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(56) Documents Cited:
US 9938693 B1 **US 20210381194 A1**
US 20210123218 A1 **US 20060129280 A1**

(58) Field of Search:
INT CL **E02F**
Other: **WPI, EPODOC**

(54) Title of the Invention: **Method of operating work machine with interchangeable implement**
Abstract Title: **METHOD OF OPERATING WORKING MACHINE WITH INTERCHANGABLE IMPLEMENT**

(57) A method and device for operating a working machine 100 configured to couple an arm 110 to an interchangeable implement 120. A controller obtains an identifier associated with an implement coupled to the working machine, compares the identifier to a list of stored identifiers, which is associated with an implement model and implement data. The identifier implement data is loaded from which a work mode is activated. The implement may comprise a first 121 and second 122 implement, with the identifier comprising a first identifier and a second identifier and the implement data for the implement comprises data for a combination of the fist and second implement. The identifier may be detected by wireless communication such as Bluetooth. A user may input the identifier.

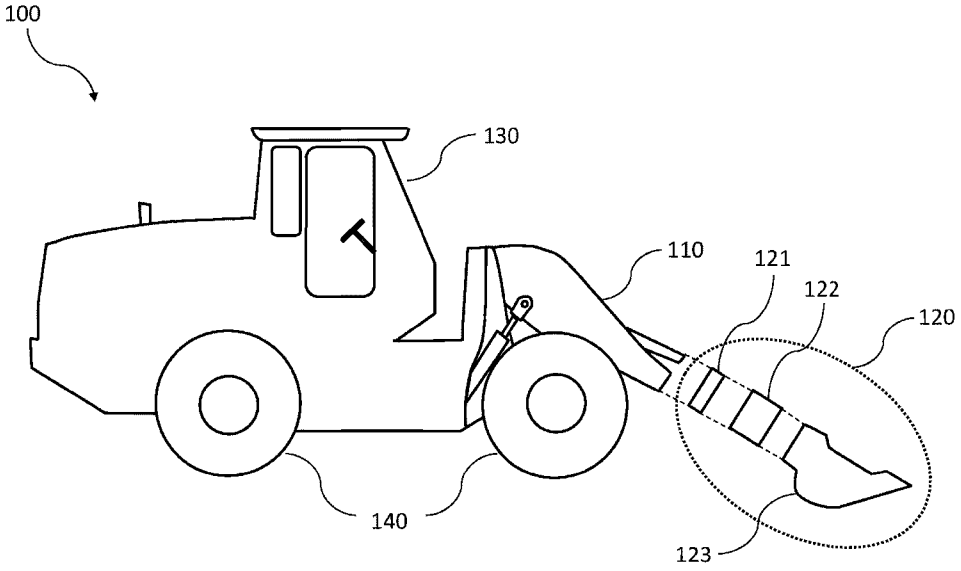

Fig. 1

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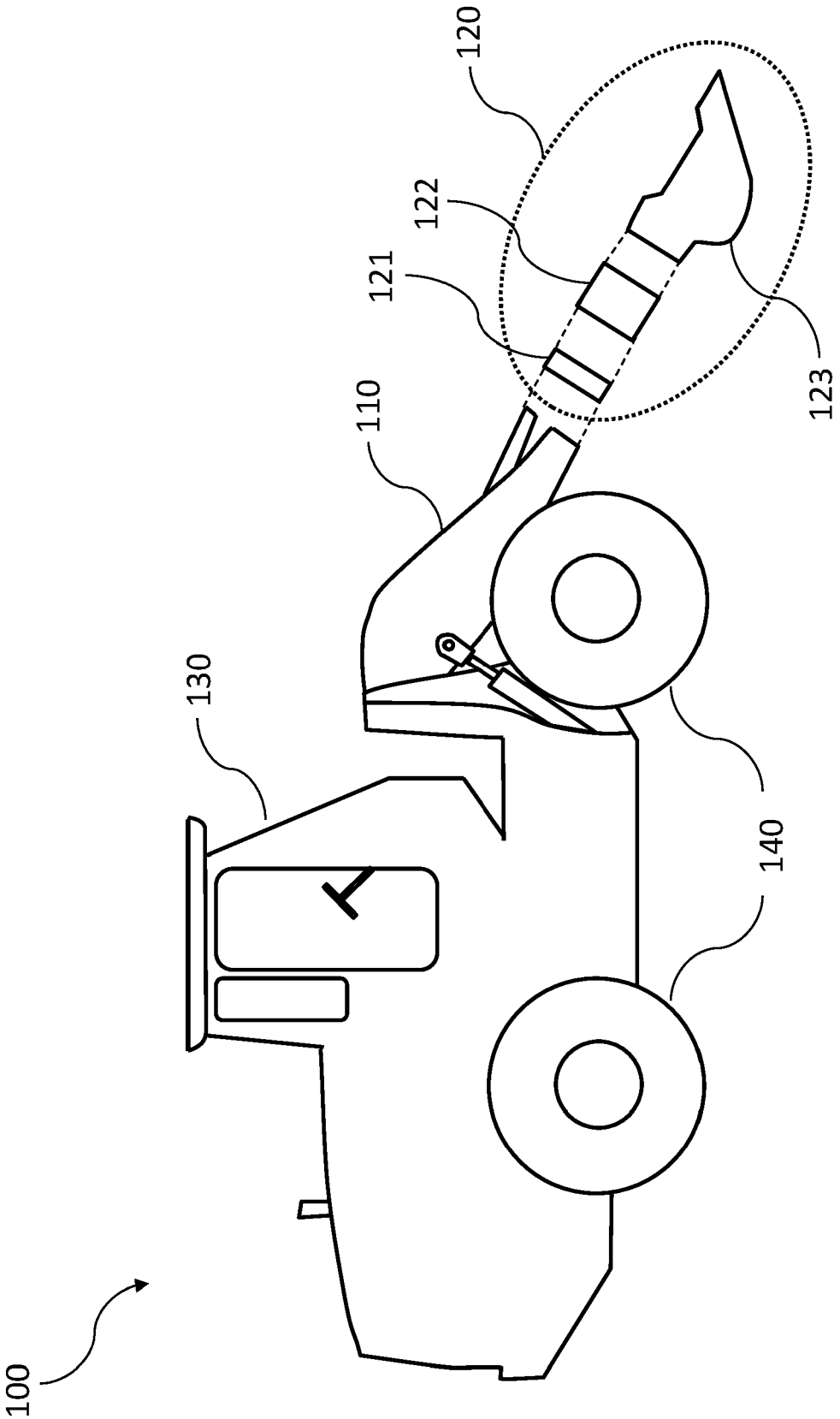

Fig. 1

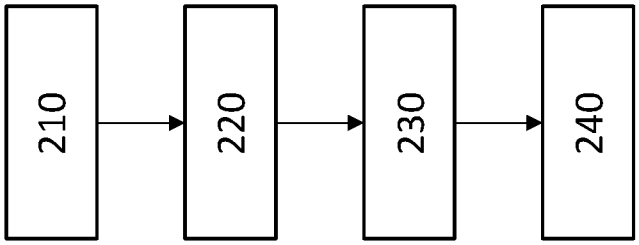

Fig. 2

Method of operating work machine with interchangeable implement

Field of the disclosure

The disclosure relates to the field of work vehicles.

Background

Certain work vehicles are known to have interchangeable tools. For example, an excavator may have interchangeable hydraulic tools such as buckets, hammers, grapples, or other tools. Typically, an operator of the work vehicle selects appropriate control settings (such as hydraulic pressure settings) for the particular interchangeable tool, either from preset settings or by manually inputting parameters of the tool. The parameters might include dimensions of the work tool. A particular mode of operation might require the operator to measure the work tool and manually enter its dimensions, for example. Otherwise, an operator might manually input or select a part number or model number of the work tool. This method of operation requires the operator to accurately select or input the setting or parameters, and/or accurately measure the work tool.

Summary of the disclosure

Against this background, there is provided: a method of operating a work vehicle comprising an arm, wherein a distal end of the arm is configured to couple to an interchangeable implement assembly. The method comprises obtaining at least one identifier of a first implement assembly coupled to the work vehicle. The method further comprises comparing the at least one identifier to a list of stored identifiers, wherein each stored identifier is associated with an implement model and each implement model is associated with implement data. The method further comprises loading implement data for the first implement assembly based on the at least one identifier. The method further comprises activating a work mode based on the implement data.

In this way, it is possible to activate a work mode based on a particular interchangeable implement assembly, which may comprise one or more implements. The work mode may, for example, be based on control settings for the interchangeable implement assembly and/or on dimensions of the interchangeable implement assembly. The work mode may be activated with less risk of operator error than conventional means. Work modes may be activated for combinations of more than one implement.

There is also provided: a device for operating a work vehicle comprising an arm, wherein a distal end of the arm is configured to couple to an interchangeable implement assembly, wherein the device comprises a controller configured to obtain at least one identifier of a first implement assembly coupled to the work vehicle. The controller is further configured to compare the at least one identifier to a list of stored identifiers, wherein each stored identifier is associated with an implement model and each implement model is associated with implement data. The controller is further configured to load implement data for the first implement assembly based on the at least one identifier. The controller is further configured to activate a work mode based on the implement data.

Brief description of the drawings

A specific embodiment of the disclosure will now be described, by way of example only, with reference to the accompanying drawings in which:

Figure 1 shows a schematic diagram of a work vehicle comprising an arm, wherein a distal end of the arm is configured to attach to an interchangeable implement assembly.

Figure 2 shows a flow chart illustrating a method of operating a work vehicle comprising an arm, wherein a distal end of the arm is configured to couple to an interchangeable implement assembly, in accordance with an embodiment of the present disclosure.

Detailed description

With reference to Figure 1, a work vehicle 100 comprises an arm 110. A distal end of the arm 110 is configured to couple to an interchangeable implement assembly 120 (indicated

by the dotted oval). The interchangeable implement may comprise one or more implement components. Figure 1 shows an example of an interchangeable implement assembly 120 comprising a first implement component 121, a second implement component 122 and a third implement component 123. The interchangeable implement assembly 120 is shown in an exploded view, with dashed lines showing that the first implement component 121 is configured to couple to the distal end of the arm 110, the second implement component 122 is configured couple to the first implement component 121 and the third implement component 123 is configured couple to the second implement component 122.

The arm 110 of the work vehicle 100 may comprise a boom. The boom may be fixed or may be movable with respect to the body of the work vehicle 100. In an example, the boom may be hydraulically movable. The boom may be a fixed length or may be extendable. The boom may be articulated. The arm 110 may also comprise a member (or stick) coupled to a distal end of the boom, wherein a distal end of the member is configured to couple to the interchangeable implement assembly 120. The arm may comprise a stick configured to be movable with respect to the work vehicle. The arm may comprise any configuration of boom and/or stick.

The work vehicle 100 shown in Figure 1 comprises a cab 130 and wheels 140. Figure 1 shows one example of a work vehicle 100 comprising an arm 110, wherein a distal end of the arm is configured to couple to an interchangeable implement assembly. The work vehicle may comprise any other type of work vehicle with any configuration of arm. The arm 110 shown in Figure 1 comprises a stick, but as described above the arm may alternatively comprise a boom and a stick.

The work vehicle 100 may be used with particular settings corresponding to a particular interchangeable implement assembly 120. The work vehicle 100 may be usable with a plurality of different interchangeable implement assemblies. Different settings may be used for different interchangeable implement assemblies.

A method of operating a work vehicle comprising an arm, wherein a distal end of the arm is configured to couple to an interchangeable implement assembly, is illustrated in Figure 2. The method comprises step 210 of obtaining at least one identifier of a first implement assembly coupled to the work vehicle. At step 220, the at least one identifier is compared to a list of stored identifiers. Each stored identifier is associated with an implement model

and each implement model is associated with implement data. Step 230 comprises loading implement data for the first implement assembly based on the at least one identifier. At step 240, a work mode is activated based on the implement data.

The first implement assembly comprises one or more implements. In an event that the first implement assembly comprises more than one implement, step 210 may comprise obtaining an identifier for each implement of the first implement assembly. Step 220 may then comprise comparing each identifier to the list of stored identifiers. Step 230 may comprise loading implement data for each implement. Otherwise, the implement data loaded at step 230 may comprise implement data for the combination of the implements, i.e. for the first implement assembly as a whole. The work mode may be based on the implement data for the first implement assembly as a whole.

For example, the first implement assembly may comprise a first implement and a second implement. The at least one identifier may comprise a first identifier and a second identifier. The implement data for the first implement assembly may comprise data for a combination of the first implement and the second implement.

The step of obtaining the at least one identifier may comprise obtaining the at least one identifier via a user input device, wherein an operator visually obtains the at least one identifier from a visible indication on the first implement assembly. The operator may enter the at least one identifier into a user input device, or may select the at least one identifier from a list on a user input device. In an embodiment, the step of obtaining the at least one identifier may comprise detecting the at least one identifier via wireless communication. The step of obtaining the at least one identifier may comprise detecting the at least one identifier via Bluetooth communication.

In an embodiment where the step of obtaining the at least one identifier comprises detecting the at least one identifier via wireless communication, the method may comprise using a mobile device to scan for identifiers within range. Otherwise, the method may comprise using a receiver on the work vehicle to receive the wireless communication. The identifiers may comprise a Bluetooth tag, RFID tag, or other detectable tag.

In an embodiment, the step of obtaining the at least one identifier may comprise one or both of detecting the at least one identifier via wireless communication and an operator

visually obtaining the at least one identifier from a visible indication on the first implement assembly. For example, in an event that the first implement assembly comprises a first implement and a second implement, a first identifier may be obtained for the first implement by detecting the first identifier by wireless communication. The second identifier may be obtained for the second implement by an operator visually obtaining the second identifier.

In an embodiment, the step of obtaining the at least one identifier may comprise a first stage of attempting to detect the at least one identifier via wireless communication. In an event that one or more identifiers are not detected via wireless communication, the step of obtaining the at least one identifier may comprise a second stage of an operator visually obtaining the at least one identifier from a visible indication on the first implement assembly.

The at least one identifier may comprise a unique identifier for the first implement assembly. In an event that the first implement assembly comprises more than one implement, the at least one identifier may comprise a unique identifier for each implement. Otherwise, the at least one identifier may comprise an implement model identifier, such that the at least one identifier is not unique to the specific implement but is indicative of the type and particular model of the implement. In an event that the least one identifier comprises an implement model identifier, each of the stored identifiers may be associated directly with implement data. In an event that the at least one identifier comprises a unique identifier, each of the stored identifiers may be associated with an implement model, wherein the implement model is associated with the implement data. Each implement model may have multiple stored identifiers associated with it (for example in an event that there are multiple tools of the same model used on a worksite).

In an embodiment, the list of stored identifiers may be configured to be updated remotely. The list of stored identifiers may be updated in response to a request by an operator, in response to an instruction from a remote controller, or each time the method is carried out.

In an embodiment, the implement data may be stored on the electric work vehicle. In another embodiment, the implement data may be downloaded after the one or more identifiers have been compared to the stored list of identifiers (i.e. after the implement model or models of the first implement assembly have been identified). Downloading the implement data may be via a wireless communication.

In use, an operator may initiate the method of operating the work vehicle after the first implement assembly has been coupled to the arm of the work vehicle. The operator may initiate the method via a user input device. The work vehicle may comprise the user input device (for example in the cab of the work vehicle), or the user input device may comprise a mobile device.

As described above, a work machine may comprise an arm wherein a distal end of the arm is configured to couple to an interchangeable implement assembly. The arm may comprise a boom and/or a stick. In an event that the arm comprises a boom and a stick, a distal end of the stick may be configured to couple to an interchangeable implement assembly.

The interchangeable implement assembly may comprise one or more implements. In an event that the interchangeable implement assembly comprises more than one implement, the distal end of the arm is configured to couple to a first implement of the interchangeable implement assembly. The first implement is configured to couple to a second implement of the interchangeable implement assembly. In an event that the interchangeable implement assembly comprises a third implement, the second implement is configured to couple to the third implement, and so on.

Several interchangeable implement assemblies will be described below, by way of example only.

The interchangeable implement assembly may comprise a first implement comprising a work tool.

The interchangeable implement assembly may comprise a first implement comprising a coupler or quick coupler. The interchangeable implement assembly may comprise a second implement comprising a work tool, wherein the work tool is configured to couple to the quick coupler.

The interchangeable implement assembly may comprise a first implement comprising a tilt device. The interchangeable implement assembly may comprise a second implement comprising a work tool, wherein the work tool is configured to couple to the tilt device.

The interchangeable implement assembly may comprise a first implement comprising a coupler or quick coupler. The interchangeable implement assembly may comprise a second implement comprising a tilt device, wherein the tilt device is configured to couple to the quick coupler. The interchangeable implement assembly may comprise a third implement comprising a work tool, wherein the work tool is configured to couple to the tilt device.

The tilt device may comprise, for example, a tilt bucket, tilt rotator or tilt hitch. The tilt device may comprise a coupler or quick coupler configured to couple to a work tool.

The interchangeable implement assembly may comprise a bracket between implements.

Examples of work tools include a bucket, hammer, thumb, TRS, clamshell, orange peel grapple, demolition and sorting grapple, shear, pulveriser, multi-processor, crusher, vibratory compactor, mulcher, mechanical grapple, rake, ripper, compaction wheel, pallet fork, any hydro-mechanical work tool, or other work tool.

In an embodiment the implement data may comprise tool control setting parameters. In another embodiment the implement data may comprise work tool dimension data. In another embodiment, the implement data may comprise both tool control setting parameters and work tool dimension data. In another embodiment, the implement data may comprise either tool control setting parameters or work tool dimension data. Whether the implement data comprises tool control setting parameters or work tool dimension data may depend on the implement model. Whether the implement data comprises tool control setting parameters or work tool dimension data may depend on a mode of operation chosen by an operator.

In an embodiment, the work mode may comprise tool settings such as hydraulic settings. Hydraulic settings may comprise one or more of maximum flow or flows, maximum pressure or pressures, or other setting. The work mode may comprise control settings, for example based on the size of the work tools, to assist in precise usage of the work tool.

In an event that the first implement assembly comprises more than one implement, the work mode may be based on the combination of the more than one implement. For example, the work mode may differ depending on whether a particular work tool is coupled

directly to the distal end of the arm of the work vehicle or the particular work tool is coupled to the distal end of the arm via a coupler. In an event that the first implement assembly comprises more than one implement, the work mode may not be based on all the implements. For example, the work mode may be the same in an event that a particular work tool is coupled directly to the distal end of the arm of the work vehicle or in the event that the particular work tool is coupled to the distal end of the arm via a coupler. Whether the work mode is based on some or all of the implements may depend on the type of work tool. For example, hydraulic settings may be the same for a bucket coupled directly to the arm and for a bucket coupled to the arm via a coupler. However, work tool dimension data may differ between a hammer coupled directly to the distal end of the arm, and a hammer coupled to the distal end of the arm via a coupler, so if the work mode is based on dimensions then a different work mode will be required depending on the presence or absence of the coupler.

As described above, the step of obtaining the at least one identifier may comprise detecting the at least one identifier via wireless communication, for example by using a mobile device to scan for identifiers within range or by using a receiver on the work vehicle. The method may further comprise sending a location of the mobile device or work vehicle to a controller.

In an embodiment, the method may further comprise notifying an operator that a work tool calibration is recommended for the first implement assembly that has been identified.

CLAIMS:

1. A method of operating a work vehicle comprising an arm, wherein a distal end of the arm is configured to couple to an interchangeable implement assembly, and wherein the method comprises:

obtaining at least one identifier of a first implement assembly coupled to the work vehicle;

comparing the at least one identifier to a list of stored identifiers, wherein each stored identifier is associated with an implement model and each implement model is associated with implement data;

loading implement data for the first implement assembly based on the at least one identifier; and

activating a work mode based on the implement data.

2. The method of claim 1 wherein:

the first implement assembly comprises a first implement and a second implement;

the at least one identifier comprises a first identifier and a second identifier; and

the implement data for the first implement assembly comprises data for a combination of the first implement and the second implement.

3. The method of claim 1 or 2 wherein the step of obtaining the at least one identifier comprises detecting the at least one identifier via wireless communication

4. The method of claim 3 wherein the step of obtaining the at least one identifier comprises detecting the at least one identifier via Bluetooth communication.

5. The method of any preceding claim wherein the step of obtaining the at least one identifier comprises obtaining the at least one identifier via a user input device.

6. The method of any preceding claim wherein the at least one identifier comprises a unique identifier for the first implement assembly.

7. The method of any of claims 1 to 5 wherein the at least one identifier comprises an implement model identifier.

8. The method of any preceding claim wherein the list of stored identifiers is configured to be updated remotely.

9. The method of any preceding claim wherein loading the implement data comprises downloading the implement data via a wireless communication.

10. A device for operating a work vehicle comprising an arm, wherein a distal end of the arm is configured to couple to an interchangeable implement assembly, wherein the device comprises a controller configured to:

obtain at least one identifier of a first implement assembly coupled to the work vehicle;

compare the at least one identifier to a list of stored identifiers, wherein each stored identifier is associated with an implement model and each implement model is associated with implement data;

load implement data for the first implement assembly based on the at least one identifier; and

activate a work mode based on the implement data.

11. The device of claim 10 wherein:

the first implement assembly comprises a first implement and a second implement;

the at least one identifier comprises a first identifier and a second identifier; and

the implement data for the first implement assembly comprises data for a combination of the first implement and the second implement.

12. The device of claim 10 or 11 wherein the controller is configured to obtain the at least one identifier by detecting the at least one identifier via wireless communication

13. The device of claim 12 wherein controller is configured to obtain the at least one identifier via Bluetooth communication.

14. The device of any preceding claim wherein the controller is configured to obtain the at least one identifier via a user input device.

15. The device of any preceding claim wherein the at least one identifier comprises a unique identifier for the first implement assembly.

Intellectual Property Office

Application No: GB2213854.9 **Examiner:** Thomas Avila

Claims searched: All **Date of search:** 13 March 2023

Patents Act 1977: Search Report under Section 17

Documents considered to be relevant:

Category	Relevant to claims	Identity of document and passage or figure of particular relevance
X	1-15	US 2021/0123218 A1 (MATZELLE et al.) See especially figure 1 and paragraph [0023], [0025] and [0037].
X	1 and 10 at least	US 2021/0381194 A1 (KENNEDY) See especially paragraph [0002].
X	1 and 10 at least	US 9938693 B1 (REED et al.) See especially column 4, lines 36-39 and column 9, lines 39-53.
X	1 and 10 at least	US 2006/0129280 A1 (THOMAS et al.) See especially paragraphs [0039] and [0041].

Categories:

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.

Field of Search:

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC^{X} :

Worldwide search of patent documents classified in the following areas of the IPC

E02F

The following online and other databases have been used in the preparation of this search report

WPI, EPODOC

International Classification:

Subclass	Subgroup	Valid From
E02F	0003/96	01/01/2006
E02F	0003/43	01/01/2006
E02F	0009/20	01/01/2006
E02F	0009/26	01/01/2006