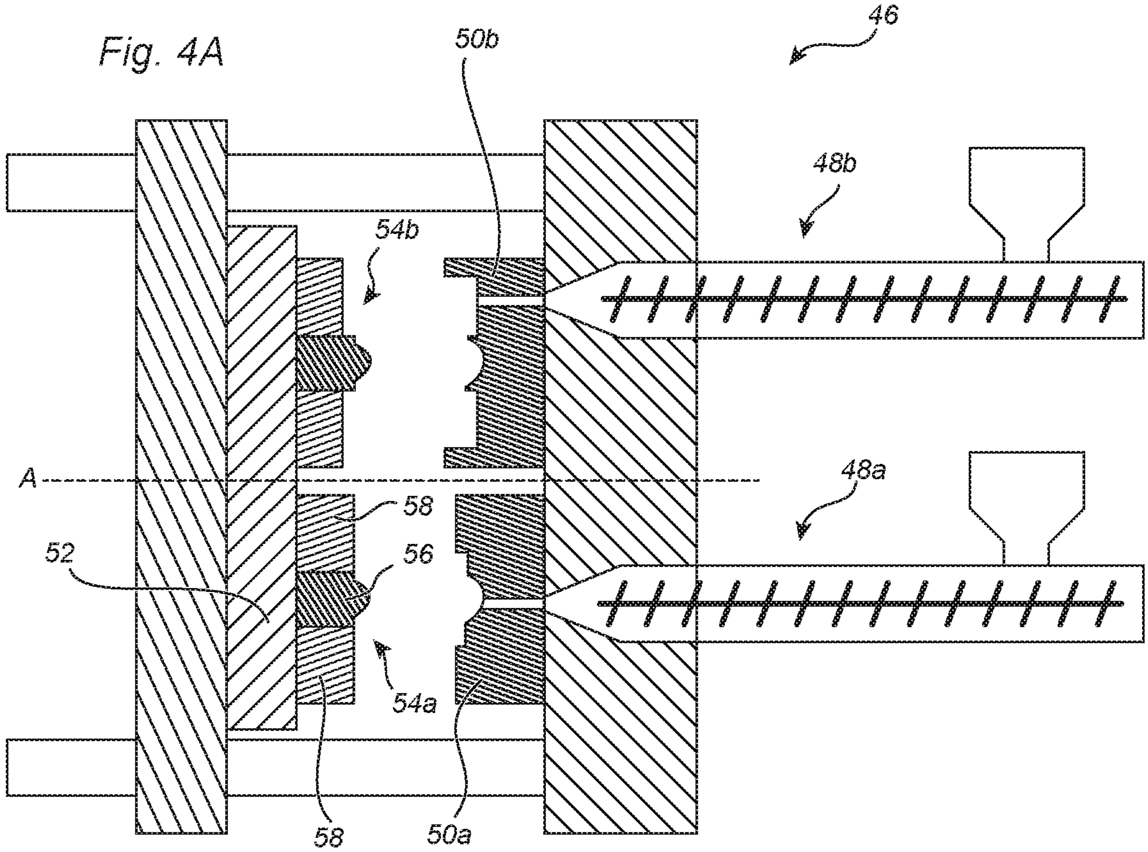


Fig. 4B

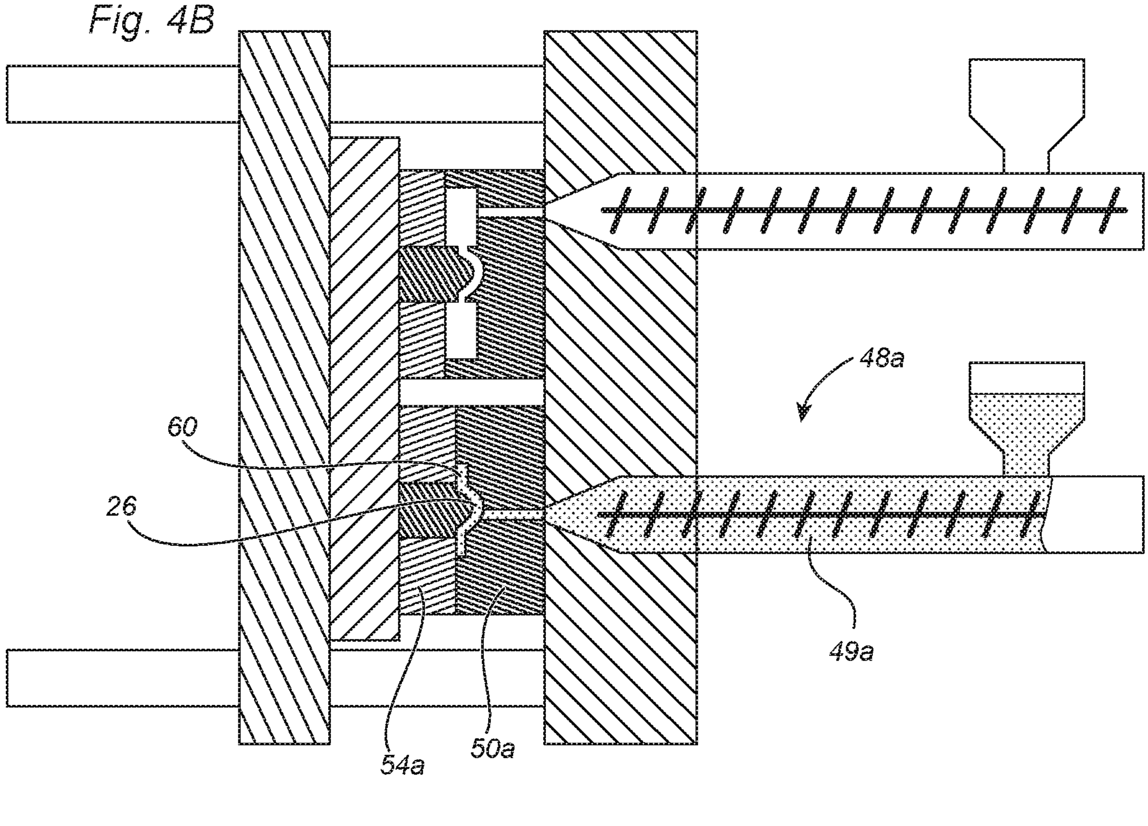


Fig. 4C

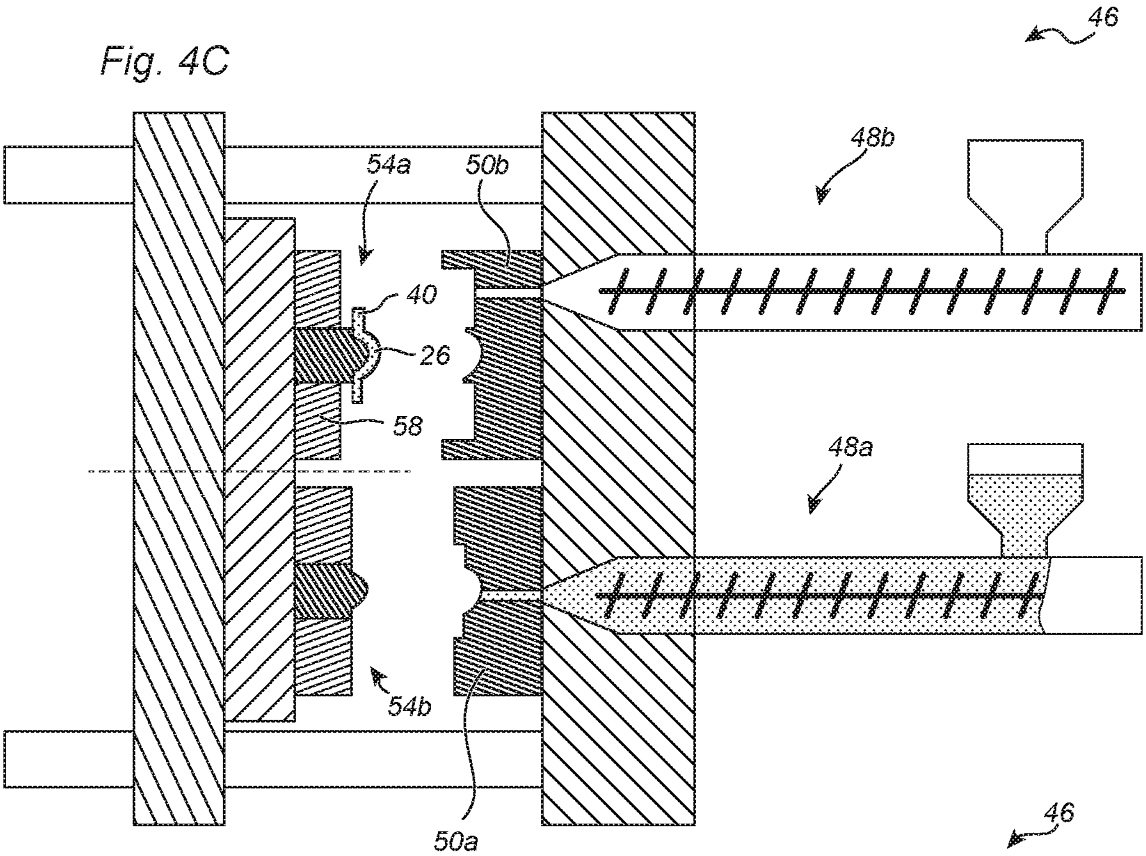

46
48b
54a
50b
40
26
58
48a
54b
50a

Fig. 4D

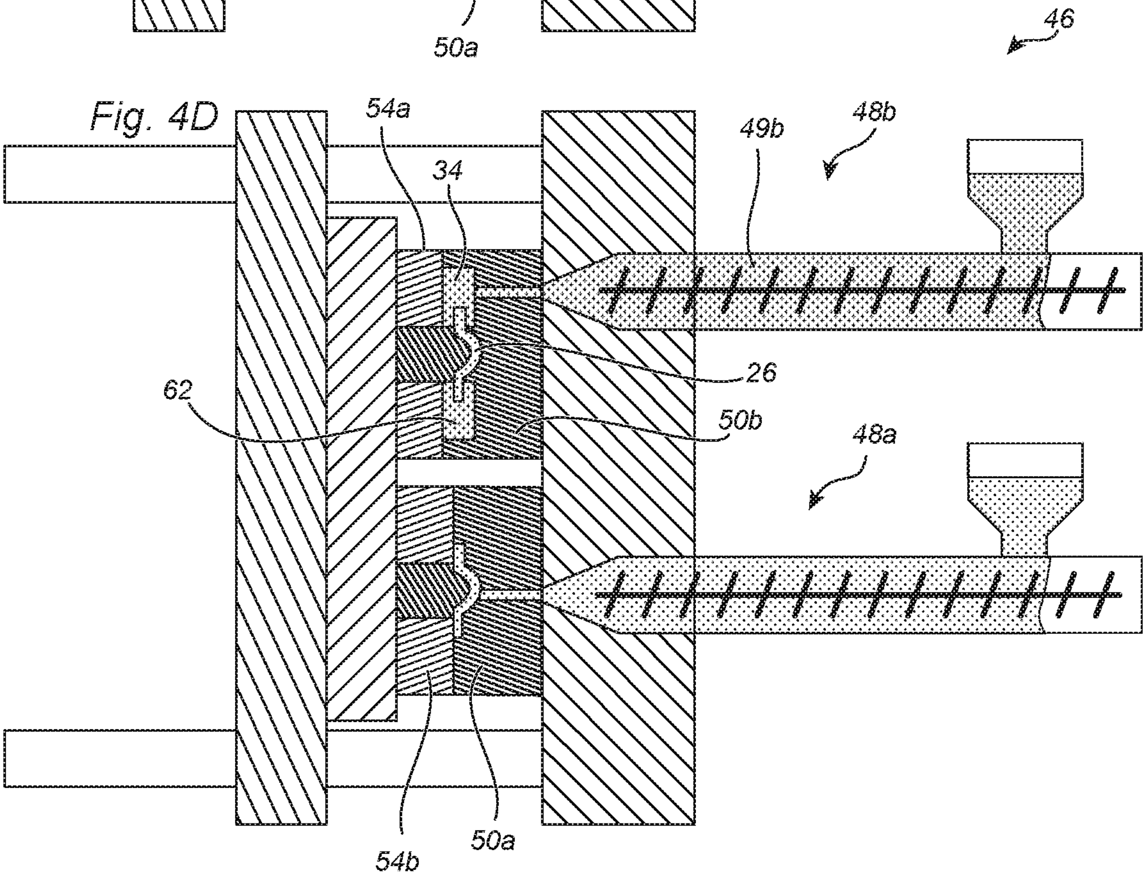

46
54a
48b
49b
34
26
62
50b
48a
54b
50a

Fig. 5B

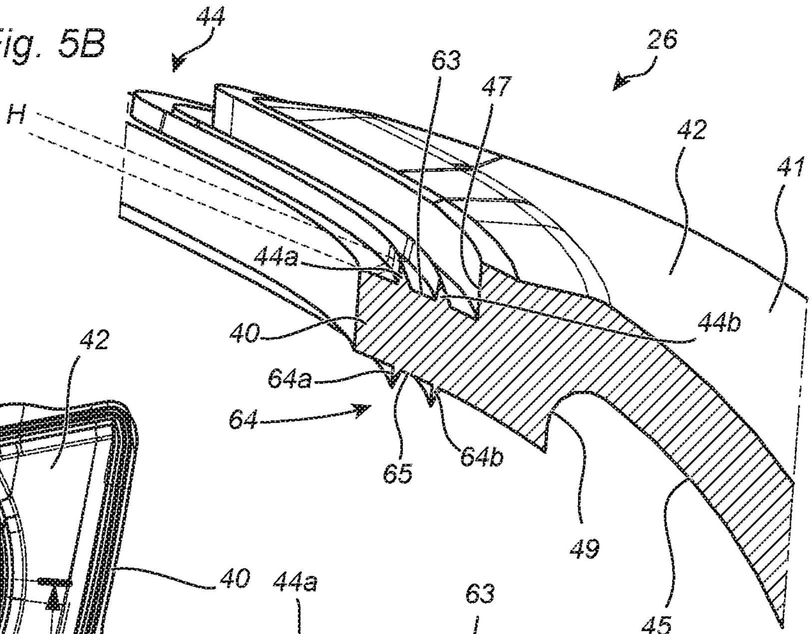
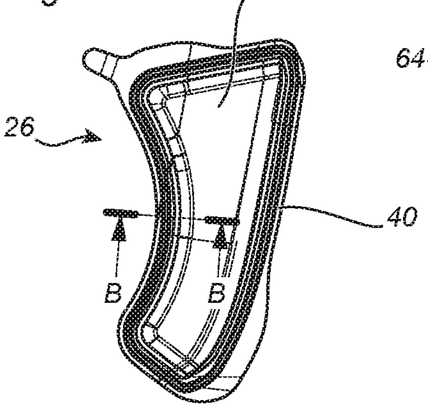


Fig. 5A



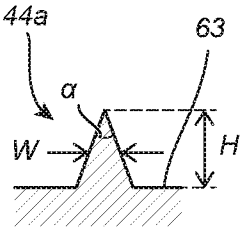


Fig. 5C

Fig. 6A

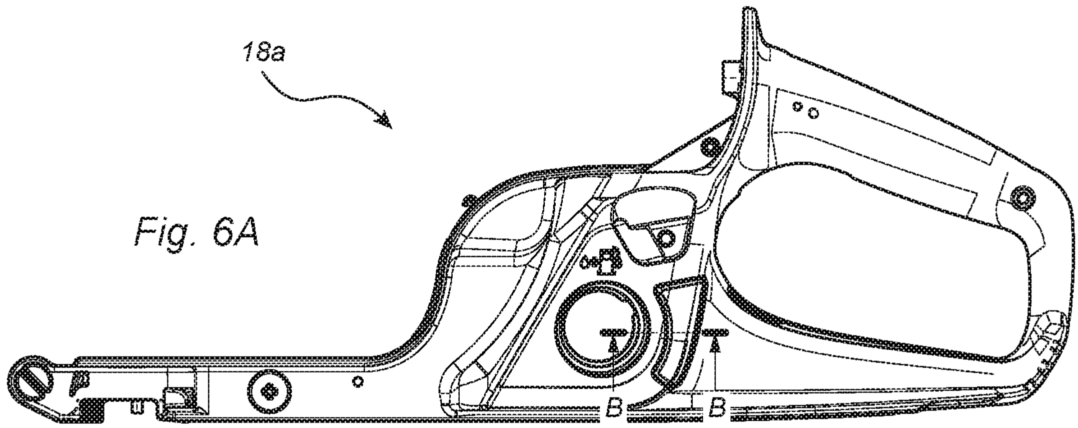


Fig. 6B

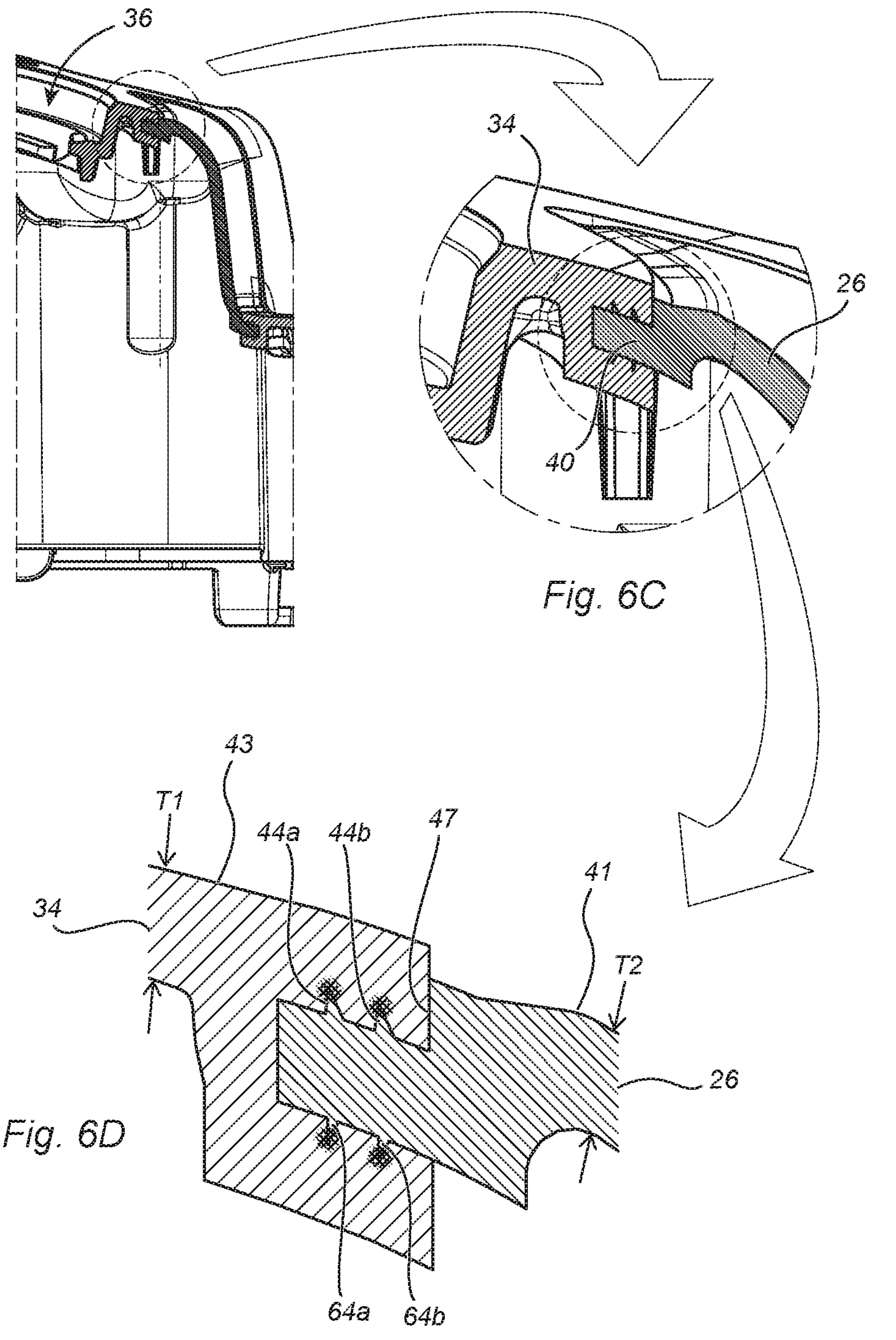


Fig. 6C

Fig. 6D

Fig. 7A

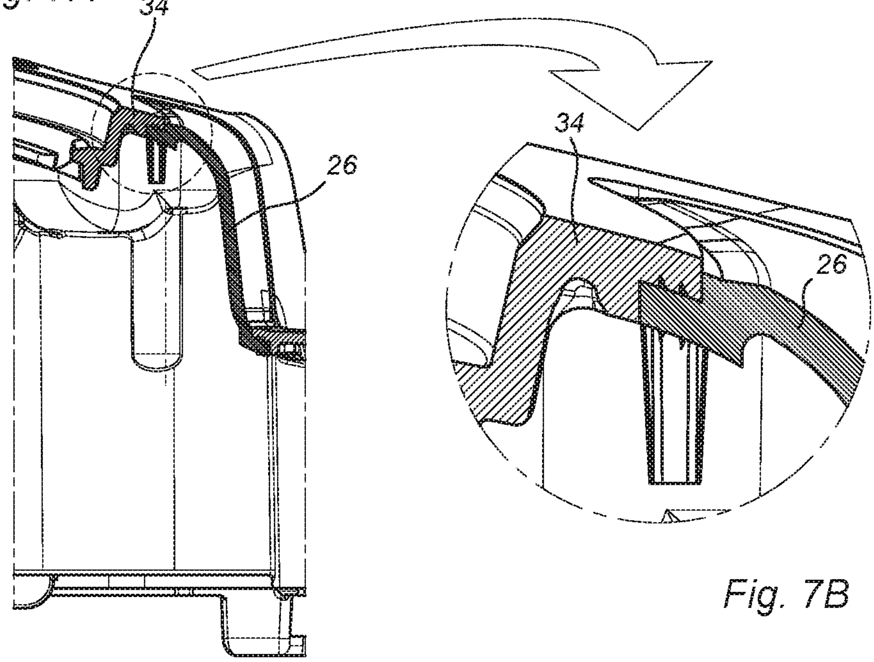
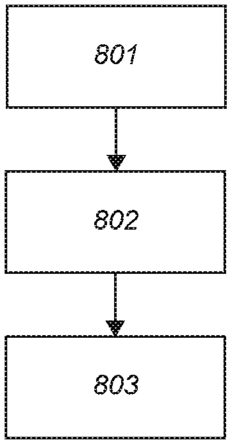


Fig. 7B

Fig. 8



INTERNATIONAL SEARCH REPORT

International application No
PCT/SE2020/050681

A. CLASSIFICATION OF SUBJECT MATTER
INV. B29C45/16 B65D25/56 B25F5/02
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
B29C B29L B25F B25H B65D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	DE 10 2006 048550 A1 (STIHL AG & CO KG ANDREAS [DE]) 17 April 2008 (2008-04-17) paragraphs [0002], [0003], [0008], [0012], [0014], [0028]; figures 2,6,7	1-22 1-22
X Y	EP 1 952 965 A1 (MARK IV SYSTEMES MOTEURS SAS [FR]) 6 August 2008 (2008-08-06) paragraphs [0032], [0014], [0003]; figures 1-5	1-22 1-22
Y	JP S61 213118 A (HITACHI MAXELL) 22 September 1986 (1986-09-22) paragraph [0001]; figure 1b; compounds 5a,5b	1-22
Y	US 2011/108198 A1 (CSABA ZAJTAI [HU] ET AL) 12 May 2011 (2011-05-12) paragraph [0084]; figures 5-9	1-22

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[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

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"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
23 September 2020	02/10/2020

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European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Mans, Peter

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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
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