

Description

[0001] This invention relates to a road sign. In particular, but not exclusively, the invention relates to a road sign of the type located at the side of a road for alerting a driver to the presence of a hazard.

[0002] Hazard signs are commonly provided at the side of roads to warn drivers of adverse driving conditions. Common hazard signs include signs indicating the presence of ice and fog, for example. At present, such signs are either permanent printed/painted signs that indicate a likelihood that the hazard may be encountered (such as 'Food' signs, or 'Danger of ice' signs) or the sign includes a fixed message that may be turned on or off by a switch. On motorways, for example, a series of signs may be provided at intervals along the road, that are switchable remotely to indicate a potential hazard. Alternatively, a programmable display may be provided to which a message may be sent from a remote control centre. In this way, a user may alter the message displayed on the sign in accordance with changes to driving conditions.

[0003] The signs currently in use allow a message to be set by a user, and allow a hazard warning to be switched on and off by a user, but the signs do not adapt automatically to changes in conditions. Furthermore, current signs do not measure environmental conditions to determine whether or not a warning should be displayed to road users.

[0004] According to an aspect of the invention we provide a road sign system comprising: a sensor assembly operable to measure an environmental property; and a signal assembly comprising a display device configured to display a determined output based on the measured environmental property.

[0005] Further features of the above aspect of the invention are described in the appended claims.

[0006] Embodiments of the invention will now be described, by way of example only, with reference to the following figures, of which:

Figure 1 is a diagrammatic representation of a road sign system according to embodiments of the invention; and

Figure 2 is a diagrammatic representation of a sensor assembly according to embodiments of the invention.

[0007] With reference to Figure 1, a road sign system 10 is shown. The system 10 comprises a sensor assembly 12 operable to measure an environmental property, and a signal assembly 14, 16 comprising a display device 20 configured to display a determined output based on the measured environmental property. In embodiments of the invention, and as shown in the Figures, the environmental property being measured by the system is the depth of water in a ford 42.

[0008] In other embodiments, the environmental prop-

erty may be the presence of ice. This may be measured using condensation sensors, temperature sensors, a combination thereof, or any other device operable to measure environmental conditions suitable for formation of ice. In other embodiments, the environmental property may be precipitation (i.e. volume of precipitation per unit area per minute), wind speed, visibility distance, or any other environmental factor that may affect driving conditions

[0009] The sensor assembly 12 comprises a first communication apparatus which may be housed in an electronics compartment 34 of the assembly 12. The signal assembly 14 comprises a second communication apparatus which may be housed in a corresponding electronics compartment 28 of the assembly 14. The first and second communication apparatuses are configured to transmit and receive, respectively, an indication of the measured environmental property. So, in other words, the sensor assembly 12 measures the property, and then transmits an indication of the measurement to the signal assembly 14.

[0010] The first and second communication apparatuses may both comprise UHF (ultrahigh frequency) transmitters and receivers, respectively. Both first and second communication apparatuses may comprise both a transmitter and a receiver, for example. The electronics compartments 28, 34 may include or be connected to solar power generating apparatus. For example, the solar power generating apparatus may include solar battery boxes generating charge via connected solar panels 22, 24. In this way, the electronic components of both the sensor assembly and signal assembly may be self-powering via the solar power chargers. The solar power generating apparatus may be connected to the respective assemblies via current regulators.

[0011] The sensor assembly 12 generally comprises a pole or post, to which one or more sensor devices are mounted (or housed within the post/pole), and communication apparatuses and power-supply and/or power-generating apparatus is mounted. The electronic components may be housed in an electronics compartment 34. In embodiments, the electronics compartment 34 is held at a height of between 2m and 5m above the ground, and preferably around 2.5m off the ground.

[0012] As shown in Figure 1, the sensor assembly 12 and signal assembly 14 may be situated remote from one another. In the case of a water depth sensing system for a ford, the sensor assembly 12 is positioned within the flooding area of the ford, and the signal assembly 14 may be positioned at the roadside on one side of the ford. As shown, the system 10 may include a second signal assembly 16 which may be identical to the first, positioned at the opposite side of the ford, so as to alert road users approaching the ford from the opposite direction.

[0013] In embodiments, the display device 20 of the signal assembly 14 includes an LED display. The LEDs may be arranged to form a specific alert message, or may form an array that can be used to display any mes-

sage or image to a road user. The display device 20 may be operated by a PCB (printed circuit board). The LEDs may be low current LEDs.

[0014] The display device 20 may be supported on a pole or post, at a height suitable for viewing by occupants of vehicles travelling on the road and/or at a height suitable for viewing by pedestrians, cyclists or horse riders. In embodiments, the or each signal assembly 14, 16 includes multiple display devices 20.

[0015] In embodiments, the signal assembly 14 comprises a proximity detector operable to detect the presence of a vehicle 18 or person. The signal assembly may be configured such that the display device 20 is operable on detection of a vehicle 18 or person by the proximity detector. In this way, power is saved by allowing the display to turn off while no people or vehicles are within sight of the display. Furthermore, by turning on the display only when a person or road user approaches, the user's attention is drawn to the display as it illuminates.

[0016] Proximity sensors of a known type may be incorporated. Proximity sensors are able to detect the presence of nearby objects, such as approaching vehicles or pedestrians. The sensor or sensors may, for example, emit an electromagnetic field or a beam of electromagnetic radiation (infrared, for instance). The sensor detects a change in the field or return signal. Proximity sensors may include capacitive sensors, laser sensors, passive optical sensors, passive thermal infrared sensors, photocell sensors, radar, sonar, or ultrasonic sensors, for example.

[0017] In embodiments, the signal assembly 14 may include multiple proximity sensors. Different ones of the proximity sensors may be suitable for detecting the presence of different ones of vehicles, pedestrians, cyclists and horses, for example.

[0018] The sensor assembly 14 includes a first sensor device 40 operable to measure the presence of a predetermined condition. In embodiments, the first sensor device 40 is operable to detect the presence of water above at or above a predetermined height above ground level. In this way, the sensor determines whether water is present at a height sufficient to cause a hazard to road users. The sensor may provide a Boolean output of yes/no, and that indication may be transmitted to the signal assembly 14 to generate a corresponding output for display on the display device 20. In other embodiments, the first sensor measures a value of the environmental property - such as the height of the water above ground level. This measurement may then be interpreted to determine an indication (a Boolean yes/no output, for example) that is transmitted to the signal assembly 14. Alternatively, the value itself (i.e. a depth value in cm, or similar) may be transmitted to the signal assembly 14.

[0019] In embodiments, the sensor assembly 12 may include a second sensor device 30 operable to measure the same environmental property as the first sensor device 40. In this way, the first sensor device 40 makes a first measurement and the second sensor device 30

makes a second measurement. The measurements may both be direct yes/no assessment of whether the water is at a hazardous level, or may both be a measurement of the depth of the water, or may be one of each. The sensor assembly 12 may be configured to determine the indication of the measured environmental property, to be transmitted to the signal assembly 14, by averaging the first measurement and second measurement. Alternatively, one or other of the first and second measurements may be used.

[0020] In embodiments, the system is operable to identify an error condition if the difference between the first measurement and second measurement reaches or exceeds a predetermined threshold. For example, if one sensor device indicates that a hazard is present, and the other sensor device indicates that no hazard is present, an error condition may be identified. Or, for example, if the first sensor device indicates that the water is 100mm deep and the second sensor device indicates that the water is 400mm deep, an error condition may be identified. The error condition may be identified where the difference between the two values is greater than a threshold of 50mm, for example. Where an error condition is identified, the sensor assembly 12 may transmit a signal to the signal assembly 14 to trigger the display of an error message on the display device 20. The error message may be displayed instead of or in addition to the usual display.

[0021] In embodiments, the first sensor device 40 comprises a hydrostatic sensor. The hydrostatic sensor 40 may comprise a pressure level sensor that is positioned close to the ground, so that the sensor is underwater where water is present in the ford 42. In such embodiments, and as shown in Figures 1 and 2, a cable is held within an upright tube 38 mounted externally to the pole supporting the electronic components of the sensor assembly 12. At the upper end of the pole, held at a position above the water level, a first pressure sensor 36 is provided. The first pressure sensor 36 is exposed to atmospheric pressure, and measures that pressure. At the lower end of the cable, supported within a lower portion of the pole, a second pressure sensor is provided. That second pressure sensor is submersed under water within the lower portion of the pole, the pole being provided with at least one aperture 32 towards its base to allow water to flow into the lower portion of the pole. As the water level increases, the pressure exerted on the second pressure sensor increases. The differential between the pressures measured using the first and second pressure sensors enables a calculation of the water height. Since large variations in temperature may cause changes in the specific gravity of water, temperature may be measured and taken into account when calculating the depth of the water. For this purpose, a thermometer may be provided, either internally or externally to the pole.

[0022] The second pressure sensor is sealed within the tube 38 housing the cable, so that the electronics are protected from the liquid environment. The back of the

second sensor may be vented to atmospheric pressure through the tube so as to negate changes in barometric pressure.

[0023] The second sensor device 30 may be an ultrasonic sensor. The ultrasonic sensor is located towards the upper end of the pole. The sensor emits a high frequency (20 kHz to 200 kHz) acoustic wave that is reflected back off the surface of the water, as the level rises within the hollow pole. The reflected wave is detected by the emitting transducer of the sensor. The detected signal allows the sensor to determine the distance h between the water level and the sensor, and since the sensor is located at a known height above ground level, the height of the water may be calculated.

[0024] Both types of sensor may produce a linear 4-20mA signal.

[0025] The sensor assembly 12 may periodically apply power to both the first and second sensor devices to take measurements. The measurement data, or indications of the measurement data (i.e. such as an hazard indication) may be transmitted to the signal assembly. In embodiments, the data is sent in encrypted check-summed data packets.

[0026] In embodiments, at least one of the signal assembly 12 and sensor assembly 14 comprises a near field communication device operable to send or receive data to and from a nearby device. The near field communication device may use Bluetooth, for example, allowing a mobile phone, tablet, laptop, or the like, to send/receive data to and from the system 10. In this way, measured data, error data, proximity sensor activation data, or any other combination of data, may be sent to a local device from the system 10.

[0027] In embodiments, at least one of the signal assembly 14 and sensor assembly 12 comprises a cellular communication device such as a GPRS or GSM unit, operable to send or receive data to and from a remote device or network. In this way, measured data and error indications may be relayed to a control centre, to indicate the usage of the system 10 or the presence of hazardous conditions, or the presence of an error having occurred (which may require manual intervention to fix). The system may be configured to transmit an indication of an error to a remote device or network on identification of an error condition, as soon as the error is detected.

[0028] The system 10 may comprise a processor operable to determine an output based on the measurement of the environmental property. In other words, the processor determines one of a preset list of outputs to display in response to the measurement of the water depth. For example, the list of outputs may be: "ROAD CLOSED", "DANGER - DO NOT CROSS", "WATER LEVEL NORMAL", and NULL. The sensor assembly 12 may determine one of those outputs, and transmit the indication of the measurement (which might simply be the determined output message, for example) to the signal assembly which then outputs that output on the display device 20. In the event of a NULL output, the display device may

remain unlit, and deactivated. Alternatively, the sensor assembly 12 may transmit the measured value (i.e. "100mm") to the signal assembly 14. In such embodiments, the display device 20 may display the value, or may display a message, symbol, or otherwise, determined according to that value. Alternatively, the sensor assembly 12 may transmit a simple binary 'yes'/'no' signal to the signal assembly 14, indicating simply whether to operate the display device 20 or not.

[0029] In embodiments, the sensor assembly 12 comprises the processor. In other embodiments, the determination is made using a processor comprised by the signal assembly 14. In other embodiments, both assemblies comprise a processor.

[0030] It should be understood that the system may include multiple signal assemblies 14, 16, which may be identical or may comprise different combinations of the features described above. In the context of a system 10 for providing warnings of water depth a ford, a signal assembly 14, 16 may be provided on each side of the ford.

[0031] While the sensor assembly 12 and signal assembly 14 have been described as remote units, separate from one another, the sensor assembly 12 and signal assembly 14 may be combined in an integral unit. In that case, communication apparatus to transmit messages between the two assemblies may not be required.

[0032] While the system 10 of the invention has been described in the context of a ford, to detect water depth in the ford, it may equally be applied to any road surface to detect flood water.

[0033] It should be understood that features of the various embodiments described herein are suitable to be used in any combination with each other, unless specified otherwise.

[0034] Preferred features of the invention are set out in the following clauses.

1. A road sign system comprising:

a sensor assembly operable to measure an environmental property; and
a signal assembly comprising a display device configured to display a determined output based on the measured environmental property.

2. A system according to clause 1 wherein:

the sensor assembly comprises a first communication apparatus configured to transmit an indication of the measured environmental property, and
the signal assembly comprises a second communication apparatus configured to receive the transmitted indication of the measured environmental property.

3. A system according to clause 2 wherein the sensor assembly and signal assembly are situated remote

from one another.

4. A system according to any one of the preceding clauses, wherein the display device includes an LED display.

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5. A system according to any one of the preceding clauses wherein the sensor assembly includes a solar power generating apparatus.

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6. A system according to any one of the preceding clauses wherein the signal assembly includes a solar power generating apparatus.

7. A system according to any one of the preceding clauses wherein the signal assembly comprises a proximity detector operable to detect the presence of at least one of: a vehicle, a person, a cyclist, a horse.

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8. A system according to clause 7 wherein the signal assembly is configured such that the display device is operable on detection of a vehicle or person by the proximity detector.

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9. A system according to clause 7 or clause 8 wherein the signal assembly includes a plurality of proximity detectors.

10. A system according to clause 9 wherein the plurality of proximity detectors includes a first and a second proximity detector, wherein the first proximity detector and second detector are operable to detect the presence of different respective ones of: a vehicle, a person, a cyclist, a horse.

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11. A system according to any one of the preceding clauses wherein the sensor assembly includes a first sensor device operable to measure the presence of a predetermined condition.

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12. A system according to clause 11 in which the first sensor device is operable to detect the presence of water above at or above a predetermined height above ground level.

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13. A system according to any one of clauses 1 to 10, wherein the sensor assembly includes a first sensor device operable to measure a value of the environmental property.

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14. A system according to clause 13 in which the first sensor device is operable to measure the height of water above ground level.

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15. A system according to any one of clauses 10 to 14 wherein the sensor assembly further comprises a second sensor device operable to measure the

same environmental property as the first sensor device, such that the first sensor device makes a first measurement and the second sensor device makes a second measurement.

16. A system according to clause 15 in which the sensor assembly is configured to determine the indication of the measured environmental property by averaging the first measurement and second measurement.

17. A system according to clause 15 or clause 16 in which an error condition is identified if the difference between the first measurement and second measurement reaches or exceeds a predetermined threshold.

18. A system according to clause 17 wherein the signal assembly is configured to display an error signal on identification of an error condition.

19. A system according to any one of clauses 10 to 18, wherein the first sensor device comprises a hydrostatic sensor.

20. A system according to any one of clauses 10 to 18, wherein the first sensor device comprises an ultrasonic sensor.

21. A system according to clause 20 wherein the second sensor device comprises an ultrasonic sensor.

22. A system according to clause 11 wherein the first sensor device is operable to detect the presence of ice.

23. A system according to clause 11 wherein the first sensor device is operable to measure environmental conditions suitable for formation of ice.

24. A system according to any one of the preceding clauses wherein at least one of the signal assembly and sensor assembly comprises a near field communication device operable to send or receive data to and from a nearby device.

25. A system according to any one of the preceding clauses wherein at least one of the signal assembly and sensor assembly comprises a cellular communication device operable to send or receive data to and from a remote device or network.

26. A system according to clause 25 where dependent directly or indirectly on clause 17, wherein the system is operable to transmit an indication of an error to a remote device or network on identification of an error condition.

27. A system according to clause 24 or clause 25, wherein the data includes at least one of: one or more measurements the environmental property, and data indicating usage of the display device.

28. A system according to any preceding clause, further comprising a processor operable to determine an output based on the measurement of the environmental property.

29. A system according to clause 28, wherein the determined output includes at least one of: a warning symbol or message, a value indicative of the measured environmental property, and no displayed output.

30. A system according to clause 29, wherein a determination of no displayed output results in the display device being inoperative.

31. A system according to clause 28, wherein the sensor assembly comprises the processor.

32. A system according to clause 28 or clause 31, wherein the signal assembly comprises the or another processor.

33. A system according to any one of the preceding clauses, further including a second signal assembly.

[0035] When used in this specification and claims, the terms "comprises" and "comprising" and variations thereof mean that the specified features, steps or integers are included. The terms are not to be interpreted to exclude the presence of other features, steps or components.

[0036] The features disclosed in the foregoing description, or the following claims, or the accompanying drawings, expressed in their specific forms or in terms of a means for performing the disclosed function, or a method or process for attaining the disclosed result, as appropriate, may, separately, or in any combination of such features, be utilised for realising the invention in diverse forms thereof.

Claims

1. A road sign system comprising:

a sensor assembly operable to measure an environmental property; and
a signal assembly comprising a display device configured to display a determined output based on the measured environmental property.

2. A system according to claim 1 wherein:

the sensor assembly comprises a first commu-

nication apparatus configured to transmit an indication of the measured environmental property, and
the signal assembly comprises a second communication apparatus configured to receive the transmitted indication of the measured environmental property.

3. A system according to claim 2 wherein the sensor assembly and signal assembly are situated remote from one another.

4. A system according to any one of the preceding claims wherein at least one of the signal assembly and the sensor assembly includes a solar power generating apparatus.

5. A system according to any one of the preceding claims wherein the signal assembly comprises a proximity detector operable to detect the presence of at least one of: a vehicle, a person, a cyclist, a horse; and
wherein the signal assembly is configured such that the display device is operable on detection of a vehicle or person by the proximity detector.

6. A system according to any one of the preceding claims wherein the sensor assembly includes a first sensor device operable to measure at least one of the presence of a predetermined condition and/or a value of the environmental property.

7. A system according to claim 6 in which the first sensor device is operable to do at least one of:

to detect the presence of water above at or above a predetermined height above ground level; and/or
to measure the height of water above ground level.

8. A system according to claim 6 or claim 7 wherein the sensor assembly further comprises a second sensor device operable to measure the same environmental property as the first sensor device, such that the first sensor device makes a first measurement and the second sensor device makes a second measurement.

9. A system according to claim 8 in which the sensor assembly is configured to determine the indication of the measured environmental property by averaging the first measurement and second measurement.

10. A system according to claim 8 or claim 9 in which an error condition is identified if the difference between the first measurement and second measurement

reaches or exceeds a predetermined threshold.

11. A system according to claim 10 wherein the signal assembly is configured to display an error signal on identification of an error condition. 5
12. A system according to any one of claims 7 to 11, wherein the first sensor device comprises a hydrostatic sensor or an ultrasonic sensor. 10
13. A system according to any one of claims 8 to 11, wherein the first sensor device comprises a hydrostatic sensor and the second sensor device comprises an ultrasonic sensor. 15
14. A system according to any one of the preceding claims wherein at least one of the signal assembly and sensor assembly comprises at least one of:
- a near field communication device operable to send or receive data to and from a nearby device; AND/OR 20
 - a cellular communication device operable to send or receive data to and from a remote device or network. 25
15. A system according to claim 14 where dependent directly or indirectly on claim 10, wherein the system is operable to transmit an indication of an error to a remote device or network on identification of an error condition. 30

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FIGURE 1

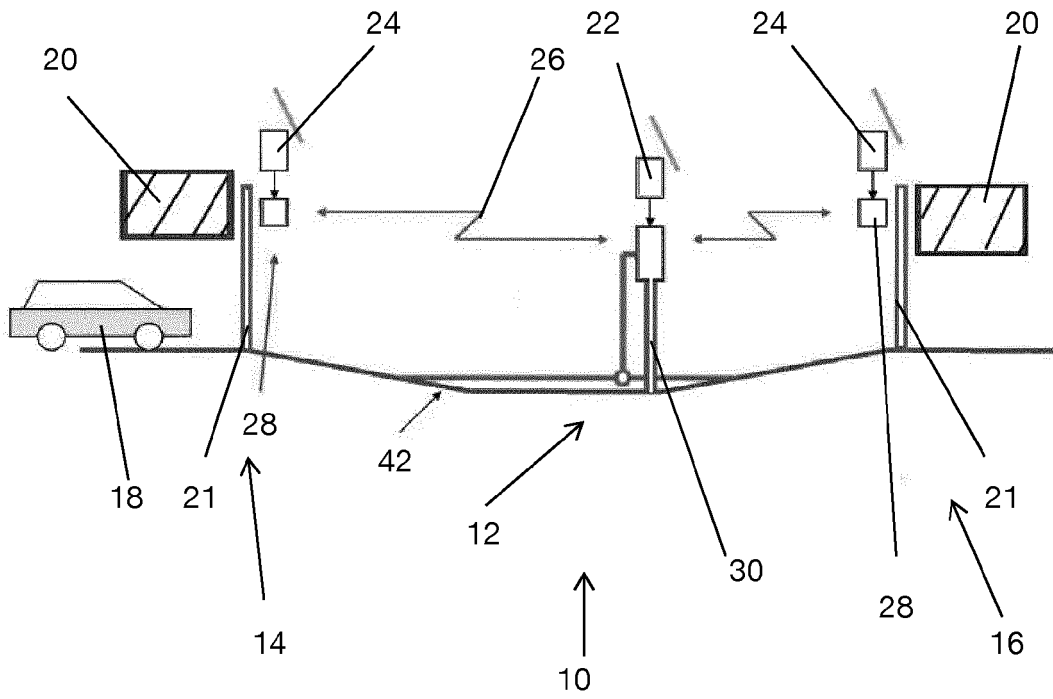
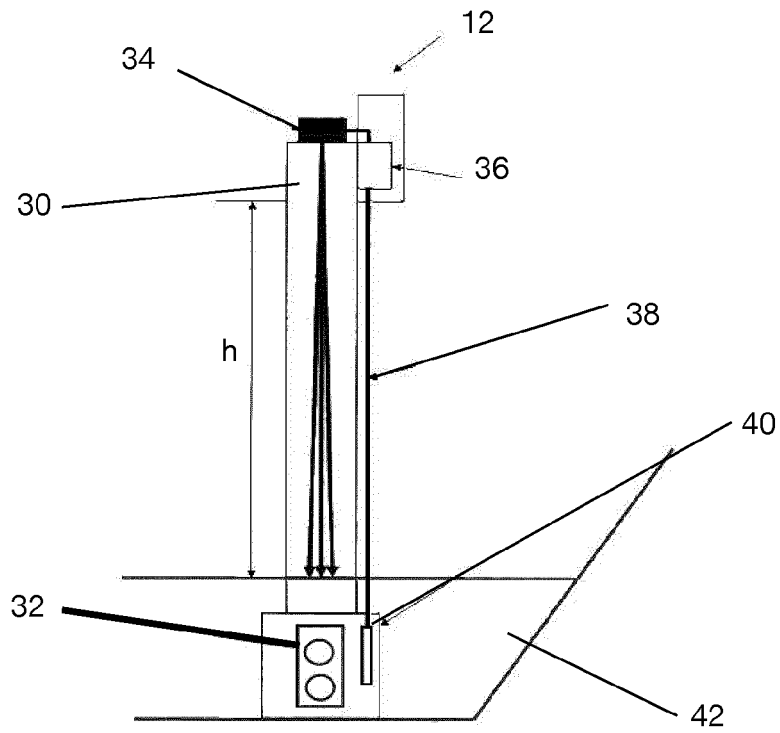


FIGURE 2





EUROPEAN SEARCH REPORT

Application Number
EP 15 16 5104

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The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 30 September 2015	Examiner de la Cruz Valera, D
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
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EP 15 16 5104

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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30-09-2015

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