Title: INDICATOR SAFETY SYSTEM

Abstract: Disclosed is an indicator safety system (10) for plant or machinery. The indicator safety system comprises lighting (12) that indicates an exclusion zone (14) with respect to the plant or the machinery. A method for safely operating the plant or machinery comprises illuminating an exclusion zone (14) with respect to the plant or the machinery.
INTICATOR SAFETY SYSTEM

Technical Field

An indicator safety system for use with plant or machinery is disclosed.

Background Art

Moving and mobile machinery employed in, for example, manufacturing, construction and mining can present safety issues. For example, cranes are used in the construction industry for lifting and moving heavy materials and in the manufacturing industry for assembling heavy equipment. When lifting and transporting loads, or when moving materials, machinery such as cranes and forklifts may be particularly dangerous to work with and around.

There is a need to improve safety systems for working around cranes, forklifts and other moving and mobile machinery. To this extent, it is known for cranes, forklifts and other moving and mobile machinery to carry illumination and warning lights, such as may warn of approach.

The above references to the background art do not constitute an admission that such art forms a part of the common and/or general knowledge of a person of ordinary skill in the art. The above references are also not intended to limit the application of the indicator safety system as disclosed herein.

Summary

Disclosed herein is an indicator safety system for use with plant or machinery e.g. moving/mobile machinery, fixed machinery having moving parts or fixed machinery. Plant is understood to include the environment around operating machinery, the space in a factory floor, construction zone etc., and can include the area surrounding factories (interior or exterior). It is also understood that the indicator safety system may be used in alternative applications. For example, in any environment, or with devices, apparatus or systems having an area that may be designated or required to be an exclusion zone. Other applications will be discussed in more detail below.

The indicator safety system comprises lighting that indicates an exclusion zone with respect to the plant or the machinery. The provision of an exclusion zone provides an alternative or additional solution to illumination or warning lights employed at plant or machinery.
The indicator safety system can thus visually indicate the exclusion zone so that users and
individuals within the vicinity are able to visually perceive an unsafe (e.g. work) area. Users and
individuals within the vicinity can then avoid that zone. A plant is inherently a noisy environment and
machinery is often used in an inherently noisy environment. As a result, the visual indication of the
exclusion zone presented by the lighting of the indicator safety system provides an effective, simply
understood, and simple-to-recognise means to users and individuals within the vicinity, that is
independent of prevailing levels of noise.

In some embodiments, the lighting can be arranged with respect to the plant or the
machinery so that the exclusion zone is in part determined by the geometry of the plant or the
machinery. In some embodiments, the lighting can be arranged with respect to the plant or the
machinery so that the exclusion zone is in part determined by a distance deemed unsafe in relation
to the plant or the machinery. The lighting may also be in part determined by both the geometry of
the plant or the machinery and the distance deemed unsafe in relation to the plant or the
machinery. 'The distance deemed unsafe' is understood to mean the distance that is determined to
be unsafe or risky to enter, move or work (e.g. within the 'line of fire') in relation to the plant or the
machinery. Different plants and types of machinery may have varying size and shape exclusion
zones and thus may also have varying unsafe, dangerous or hazardous distances for users to enter in
proximity to the machinery.

The arrangement of the lighting system allows the exclusion zone to be tailored to the
specific type of plant or machinery. In this regard, the exclusion zone may be 2-dimensional and
located on any surface. For example, the exclusion zone may, in relation to the plant or the
machinery, be located on (e.g. projected onto) the ground, located on a wall, and/or located on a
ceiling. The exclusion zone may also be 3-dimensional. For example, the exclusion zone may be
located on a set of stairs or up a ladder.

In some forms, the lighting can be in the form of LED lights. Advantageously, LED lights have
a high and focused intensity that enables the exclusion zone to be easily identified or perceived by a
user. This is also advantageous in that the boundary of the exclusion zone in relation to the plant or
the machinery is able to be clearly signified to users, so that users clearly (and potentially even
intrinsically) understand not to enter the exclusion zone. In alternative embodiments, any suitable
type of lighting may be used. For example, strip-lighting, low-powered lasers lighting, incandescent
lighting or fluorescent lighting etc.
The lighting may define at least an outer margin of the periphery of the exclusion zone. This embodiment is beneficial as it is designed to permit different degrees of safety to be visually represented and communicated to the users. For example, the outer margin may have a different light intensity to the interior of the exclusion zone. Further, the exclusion zone may be solely indicated by the outer margin.

In some embodiments, the lighting can demarcate the exclusion zone by defining a distinct boundary. This embodiment is beneficial as it is designed to clearly mark the boundary of the exclusion zone. The exclusion zone may be solely marked by the distinct boundary. The lighting may also fill in the exclusion zone where the periphery is marked by either an outer margin of the illuminated zone, or by the distinct boundary.

In some embodiments, the lighting can be selected to illuminate the exclusion zone red. The colour red is advantageous as it generally (or intrinsically) signifies stop or warning. As a result, users and individuals are alerted to the circumstances that the area illuminated red is dangerous to enter.

The indicator safety system may also comprise a control indicator having an operative mode that indicates to users that the exclusion zone is safe to enter. In this regard, the control indicator may permit users to enter the exclusion zone (e.g. even when the exclusion zone is still being indicated). When the control indicator is in the operative mode, users may approach the plant or the machinery and, if necessary, interact with the plant or the machinery. Advantageously, the indicator safety system can be configured to control when and if users are permitted to enter the exclusion zone safely. The control indicator may be operated by an operator who is able to determine when the plant or the machinery is safe to approach. This may be manual or automated.

For example, in some embodiments, the control indicator may only be able to be placed in the operative mode when at least part of the machinery has been inhibited or disabled from functioning (e.g. from moving). Advantageously, this allows for a redundant/failsafe system to ensure the safety of all users.

In some embodiments, the control indicator may be such that it may only be activated to the operative mode when the plant or the machinery is in a 'pre-determined position'. The 'pre-determined position' is understood to mean an area of the plant or a position of the machinery determined by the system, the machine or the operator to be safe for other users to approach the area of the plant of the machinery and, if necessary, to interact with the area of the plant or the machinery and/or the loads it is lifting, shifting or moving.
The control indicator may also comprise lighting that indicates that the exclusion zone is safe to enter. In alternative embodiments, the control indicator may provide an audible signal or a combination of visual and audible signals to indicate that the exclusion zone is safe to enter. In further embodiments, the control indicator may also be operative to appeal to a user's sense of touch, for example, using a vibration mechanism as the signal. In some embodiments, the control indicator may be in the form of switching off the lighting for the exclusion zone.

In some embodiments, the lighting of the control indicator that indicates that the exclusion zone is safe to enter can be green. The colour green is advantageous as it indicates (e.g. intrinsically) to users that they may proceed to approach the machinery. The lighting of the control indicator may also be in the form of LED lights. As above, LED lights are beneficial as they have a high intensity which enables them to be highly visible.

The control indicator may alternatively be provided by changing the colour of the exclusion zone (e.g. from red to green). Here, the changed colour may be an indication to users only (and/or to everyone) that they may enter the exclusion zone (but e.g. with caution).

Also disclosed herein is a method of safely operating a plant or machinery. The method comprises the step of illuminating an exclusion zone with respect to the plant or the machinery. Advantageously, the method can allow an operator to indicate a hazardous area in proximity to the plant or the machinery by a visual indicator. Such a visual representation can be beneficial in inherently noisy environments.

In some embodiments, the method may further comprise the step of ensuring all users remain outside of the exclusion zone. The operator may clearly indicate the boundary of the exclusion zone, and optionally may vary this boundary, and also may control when and if users are able to safely enter the exclusion zone.

In some embodiments, the step of illuminating the exclusion zone can occur while the plant or the machinery is operating. Typically, during normal operation, the exclusion zone will always be indicated. In some embodiments, the step of illuminating the exclusion zone can occur while the machinery is stationary or where there are no moving parts in the relevant area of the plant. For example, the exclusion zone may be illuminated while the machinery is powered 'on' and optionally 'off'. In some embodiments, the step of illuminating the exclusion zone can occur while the plant or the machinery is operating, at least in part stationary and/or stationary. In this regard, the machinery may be 'on' but static and the exclusion zone may still be indicated.
The method may further comprise the step of allowing users into the exclusion zone. Advantageously, this can allow the system and/or a machine operator to control when users enter the exclusion zone. For example, the machine operator may allow a user to enter the exclusion zone when the machine operator determines the exclusion zone is safe to enter. In this regard, the step of allowing users into the exclusion zone may be accomplished by providing a separate indication to that of the exclusion zone. During the step of providing a separate indication to allow users into the exclusion zone, the method may further comprise inhibiting at least part of the plant or the machinery from functioning. In some forms, the separate indication may be in the form of a control indicator. The control indicator may also employ lighting. In some forms, the lighting may be green.

**Brief Description of the Drawings**

Embodiments of the indicator safety system and method will now be described, by way of example only, with reference to the accompanying drawings in which:

- Fig. 1 is a perspective view of an embodiment of an indicator safety system installed on a piece of machinery;
- Fig. 2 is a perspective view of a second embodiment of an indicator safety system installed on a piece of machinery;
- Fig. 3 is a perspective view of an embodiment of an exclusion zone; and
- Fig. 4 is a perspective view of an embodiment of an indicator safety system installed on machinery.

**Detailed Description of the Drawings**

Referring to the Figures 1 to 4, illustrative embodiments of an indicator safety system 10 for use with plant or machinery are shown and will now be described. The indicator safety system 10 comprises lighting 12 that indicates an exclusion zone 14 with respect to the plant or the machinery. The indicator safety system 10 is generally used in relation to machinery, but is equally installable in any plant environment. The indicator safety system 10 has particular application in inherently noisy environments where the location of all users are not easily identified or known.

In the embodiments illustrated in Figs. 1 and 2, the indicator safety system 10 is mounted to machinery, and the machinery is in the form of an excavator and mobile crane 16. In Fig. 1 the excavator 16 includes an arm 18, a bucket 20, a body 22, an operator cab 24, and continuous treads 26. The body 22 is rectangular and rotatably mounted on the continuous treads 26. The arm 18 and
the bucket 20 generally extend from the body 22. In the illustrated embodiment, the lighting 12 is mounted to the body 22 and in particular, is arranged about the periphery of the body 22. This lighting arrangement illuminates the exclusion zone 14.

Some relevant safety considerations includes designing a system that allows users to approach the machinery 16, users to interact with the load located in the bucket 20, and generally the position of users in relation to the machinery 16. The exclusion zone 14 is understood to be a hazardous area generally proximate the machinery 16. The exclusion zone will generally be an area larger than the machinery 16 to allow the machinery to have a sufficient space to operate in.

In this regard, the lighting 12 is arranged with respect to the machinery 16 so that the exclusion zone 14 is in part determined by the geometry of the machinery and/or is in part determined by a distance deemed unsafe in relation to the machinery. The exclusion zone 14 generally corresponds to the geometry of the machinery 16 because it is the machinery itself and its movements during operation that are a safety risk for users. In addition, the exclusion zone marks the boundary of the distance deemed safe in relation to the machinery 16. Users will understand that they are required to remain outside of the exclusion zone and thus the distance from the machinery classified as hazardous (i.e., the 'line of fire').

In the illustrated embodiment, the lighting 12 extends about the periphery of the body 22 generally parallel to the ground to illuminate the exclusion zone 14. The lighting 12 illuminates an area that is 3-dimensional, larger than the machinery that generally corresponds to the shape of the machinery. As the lighting 12 is mounted to the machinery 16 this allows for the exclusion zone 14 to move along the ground with the machinery 16 during operation. In non-illustrated alternative embodiments, the lighting may also be mounted to the operator cab 24, the arm 18 and/or the bucket 20. It is understood that the exclusion zone may be any suitable shape, size, length, width, or height etc.

In the illustrated embodiment, the lighting 12 is in the form of LED lights. LED lights are advantageous as they are safe under all conditions of normal use, are highly visible, and clearly illuminate the exclusion zone 14. In some forms, another advantageous of using LED lights is that they will not cause temporary blindness. The LED lights are in the form of red LED lights illuminating the exclusion zone 14 red. The colour red inherently indicates to users that the exclusion zone 14 is dangerous and they must stop and not enter the exclusion zone 14.

Fig. 1 also illustrates the system 10 including a control indicator 28 that has an operative mode which indicates to users that the exclusion zone 14 is safe to enter. When the control
indicator 28 is in the operative mode, at least part of the machinery is inhibited from functioning or is locked. For example, when the machinery operator activates the control indicator 28 by putting it in the operative mode, the operator cab 24 and the body 22 are not able to rotate in relation to the continuous treads 26, and the arm 18, and the bucket 20 are prevented from being operated when they are at a correct height such that no further raise/lower functions are required for the task being performed. Thus, the control indicator 28 indicates that users can enter the exclusion zone 14 if necessary.

In another example, when used on a crane, the crane controls are inter-engaged with the control indicator so that when the control indicator is activated in the operative mode the crane controls will not work and therefore the crane will not raise, lower or move until the control indicator is de-activated.

Alternatively, the control indicator 28 is such that it is only able to be activated to the operative mode when the machinery 16 is in a pre-determined position. In the illustrated embodiment, the arm 18 and bucket 20 may be maintained at a position suitable for personnel to load/unload the bucket 20. The bucket 20 is much safer to approach when the arm 18 is static therefore greatly reducing the risk of uncontrolled lowering of the bucket 20. The control indicator 28 allows the equipment operator to control the exclusion zone 14 by giving users permission to enter the exclusion zone 14.

The control indicator 28 is highly visible to users and is positioned on top of the operator cab 24. In non-illustrated alternative embodiments, the control indicator 28 may be solely audible, a combination of visual and audible or any other suitable indicator that the users are able to perceive.

The control indicator 28 is also able to be not-activated. When the control indicator is not-activated, the control indicator 28 is ‘off’ and the indicator lighting 12 illuminates the exclusion zone 14. The control indicator may also be in the form of simply switching ‘off’ the lighting for the exclusion zone.

In the illustrated embodiment, the control indicator 28 comprises lighting that indicates the exclusion zone 14 is safe to enter. The lighting may be in the form of LED lights. In some forms, the LED lights are green. The colour green inherently signifies safety to the users and that they may enter the exclusion zone 14. In another embodiment, the control indicator may be performed by changing the colour of the exclusion zone (e.g. from red to green).

Referring to Fig. 2, a second embodiment of the indicator safety system 10 is illustrated. Like reference numerals are used for like features. The mobile crane 16 includes a jib 30, the body
22 and the operator cab 24. The body 22 is rectangular and rotatably mounted on a main body. The jib 30 generally extends from the body 22. In the illustrated embodiment, the lighting 12 is mounted to the body 22 and in particular, is arranged about the periphery of the body 22. This lighting arrangement illuminates the exclusion zone 14.

A difference between the embodiment illustrated in Fig. 1 and the embodiment illustrated in Fig. 2 is that the lighting 12 is mounted to the machinery 16 in a different arrangement, and as such the exclusion zone 14 is of a different shape and size in relation to the machinery 16. A further difference is that the control indicator 28 is in the form of two lights positioned at the front and rear of the body 22 of the machinery 16.

Referring to Figs. 3 and 4, the indicator safety system 10 is mounted to a machine simulator for an overhead crane. In alternative embodiments, the indicator safety system may be mounted to or installed on any type of machinery or in any environment having hazards. For example, the indicator safety system could be used to illuminate a floor trap or a doorway that is hazardous and unsafe to enter.

In Figs. 3 and 4, the lighting 12 defines at least an outer margin 32 of the periphery of the exclusion zone 14. In this example, the outer margin 32 is formed by an area that has a length and a width in which the degree of intensity of the lighting is faded in relation to the interior of the zone 14. The faded outer margin is able to represent different degrees of risk. Figs. 1 and 2 illustrate embodiments where the lighting 12 demarcates the exclusion zone 14 by defining a distinct boundary. In all Figures, the lighting 12 also fills in the exclusion zone 14. However, it is understood that in non-illustrated alternative embodiments, the lighting is not required to fill in the interior of the exclusion zone and may solely illuminate the boundary or the outer margin of the exclusion zone.

**Example 1**

A method of safely operating the machinery of Figs. 1 or 2 was performed by an operator as follows. The method as performed included at least step 1 and optionally included steps 2 and 3.

1. The exclusion zone 14 was illuminated with respect to the machinery 16.
   a. This step could occur while the machinery 16 was operating.
   b. This step could occur while the machinery 16 was stationary.

2. Ensuring all users remained outside of the exclusion zone 14.

3. Allowing users into the exclusion zone 14.
a. This step was able to be accomplished by providing a separate indication to that of the exclusion zone. The separate indication was, for example, able to take the form of a control indicator being activated to an operative mode.

b. The step of providing a separate indication to allow users into the exclusion zone was also able to include inhibiting at least part of the plant or the machinery from functioning.

The indicator safety system was able to be used in many alternative applications. Some examples of alternative applications were as follows.

1. Trains and the broader rail network. For example, lighting can be arranged on the side of a passenger train. The lighting can indicate an exclusion zone onto the platform as the train enters the station. In some embodiments, the control indicator can be arranged to be activated to its operating mode when it is safe to get on and off the train. This application could be particularly useful during peak travel times.

2. Bus and like vehicles. Lighting could be arranged to designate an exclusion zone proximate the doors prior to doors closing.

3. Garage/roller doors or car park entry/exports where access to the roller door or car part entry is across footpaths/pedestrian access areas. For example, cars are required to drive across a busy footpath entering or exiting the car park.

4. Domestic/General public applications for people with hearing impairments. For example, the exclusion zone could be an indicator or warning for doors opening, vehicle movements etc.

5. Sporting applications to designate boundaries. For example, a 10m zone rule in rugby/rugby league/soccer penalties.

6. Domestic/General public applications for warning of exclusion zones. For example, road works or footpath repairs, and clearways in crowded areas etc.

Example 2
In the following illustrative example, the indicator safety system was mounted to a simulated crane. The exclusion zone lighting was in the form of 'Boundary Lighting', and the control indicator was in the form of 'Controlled Approach Lighting'.

**Area:** Steelmaking Pitbay

**Task:** Using Controlled Approach Lighting (GREEN) and Boundary Lighting (RED Beam) during simulated crane operations

### Controlled Approach Lighting (GREEN)

- **Details:**
  - When the Crane returns to the safe zone after a load is lifted or manipulated, the system indicates that the load is safe to move.

- **Illustration:**
  - Diagram of the system's arrangement and components.

### Boundary Lighting (RED Beam)

- **Details:**
  - The Boundary Lighting (RED Beam) remains active at all times and provides a visual cue to crane operators when a load is not within the safe zone.

- **Illustration:**
  - Diagram of the light's position and effect.

### Scenarios

<table>
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<tr>
<th>Scenarios</th>
<th>Action-required-by-Crane-Driver</th>
<th>Action-required-by-personnel-working-in-area</th>
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<tr>
<td>Controlled Approach Lighting (GREEN) is activated</td>
<td>Monitor and perform task as per normal operation.</td>
<td>The area inside the Boundary Lighting (RED Beam) can be entered to complete specific task.</td>
</tr>
<tr>
<td>Controlled Approach Lighting (GREEN) is not activated</td>
<td>Monitor and perform task as per normal operation while ensuring all personnel remain outside of the area illuminated by the Boundary Lighting (RED Beam).</td>
<td>Remain outside of the area illuminated by the Boundary Lighting (RED Beam).</td>
</tr>
<tr>
<td>Loading / unloading Ladles at the horizontal load position when the Ladle is greater than 300mm from the home position</td>
<td>Monitor and perform task as per normal operation.</td>
<td>The area inside the Boundary Lighting (RED Beam) can be entered to complete specific task even though the Controlled Approach Lighting (GREEN) has not been activated.</td>
</tr>
<tr>
<td>Loading / unloading Ladles at the horizontal load position when the Ladle is less than 300mm from the home position</td>
<td>Monitor and perform task as per normal operation.</td>
<td>Remain outside of the area illuminated by the Boundary Lighting (RED Beam).</td>
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</table>

Note: Ensure a safe escape path is available.
Advantages of the indicator safety system according to the present application are as follows:

1. The arrangement of the lighting of the exclusion zone and, in some forms, the control indicator, is adaptive given the layout of the environment, the operations, and the tasks required to be performed within this layout. The indicator safety system enables users to safely interact with the plant or the machinery.

2. The exclusion zone is visible to all users, and in some forms, the control indicator is in its operative mode. Due to the inherently noisy environment in the construction and manufacturing industries, users are able to easily identify the exclusion zone in relation to the plant or the machinery and easily identify when they are able to approach the area of the plant or the machinery to allow sufficient time for adequate separation. In particular, the operator is able to give users permission to approach the area of the plant or the machinery by activating the control indicator.

Whilst a number of specific embodiments have been described, it should be appreciated that the indicator safety system and method can be embodied in many other forms.

In the claims which follow and in the preceding description, except where the context requires otherwise due to express language or necessary implication, the word "comprise" or variations such as "comprises" or "comprising" is used in an inclusive sense, i.e., to specify the presence of the stated features but not to preclude the presence or addition of further features in various embodiments of the system and the method.
CLAIMS

1. An indicator safety system for plant or machinery, the indicator safety system comprising lighting that indicates an exclusion zone with respect to the plant or the machinery.

2. The indicator safety system according to claim 1 wherein the lighting is arranged with respect to the plant or the machinery so that the exclusion zone is in part determined by the geometry of the plant or the machinery.

3. The indicator safety system according to either claim 1 or claim 2 wherein the lighting is arranged with respect to the machinery so that the exclusion zone is in part determined by a distance deemed unsafe in relation to the plant or the machinery.

4. The indicator safety system according to any one of the preceding claims wherein the lighting is in the form of LED lights.

5. The indicator safety system according to any one of the preceding claims wherein the lighting defines at least an outer margin of the periphery of the exclusion zone.

6. The indicator safety system according to any one of claims 1 to 4 wherein the lighting demarcates the exclusion zone by defining a distinct boundary.

7. The indicator safety system according to either claim 5 or claim 6 wherein the lighting also fills in the exclusion zone

8. The indicator safety system according to any one of the preceding claims wherein the lighting illuminates the exclusion zone red.

9. The indicator safety system according to any one of the preceding claims further comprising a control indicator having an operative mode that indicates to users that the exclusion zone is safe to enter.

10. The indicator safety system according to claim 9 wherein, when the control indicator is in the operative mode, at least part of the plant or the machinery is inhibited from functioning.
11. The indicator safety system according to either claim 9 or claim 10 wherein the control indicator is such that it is only able to be activated to the operative mode when the plant or the machinery is in a pre-determined position.

12. The indicator safety system according to any one of claims 9 to 11 wherein the control indicator further comprises lighting that indicates that the exclusion zone is safe to enter.

13. The indicator safety system according to claim 12 wherein the lighting of the control indicator that indicates that the exclusion zone is safe to enter is green.

14. The indicator safety system according to either claim 12 or 13 wherein the lighting of the control indicator is in the form of LED lights.

15. A method for safely operating a plant or machinery, the method comprising the step of illuminating an exclusion zone with respect to the plant or the machinery.

16. The method according to claim 15 further comprising the step of ensuring all users remain outside of the exclusion zone.

17. The method according to either claim 15 or claim 16 wherein the step of illuminating occurs while the plant or the machinery is operating.

18. The method according to either claim 15 or claim 16 wherein the step of illuminating occurs while the plant or the machinery is at least in part stationary.

19. The method according to any one of claims 15 to 18 further comprising the step of allowing users into the exclusion zone.

20. The method according to claim 19 wherein the step of allowing users into the exclusion zone is accomplished by providing a separate indication to that of the exclusion zone.

21. The method according to claim 20 wherein during the step of providing a separate indication to allow users into the exclusion zone, the method further comprises inhibiting at least part of the plant or the machinery from functioning.
INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER

G08B 5/36 (2006.01)  F16P 3/00 (2006.01)

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

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

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

WPIAP, EPDOC, INSPEC: IPC/CPC marks G08B5/36, F16P3/00; exclusion, safety, warning, and like terms; light, illumination, indicator and like terms; zone, region, area and like terms; machine, equipment, vehicle and like terms; search for documents citing or cited by D1 and D3.

Esp@cenet: "Commonwealth Steel", "Wellard", "Keith Ritchie"

Google Patents: Commonwealth Steel and like terms, "Wellard", "Keith Ritchie"; exclusion zone, safety zone, illuminate, and like terms.

Applicant and inventor names searched in internal databases provided by IP Australia.

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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<td>Further documents are listed in the continuation of Box C</td>
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"A" special categories of cited documents:
- document defining the general state of the art which is not considered to be of particular relevance
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- document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
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"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search
8 December 2015

Date of mailing of the international search report
08 December 2015

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<td>X</td>
<td>US 4818866 A (WEBER) 04 April 1989 column 1, lines 32-53; column 3, lines 49-64; column 4, lines 49-54</td>
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End of Annex

Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.

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