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(71) Applicant: FOSECO INTERNATIONAL LIMITED
Central Park
Barlborough Links
Derbyshire S43 4XA (GB)

(72) Inventors:
- SANDER, Fabian Wilhelm
7534 LG Enschede (NL)
- VOLKS, Christof
46342 Velen (DE)

(74) Representative: Ward, David Ian et al
Marks & Clerk LLP
Alpha Tower
Suffolk Street
Queensway
Birmingham B1 1TT (GB)

(54) FEEDER SLEEVE AND KIT

(57) A feeder sleeve for use in casting molten metal, and a kit for assembling the feeder sleeve, is described. The kit includes a feeder sleeve neck, a first continuous sidewall and a second continuous sidewall. The second continuous sidewall is sized to be received on a mounting surface provided on the feeder sleeve neck, and the first continuous sidewall is sized to be received within the second continuous sidewall. The kit enables the construction of modular feeder sleeves which can be tailored in size and shape according to the desired application.

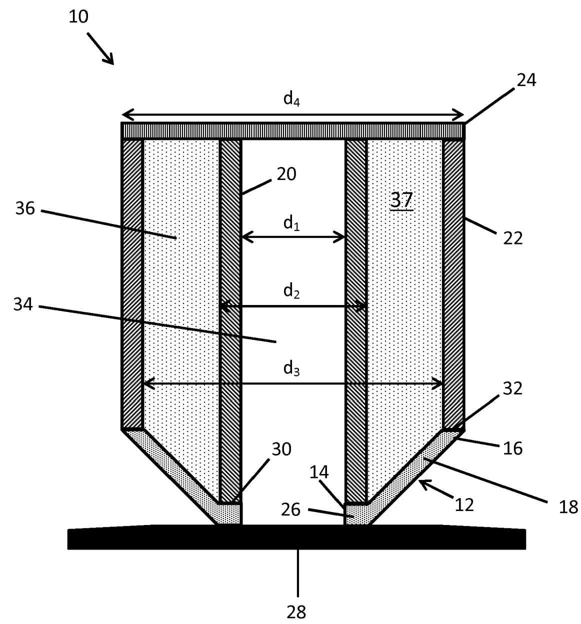

Figure 1

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Description

[0001] The present invention relates to feeder sleeves for use in metal casting operations utilising casting moulds. In particular, the present invention relates to components and kits for assembling feeder sleeves, and feeder sleeves made therefrom.

[0002] In a typical casting process, molten metal is poured into a pre-formed mould cavity which defines the shape of the casting. However, as the metal solidifies it shrinks, resulting in shrinkage cavities which in turn result in unacceptable imperfections in the final casting. This is a well-known problem in the casting industry and is addressed by the use of feeder sleeves or risers which are integrated into the mould during mould formation. Each feeder sleeve provides an additional (usually enclosed) volume or cavity which is in communication with the mould cavity, so that molten metal also enters into the feeder sleeve on casting. During solidification, molten metal within the feeder sleeve flows back into the mould cavity to compensate for the shrinkage of the casting. It is important that metal in the feeder sleeve cavity remains molten longer than the metal in the mould cavity, so feeder sleeves are made to be highly insulating or more usually exothermic, so that upon contact with the molten metal additional heat is generated to delay solidification.

[0003] After solidification and removal of the mould material, unwanted residual metal from within the feeder sleeve cavity remains attached to the casting and must be removed. In order to facilitate removal of the residual metal (commonly referred to as a "feeder"), the feeder sleeve cavity may be tapered towards its base (i.e. the end of the feeder sleeve which will be closest to the mould cavity) in a design commonly referred to as a neck down sleeve. When a sharp blow is applied to the feeder it separates at the weakest (narrowest) point which will be near to the mould (the process commonly known as "knock off'). A small footprint on the casting is also desirable to allow the positioning of feeder sleeves in areas of the casting where access may be restricted by adjacent features.

[0004] Moulding practices are well known and are described for examples in chapters 12 and 13 of Foseco Ferrous Foundryman's Handbook (ISBN 075064284 X).

[0005] As casting size increase, so does the size and weight of the feeder sleeves required to feed the casting. The availability of large feeder sleeves, typically over 400 mm in diameter, is particularly important for foundries producing large castings where maximizing yield is important, such as those casting high alloy steel which is expensive to re-melt. Whilst small to medium size feeder sleeves are lightweight and easy to manufacture as a single piece, larger feeder sleeves are more difficult due to both their size and weight. Being heavy and bulky in size, they are expensive to transport. In addition, their weight (typically over 50 kg) means they are also difficult to manually handle and apply in foundries.

[0006] The present invention has been devised with these issues in mind.

[0007] According to a first aspect of the present invention, there is provided a kit for a feeder sleeve for use in casting molten metal, the kit comprising:

a feeder sleeve neck having a narrower first end and a wider second end;
a first continuous sidewall, defining a first bore which extends between two ends, at least one of which is open; and
a second continuous sidewall, defining a second bore which extends between two open ends, wherein the second continuous sidewall is sized to be received on a mounting surface provided on the feeder sleeve neck, at or close to the second end thereof, and
wherein the first continuous sidewall is sized to be received within the second continuous sidewall such that a gap is formed between an outer surface of the first continuous sidewall and an inner surface of the second continuous sidewall.

[0008] In some embodiments, the first and/or second continuous sidewall is tubular. By "tubular" it will be understood that the continuous sidewall defines a bore having a cross sectional area which is approximately constant throughout the length of the bore. In some embodiments, the cross sectional area of the first and/or second bore varies along its length. For example, the bore may widen in the middle and narrow towards its ends. In another example, the first and/or second continuous sidewall may be tapered such that the first and/or second bore narrows from one end to the other end.

[0009] In cross section, the first and/or second bore may be circular, oval, obround, square, rectangular, triangular or any other suitable shape.

[0010] It will be appreciated that an inner surface of the first continuous sidewall, which forms the first bore (i.e. the feeder sleeve cavity), defines an internal diameter of the first continuous sidewall, while an external diameter can be measured across the outer surface of the first continuous sidewall. Similarly, the inner surface of the second continuous sidewall defines an internal diameter of second continuous sidewall, while an outer surface of the second continuous sidewall defines an external diameter of the second continuous sidewall, which may also be the external diameter of the whole feeder sleeve, when assembled.

[0011] The internal diameter of the second continuous sidewall is greater than the external diameter of the first continuous sidewall. Therefore, when the feeder sleeve is assembled with the first continuous sidewall received within the second continuous sidewall, a gap is formed therebetween. This gap may be filled with a material which enhances the insulating and/or exothermic properties of the feeder sleeve.

[0012] It will be understood that the term "diameter" does not imply that the sidewall must be circular in cross section. For any embodiments wherein the cross-section is non-circular, the term "diameter" will be understood as referring to the largest dimension measured along a line between two points on the sidewall, said line passing through the centre of the bore.

[0013] In some embodiments the external diameter of the second continuous sidewall (and of the feeder sleeve) is greater than 200 mm, greater than 250 mm, greater than 300 mm, greater than 350 mm or greater than 400 mm.

[0014] In some embodiments, the internal diameter of the first continuous sidewall (i.e. the diameter of the feeder sleeve cavity) is greater than 100mm, greater than 150 mm, greater than 170 mm or greater than 200 mm.

[0015] In the assembled feeder sleeve, an inner surface of the first continuous sidewall forms an internal wall of the feeder sleeve which defines the feeder sleeve cavity, while an outer surface of the second continuous sidewall forms an external wall of the feeder sleeve. Thus, the distance between the inner surface of the first continuous sidewall and the outer surface of the second continuous sidewall defines the overall thickness of a sidewall of the sleeve (referred to herein as the "sleeve sidewall").

[0016] It will be appreciated that at least one end of the first continuous sidewall must be open, to allow molten metal to flow into and out of the first bore (i.e. the feeder sleeve cavity). In some embodiments, the first bore, defined by the first continuous sidewall, is open at both ends. Alternatively, the first bore may be closed at one end (i.e. the end distal from the feeder sleeve neck).

[0017] The feeder sleeve neck may be defined by a tapered sidewall which extends from the narrower first end to the wider second end. In such embodiments the feeder sleeve neck is frustoconical in shape. In some embodiments the feeder sleeve neck is defined by a curved sidewall, such that the feeder sleeve neck has a rounded profile. In some embodiments, the wall defining the feeder sleeve neck has a thickness which is no more than 30% of the thickness of the sleeve sidewall.

[0018] The tapered sidewall of the feeder sleeve neck may have an angle of inclination of from 10° to 60°, relative to a longitudinal axis of the feeder sleeve neck which passes through the first and second ends.

[0019] The feeder sleeve neck is open at each end, the narrower first end defining an aperture of the feeder sleeve through which molten metal flows from the casting cavity, in use. In some embodiments the opening at the first end of the feeder sleeve neck (also referred to as the neck aperture) has a diameter which is from 20 to 80% of the internal diameter of the first continuous sidewall (i.e. the diameter of the first bore). In some embodiments the neck aperture is from 20 to 50% of the external diameter of the feeder sleeve, as measured from the outer surface of the second continuous sidewall. However, it will be appreciated that the size of the feeder sleeve neck is at least partly determined by the size of the casting and the type of alloy.

[0020] In the assembled feeder sleeve, the second continuous sidewall will be mounted on the feeder sleeve neck. In some embodiments, the feeder sleeve neck may terminate at its second end in an annular surface on which the second continuous sidewall can be mounted. In some embodiments, the annular surface may comprise a groove or cut-out for receiving a complementary protrusion on the end of the second continuous sidewall. Alternatively, or additionally, the annular surface may comprise a protrusion for mating with a complementary groove or cut-out in the end of the second continuous sidewall.

[0021] The first continuous sidewall may also be mounted on the feeder sleeve neck. In some embodiments, the tapered sidewall of the feeder sleeve neck terminates at the first end in an inwardly directed flange. This provides an annular mounting surface on which the first continuous sidewall may be supported. The width of the flange will determine the size of the neck aperture.

[0022] In some embodiments, an inner surface of the tapered sidewall of the feeder sleeve neck serves as the mounting surface and comprises one or more notches for receiving an end of the first or second continuous sidewall. Alternatively, or additionally, the inner surface of the tapered sidewall may comprise one or more ledges for supporting an end of the first or second continuous sidewall.

[0023] Notches and/or ledges for receiving the second continuous sidewall may be positioned closer to the second end of the feeder sleeve neck. Notches and/or ledges for receiving the first continuous sidewall may be positioned closer to the first end of the feeder sleeve neck. It will be appreciated that the positioning of the notches/ledges in the feeder sleeve neck can be used to determine the thickness of the sleeve sidewall, in the assembled feeder sleeve. For example, a thicker sidewall can be created by spacing the notches/ledges far apart, such that the first continuous sidewall is positioned at or close to the first end of the feeder sleeve neck, while the second continuous sidewall is positioned at or close to the second end of the feeder sleeve neck, thereby creating a wider gap between the sidewalls. A thinner sidewall can be created by positioning the notches/ledges closer together, such that the gap between the first and second continuous sidewalls is reduced.

[0024] The notch or ledge may extend around the entire circumference of the inner surface of the tapered sidewall. Alternatively, a series of notches or ledges (each one of the series being positioned at the same distance from the first end of the feeder sleeve neck as the others in the series) may be provided which are spaced apart around the circumference.

[0025] For example, a larger feeder sleeve cavity can be created by increasing the diameter of the first continuous sidewall diameter (which requires positioning the notches/ledges for receiving the first continuous sidewall closer to the first end of the feeder sleeve neck), while retaining the position of the second continuous sidewall.

Alternatively, by maintaining the diameter of the first continuous sidewall and reducing that of the second continuous sidewall, a feeder sleeve can be produced having the same size feeder sleeve cavity but a smaller overall feeder sleeve diameter. The modular system of the invention thus allows multiple parameters of the feeder sleeve to be varied as desired by the user.

[0026] In some embodiments, multiple notches and/or ledges (or multiple series of notches and/or ledges) are provided between the first and second ends of the feeder sleeve neck. In such embodiments, each notch/ledge (or series of notches/ledges) is positioned at a different distance from the first end of the feeder sleeve neck. This provides a choice of positions for mounting the first and/or second continuous sidewall on the feeder sleeve neck, and thus enables the thickness of the sleeve sidewall to be modified as required.

[0027] Each notch or ledge may have a depth which is equal to or greater than the thickness of the first and/or second continuous sidewall.

[0028] In some embodiments, the first continuous sidewall is sized to be received inside the neck aperture. This provides an alternative to mounting the first continuous sidewall on the feeder sleeve neck. In such embodiments, in the assembled feeder sleeve the outer surface of the first continuous sidewall may be fixed to the feeder sleeve neck within the neck aperture, for example using adhesive. In such embodiments, the feeder sleeve neck and the first continuous sidewall may be mounted on a breaker core.

[0029] In some embodiments, the height of the first continuous sidewall and the height of the second continuous sidewall are selected such that when the first and second continuous sidewalls are mounted on the feeder sleeve neck, the free ends of the continuous sidewalls (i.e. the ends which are opposite to the ends in contact with the feeder sleeve neck) are vertically aligned.

[0030] The first and/or second continuous sidewalls may be stackable. Thus, for example, an outer wall of a feeder sleeve may be assembled by stacking two or more second continuous sidewalls (which may be the same or different) on top of one another. This enables the height of the feeder sleeve to be selected according to the desired use.

[0031] In some embodiments, the kit comprises two or more of the first and/or second continuous sidewalls. In some embodiments, the kit comprises a plurality of first continuous sidewalls and/or a plurality of second continuous sidewalls. The plurality of first/second continuous sidewalls within a kit may be all of the same type (i.e. dimensions and material), or they may be different. For example, a kit may include a single type of first continuous sidewalls, and a number of different types of second continuous sidewalls, having different heights.

[0032] In some embodiments, the relative heights of the first and second continuous sidewalls may be selected such that when the first and second continuous sidewalls are mounted on the feeder sleeve neck, the free end of the (or the uppermost) second continuous sidewall extends beyond that of the first continuous sidewall. This arrangement is suitable for embodiments in which the first continuous sidewall has a closed end which, in the assembled feeder sleeve, is opposite to the end mounted on the feeder sleeve neck. In this embodiment a gap is formed between the closed end of the first continuous sidewall and the free end of the (or the uppermost) second continuous sidewall, which may be closed by a lid. This gap may be filled with an insulating material. Advantageously, this helps to prevent heat loss through the top of the feeder sleeve.

[0033] In some embodiments the kit further comprises a filler. The filler may comprise a mixture of refractory materials having different densities, particle size and/or composition to give the required thermal and heat resistant properties.

[0034] The filler may be insulating, exothermic or a combination of both.

[0035] Insulating fillers may comprise high or low bulk density refractory fillers, or a mixture thereof. In some embodiments, the filler may comprise a low bulk density (typically in the range of 0.3-0.6 g/cm^3, as measured on untapped freely settled) material. Suitable materials include, but are not limited to, alumino-silicate hollow microspheres (cenospheres, fly ash floaters), rice husk ash (calcined), fibres (alumino silicate) and mineral wool. Other commonly used higher bulk density refractory fillers include silica sand, olivine, chamotte (grog, firesand), alumina (calcined), pumice, perlite, vermiculite, wollastonite (calcium metasilicate) dead burned magnesite and fire clay. These fillers have higher bulk (i.e. untapped) densities, typically in the range of 0.9-1.5 g/cm^3.

[0036] An exothermic filler may comprise a fuel (such as aluminium or an aluminium alloy), an oxidant (typically iron oxide, manganese dioxide, or potassium nitrate) and, optionally, an initiator/sensitiser (such as cryolite).

[0037] Formulations will vary according to the required application, however, most exothermic / exothermic insulating fillers have the general formulation: 20-25% fuel; 10-20% oxidants and/or sensitisers; and 35-60% refractory fillers, the type of refractory fillers used having the most direct influence on overall filler density and insulation properties.

[0038] Suitable filler compositions include, for example, mixes available from Foseco under the trade names FEEDEX, KALMINEX and KALMIN. These premixes have similar filler compositions to the standard feeders sold by Foseco under the same brand names, but are all loose flowing (unbonded) powder mixtures. KALMIN premixes are low density (0.3-0.5 g/cm^3) insulating mixtures, KALMINEX premixes are low to medium density (0.55-0.85 g/cm^3) insulating exothermic mixtures, and FEEDEX mixes are high density (1.25-1.55 g/cm^3) highly exothermic mixtures, wherein the densities given are for tapped material, attained by mechanically tapping a container containing the powder mixture sample prior to measuring the density.

[0039] In some embodiments, the filler is in particulate form. The kit may comprise a bulk quantity of filler (e.g. in a single large bag or container), or it may comprise a plurality of smaller quantities. For example, the filler may be supplied in multiple bags which can be inserted directly into the gap between the first and second continuous sidewalls.

[0040] The filler may further comprise a solvent (such as water or a non-volatile polyol) and/or a liquid binder/resin (which may be a pure liquid, a solution or a suspension) The inclusion of small amount of liquid (typically no more than 5% of the total filler weight) may help to prevent segregation of the different particle sizes and/or different density filler materials, and may also dampen a particulate filler and prevent dust formation, thereby reducing the risk of fire or explosion which is particularly important for exothermic filler mixtures. The binder/resin may also help to hold together and bind the filler particles once the sleeve has been assembled and the filler added and compacted.

[0041] In some embodiments the kit does not include a filler. A feeder sleeve assembled without the use of a filler between the inner and outer walls of the sleeve is commonly referred to as an airgap sleeve, wherein the air has insulating properties.

[0042] The first continuous sidewall and/or the second continuous sidewall may be insulating, exothermic or a combination of both.

[0043] The first and second continuous sidewalls may be formed from the same material, or they may be formed from different materials.

[0044] In some embodiments, the first and/or second continuous sidewall is formed from a fired refractory material. Examples of fired refractory materials include fused silica, aluminosilicate (mullite, sillimanite, fireclay, high-alumina), magnesite (magnesium oxide), spinel (alumina-magnesia), high alumina cement (e.g. calcium aluminate cement) or silicon carbide (both clay and carbon bonded).,

[0045] In some embodiments, the first continuous sidewall is formed from metal e.g. steel.

[0046] In some embodiments, the second continuous sidewall is formed from cardboard, plastic or metal e.g. steel.

[0047] In some embodiments, the first and/or second continuous sidewall is made from a conventional feeder sleeve composition. The composition may be insulating, insulating-exothermic or exothermic. Examples of suitable compositions from which the first continuous sidewall may be made include those sold by Foseco under the trade names: FEEDEX HD (a high density highly exothermic material), KALMINEX XP or KALMINEX 2000 (medium density exothermic-insulating material), and KALMIN 70 or KALMIN S (low density insulating material).

[0048] The first and/or second continuous sidewall may be formed by any of the known methods of forming feeders. For example, the first continuous sidewall may be formed by vacuum forming a slurry of the material around a former and inside an outer mould, followed by heating to remove the water and to harden or cure the material. Alternatively, the first continuous sidewall may be formed by ramming or blowing the material in a core box (core shot method), and curing the material via the passage of a reactive gas or catalyst through the material to cure the binder, or via application of heat by using a heated core box, or by removing the first continuous sidewall and heating in an oven.

[0049] In some embodiments, the first continuous sidewall is formed from a fired refractory (such as used silica) or a steel tube, and the second continuous sidewall is formed from an insulating material such as Foseco's KALMIN 70 or KALMIN S.

[0050] In some embodiments, the first continuous sidewall is formed from an insulating-exothermic material, such as Foseco's KALMINEX 2000 or an exothermic material such as Foseco's FEEDEX HD, and the second continuous sidewall is formed from an insulating material such as Foseco's KALMIN 70 or KALMIN S.

[0051] In some embodiments the first continuous sidewall is sized to mate with the feeder sleeve neck, on or close to the first end thereof. In such embodiments, when the first and second continuous sidewalls are assembled with the feeder sleeve neck, a cavity is formed which is closed at one end by the feeder sleeve neck, which acts as a base. This cavity can be filled with a filling material.

[0052] In some embodiments, the kit further comprises a breaker core. The breaker core may be a disc of refractory material (typically a resin bonded sand core, a ceramic core or a core of feeder sleeve material). As is known in the art, the breaker core sits between the mould cavity and the feeder sleeve. The breaker core has a hole (typically at its centre) which enables the passage of molten metal between the mould cavity and the feeder sleeve cavity.

[0053] The diameter of the hole in the breaker core may be smaller than the diameter of the feeder sleeve cavity (i.e. the diameter of the first bore). This helps to ensure that removal of the residual metal feeder after casting (commonly referred to as "knock off') occurs at the breaker core close to the casting surface.

[0054] In some embodiments, the breaker core comprises a locating groove for receiving the first end of the feeder sleeve neck and, optionally, an end of the first continuous sidewall.

[0055] In the assembled feeder sleeve, the feeder sleeve neck may be mounted on the breaker core, and the first continuous sidewall may be sized to be mounted on the feeder sleeve neck, at or close to the first end. Alternatively, the first continuous sidewall may be sized to be mounted directly on the breaker core. For example, the diameter of the first continuous sidewall may be smaller than that of the first end of the feeder sleeve neck.

[0056] In some embodiments, the kit further comprises a lid. Multiple lids may be provided in the kit, which may the same or different.

[0057] The lid may be sized and shaped so as to extend at least across the second bore defined by the second continuous sidewall. Therefore, when the feeder sleeve is assembled the lid covers a feeder sleeve cavity defined by the first continuous sidewall, and encloses the filler (if present) in the gap between the first and second continuous sidewalls.

[0058] The lid may be formed from any suitable material. Suitable materials include, but are not limited to, fused silica, aluminosilicate (mullite, sillimanite, fireclay, high-alumina), magnesite (magnesium oxide), spinel (alumina-magnesia), high alumina cement (calcium aluminate cement) and silicon carbide (both clay and carbon bonded).

[0059] In some embodiments, the lid is formed from metal e.g. steel. In some embodiments, the lid is formed from thick card or cardboard.

[0060] In other embodiments, the lid is formed from a conventional feeder sleeve composition. The composition may be insulating, insulating-exothermic or exothermic. Examples of suitable compositions are described above. The lid may be formed by any of the known methods described above for forming feeder sleeves.

[0061] In some embodiments the lid has a thickness which is from 50% to 150% of the thickness of the first and/or second continuous sidewall.

[0062] In some embodiments, the lid is formed from the same material as the first and/or second continuous sidewall.

[0063] In some embodiments the kit is for a feeder sleeve having a total height of greater than 450 mm, greater than 500 mm, greater than 550 mm or greater than 600 mm.

[0064] The total height of the feeder sleeve is measured from the first end of the feeder sleeve neck to the end of the second continuous sidewall (which is opposite to the end that is mounted on the feeder sleeve neck). Alternatively, in embodiments wherein the feeder sleeve comprises a lid, the total height of the feeder sleeve is measured from the first end of the feeder sleeve neck to an upper surface of the lid. It will therefore be appreciated that the total height of the feeder sleeve will depend on the height of the feeder sleeve neck, the height of the second continuous sidewall, the positioning of the second continuous sidewall on the feeder sleeve neck (for example, whether the second continuous sidewall is mounted on the second end of the feeder sleeve neck, or on a notch or ledge spaced from the second end of the feeder sleeve neck), and the thickness of the lid, if present. The dimensions of the individual components can therefore be selected by the skilled person according to the required total height of the feeder sleeve.

[0065] In some embodiments the kit is for a feeder sleeve having a modulus of greater than 7 cm. The modulus of a feeder sleeve is a numerical value used by foundries to estimate the minimum size of a sleeve necessary to supply sufficient liquid metal i.e. feed a casting or casting section. The modulus is defined as the Geometric Modulus multiplied by the MEF (Modulus Extension Factor). The Geometric Modulus is calculated by dividing the volume of a sleeve by its surface area. The MEF depends on the composition of the sleeve, its thermophysical properties and geometry. The MEF can be determined by conducting test casting trials, such as those detailed in the article titled "Measuring the Thermal Efficiency of Feeding Aids", Foundry Practice Number 205, pages 6-10, published June 1982 by Foseco international. In this method, a cylindrical sleeve comprising the test material and of known geometric modulus, is used on a riser on top of a test cube casting, and compared to different sized sand risers on individual identical test castings. Thermocouples are used to measure the solidification time of each casting, and once the solidification time of the test sleeve casting can be matched to a sand riser of known geometric modulus, the MEF of the sleeve can be calculated. The MEF for an insulating sleeve is typically 1.2 whereas the MEF for an insulating-exothermic sleeve such as Foseco's KALMINEX 2000 is 1.6.

[0066] In some embodiments, the kit comprises two or more different types of feeder sleeve necks, first continuous sidewalls and/or second continuous sidewalls. For example, the kit may comprise a single type of feeder sleeve neck, two or more different types of first continuous sidewall, and two or more different types of second continuous sidewall. The different types of first/second continuous sidewall may differ in their dimensions and/or their materials.

[0067] This modular arrangement enables the components of the sleeve to be mixed and matched, so that the properties and/or size of the feeder sleeve can be tailored by the user according to the required purpose.

[0068] According to a second aspect of the present invention there is provided a feeder sleeve for use in casting molten metal, the feeder sleeve comprising:

a feeder sleeve neck having a narrower first end and a wider second end,

a first continuous sidewall, defining a first bore which extends between two ends, at least one of which is open; and

a second continuous sidewall, defining a second bore which extends between two open ends, wherein the second continuous sidewall is mounted on the feeder sleeve neck, at or close to the second end thereof, and

wherein the first continuous sidewall is received within the second continuous sidewall such that a gap is formed therebetween.

[0069] In some embodiments the first continuous sidewall is received concentrically within the second continuous sidewall. In other words, the gap formed between first and second continuous sidewalls is of a uniform width all the way around the sidewalls.

[0070] The gap between the first and second continuous sidewalls may be filled with a filling material. Suitable filling materials are described above.

[0071] In some embodiments the first continuous sidewall mates with the feeder sleeve neck, on or close to the first end thereof.

[0072] In some embodiments, the first end of the feeder sleeve neck and the first continuous sidewall are mounted on a breaker core.

[0073] In some embodiments, the feeder sleeve further comprises a lid.

[0074] It will be understood that any of the embodiments described herein may be combined in any way and with any aspect of the invention, unless stated otherwise.

[0075] Embodiments of the invention will now be described with reference to the accompanying Figures in which:

Figure 1 is a cross-sectional view of an embodiment of a feeder sleeve, formed from a kit, in accordance the present invention;
Figure 2 is cross-sectional view of a further embodiment of a feeder sleeve in accordance with the present invention;
Figure 3 is cross-sectional view of an alternative embodiment of a feeder sleeve in accordance with the present invention;
Figure 4 is cross-sectional view of a yet further embodiment of a feeder sleeve in accordance with the present invention; and
Figures 5a-5c are cross-sectional views of different feeder sleeves which may be constructed from a kit in accordance with the present invention.

[0076] Figure 1 shows a modular feeder sleeve 10 which has been assembled from a kit according to the first aspect of the invention. The kit comprised a feeder sleeve neck 12, having a narrower first end 14, a wider second end 16 and a tapered sidewall 18 therebetween. The kit further comprised a first continuous sidewall 20, a second continuous sidewall 22 and a lid 24.

[0077] The first end 14 of the feeder sleeve neck 12 is provided with an inwardly directed flange 26 which provides a base of the feeder sleeve 10 for resting on a mould pattern 28, and also provides an annular surface 30 on which the first continuous sidewall 20 is mounted in the assembled feeder sleeve 10. The flange 26 further defines an aperture of the feeder sleeve neck 12. The second end 16 of the feeder sleeve neck 12 provides a second annular surface 32 on which the second continuous sidewall 22 is mounted.

[0078] The first continuous sidewall 20 is a tubular body which is open at each end, having an internal diameter d_1 and an external diameter d_2. The first continuous sidewall 20 defines a bore that functions as a feeder sleeve cavity 34 in use. The second continuous sidewall 22 is also a tubular body, with an internal diameter d_3 and an external diameter d_4. As can be seen from Figure 1, the internal diameter d_3 of the second continuous sidewall 22 is greater than the external diameter d_2 of the first continuous sidewall 20, such that a gap 36 is formed between the first and second continuous sidewalls 20, 22 when they are mounted on the feeder sleeve neck 12. In the embodiment shown, this gap 36 is filled with a filler 37. The filler 37 may be supplied as part of the kit, or separately. The filler 37 is contained within the gap 36 by the lid 24 which extends across the external diameter d_4 of the second continuous sidewall 22 and of the feeder sleeve 10. It can be seen from Figure 1 that the relative heights of the first and second continuous sidewalls 20, 22 are selected such that, when they are mounted on the feeder sleeve neck 12, the ends of the sidewalls distal to the feeder sleeve neck 12 are vertically aligned (in the in-use orientation) such that the lid 24 is flush with both ends of the first and second continuous sidewalls 20, 22.

[0079] The feeder sleeve 10 of Figure 1 may be exothermic, having an exothermic feeder sleeve neck 12, exothermic first and second continuous sidewalls 20, 22, an exothermic lid 24 and an exothermic filler 37.

[0080] With reference to Figure 2, in another embodiment a feeder sleeve 10 is assembled from a kit comprising a feeder sleeve neck 12, a first continuous sidewall 20, two second continuous sidewalls 22a, 22b and a lid 24.

[0081] The feeder sleeve neck 12 has a first end 14 and a second end 16, with a tapered sidewall 18 therebetween. The first end 14 has an inwardly-directed pointed edge 41, which creates a defined notch in the metal feeder, which in turn facilitates knock-off of the feeder from the casting. Close to the first end 14 of the feeder sleeve neck 12, a notch 40 is provided in an inner surface 42 of the feeder sleeve neck 12. The notch 40 provides a mounting surface for the first continuous sidewall 20. At the second end 16 of the feeder sleeve neck 12, the annular surface 32 has a protrusion 44 for providing a tongue-and-groove connection with a complementary groove 46 in a lower end 48 of the second continuous sidewall 22a. An upper end 50 of the second continuous sidewall 22a is provided with a protrusion 51 which similarly forms a tongue-and-groove connection with a lower end 53 of another second continuous sidewall 22b, which in turn is connected in the same manner to the lid 24.

[0082] The second continuous sidewalls 22a, 22b are stacked together to form an outer tubular sidewall 38 of the feeder sleeve 10. It will therefore be appreciated that multiple second continuous sidewall pieces can be combined to provide feeder sleeves of varying height.

[0083] As in the embodiment of Figure 1, a gap 36 is formed between the first continuous sidewall 20 and the outer tubular sidewall 38, this gap 36 being filled with a filler material 37. In the embodiment of Figure 2, the first continuous sidewall 20 has a closed end 52. In the assembled feeder sleeve 10 this closed end 52 is located distal to the feeder sleeve neck 12. The outer tubular sidewall 38 extends further vertically (in the in-use orientation) than the first continuous sidewall 20, such that another gap 54 is formed between the closed end 52 and the lid 24. This gap 54 is also filled with a filler material 37. In the embodiment shown the feeder sleeve neck 12, sidewalls 20, 22a, 22b, 38 and filler 37 may be exothermic, while the lid 24 may be insulating.

[0084] Figure 3 shows a further embodiment of a modular feeder sleeve 10, having a similar overall construction to the feeder sleeve of Figure 2. In this embodiment, the feeder sleeve 10 is again constructed from a feeder sleeve neck 12a, a first continuous sidewall 20, second continuous sidewalls 22a, 22b which together form an outer sidewall 60, a lid 24 and a filler 37.

[0085] In this embodiment, the feeder sleeve neck 12a is defined by a curved sidewall 56, giving the feeder sleeve neck 12a a rounded profile. The first end 14 of the feeder sleeve neck 12a has an inwardly-directed pointed edge 41, which facilitates knock-off. Close to the first end 14 of the feeder sleeve neck 12a, an annular surface 30 is provided for supporting the first continuous sidewall 20. At the end distal to the feeder sleeve neck 12a, the feeder sleeve cavity 34 defined by the first continuous sidewall 20 is closed by an inner lid 58. The relative heights of the first continuous sidewall 20 and the outer sidewall 60 (formed from the second continuous sidewalls 22a, 22b) in the assembled feeder sleeve 10 are such that a significant gap is formed between the (outer) lid 24 and the inner lid 58 which closes the feeder sleeve cavity 34. This results in a thick layer of filler material 37 above the feeder sleeve cavity 34. In the embodiment shown the sidewalls 20, 22a, 22b, feeder sleeve neck 12, lids 24, 58 and filler 37 may be made from an insulating material.

[0086] In the embodiment of Figure 3 the second continuous sidewalls 22a, 22b each define a bore having a cross sectional area which varies along its length. The lower second continuous sidewall 22a is oriented such that the bore widens towards the upper end of the assembled feeder sleeve 10 (in the in-use orientation), whereas the upper second continuous sidewall 22b is oriented such that the bore narrows in the direction of the upper end of the assembled feeder sleeve 10. The second continuous sidewalls 22a, 22b are therefore joined at their wider ends. As a result, the overall feeder sleeve 10 is wider in its middle region than at its upper and lower ends.

[0087] Figure 4 shows a further embodiment of a feeder sleeve 10 assembled from a feeder sleeve neck 12 having a tapered sidewall 18, a first continuous sidewall 20, a second continuous sidewall 22, a lid 24, an inner lid 58 and a filler 37. The overall construction of the feeder sleeve 10 is similar to the embodiment of Figure 2, one difference being that there is only one second continuous sidewall 22. In this embodiment the second continuous sidewall 22 defines a bore of which the cross-sectional area decreases along its length. In the assembled feeder sleeve 10, the bore, and thus the external diameter, narrows slightly towards the upper end of the feeder sleeve 10. Both the inner and outer lids 24, 58 are provided with cut-outs for receiving the ends of their respective sidewalls 20, 22.

[0088] In the embodiment of Figure 4 a breaker core 62 is provided. The breaker core 62 has a recess 64 in its upper surface, on which the narrower first end 14 of the feeder sleeve neck 12 is mounted. The first continuous sidewall 20 is also mounted directly in the recess 64 of the breaker core 62, rather than on the feeder sleeve neck 12 as in the previous embodiments. An inwardly directed point 43 is formed in the neck aperture defined by the breaker core 62. The breaker core 62 may be formed from an insulating material, such as sand.

[0089] In this embodiment the first continuous sidewall 20 may be formed from metal, such as steel. The second continuous sidewall 22, the feeder sleeve neck 12, the lid 24 and the inner lid 58 may be formed from exothermic materials. The filler 37 may be exothermic.

[0090] Figures 5a, 5b and 5c show how the modular system of the invention may be used to provide feeder sleeves of varying height and diameter. Figures 5a, 5b and 5c show feeder sleeves 100a, 100b and 100c, respectively. All three feeder sleeves are assembled from a kit comprising a feeder sleeve neck 112, two types of first continuous sidewall 120a, 120b, two types of second continuous sidewall 122a, 122b, a plurality of lids 124a, 124b, 58a, 58b, and a filler 37.

[0091] The feeder sleeve neck 112 has an inner surface 130 comprising a plurality of steps 132 on which the sidewalls can be mounted. The first and second continuous sidewalls 120a, 120b, 122a, 122b are provided with cut-outs in each end which correspond in shape and size to the steps 132. By altering the position of the first and/or second continuous sidewall 120a, 120b, 122a and 122b on the stepped inner surface 130 of the feeder sleeve neck 112, the height of the feeder sleeve as well as its internal and external diameters can be selected.

[0092] Thus, in the embodiment of Figure 5a, the first continuous sidewall 120a is mounted on the two steps closest to the first end 114 of the feeder sleeve neck 112, while the second continuous sidewall 122a is mounted on the two steps closest to the second end 116, thereby placing the sidewalls 120a, 122a as far apart as possible. This maximizes the height of the feeder sleeve, and the overall sidewall thickness.

[0093] In the embodiment of Figure 5b, the alternative second continuous sidewall 122b is selected. This has a reduced diameter compared to that of Figure 5a, and so must be located further down the stepped inner surface 130 of the feeder sleeve neck 112. As a result, the overall height and wall thickness of the feeder sleeve 100b is reduced compared to the feeder sleeve 100a of Figure 5a.

[0094] In the embodiment of Figure 5c, the feeder sleeve 100c is constructed using the same second continuous sidewall 122a as in Figure 5a. In this embodiment, an alternative first continuous sidewall 120b is selected, which has an increased diameter compared to the first continuous sidewall 120a used in the feeder sleeves 100a, 100b shown in Figures 5a and 5b. Accordingly, the first continuous sidewall 120b is located on the inner surface 130 a few steps away from the first end 114 of the feeder sleeve neck 112. This arrangement increases the internal volume of the feeder sleeve cavity 34. The filler 37 may be insulating.

[0095] The present invention thus provides a kit that enables the construction of modular feeder sleeves which can be tailored in size and shape according to the desired application. Advantageously, the modular system enables large feeder sleeves to be assembled in situ.

Claims

1. A kit for a feeder sleeve for use in casting molten metal, the kit comprising:

a feeder sleeve neck having a narrower first end and a wider second end;
a first continuous sidewall, defining a first bore which extends between two ends, at least one of which is open; and
a second continuous sidewall, defining a second bore which extends between two open ends, wherein the second continuous sidewall is sized to be received on a mounting surface provided on the feeder sleeve neck, at or close to the second end thereof, and
wherein the first continuous sidewall is sized to be received within the second continuous sidewall such that a gap is formed between an outer surface of the first continuous sidewall and an inner surface of the second continuous sidewall.

2. The kit of claim 1, wherein the first and/or second continuous sidewall is tubular.

3. The kit of claim 1 or claim 2, wherein the feeder sleeve neck is frustoconical in shape.

4. The kit of any one of claims 1-3, wherein the first continuous sidewall is sized to mate with the feeder sleeve neck, on or close to the first end thereof.

5. The kit of any preceding claim, wherein the feeder sleeve neck has an inner surface which is provided with one or more notches or ledges for receiving an end of the first and/or second continuous sidewall thereon.

6. The kit of any preceding claim, wherein the first and/or second continuous sidewall is made of a material which is exothermic or exothermic insulating.

7. The kit of any preceding claim, wherein the first and/or second continuous sidewall is formed from a fired refractory material.

8. The kit of any one of claims 1 to 5, wherein the first and/or second continuous sidewall is formed from steel.

9. The kit of any preceding claim, further comprising a filling material for filling the gap between the first and second continuous sidewalls.

10. The kit of any preceding claim, further comprising a lid which is sized to cover the second bore.

11. The kit of any preceding claim, further comprising a breaker core.

12. The kit of any preceding claim, wherein the kit is for a feeder sleeve having a modulus of greater than 7 cm.

13. A feeder sleeve for use in casting molten metal, the feeder sleeve comprising:

a feeder sleeve neck having a narrower first end and a wider second end;
a first continuous sidewall, defining a first bore which extends between two open ends, at least one of which is open; and
a second continuous sidewall, defining a second bore which extends between two open ends, wherein the second continuous sidewall is mounted on the feeder sleeve neck, at or close to the second end thereof, and
wherein the first continuous sidewall is received within the second continuous sidewall such that a gap is formed therebetween.

14. The feeder sleeve of claim 13, wherein the first continuous sidewall mates with the feeder sleeve neck, on or close to the first end thereof.

15. The feeder sleeve of claim 13 or claim 14, wherein the gap between the first and second continuous sidewalls is filled with a filling material.

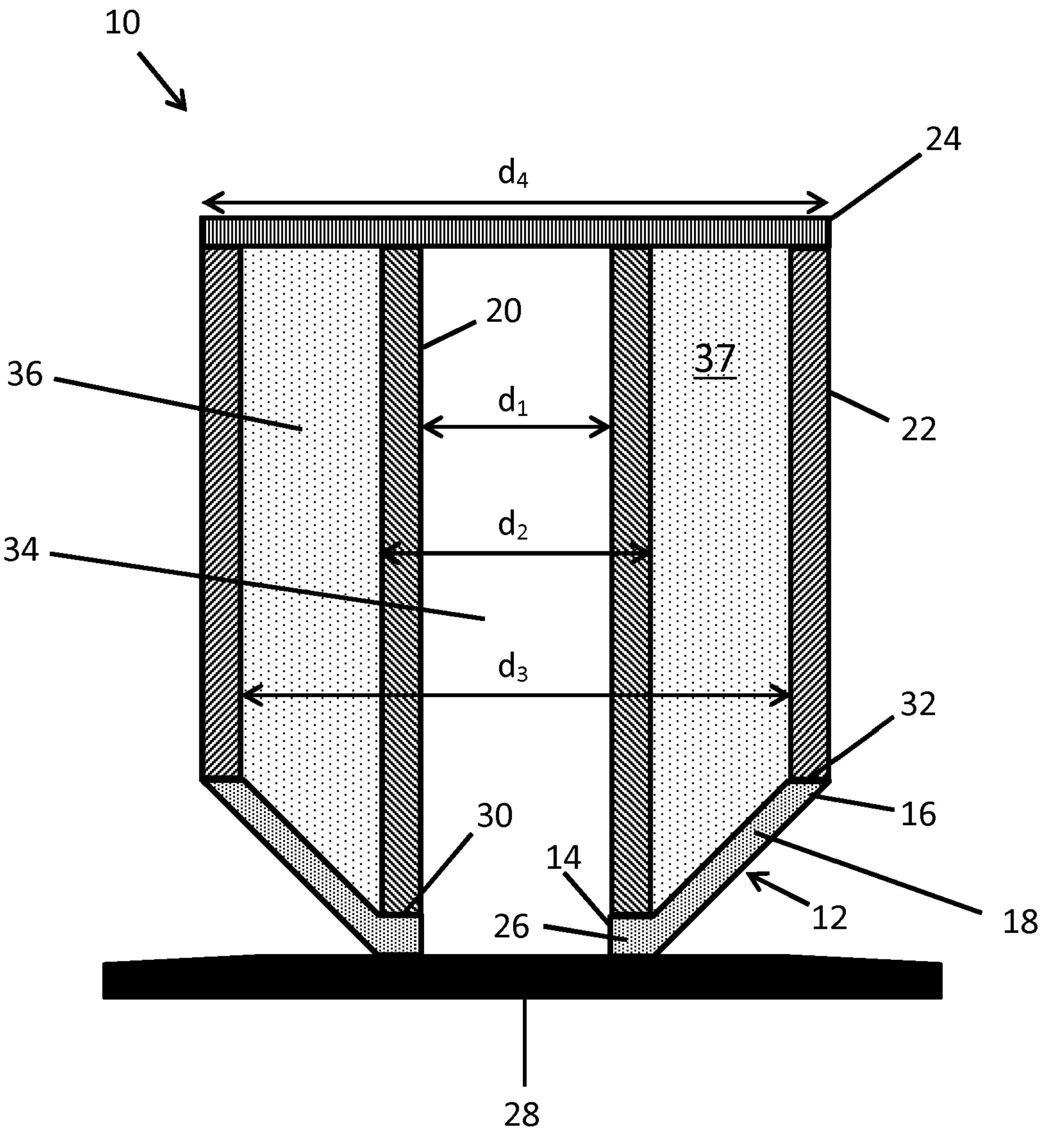

Figure 1

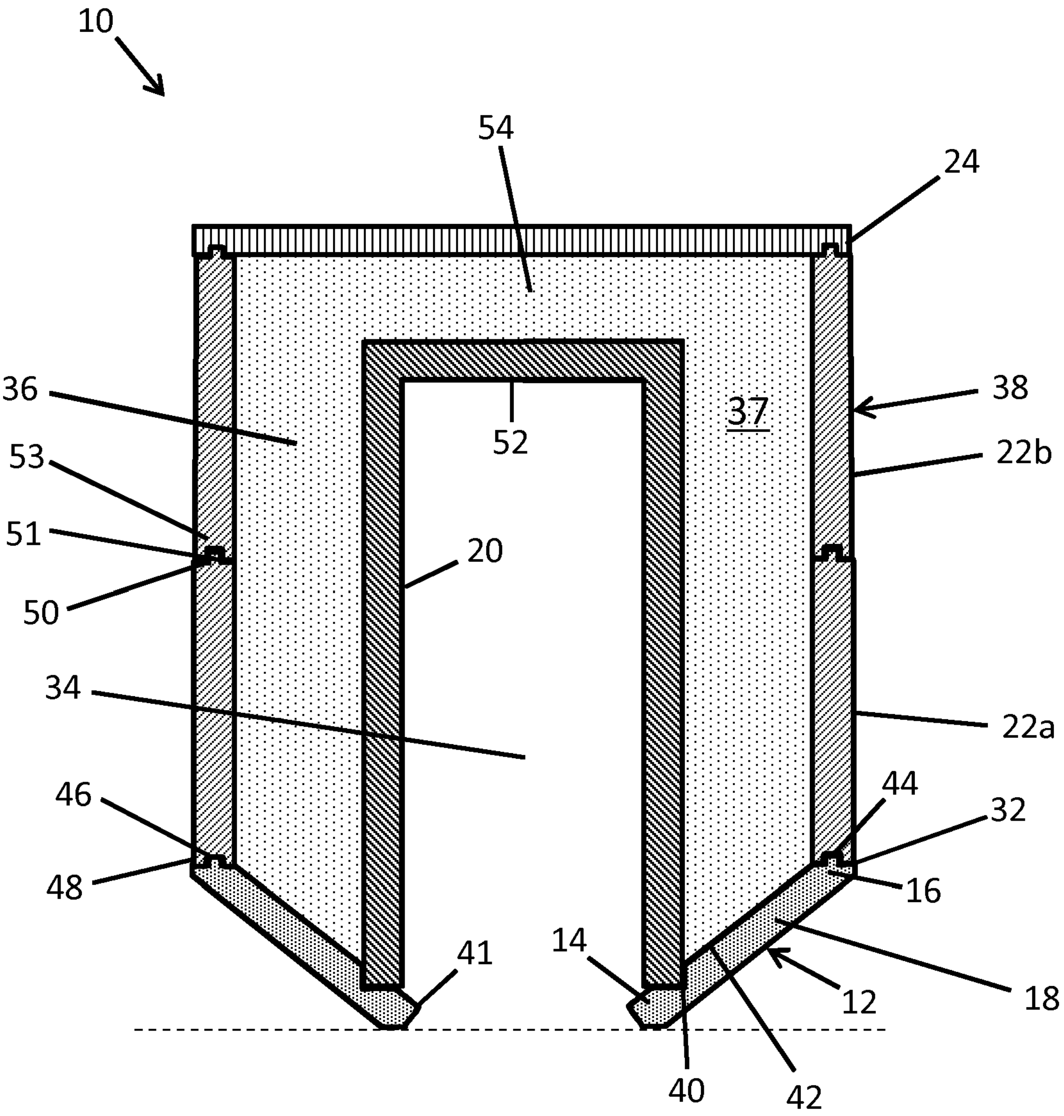
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Figure 2

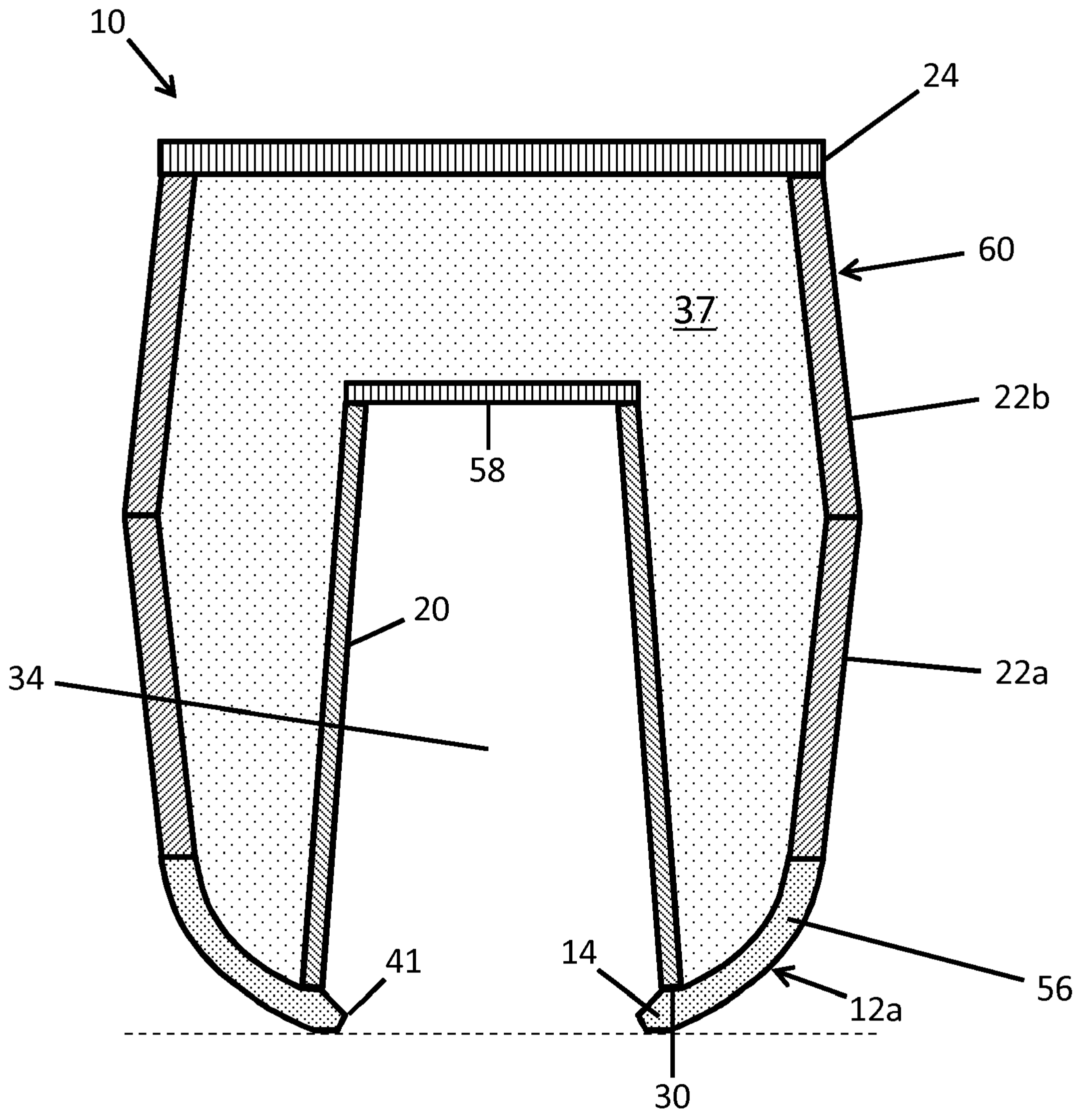

Figure 3

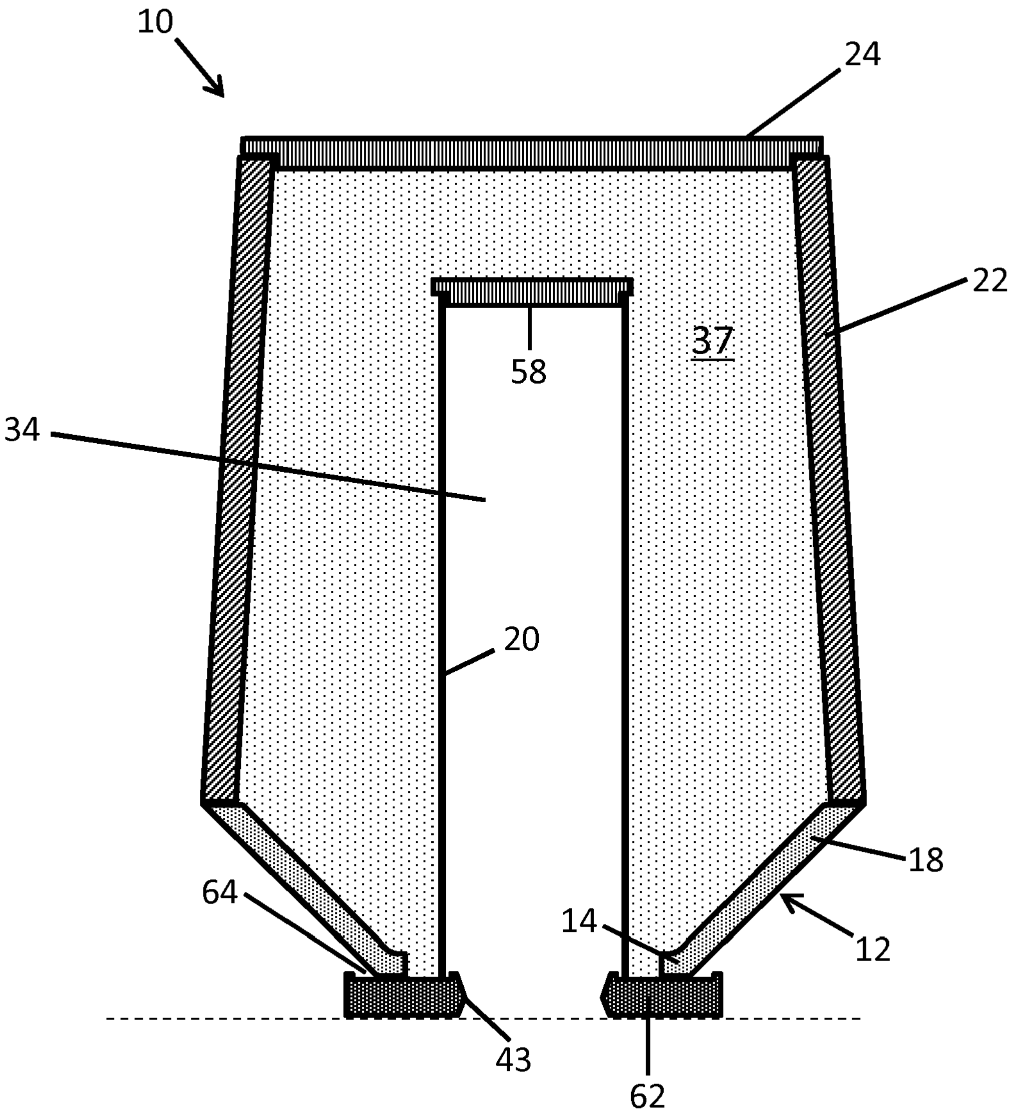

Figure 4

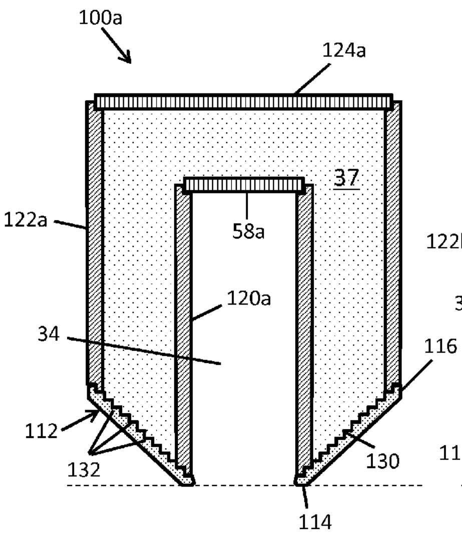

Figure 5a

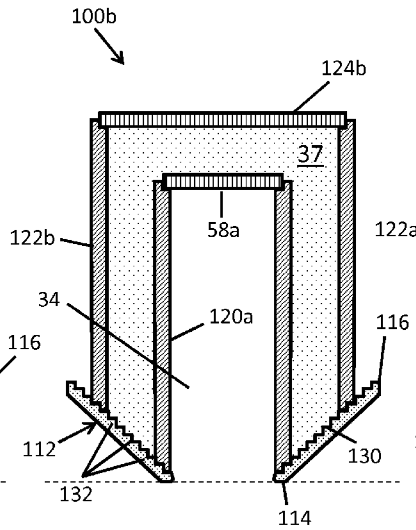

Figure 5b

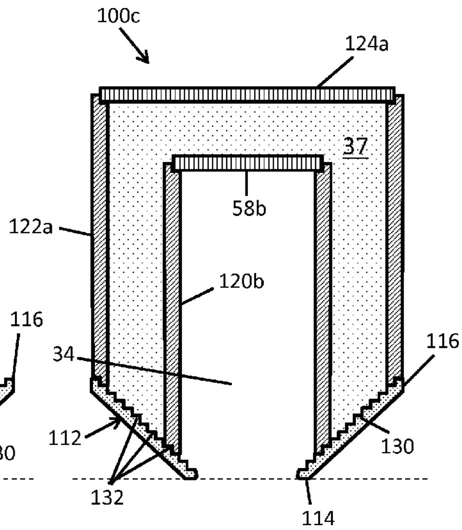

Figure 5c

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EUROPEAN SEARCH REPORT

Application Number
EP 19 15 2663

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X A	WO 00/27562 A1 (ASHLAND INC [US]) 18 May 2000 (2000-05-18) * figures 1-2 * -----	13,14 1-12,15	INV. B22C9/08
X A	DE 10 2007 012117 A1 (LUENGEN GMBH AS [DE]) 18 September 2008 (2008-09-18) * figures 1-5 * -----	13,14 1-12,15	
			TECHNICAL FIELDS SEARCHED (IPC)
			B22C

The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
Munich	27 February 2019	Baumgartner, Robin

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27-02-2019

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WO 0027562 A1	18-05-2000	AU 2146600 A WO 0027562 A1	29-05-2000 18-05-2000
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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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