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Title: IMPROVEMENTS IN AND RELATING TO COUPLERS

Abstract: A coupler for attaching an implement to a machine, the coupler including a body portion, a first jaw configured to engage a first attachment portion associated with the implement; a moveable jaw configured to engage a second attachment portion associated with the implement; and a first sensor located on the body portion configured to detect the presence of the implement adjacent to the body portion and to indicate one of a safe position in which the implement is securely held by the coupler and an unsafe position in which the implement is not securely held by the coupler.
IMPROVEMENTS IN AND RELATING TO COUPLERS

TECHNICAL FIELD
The present invention relates to improvements in and relating to couplers, in particular to couplers for attaching an implement to a machine.

BACKGROUND ART
Couplers are commonly used for releasably attaching various implements to a machine. An example of such a machine is an excavator. The couplers used by excavators commonly include at least one, or often two jaws. The jaw(s) each engage a pin on an implement to secure the implement to the coupler. The couplers are often remotely operable to release and engage an implement. The main reason for this is for ease of use. However, it may also be due to the fact that the implement to be attached is often large and/or heavy and is therefore impossible to move manually, or alternatively is likely to injure personnel attempting to manually attach the implement to the machine.

One problem that exists with remotely operable couplers is that it is difficult to tell whether the implement is in the correct position which allows the jaws of the coupler to engage with the implement pin(s) and thereby secure the implement to the coupler ready for use. Due to the large size and weight of some implements this poses a substantial risk to personnel and or equipment in the event in which the coupler is not correctly engaged. An unsecured implement may come free of the coupler and fall, potentially causing substantial damage, injury or death.

This danger has been mitigated in part by providing sensors which indicate when an implement is locked into a jaw of the coupler. This is typically achieved by locating sensors in one or more of the jaws of a coupler. The sensors indicate positive engagement of the implement with the jaws. However, such systems still require the operator to judge whether the implement is in the correct position to allow it to be correctly engaged with the coupler. Often a number of attempts must be made before positive engagement is achieved. This problem is particularly prevalent with excavators where the coupler is positioned some distance from the operator of the excavator, and the coupler is often obscured from direct view by the excavator arm.

Some couplers include a sensor that determines whether a pin is secured in a jaw of the coupler. An example of this type of coupler is described in GB2009/002602.

However, the type of coupler described in GB2009/002602 can result in an unsafe situation.
This situation arises when the sensor detects the presence of an implement pin within the moveable jaw, yet the implement is not properly secured. One example of when this situation may arise is if the actuator associated with the moveable jaw is faulty. When the coupler is oriented to a position in which the faulty actuator is bearing the weight of the implement, by way of a pin in the movable jaw, the actuator may move under the weight of the implement from a locked position to a position in which the implement is not secured. The operator still sees a locked status from the sensor and, unaware of this situation, may then operate the unsecured implement in a manner which risks damage, injury or death.

Another issue that can arise due to wear of the implement pins. Some couplers that include sensors in one of the jaws may detect a worn pin as being locked in the jaw(s) of the coupler, yet the pin maybe worn to a degree whereby the actuator cannot move the jaw sufficiently far to fully engage the pin. In use, and under load, it may therefore be possible for the implement to pull free from the coupler due to insufficient overlap between the pins and the jaws.

It would therefore be useful to have a system which alerts an operator when the coupler and implement to be attached are in the correct position for coupling.

All references, including any patents or patent applications cited in this specification are hereby incorporated by reference. No admission is made that any reference constitutes prior art. The discussion of the references states what their authors assert, and the applicants reserve the right to challenge the accuracy and pertinency of the cited documents. It will be clearly understood that, although a number of prior art publications are referred to herein, this reference does not constitute an admission that any of these documents form part of the common general knowledge in the art, in New Zealand or in any other country.

Throughout this specification, the word "comprise", or variations thereof such as "comprises" or "comprising", will be understood to imply the inclusion of a stated element, integer or step, or group of elements integers or steps, but not the exclusion of any other element, integer or step, or group of elements, integers or steps.

It is an object of the present invention to address the foregoing problems or at least to provide the public with a useful choice.

Further aspects and advantages of the present invention will become apparent from the ensuing description which is given by way of example only.
DISCLOSURE OF THE INVENTION

The present invention relates to a method and apparatus for engaging an implement with a coupling device and indicating a secure state to an operator of the coupler without the need for latching the implement in place. The present invention is particularly useful in respect of couplers that are used to couple implements to a backhoe, or excavator. However, the method and apparatus should not be seen as being limited to use solely with such machines.

According to one aspect of the present invention there is provided a coupler for attaching an implement to a machine, the coupler including:

- a body portion;
- a first jaw configured to engage a first attachment portion associated with the implement;
- a moveable jaw configured to engage a second attachment portion associated with the implement; and
- a first sensor located on the body portion configured to detect the presence of the implement adjacent to the body portion.

In preferred embodiments the first jaw is a fixed jaw.

Preferably the fixed jaw is attached to or formed integrally with the body portion. An integral attachment could be one in which the fixed jaw is formed from the same piece of material as the body portion, or alternatively the fixed jaw could be attached in a way in which the fixed jaw and body portion are fixed together, examples of such attachment may include welding, bolting, riveting or the like.

In some preferred embodiments the coupler may be configured to attach to an articulated arm. Preferably the articulated arm is a backhoe.

In preferred embodiments the fixed jaw is substantially 'U' shaped, the opening of the 'U' facing in an outward direction substantially parallel to the length of the body portion.

In preferred embodiments the fixed jaw is configured to engage with a first attachment portion in the form of a pin.

In preferred embodiments the moveable jaw is moveable between:
• an engaging position in which it engages the second engagement portion; and
• a non-engaging position in which it does not engage the second engagement.

In a particularly preferred embodiment the moveable jaw is slidably coupled to the body portion so that the moveable jaw moves in a sliding motion between the engaged position and the non-engaging position. However, the moveable jaw may also be rotatable or pivotal between the engaged position and the non-engaging position.

In preferred embodiments the moveable jaw includes a substantially 'U' shaped engaging portion configured to engage with the second attachment portion.

Preferably, the opening of the 'U' facing in an opposite direction to the fixed jaw when in the engaging position.

The coupler of the present application is for use with an implement that includes an attachment in the form of two spaced apart parallel pins or the like. The spacing between the jaws in the non-engaging position is such that when a first pin of the implement is positioned in the U shaped fixed jaw the implement can be rotated to position the second pin opposite the U shaped opening of the moveable jaw. Moving the moveable jaw to the engaging portion increases the spacing between the fixed and movable jaws and locks the moveable jaw in the coupler.

In preferred embodiments the first sensor is located adjacent the moveable jaw.

In preferred embodiments the first sensor is positioned so as to be abutted by a portion of the implement when, in use, the implement is positioned such that the second attachment portion is engageable by the moveable jaw. In use, when the implement is rotated to position the second pin opposite the moveable jaw the second attachment portion, or part of the implement, abuts the coupler. The weight of the implement presses on the sensor to indicate the second attachment portion is in a safe position, i.e. the first attachment portion of the implement is secured in the fixed jaw and cannot, for example, bounce free.

Preferably the first sensor is positioned so as to abut the second attachment portion of the implement, or part thereof.

It will be appreciated that the first sensor may be positioned in a number of locations along the length of the body portion, provided it is capable of either directly or indirectly detecting when the second attachment portion is opposite to and engageable by the moveable jaw. In use, the first attachment portion is hooked/engaged by the first/fixed jaw of the coupler. The coupler is
then rotated, causing the second attachment portion to swing towards the coupler. When the first sensor detects the second attachment portion as being opposite the moveable jaw the operator can activate the moveable jaw to lock the implement in place. Alternatively, if the implement only requires moving, or lifting, onto a transport vehicle the operator does not necessarily need to activate the moveable jaw. The reason for this is that when the second attachment portion of the implement is detected as being located proximate the coupler body the first attachment portion is located within the first, or fixed, jaw of the coupler. In this position the weight of the implement is sufficient to prevent the implement from unhooking from the first/fixed jaw. In some embodiments the functionality of the machine may be limited when the moveable jaw is not engaged with the second attachment portion of the implement, for example the maximum speed, angle on which the machine will operate, rate of movement of one or more components, or height to which the implement can be lifted may be limited.

In use, when the first attachment portion of an implement is engaged with the fixed jaw, sensing of the implement as being adjacent to the body portion at a location spaced apart from the fixed jaw indicates the angular position of the coupler relative to the implement.

In some preferred embodiments the coupler may include a second sensor configured to detect whether the movable jaw is in the engaging position, or non-engaging position. The second sensor may take a number of forms. However it will typically take the form of a sensor configured to measure the state of an actuator associated with movement of the moveable jaw.

In some preferred embodiments the coupler may include a third sensor configured to detect the presence of the first attachment portion within the fixed jaw.

In some preferred embodiments the second sensor may sense the position of a component associated with the moveable jaw.

Preferably the actuator is a hydraulic cylinder and the second sensor is configured to measure the expansion and/or degree of contraction of the actuator.

In use, the first sensor is used in combination with the second sensor and/or third sensor to indicate whether the implement is securely retained by the coupler. It will be appreciated by a person skilled in the art that for the implement to be securely retained the implement first attachment portion must be retained in the first jaw, the implement must be adjacent to the body portion of the coupler and the moveable jaw must be in the engaging position.

The third sensor indicates that the first attachment portion has been hooked by the fixed jaw; this indicates to the operator that the coupling can be safely rotated. The first sensor indicates
when the second attachment is positioned opposite the moveable jaw, this indicates that the first attachment portion is safely secured in the fixed jaw and also indicates that the implement can be locked into position by moving the moveable jaw to the engaging position. The second sensor indicates that the movable jaw is in the engaging position.

According to a further aspect of the present invention there is provided a system for coupling an implement to a machine, the system including:

- a coupler having a body portion including a fixed jaw attached to the body portion and configured to engage a first attachment portion associated with the implement; a moveable jaw moveably attached to the body portion and configured to engage a second attachment portion associated with the implement;
- an attachment between the coupler and the machine, the attachment configured to impart a rotation to the coupler about a pivot axis parallel to a width of the fixed jaw, wherein, in use, rotation of the coupler about the pivot axis allows the body portion of the coupler to be rotated relative to the implement first attachment portion, and
- a first sensor located on the body portion configured to detect the presence of the implement adjacent to the body portion and at a location spaced apart from the fixed jaw.

In some preferred embodiments the system for coupling may include a second sensor configured to detect the position of the movable jaw. It should be appreciated that measurement of the position of the movable jaw may be made directly, or indirectly. Direct measurement may involve, for example measuring the physical position of the jaw. Indirect measurement may involve sensing the position of a component associated with the moveable jaw. In such alternatives the position of the component being measured is directly relatable to the position of the moveable jaw.

Preferably the second sensor configured to detect the position of the movable jaw senses whether the movable jaw is in an engaging position, or a non-engaging position.

In some preferred embodiments the system may include a third sensor configured to detect the presence of the first attachment portion within the fixed jaw.

In preferred embodiments the system includes an indicator unit. The indicator unit provides an indication to an operator of the system when the presence of the implement is detected as being adjacent to the body portion.
In preferred embodiments the indicator unit includes an electronic indicator; examples of
electronic indicators may include, but should not be limited to, visible lights such as LEDs,
alarms, buzzers or tactile feedback or the like.

In preferred embodiments the indicator unit is located remotely to the coupler.

In some preferred embodiments the system may be integrated with, or coupled to, a control
system associated with a machine to which the coupler is attached.

In some preferred embodiments the control system associated with the machine to which the
coupler is attached may limit one or more functions of the machine if, in use, the implement is
not sensed as being adjacent to the body portion. Non-limiting examples of appropriate features
that may be limited are, hydraulic power, a reduced range of motion, a reduced rate of
movement, or similar.

According to a further aspect of the present invention there is provided a method of coupling an
implement to a machine using a coupler, the coupler having a body portion including a fixed jaw
attached to the body portion and configured to engage a first attachment portion associated
with the implement; a moveable jaw moveably attached to the body portion and configured to
engage a second attachment portion associated with the implement, and a first sensor located
on the body portion configured to detect the presence of the implement adjacent to the body
portion and at a location spaced apart from the fixed jaw, the method including the steps of:

a) engaging the implement first attachment portion with the fixed jaw;

b) rotating the coupler about a pivot axis parallel to a width of the fixed jaw so as to move
the underside of the body portion towards the implement;

c) detecting, by way of the first sensor, whether the second attachment portion of the
implement is in a position in which it can be engaged by the moveable jaw;

d) outputting a signal indicative of whether the second attachment portion is in a position in
which it can be engaged by the moveable jaw.

In use, the outputting of a signal of step d) indicates the implement is in a position whereby the
implement can be locked into position by the moveable jaw.

According to a further aspect of the present invention there is provided a sensor configured to
be used with a coupler for attaching an implement to a machine, the sensor including

• an insulating portion formed from a resilient electrically insulating material, the insulating
portion having a base on one side and a receiving surface on the opposite side; and

• a conductive member configured to be retained on the receiving surface,

wherein the conductive member is electrically isolated from the base of the insulating portion.

In use the sensor operates in conjunction with the chassis of the machine to which the coupler is attached. The machine, coupler body, and implement to be attached form an electrically conductive path through which a current can flow. In use current passes through the machine, into the coupler and through the implement via the first attachment; which is held in the fixed jaw. The implement forms a mechanical switch which is closed, i.e. conducts current, when a portion of the implement abuts the conductive member of the sensor. When the implement first attachment is located in the first jaw and the implement does not contact the conductive member of the sensor a closed circuit is not formed and no current flows. Preferably an insulated return wire is provided from the conductive member to a detection circuit.

In preferred embodiments the conductive member is configured to be electrically coupled to an electrical signal detector.

In preferred embodiments the conductive member is configured to project outwards from the receiving surface of the insulating portion.

In preferred embodiments the base is configured to be attached to a surface of the coupler.

In preferred embodiments the insulating portion is elongate.

In preferred embodiments the conductive member is elongate.

In preferred embodiments the conductive member is configured, in use, to abut a portion of an implement when a second attachment portion of the coupler is in a position in which it can be engaged by a moveable jaw of the coupler.

In preferred embodiments the sensor is configured to be compressed between a portion of the implement and a portion of the coupler body.

Preferred embodiments of the present invention may provide a number of advantages over the prior art, examples of which may include:

• indicating to an operator when an implement is in a position in which actuating a moveable jaw of a coupler will engage the moveable jaw with the implement, thereby securing the implement to the coupler;
• providing a warning to an operator when an implement is no longer securely held in a secure position, for example in the event whereby the actuator fails and disengages the moveable jaw;

• providing a warning system that indicates an unsafe condition whereby an implement may be engaged with the coupler, but due to wear, or actuator fault may not be safely held in the coupler.

BRIEF DESCRIPTION OF DRAWINGS

Further aspects of the present invention will become apparent from the following description which is given by way of example only and with reference to the accompanying drawings in which:

Figure 1a  shows a plan view of a coupler in accordance with one preferred embodiment of the present invention;

Figure 1b  shows a plan view of the coupler of Figure 1 in an engaged position;

Figure 2  shows a cross sectional view of the coupler of Figure 1.

Figure 3a  shows a perspective view of a sensor in accordance with one preferred embodiment of the present invention;

Figure 3b  shows an exploded view of the sensor of Figure 2a;

Figure 4  shows a plan view of the coupler of Figure 1 and an attached implement in an unsecure position;

Figure 5  shows a plan view of the coupler of Figure 1 and an attached implement in a secure position;

Figure 6  shows a plan view of the coupler of Figure 1 and an attached implement in an engaged position,

Figure 7a - 7c  show schematic views of a system for coupling an implement to a machine in accordance with one preferred embodiment of the present invention.

BEST MODES FOR CARRYING OUT THE INVENTION

With reference to Figure 1a, 1b, 2 and 4, 5 and 6 there is shown a coupler as generally
indicated by 1. Coupler 1 includes a body portion 2 to which is attached a fixed jaw 3. The jaw 3 is fixed in the sense that it does not move with respect to the body portion 2. It will be appreciated that fixed jaw 3 may take a number of forms without departing from the scope of the present invention. For example, fixed jaw 3 may be formed integrally with the body portion of coupler 2, or it may be attached to the body portion 2 by way of bolts or other suitable fasteners.

Fixed jaw 3 includes a "LT shaped opening 3a facing in an outward direction substantially parallel to the length of the body portion. The "LT shaped opening is configured to receive the circular cross section of a first attachment pin 12a (shown in figure 2) of an implement (shown in figures 4, 5 and 6) the first pin 12a extends across the width of the fixed jaw 3 so as to be substantially transverse to the length of body portion 2.

A moveable jaw 4 is moveably attached to the body portion 2. The movable jaw 4 includes a substantially "LT shaped engaging portion 4a, the opening of the 'U' facing in an opposite direction to the 'LT shape of the fixed jaw 3. The 'U' shaped engaging portion 4a is configured to receive a second attachment pin 12b (shown in Figure 2), which, in use, extends across the width of the movable jaw 4. In the embodiment shown in Figure 2 a second sensor 40 detects the position of movable jaw 4 by measuring the position of the shaft of hydraulic ram 41 (shown in Figure 2), and a third sensor 14 detects the presence of first pin 12a in fixed jaw 3.

The moveable jaw 4 is configured to slide along a portion of the length 4b of the coupler body portion 2 towards and away from fixed jaw 3. In use, movement of the moveable jaw 4 alters the spacing between the fixed jaw 3 and the moveable jaw 4, this movement facilitates the clamping, or engagement of an implement with the coupler 1. It should be appreciated that alternatives to sliding movement of the moveable jaw 4 may be considered, for example, the movable jaw may rotate rather than slide. The manner in which the fixed jaw and moving jaw provide clamping of an implement is explained in greater detail later in this document with respect to Figures 2 to 5.

A person skilled in the art will appreciate that the configuration of the fixed jaw 3 and moveable jaw 4 will depend on the type of attachment portions provided on a particular implement.

The moveable jaw 4 is moveable between an engaging portion, shown in figure 1a wherein the moveable jaw is positioned relatively closer to the fixed jaw 3 and a non-engaging position, shown in Figure 1b, wherein the moveable jaw 4 is positioned relatively further from the fixed jaw 3.
The coupler 1 also includes a first sensor 5 located on the body portion 2, the first sensor 5 is positioned adjacent to the moveable jaw 4.

Referring now to Figures 3a and 3b that show the sensor 5 in more detail. The first sensor 5 includes an insulating portion 6 formed from a resilient electrically insulating material. The insulating portion 6 has a base 7 on one side and a receiving surface 8 on the opposite side. A cable 10 is sandwiched between conductive member 9 and the receiving surface 8 to which the conductive member 9 is attached. The insulating portion 6 base 7 is, in use, attached to the coupler body 2. Because the conductive member 9 is insulated by the insulating portion 6 there is no electrical connection between the coupler body and the conductive member 9. In use the conductive member 9 is configured to abut a portion of an implement. If the implement is in contact with the coupler body portion, for example by way of a first attachment portion of an implement being held by the fixed jaw 3, and the implement is in contact with the conductive member 9 an electrical circuit is completed between the coupler 1, through the body of the implement, and the cable.

It should however be appreciated that the present invention could be performed using various types of sensors, such as, for example, proximity sensor, mechanical switches, or the like.

Typically the first sensor 5 will be elongate, so as to cater for a range of differently spaced first and second attachment pins. The insulating portion 6 compresses when an implement presses against the conductive member 9, this allows contact to be made between the implement and the conductive member 9 whilst allowing the implement to bear against the body portion 2.

Coupler 1 is configured to attach to a machine by way of connection points 11a and 11b. Typically the machine will include an articulated arm such as a back hoe. Connection points 11a and 11b allow for rotation of the coupler about an axis substantially parallel to the width of the fixed jaw 3.

With reference to Figures 4 to 6 there is shown a coupler 1 to which an implement in the form of an excavator bucket 12 is attached. Excavator bucket 12 includes a first attachment portion in the form of pin 12a and a second attachment portion, spaced apart from the first attachment portion, in the form of pin 12b. Figure 2 shows the implement 12 first attachment portion pin 12a engaged within fixed jaw 3.

Figure 4 shows the coupler of figure 2 in a position in which the coupler 1 has been rotated about a pivot axis parallel to a width of the fixed jaw 3. Rotation is facilitated by an attachment (not shown) between the coupler 1 and the machine (not shown).
Rotation of the coupler 1 rotates the body portion 2 relative to the first attachment portion pin 12a, thereby moving the moveable jaw 4 towards the second attachment portion 12b. It will be appreciated that, in use, the implement will typically hang from the fixed jaw 3 by way of the first attachment portion pin 12a. The hanging orientation of the implement will therefore be dictated by its centre of mass relative to the first attachment portion pin 12a.

Rotation of the coupler 1 results in the excavator bucket 12 second attachment portion 12b pressing against the first sensor 5 conductive member 9 compressing insulating portion 6. Compression of the insulating portion 6 allows the second attachment portion 12b to bear against the coupler body portion 2 whilst completing an electrical circuit through the coupler fixed jaw 3, the first attachment portion 12a, the excavator bucket 12, the second attachment portion 12b, the conductive member 9 and cable 10.

Completion of the electrical circuit is indicative of the position of pin (12b) with respect to the body portion (2). Therefore, it is possible to determine whether the coupler (1) is in a position in which movable jaw (4) can engage pin (12b). Completion of the circuit results in an indication to a user that the implement second attachment portion pin 12b is in a position in which the movable jaw 4 can be moved from a non-engaging position (shown in Figure 4), wherein the second engagement portion 12b is able to move freely relative to the body portion 2, to an engaging position (shown in Figure 5), wherein the second engagement portion 12b is engaged by, and held substantially fixed relative to, the body portion 2 by the moveable jaw 4.

With respect to Figures 7a to 7c there is shown a schematic of a system for coupling an implement to a machine. The system includes coupler 30 of the type shown in figures 1 to 2, coupler 30 includes a third sensor 31 which is provided for association with the fixed jaw and is positioned so as to detect the presence of the first attachment portion 12a within the fixed jaw. A first sensor 32 is positioned adjacent the moveable jaw and is configured to detect the presence of the implement when it is adjacent to the body portion of the coupler. An indicator unit 33 is located remotely from the coupler 30 and includes a relay switch 36 to toggle between safe indication light source 34 and unsafe indication light source 35. The third sensor 31 and first sensor 32 are connected in parallel by way of sense wire 37 and through the chassis 38 of the coupler. When the circuit through the sense wire 37 is not completed by way of either of third sensor 31 or first sensor 32 relay 36 activates unsafe indication light source 35, shown in figure 7b. This situation occurs when the first attachment portion pin 12a is detected as being in the fixed jaw, but the second attachment portion pin 12b is not detected as being adjacent the coupler body.
When the circuit through sense wire 37 is not completed through either of third sensor 31, or first sensor 32, relay 36 activates safe indication light source 34, shown in figures 7a and 7b. Activation of safe indication light source 34 can occur in two circumstances:

a) the first attachment portion pin 12a is not located in the fixed jaw and second attachment portion pin 12b is not detected as being adjacent the coupler body, OR

b) the first attachment portion pin 12a is located in the fixed jaw and second attachment portion pin 12b is detected as being adjacent the coupler body.

Variants that include a second sensor for measuring the position of the moveable jaw 4, shown in figure 2, will also require that the moveable jaw is in the engaged position. This is in addition to the requirements detailed in step b) above. Typically such variants would incorporate a second sensor which sits in parallel with the first and third sensors. When the jaw is in a non-engaging position the second sensor 40 completes the circuit through sense wire 37 and thereby indicates an unsafe condition. The advantage of monitoring the position of the moveable jaw is that if the actuator, hydraulic ram of figure 2, fails and disengages, or fails to move, the moveable jaw to engage the second work attachment pin 12b the operator is alerted.

It will be appreciated by persons skilled in the art that the system of Figures 7a - 7c is provided by way of example only and that there are numerous circuit configurations that could provide the same or similar functionality, therefore the example provided should not be seen as being limiting.

In some alternatives the system may also include a further sensor (not shown) that indicates the position of the movable jaw 4. Numerous alternatives exist by which the jaw position could be measured, not limiting examples of which include, measuring the shaft position of a hydraulic cylinder associated with the movable jaw, measuring a hydraulic pressure provided to the movable jaw, or direct measurement of the position of the jaw.

In some alternatives the system may also limit one or more functions of the machine when an implement is not detected as being secure within the fixed jaw, ie when the unsafe indication light source 35 is active. Non-limiting examples of limitation of one or more functions of the machine may include, reduced hydraulic power, a reduced range of motion, or a reduced rate of movement.

It will be appreciated by persons skilled in the art that the detection of the implement moving away from the body of the coupler may be indicative of a number of unsafe conditions. For example, in the event in which the actuator fails and releases one of the implement pins the
implement will swing away from the coupler, at which time the operator will be alerted as to the unsafe operating condition.

A further example is the situation whereby the implement pins may be worn. Whilst pin detection sensors in the jaws may indicate the presence of the pins in the jaws, indication of the, or a, pin moving away from the coupler body, but still remaining within the jaw, is indicative of pin wear. If a pin is worn to the point whereby it begins to move away from the coupler body during use, the operator will be alerted. Once the pins begin moving in the coupler jaws during use the rate of wear will increase substantially. By alerting the operator early remedial action may be taken early avoiding costly downtime in the event of a pin failure, and also avoiding safety risks.

Aspects of the present invention have been described by way of example only and it should be appreciated that modifications and additions may be made thereto without departing from the scope thereof.

DOHERTY ENGINEERED ATTACHMENTS LIMITED

by its authorised agents

JAMES & WELLS INTELLECTUAL PROPERTY
WHAT WE CLAIM IS:

1. A coupler for attaching an implement to a machine, the coupler including:
   • a body portion;
   • a first jaw configured to engage a first attachment portion associated with the implement;
   • a moveable jaw configured to engage a second attachment portion associated with the implement; and
   • a first sensor located on the body portion configured to detect the presence of the implement adjacent to the body portion.

2. The coupler as claimed in claim 1 wherein the first jaw is a fixed jaw.

3. The coupler as claimed in claim 2 wherein the fixed jaw is formed integrally with the body portion.

4. The coupler as claimed in any one of claims 1 to 3 wherein the coupler is configured to attach to an articulated arm.

5. The coupler as claimed in any one of claims 1 to 4 wherein the fixed jaw is configured to engage with a first attachment portion in the form of a pin.

6. The coupler as claimed in claim 5 wherein the fixed jaw is substantially 'U' shaped.

7. The coupler as claimed in any one of claims 1 to 6 wherein the moveable jaw is moveable between:
   • an engaging position in which it engages the second engagement portion; and
   • a non-engaging position in which it does not engage the second engagement portion.

8. The coupler as claimed in claim 7 wherein the moveable jaw is slidably coupled to the body portion so that the moveable jaw moves in a sliding motion between
the engaging position and the non-engaging position.

9. The coupler as claimed in either one of claim 7 or claim 8 including a second sensor configured to detect whether the movable jaw is in the engaging position.

10. The coupler as claimed in any one of claims 7 to 9 including a second sensor configured to detect whether the movable jaw is in the non-engaging position.

11. The coupler as claimed any one of the preceding claims wherein the movable jaw includes a substantially 'U' shaped engaging portion configured to engage with the second attachment portion.

12. The coupler as claimed in any one of the preceding claims wherein the first sensor is located proximate the moveable jaw.

13. The coupler as claimed in claim 12 wherein the first sensor is positioned so as to abut a portion of an implement when, in use, the implement is positioned such that the second attachment portion is engageable by the moveable jaw.

14. The coupler as claimed in claim 13 wherein the first sensor is positioned so as to abut the second attachment portion of the implement, or part thereof.

15. The coupler as claimed in any one of the preceding claims including a third sensor configured to detect the presence of the first attachment portion within the fixed jaw.

16. A system for coupling an implement to a machine, the system including:

- a coupler having a body portion including a fixed jaw attached to the body portion and configured to engage a first attachment portion associated with the implement; a moveable jaw moveably attached to the body portion and configured to engage a second attachment portion associated with the implement;

- an attachment between the coupler and the machine, the attachment configured to impart a rotation to the coupler about a pivot axis parallel to a width of the fixed jaw, wherein, in use, rotation of the coupler about the pivot axis allows the body portion of the coupler to be rotated relative to
the implement first attachment portion, and

- a first sensor located on the body portion configured to detect the presence of the implement adjacent to the body portion and at a location spaced apart from the fixed jaw.

17. The system as claimed in claim 16 including a second sensor configured to detect whether the movable jaw is in an engaging position.

18. The system as claimed in either one of claim 16 or claim 17 including a second sensor configured to detect whether the movable jaw is in a non-engaging position.

19. The system as claimed in any one of claims 16 to 18 including a third sensor configured to detect the presence of the first attachment portion within the fixed jaw.

20. The system as claimed in any one of claims 16 to 19 including an indicator unit that indicates a sensor status.

21. The system as claimed in claim 20 wherein the indicator unit is located remotely to the coupler.

22. The system as claimed in any one of claims 16 to 21 integrated with, or coupled to, a control system associated with the machine to which the coupler is attached.

23. The system as claimed in claim 22 wherein the control system associated with the machine to which the coupler is attached limits one or more functions of the machine if, in use, the second attachment portion of the implement is detected as not being adjacent to the body portion of the coupler.

24. A method of coupling an implement to a machine using a coupler, the coupler having a body portion including a fixed jaw attached to the body portion and configured to engage a first attachment portion associated with the implement; a moveable jaw moveably attached to the body portion and configured to engage a second attachment portion associated with the implement, and a first sensor located on the body portion and configured to detect when the second
attachment portion of the implement is in a position in which it can be engaged by the moveable jaw, the method including the steps of:

a) engaging the implement first attachment portion with the fixed jaw;

b) rotating the coupler about a pivot axis parallel to a width of the fixed jaw so as to rotate the body portion towards the implement;

c) detecting, by way of the first sensor, whether the second attachment portion of the implement is in a position in which it can be engaged by the moveable jaw;

d) outputting a signal indicative of whether the second attachment portion is in a position in which it can be engaged by the moveable jaw.

25. A sensor configured to be used with a coupler for attaching an implement to a machine, the sensor including:

- an insulating portion formed from a resilient electrically insulating material, the insulating portion having a base on one side and a receiving surface on the opposite side;

- a conductive member configured to be retained on the receiving surface;

wherein the conductive member is electrically isolated from the base of the insulating portion.

26. The sensor as claimed in claim 25 wherein the conductive member projects outwards from the receiving surface of the insulating portion.

27. The sensor as claimed in either one of claim 25 or claim 26 wherein the base is configured to be attached to a surface of the coupler.

28. The sensor as claimed in any one of claims 25 to 27 wherein the conductive member is configured, in use, to abut a portion of an implement when a second attachment portion of the coupler is in a position in which it can be engaged by a moveable jaw of the coupler.
29. The sensor as claimed in any one of claims 25 to 28 wherein the sensor is configured to be compressed between a portion of the implement and a portion of the coupler body.

30. A coupler for attaching an implement to a machine substantially as described herein with reference to the disclosure of the invention, the best modes and figures 1a, 1b, 2, 4, 5 and 6.

31. A system for coupling an implement to a machine substantially as described herein with reference to the disclosure of the invention, the best modes and figures 4, 5 and 6.

32. A method of coupling an implement to a machine substantially as described herein with reference to the disclosure of the invention, the best modes and figures 4, 5 and 6.

33. A sensor configured to be used with a coupler substantially as described herein with reference to the disclosure of the invention, the best modes and figures 3a and 3b.
INTERNATIONAL SEARCH REPORT

International application No.
PCT/NZ2014/000221

A. CLASSIFICATION OF SUBJECT MATTER

E02F 3/36 (2006.01)  E02F 9/26 (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)


DATABASE: GOOGLE PATENTS & KEYWORDS: "E02F" quick couple sensor, "E02F" quick couple rotat.

DATABASE: ESP@CENET & APPLICANT SEARCH

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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<th>Relevant to claim No.</th>
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<td>Documents are listed in the continuation of Box C</td>
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* Further documents are listed in the continuation of Box C

**X** See patent family annex


e | Special categories of cited documents:

**"A"** document defining the general state of the art which is not considered to be of particular relevance

**"E"** earlier application or patent but published on or after the international filing date

**"L"** 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)

**"O"** document referring to an oral disclosure, use, exhibition or other means

**"P"** document published prior to the international filing date but later than the priority date claimed

**"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

**"X"** document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

**"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
23 February 2015

Date of mailing of the international search report
23 February 2015

**Name and mailing address of the ISA/AU**

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Form PCT/ISA/210 (fifth sheet) (July 2009)
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<td>US 2011/0313625 A1 (MILLER et al.) 22 December 2011 Abstract, Fig. 2, para 0045, 0054,</td>
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<td>WO 2012/156672 A1 (SHADOWFICTION LIMITED) 22 November 2012 Abstract, Fig. 3, 5A-F, 6-7, Pg 8</td>
<td>1-8, 11-14, 16-24</td>
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### INTERNATIONAL SEARCH REPORT

**International application No.**
PCT/NZ2014/000221

**Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)**

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. [ ] Claims Nos.: because they relate to subject matter not required to be searched by this Authority, namely: the subject matter listed in Rule 39 on which, under Article 17(2)(a)(i), an international search is not required to be carried out, including

2. [x] Claims Nos.: 30-33 because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically: See Supplemental Box

3. [ ] Claims Nos: because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a)

**Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)**

This International Searching Authority found multiple inventions in this international application, as follows:

See Supplemental Box for Details

1. [ ] As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. [ ] As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.

3. [ ] As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. [x] No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.: 1-24

**Remark on Protest**

[ ] The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

[ ] The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

[ ] No protest accompanied the payment of additional search fees.
Continuation of Box II
The claims do not comply with Rule 6.2(a) because they rely on references to the description and/or drawings.

Continuation of: Box III
This International Application does not comply with the requirements of unity of invention because it does not relate to one invention or to a group of inventions so linked as to form a single general inventive concept.

This Authority has found that there are different inventions based on the following features that separate the claims into distinct groups:

- Claims 1-24 are directed to a coupler for attaching an implement to a machine. The feature of a sensor located on a body portion of the coupler, configured to detect the presence of an implement adjacent to the body portion is specific to this group of claims.
- Claims 25-29 are directed to a sensor. The feature of the sensor including a conductive member electrically insulated from an insulating portion is specific to this group of claims.

PCT Rule 13.2, first sentence, states that unity of invention is only fulfilled when there is a technical relationship among the claimed inventions involving one or more of the same or corresponding special technical features. PCT Rule 13.2, second sentence, defines a special technical feature as a feature which makes a contribution over the prior art.

When there is no special technical feature common to all the claimed inventions there is no unity of invention.

In the above groups of claims, the identified features may have the potential to make a contribution over the prior art but are not common to all the claimed inventions and therefore cannot provide the required technical relationship. Therefore there is no special technical feature common to all the claimed inventions and the requirements for unity of invention are consequently not satisfied a priori.
This Annex lists known patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

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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.

Form PCT/ISA/210 (Family Annex)(July 2009)