IMPROVEMENTS RELATING TO TACTILE GROUND SURFACE INDICATORS

Field of the Invention

The present invention provides improvements in relation to tactile ground surface indicators. More particularly, the invention provides improved methods of manufacturing a tactile ground surface indicator, and indicators formed by such methods.

Background

Tactile ground surface indicators comprise protuberances which are fixed over walking surfaces, including in particular footpaths, stairs and platforms, principally to warn blind and vision-impaired pedestrians of a hazard ahead and/or to provide them with directional orientation information. The present invention provides improvements relating to tactile ground surface indicators, particularly the manufacture thereof.

Summary of the Invention

According to a first aspect of the present invention, there is provided a method of manufacturing a tactile ground surface indicator which comprises a head configured to lie fixed over a ground surface, the method comprising plastically deforming a section of metal plate to form a dish-shaped piece and machining an exterior of the dish-shaped piece whereby an external profile of said head is formed.

In a preferred embodiment of the invention, the section of metal plate is substantially simultaneously cut – preferably punched - from flat metal plate and plastically deformed to form said piece. In an alternative embodiment of the invention, the section of metal plate is cut – preferably punched – from the flat metal plate to form a blank and the blank is thereafter plastically deformed to form said piece.

Preferably, said section is coined to form the dish-shaped piece. Alternatively, said section may be forged to form the dish-shaped piece.

Preferably said dish-shaped piece is formed so as to have a substantially flat central portion

and a sloped peripheral portion extending radially outwardly from the central portion.

Preferably, the section is substantially circular, whereby the dish-shaped piece is generally frustoconical and the head is generally button-shaped. Preferably, the head is formed such that a lower end of a peripheral side wall thereof has an outer diameter of about 35mm and an upper end of the peripheral side wall has an outer diameter of about 25mm. Preferably, the head is formed such that it has a height in the range of about 4mm to about 5mm.

Preferably, said head is configured with a grip, and said machining comprises machining the central portion to form the grip.

Preferably, the grip comprises concentric upwardly projecting ribs. Preferably, the dish-shaped piece is the generally frustoconical one, whereby the ribs comprise rings.

In one embodiment of the invention, the machining is effected such that the grip includes or is defined by an upwardly projecting lip which is coincident with or closely adjacent to an upper end of an inclined peripheral side face of the head. Preferably, the dish-shaped piece is the generally frustoconical one, such that the lip is a ring.

In one embodiment of the invention, said head is to have a smooth inclined peripheral side face and said machining comprises machining the peripheral portion to define said side face. In another embodiment of the invention, said head is to have a peripheral side wall having an inclined, stepped exterior, and said machining comprises machining the peripheral portion to define that exterior.

Preferably, the indicator is manufactured so as to include a downwardly projecting stem connected to the head to be fixedly receivable by a cavity formed through the ground surface for anchoring the indicator head over the ground surface.

Preferably, the method includes connecting an element defining the stem or from which the stem is derived to the head or a piece from which the head is derived to effect the

interconnection between the head and the stem.

Preferably, the element is positioned such that an end portion thereof extends through a hole formed through the head/piece and plastic deformation of the end and/or head/piece is effected to create an interlock between the head/piece and stem/element.

Preferably, the element is connected to the head/piece before the machining. Advantageously, the dish-shaped piece can then be mounted to an apparatus, preferably a lathe, used to effect the machinining, via the element.

In a preferred embodiment of the invention the method comprises~~According to a second aspect of the present invention, there is provided~~ a method of manufacturing a tactile ground surface indicator having a head and a downwardly projecting member connected to the head to be fixedly receivable by a cavity formed through the ground surface for anchoring the head over a ground surface, in which method an element defining the downwardly projecting member or from which that member is derived is positioned such that an end portion thereof extends through an opening formed through either the head or a piece from which is derived an exterior portion of the head arranged to be visibly exposed when the head is anchored, and plastic deformation of the end portion and/or piece is effected to create an interlock between the piece and element.

Preferably, the plastic deformation is effected by swaging.

In a preferred embodiment of the invention the downwardly projecting member comprises a stem. In such an embodiment, the head may be generally button-shaped or configured in the form of a truncated cone.

Preferably, the opening is defined by a hole.

In an embodiment of the invention, substantially the entirety of the head is derived from said piece.

In a preferred embodiment of the invention the method comprises ~~According to a third aspect of the present invention, there is provided~~ a method of manufacturing a tactile ground surface indicator having a head and a downwardly projecting stem connected to the head to be fixedly receivable by a cavity formed through the ground surface for anchoring the indicator head over a ground surface, in which method an element defining the stem or from which the stem is derived is positioned such that an end portion thereof extends through a hole formed through either the head or a piece from which the head is derived and plastic deformation of the end portion and/or head/piece is effected to create an interlock between the head/piece and stem/element.

In one embodiment of the invention, the method includes ~~according to the second or third aspect of the invention accords with the first aspect of the invention, formation of the head comprising~~ deformation of said section of metal plate. In another embodiment of the invention, the head comprises a substantially flat base occupying substantially the entirety of a footprint of the head to be receivable against the ground surface. Preferably, in the latter embodiment, the head is a substantially solid piece of metal.

In a preferred embodiment of the invention ~~any one of the first to third aspects~~, said element is configured with a plug portion which is sized so as to be incapable of passing through said opening or hole such that withdrawal of the downwardly projecting member or stem from the head in an axial direction from the plug portion to the opening or hole is precluded.

Preferably, the element is further configured with a void and the head/piece is plastically deformed such that material of which the head/piece is comprised flows into said void to occupy it, thereby precluding withdrawal of the downwardly projecting member or stem from the head in an axial direction from the opening or hole to the plug portion. Preferably, said material flows to occupy substantially the entirety of said void. Preferably, the plug portion is formed at an upper end of said end portion and said void is formed below that upper end. Preferably, the void is bounded at an upper end thereof by a

lower end of said plug portion. Preferably, the void extends circumferentially. Preferably, the element is configured with a radially inward or transverse taper defining said void. Preferably, the plastic deformation of the head/piece is effected by applying pressure through the plug portion. Preferably, the application of said pressure through the plug portion effects countersinking of part of the plug portion in the head/piece. In an advantageous embodiment of the invention, the plug portion can thus thereafter be machined such that what remains thereof is flush with an upwardly facing surface of the indicator head.

Preferably, the downwardly projecting member or stem is metal.

Preferably, the metal is steel. Preferably, the steel is stainless steel.

In one embodiment of ~~any one of the first, second and third aspects of~~ the invention, the indicator is one in which the downwardly projecting member or stem is fully exposed. The downwardly projecting member or stem may then be received directly into cement or adhesive in the cavity to be secured thereby when the cement or adhesive sets, such that anchorage of the head over the ground surface is effected. Preferably the downwardly projecting member or stem is shaped to form an interlock with the cement or adhesive when set; to this end, the downwardly projecting member or stem may be configured with a circumferentially extending notch or channel into which adhesive/cement in the channel can flow before it sets.

In another embodiment of ~~any one of the first, second and third aspects of~~ the invention, the indicator is to include a casing over said downwardly projecting member or stem, which casing is configured to deform against a side wall of the cavity when forced into the cavity, thereby effecting anchorage of the head over the ground surface. Preferably the downwardly projecting member or stem is shaped to form an interlock with the casing; to this end, the downwardly projecting member or stem may be configured with a peripherally or circumferentially or peripherally extending notch or channel which receives a complementarily formed, transversely or radially inwardly projecting portion of said

casing.

Preferably, the casing is plastic.

Preferably, the casing is moulded to the downwardly projecting member or stem. Preferably, the casing is formed by injection moulding.

In a preferred embodiment of ~~the first aspect of~~ the invention, the injection moulding is effected to form, in addition to said casing, an infill which occupies a downwardly opening recess defined within the head and created by the plastic deformation of the section of metal plate.

According to a ~~fourth~~second aspect of the present invention, there is provided an indicator formed by a method according to ~~any one of said~~the first aspect~~, said second aspect and said third aspect~~.

Brief Description of the Drawings

The present invention will now be described, by way of non-limiting example only, with reference to the accompanying drawings, in which:

Figure 1 is a perspective view of a blank for forming a head of a tactile ground surface indicator in accordance with a first preferred embodiment of the invention;

Figure 2 is a schematic view showing preliminary fitting of an elongate metal element to the blank for the purposes of forming a metal stem of the indicator;

Figures 3A to 3C schematically depict subjection of a preassembly, comprising the blank and elongate element, to a stamping and pressing process to effect coining of the blank, thereby forming a dish-shaped piece therefrom, and plastic deformation of an upper end of the elongate element to fix that element to the piece;

Figure 4 schematically depicts machining of an upper surface of the dish-shaped piece and lower end of the elongate element to form a gripping pattern and annular channel respectively;

Figure 5 schematically depicts the formation, by injection moulding, of a casing

over the stem and an infill occupying a recess defined in the head;

Figure 6 is an upper perspective view of the indicator as formed in accordance with the first embodiment;

Figure 7 is a lower perspective view of the indicator shown in Figure 6;

Figure 8 is a cross sectional elevation view of the indicator shown in Figure 6 installed;

Figure 9 schematically depicts simultaneous cutting out and deforming of a section of stainless steel plate, from which an indicator head derives, in the manufacture of an indicator in accordance with a second preferred embodiment of the present invention;

Figure 10 shows a dish-shaped piece formed by the step depicted in Figure 9;

Figure 11 depicts preassembly of the piece shown in Figure 10 and an elongate element defining a stem of the indicator;

Figure 12 schematically depicts subjection the resulting preassembly to a pressing process to effect plastic deformation and thus fixing of the element to the dish-shaped piece;

Figures 13A and 13B schematically illustrate the manner in which the dish-shaped piece and an upper end of the elongate element are deformed in the step depicted in Figure 12;

Figure 14 schematically illustrates the assembly created via the step depicted in Figure 12;

Figure 15 schematically depicts machining of the assembly shown in Figure 14 to form the steel component of the indicator manufactured in accordance with the second embodiment;

Figure 16 schematically depicts what remains of a deformed upper end of the elongate element following the machining step depicted in Figure 15;

Figure 17 schematically depicts the formation, by injection moulding, of a casing over the stem and an infill occupying a recess defined in the head in the method according to the second embodiment;

Figure 18 is an upper perspective view of the indicator as formed in accordance with the second embodiment;

Figure 19 is a perspective view of a blank for forming a head of a tactile ground

surface indicator in accordance with a third preferred embodiment of the invention;

Figure 20 is a schematic view showing preliminary fitting of an elongate metal element to the blank for the purposes of forming a metal stem of the indicator in the method according to the third embodiment;

Figures 21 and 22 schematically depict subjection of a preassembly comprising the blank and elongate element, resulting from the step shown in Figure 20, to a pressing process to effect plastic deformation of an upper end of the elongate element to fix that element to the piece;

Figure 23 schematically depicts machining of an assembly formed by the step shown in Figures 21 and 22 to form a gripping pattern and annular channel;

Figure 24 schematically depicts the formation, by injection moulding, of a casing over the indicator stem defined as a result of the step shown in Figure 23;

Figure 25 is a lower perspective view of the indicator as formed in accordance with the third embodiment;

Figure 26 is a perspective view of a blank for forming a head of a tactile ground surface indicator in accordance with a fourth preferred embodiment of the invention;

Figure 27 is a schematic view showing preliminary fitting of an elongate metal element to the blank for the purposes of forming a metal stem of the indicator in the method according to the fourth embodiment;

Figures 28 and 29 schematically depict subjection of a preassembly comprising the blank and elongate element, resulting from the step shown in Figure 27, to a pressing process to effect plastic deformation and thus fixing of the blank to the element;

Figure 30 schematically depicts machining of an assembly formed by the step shown in Figures 28 and 29 to form a gripping pattern and annular channel;

Figure 31 schematically depicts what remains of a deformed upper end of the elongate element following the machining step depicted in Figure 30;

Figure 32 schematically depicts the formation, by injection moulding, of a casing over the indicator stem defined as a result of the step shown in Figure 30; and

Figure 33 is a lower perspective view of the indicator as formed in accordance with the fourth embodiment.

Detailed Description of the Preferred Embodiments

The present invention is embodied in methods of manufacturing a tactile ground surface indicator, and indicators manufactured by such methods, including the indicators 100 and~~,~~ 100'~~, 200, 200'~~ illustrated in Figures 6~~,~~ and 18~~, 25 and 33~~ respectively.

~~Manufacture of an indicator according to each of the preferred embodiments comprises interconnection of a piece defining a head of the indicator, or from which the head is derived (i.e., out of which the head is formed), to an element defining a stem of the indicator, or from which the stem is derived (i.e., out of which the stem is formed), by effecting plastic deformation of either or each of the element and piece.~~

A method of manufacturing indicator 100, shown in Figures 6 and 7, will now be described. The indicator 100 comprises a head 5, a downwardly projecting stem 10 and a single-piece moulding 15 which defines both a casing 16 over the stem 10 and an infill 19 which occupies a downwardly opening recess formed in the underside of the head 5.

Manufacture of the indicator 100 commences, referring to Figures 1 and 2, with the formation of a blank 2, from which the head 5 is derived, and an elongate element 6, from which the stem 10 is derived. The blank 2 comprises a section cut from 2.5mm thick stainless steel plate. The blank 2 is circular, thus assuming the configuration of a disc, and is formed with a hole 3 therethrough. Preferably, the formation of the hole 3 and the formation of the disc perimeter are simultaneous, i.e. both are formed by subjecting the steel plate to a single punching step. The elongate element 6 is formed from a section of 4.5mm diameter stainless steel round bar, which section is machined at one end such that the element is configured with an end portion 7 of reduced diameter and an annular shoulder 9. The end portion 7 has a diameter which is a fraction larger than that of the hole 3 and is introduced into the hole 3, for example by gentle tapping of the opposite end of the element 6 with a hammer, such that the shoulder 9 abuts one of the main faces 4 of the blank, whereby there is formed a preassembly 11, comprising the blank 2 and element 6, in which an axially outermost end of the end portion 7 projects proud of the other main face 4 of the blank 2.

Referring to Figure 3A, the element 6 is then introduced into a cylindrical cavity 20 in a mounting part 22 of a die press 27, whereby the blank 2 and exposed end of portion 7 are presented to a frustoconical cavity 25 of the die 28. Referring to Figures 3B and 3C, when the die 28 is urged towards the mounting part 22, the exposed end of portion 7 and the blank 2 are forced against the internal wall structure of the cavity 25, comprising a flat upper face 25A and an inclined circumferential face 25B, whereby the blank 2 is deformed so as to form a domed or dish-shaped piece 12, comprising a substantially flat central portion 13 and a sloped peripheral portion 14 extending radially outwardly from the central portion 13, the portions 13 and 14 defining a downwardly opening recess 8, and the end of portion 7 is plastically deformed, thereby spreading or mushrooming to form a plug portion 7A which is transversely too large to be drawn through the hole 3. The pressure applied through the exposed end of portion 7, by the face 25A, may, in addition to causing the plastic deformation of that end, cause localised plastic deformation of an annular portion of the blank 2 adjacent the hole 3 such that at least part of the plug portion 7A is countersunk in the dish-shaped piece.

The element 6 is thus swaged. More particularly, the portion 13 is trapped between the shoulder 9 and plug portion 7A such that the piece 12 is securely fixed to the element 6.

Next, referring to Figure 4, the preassembly, comprising the thus securely interconnected element 6 and piece 12, is machined such that a circumferential notch or channel 17 is formed into the element 6 adjacent a lower end thereof, whereby the stem 10 is defined, and an external profile is formed on the piece 12, whereby the head 5 is defined. The circumferential channel 17 can alternatively be formed in the element 6 before it is attached to the blank 2, without departure from the invention.

In the formation of the head external profile, the preassembly is mounted in a lathe, via element 6, and portions 14 and 13 machined such that the head 5 has a smooth inclined circumferential side face 5A and a top portion configured with concentric upwardly projecting rings 104 which define a grip that reduces the likelihood of slippage when the

head 5 is stepped upon.

In this embodiment, and each of the other embodiments, the resulting assembly 30, comprising the head 5 and stem 10, may constitute an indicator in its own right. Specifically, the stem 10 can be received directly into adhesive or cement provided in a cavity formed through the ground surface, whereby the adhesive/cement flows such that some of it occupies the annular channel, creating an interlock with the stem when the adhesive/cement sets, to anchor the head 5 over the ground surface. This being said, it is preferable that a deformable casing be applied to the stem, as outlined below.

The assembly 30, referring to Figure 5, is mounted in an injection moulding apparatus 40 in a manner such that there is defined a mould cavity 41 which is bounded by the inner surface 5A of the head 5 and by the exterior surface 10A of the stem 10, and also bounded by mould tool sections of the apparatus 40, whereby plastic injected into the cavity 41 forms a single-piece moulding 15 comprising an infill 19 which occupies the recess 8 defined by the dish-shaped head 5, and a casing 16 which surrounds the stem 10 and which additionally covers the lower end thereof whereby no part of the stem 10 is exposed (see also Figures 6 and 7). During the injection moulding, plastic flows into the annular channel 17 whereby an interlock between the moulding 15 and assembly 30 is created, reliably securing the former to the latter.

The casing 16 is preferably moulded in a manner such that it is configured with four axially extending ribs 16A spaced therearound at 90° intervals, and a tapered lower end 16B.

Advantageously, infilling of the recess 8 with plastic (to form infill 19) when the casing 16 is formed eliminates the need for a mould piece which would otherwise need to be received by the cavity, whereby the mould tooling is simplified, as will be recognised by a person skilled in the art.

The infill 19 has a flat exterior face which is flush with a flat annular face defining the base

of the head 5.

With reference to Figure 8, installation of the indicator 100 comprises drilling of a cavity 80 into hard ground 85, e.g. concrete, introducing the end 18B of the casing 16 into the cavity 80 and driving the indicator 100 downwardly, such that the ribs are compressed radially inwardly by the circumferential cavity wall, until the base of the head 5 and underside (exterior face) of the infill 19 abut the ground surface 82, the resulting frictional and compressive engagement between the casing 16 and the ground securely anchoring the head 5 over the surface 82.

In the forthcoming description of the additional embodiments of the invention, the same reference numerals as have been used in relation to earlier-described embodiments will, where appropriate, be used to denote and refer to the same or corresponding features.

Manufacture of indicator 100', shown in Figure 18, in accordance with a second preferred embodiment of the invention is the same as for the indicator 100 except with respect to the manner in which portions from which the head and stem derive are formed, brought together and fixed together. In this embodiment, referring to Figure 9, the section of stainless steel plate 2' from which the head 5 derives is simultaneously cut out from steel plate and deformed, in a combined punching and deforming/coining operation whereby circular piece 12' is formed, as illustrated in Figure 10. The operation is effected by way of an apparatus 27' comprising a die 28' similar to the die 28 except that is additionally comprises an inner cylindrical cutter 29A, for forming the hole 3, and outer cylindrical cutter 29B, for forming the perimeter of the piece 12, and further comprising a part 22' similar to the part 22 except that it is formed with a shallow recess 20', which receives a portion of the cutter 29A once it has been driven through the plate section.

Referring to Figure 11, the elongate element 6, prior to being received by piece 12', is formed with annular channel 17 and configured at an upper end thereof with a shallow head 6A, defining a radially outwardly projecting flange, and an undercut 6B, preferably defined by a taper, immediately below the head 6A. In this embodiment, the element 6 and

piece 12 are brought together by introducing a bottom end of the element 6 through the top end of the hole 3 and passing the stem-defining part of the element through the hole 3 such that the underside of the head 6A is received against the top face of the piece 12 and the undercut 6B is located within the hole 3 whereby it defines, as shown in Figure 13A, a void 6C between the surface of the taper and the cylindrical internal face which defines the hole 3. The hole 3 has a greater diameter than in the previous embodiment, such that the stem-defining part of the element can be passed therethrough. Referring to Figure 12, the preassembly thus created is mounted in a press 27", which is similar to the apparatus 27, comprising a part 22 which receives the element 6 and is received against the bottom surface of the upper portion 13, and a part 23 which is receivable against the top of the head 6A, the working face of the latter part in this embodiment comprising solely a flat face 25C. The part 23 is then urged toward the part 22, or vice versa, whereby the face 25C and head 6A are forced against each other, such that an annular portion of the piece 12 adjacent the undercut 6B is plastically deformed (and the piece 12' thus swaged) and the material forming that portion is displaced so as to occupy the undercut and such that a bottom section of the head is countersunk in the thus-deformed central portion 13, whereby a plug portion 7A which is transversely too large to be drawn through the hole 3 is formed, as shown in Figure 13B. The underside of the head, the taper and the material occupying the void 6C together define an interlock whereby the piece 12 is securely fixed to the element 6.

The thus-formed assembly, shown in Figure 14, is then machined, as shown in Figure 15, to define the external profile of the head, including the smooth, inclined circumferential side face 5A and the top 5B formed with the grip comprising concentric upwardly projecting rings 104. Advantageously, because the plug portion 7A' is partially countersunk, as described above, it can be machined such that what remains of it is flush with an upwardly facing surface of the head 5, as shown in Figure 16.

Referring to Figure 17, the moulding 19 is then formed in exactly the same manner as described for the indicator 100.

It will be noted that, in first and second embodiments, part of the piece 12 or element 6 is deformed plastically to effect fixing of the piece 12 and element 6 together. In indicators formed in accordance with variants of these embodiments, which variants also fall within the scope of the invention, the attachment between the head and stem is effected in an alternative manner – e.g. by welding or fusion, or there is no stem whatsoever and the indicator head, formed by deformation and machining, is anchored over the ground surface in an alternative manner - e.g. by adhesive between the head underside and the ground surface – the indicators.

The head 5 can vary in size and thickness. This being said, it is generally preferable that, in all of the embodiments, the lower end/base of the head have an outside diameter of about 35mm, the upper end of the head have a diameter of about 25mm and the head have a height of 4-5mm, whereby the indicator can comply with relevant prescribed standards, including Australian Standard 1428. The inventor has found that the steel plate section thickness being 2.5mm (at least) is sufficient to permit, advantageously, machining of the piece 12, coined from that section, to form the external profile of the head 5 in the indicators 100 and 100'.

Manufacture of indicator 200, shown in Figure 25, in accordance with a third embodiment of the present invention will now be described. The indicator 200 also comprises a head 5, a downwardly projecting stem 10 attached to the head 5, and a moulding defining casing 16 over the stem 10.

The interconnection between the head and stem in this embodiment is effected in the same manner as in the manufacture of indicator 100. However, formation of the generally frustoconical shape of the head 5 in this embodiment does not comprise plastic deformation/coining. Instead, referring to Figures 19 to 22, the blank 2 is punched from thicker steel plate, preferably having a thickness of 5-6mm and, once the elongate piece 6 has been fitted thereto, the resulting preassembly 11 is pressed, using apparatus 27", in a manner such that the end portion 7 (which in this embodiment is longer such that its end protrudes from an upper end of the blank 2) mushrooms/spreads out and preferably also an

annular portion of the blank 2 adjacent the hole 3 plastically deforms such that at least part of the thus-formed plug portion 7A is countersunk in the blank (in generally the same manner as described for the indicator 100). With reference to Figure 23, with the blank 2 now securely fixed to the piece 6, machining is then carried out such that the external profile of the head 5, comprising the side face 5A and top portion 5B having the gripping pattern comprising rings 104, is formed. In the manufacture of both the indicator 200 and the indicator 100, assuming that manufacture involves the aforementioned countersinking of part of the plug portion 7A, the machining can, advantageously, include machining of an upper end portion of the plug portion 7A to form a flat upwardly facing surface that is flush with an annular surface portion adjacent thereto which is formed by machining the blank 2. In this embodiment, the head 5, having not been formed by coining/deformation, comprises a solid piece of steel having a flat base receivable directly against the ground surface; it does not include downwardly opening recess 8. Accordingly, referring to Figure 24, the injection moulding is effected to create only casing 16, since the flat base of the steel piece defines an end of the mould cavity.

Manufacture of indicator 200', shown in Figure 33, is essentially the same as the manufacture of indicator 200 with respect to formation of the head 5, which does not comprise plastic deformation/coining but instead, referring to Figure 26, comprises punching the blank 2 from thicker steel plate, preferably having a thickness of 5-6mm. The manufacture of indicator 200' differs with respect to the manner in which the portion from which the stem derives is formed and the interconnection between the stem and head is formed, and is consistent in this regard with the manufacture of the indicator 100', as will be apparent from the following description. Referring to Figure 27, elongate element 6 is formed with annular channel 17 and configured at an upper end thereof with a shallow head 6A, defining a radially outwardly projecting flange, and an undercut 6B, preferably defined by a taper, immediately below the head 6A, the element 6 and blank 2 are brought together by introducing a bottom end of the element 6 through the top end of the hole 3 and passing the stem-defining part of the element through the hole 3 such that the underside of the head 6A is received against the top face of the blank 2 and the undercut 6B is located within the hole 3 whereby it defines a void, essentially the same as

void 6C shown in Figure 13A, between the surface of the taper and the cylindrical internal face which defines the hole 3. The preassembly thus created, referring to Figures 27 and 28, is mounted in apparatus 27", and the face 25C and head 6A are forced against each other, such that an annular portion of the blank 2 adjacent the undercut 6B is plastically deformed and the material forming that portion is displaced so as to occupy the undercut and such that a bottom section of the head 6A is countersunk in the thus-deformed central portion whereby a plug portion 7A which is transversely too large to be drawn through the hole 3 is formed, as shown in Figure 31. The underside of the head, the taper and the material occupying the void 6C together define an interlock whereby to create the interconnection.

The thus-formed assembly is then machined, as shown in Figure 30, to define the external profile of the head, including the smooth, inclined circumferential side face 5A and the top 5B formed with the grip comprising concentric upwardly projecting rings 104. Advantageously, because the plug portion 7A' is partially countersunk, as previously described, it can be machined such that what remains of it is flush with an upwardly facing surface of the head 5, as previously described.

Referring to Figure 32, the moulding 19 is then formed in exactly the same manner as described for the indicator 200.

In the embodiments which have been described and illustrated, the entirety of that part of the head which is visibly exposed when the indicator is installed is defined by or formed out of the metal component which is machined and/or coined/stamped. However, in other embodiments, part of that visually exposed part may, without departure from the invention, be defined by another component; for example, the head of the finished indicator may be formed so as to include an infill, e.g. comprising carborundum, which defines an anti-slip top surface of the head.

While various embodiments of the present invention have been described above, it should be understood that they have been presented by way of example only, and not by way of

limitation. It will be apparent to a person skilled in the relevant art that various changes in form and detail can be made therein without departing from the spirit and scope of the invention. Thus, the present invention should not be limited by any of the above described exemplary embodiments.

Throughout this specification and the claims which follow, unless the context requires otherwise, the word "comprise", and variations such as "comprises" and "comprising", will be understood to imply the inclusion of a stated integer or step or group of integers or steps but not the exclusion of any other integer or step or group of integers or steps.

The reference in this specification to any prior publication (or information derived from it), or to any matter which is known, is not, and should not be taken as an acknowledgment or admission or any form of suggestion that that prior publication (or information derived from it) or known matter forms part of the common general knowledge in the field of endeavour to which this specification relates.

The claims defining the invention are as follows:

1. A method of manufacturing a tactile ground surface indicator which comprises a head configured to lie fixed over a ground surface, the method comprising plastically deforming a section of metal plate to form a dish-shaped piece and machining an exterior of the dish-shaped piece whereby an external profile of said head is formed.

2. A method according to claim 1, wherein the section of metal plate is substantially simultaneously cut from flat metal plate and plastically deformed to form said piece.

3. A method according to claim 1, wherein the section of metal plate is cut from the flat metal plate to form a blank and the blank is thereafter plastically deformed to form said piece.

4. A method according to claim 2 or 3, wherein said section is punched from said flat metal plate.

5. A method according to any one of the preceding claims, wherein said section is coined to form the dish-shaped piece.

6. A method according to any one of the preceding claims wherein said section is forged to form the dish-shaped piece.

7. A method according to any one of the preceding claims, wherein the dish-shaped piece is formed so as to have a substantially flat central portion and a sloped peripheral portion extending radially outwardly from the central portion.

8. A method according claim 7, wherein said head has a smooth inclined peripheral side face and said machining comprises machining the peripheral portion to define said side face.

9. A method according to claim 7 or 8, wherein said head is configured with a grip and the machining comprises machining the central portion to form the grip.

10. A method according to claim 9, wherein the grip comprises concentric upwardly projecting ribs.

11. A method according to any one of the preceding claims, wherein the section is substantially circular, whereby the dish-shaped piece is generally frustoconical and the head is generally button-shaped.

12. A method according to claim 11 as appended to claim 10, wherein the ribs comprise rings.

13. A method according to any one of the preceding claims, wherein the machining is effected such that the grip includes or is defined by an upwardly projecting lip which is coincident with or closely adjacent to an upper end of an inclined peripheral side face of the head.

14. A method according to claim 13 as appended to claim 11 or 12, wherein the lip is a ring.

15. A method according to any one of the preceding claims, wherein the head is formed such that a lower end of a peripheral side wall thereof has an outer diameter of about 35mm and an upper end of the peripheral side wall has an outer diameter of about 25mm.

16. A method according to claim 15, wherein the head is formed such that it has a height in the range of about 4mm to about 5mm.

17. A method according to any one of the preceding claims, wherein the indicator is manufactured so as to include a downwardly projecting member or stem connected to the

head to be fixedly receivable by a cavity formed through the ground surface for anchoring the indicator head over the ground surface.

18. A method according to claim 17, including connecting an element defining the member/stem or from which the member/stem is derived, to a piece defining the head or from which is derived an external portion of the head arranged to be visibly exposed when the indicator is anchored, to effect the interconnection between the head and the member/stem.

19. A method according to claim 18, wherein the element is positioned such that an end portion thereof extends through an opening formed through the piece and plastic deformation of the end and/or piece is effected to create an interlock between the piece and the element.

20. A method according to 18 or 19, wherein the element is connected to the head/piece before the machining.

21. A method according to claim 20, wherein the dish-shaped piece is mounted via the element to an apparatus used to effect the machining.

22. A method according to any one of the preceding claims, substantially as hereinbefore described with reference to the drawings and/or examples.

23. The tactile ground surface indicator manufactured by a method according to any one of the preceding claims.

~~22. A method of manufacturing a tactile ground surface indicator having a head and a downwardly projecting member connected to the head to be fixedly receivable by a cavity formed through the ground surface for anchoring the head over a ground surface, in which method an element defining the downwardly projecting member or from which that member is derived is positioned such that an end portion thereof extends through an~~

~~opening formed through either the head or a piece from which is derived an exterior portion of the head arranged to be visibly exposed when the head is anchored, and plastic deformation of the end portion and/or piece is effected to create an interlock between the piece and element.~~

~~23. A method according to claim 22, wherein the downwardly projecting member comprises a stem.~~

~~24. A method according to claim 22 or 23, wherein the opening is defined by a hole.~~

~~25. A method according to any one of claims 22 to 24, wherein substantially the entirety of the head is derived from said piece.~~

~~26. A method according to any one of claims 22 to 25, said method being in accordance with any one of claims 1 to 21, wherein formation of the head comprises deformation of said section of metal plate.~~

~~27. A method according to any one of claims 22 to 25, wherein the head is formed so as to comprise a substantially flat base occupying substantially the entirety of a footprint of the head to be receivable against the ground surface.~~

~~28. A method according to claim 27, wherein the head comprises a substantially solid piece of metal.~~

~~29. A method according to any one of claims 22 to 28, wherein said element is configured with a plug portion which is sized so as to be incapable of passing through said opening such that withdrawal of the downwardly projecting member from the head in a direction from the plug portion to the opening is precluded.~~

~~30. A method according to any one of claims 22 to 29, wherein the element is further configured with a void and the piece is plastically deformed such that material of which the~~

~~piece is comprised flows into said void to occupy it, thereby precluding withdrawal of the downwardly projecting member from the head in an axial direction from the hole to the plug portion.~~

~~31. A method according to claim 30, wherein said material flows to occupy substantially the entirety of said void.~~

~~32. A method according to claim 30 or 31, wherein the plug portion is formed at an upper end of said end portion and said void is formed below that upper end.~~

~~33. A method according to any one claims 30 to 32, wherein the void is bounded at an upper end thereof by a lower end of said plug portion.~~

~~34. A method according to any one of claims 30 to 33, wherein the void extends transversely or circumferentially.~~

~~35. A method according to any one of claims 30 to 34, wherein the element is configured with a transversely or radially inward taper defining said void.~~

~~36. A method according to any one of claims 30 to 34, wherein the plastic deformation of the piece is effected by applying pressure through the plug portion.~~

~~37. A method according to claim 36, wherein the application of said pressure through the plug portion effects countersinking of part of the plug portion in the piece.~~

~~38. A method according to claim 37, wherein the plug portion is machined after the countersinking is effected such that what remains thereof is flush with an upwardly facing surface of the indicator head.~~

~~39. A method according to any one of claims 22 to 38, wherein the indicator is formed so as to include a casing over said downwardly projecting member, which casing is~~

configured to deform against a side wall of the cavity when forced into the cavity, thereby effecting anchorage of the head over the ground surface.

40. A method according to claim 39, wherein the downwardly projecting member is shaped to form an interlock with the casing.

41. A method according to claim 40, wherein the downwardly projecting member is configured with a peripherally or circumferentially extending notch or channel which receives a complementarily formed, transversely or radially inwardly projecting portion of said casing.

42. A method according to any one of claims 39 to 41, wherein the casing is plastic.

43. A method according to any one of claims 39 to 42, wherein the casing is moulded to the downwardly projecting member .

44. A method according to any one of claims 39 to 43, wherein the casing is formed by injection moulding.

45. A method according to claim 43 or 44, wherein the moulding is effected to form, in addition to said casing, an infill which occupies a downwardly opening recess defined within the head.

46. A method according to any one of claims 22 to 45, wherein the downwardly projecting member is metal.

47. A method according to any one of the preceding claims, wherein said metal is steel.

48. A method according to claim 47, wherein the steel is stainless steel.

49. The indicator as manufactured by a method according to any one of the preceding

~~claims.~~