METHOD AND APPARATUS FOR IDENTIFYING PARTS USED IN THE CONSTRUCTION AND MAINTENANCE OF AN OIL OR GAS WELL

The present invention relates to a method and apparatus for identifying parts used in the construction and maintenance of an oil or gas well.

A top drive system for drilling wellbores, such as oil and gas wells, is one of two common types of system, the other being a rotary table system. A top drive system generally comprises a main body which houses a motor for rotating a sub which has a rotor connected to a sub connectable to a single, stand or string of tubulars. The tubulars may be any of: drill pipe, casing, liner, premium tubular or any other such tubular used in the construction, maintenance and repair of wellbores, such as oil and gas wells. A top drive system is generally arranged on a substantially vertical track on a derrick of a rig. The top drive system is lifted and lowered on the track with a line over a crown block on a travelling block connected to the top drive system. The line is reeled in and let out using a winch commonly known as a drawworks. The top drive system can thus be used to trip tubulars in and out of the wellbore; turn the drill string to facilitate drilling the wellbore; and turn a single or stand of tubulars in relation to a string of tubulars hung in the wellbore to threadedly connect or disconnect tubulars from a string of tubulars in the drill string to length or shorten the string of tubulars. An elevator generally depends on links attached to the top drive to facilitate handling of tubulars and alignment with the sub for connection and disconnection therewith. A top drive system may also be used in conjunction with a passive or active spider and/or with rotary tongs to facilitate connection and disconnection

of tubulars from the string of tubulars. A casing running tool can be used to allow a top drive to connect a joint of casing to a string of casing held in a spider in the floor of a drilling rig. The casing running tool may have external slips or internal slips to allow the joint of casing to be gripped and rotated by the top drive relative to the static casing string held in the spider. The casing running tool may comprise a fluid connection so that circulation of drilling mud can continue whilst the joint of casing, once connected to the string, can be lowered into the well. The casing running tool may also comprise a blow out preventer for inhibiting a blow out during tripping of the casing string.

The inventors have noted that certain parts used in the construction and maintenance of an oil or gas well need to be identified accurately so that they can be used in the correct circumstance. The inventors have observed that certain parts, particularly but not exclusively links used in rotary table and top drive rigs which can be used for handling tubulars and strings of tubulars may be selected for handling tubulars and strings of tubulars for which they are not intended. Rigs are now commonly handling string weights in excess of 1000 tonnes. In the past, a rig hand could quickly gauge if a link was suitable for a particular string weight. The links would be made of the same material and thus the larger the link, the more weight the link could carry. However, with the increase in string handling capacity, the links are made of unusual materials and it is not always easy to tell which links are designed for carrying heavy strings or light strings. Furthermore, there has been a move towards minimizing the number of rig hands on the rig floor. Mechanisation and computerisation of handling of

equipment used on the rig floor has created a new set of problems. For example, handling of tubulars and strings can now be carried out from a drillers chair at a remote location using camera equipment. The remote location can be on the rig or in a remote location from an operating room thousands of miles away. It may be difficult to tell by from the camera image on a screen what sort of link is being used.

The prior art discloses a variety of systems and methods for using surface acoustic wave tags or radio frequency identification tags in identifying items, including items used in the oil and gas industry such as drill pipe. (See e.g. U.S. Patents 4,698,631; 5,142,128; 5,202,680; 5,360,967; 6,333,699; 6,333,700; 6,347,292; 6,480,811; and U.S. Patent Applications Ser. Nos. 10/323,536 filed Dec. 18, 2002; 09/843,998 filed Apr. 27, 2001; 10/047,436 filed Jan. 14, 2002; 10/261,551 filed Sep. 30, 2002; 10/032,114 filed Dec. 21, 2001; and 10/013,255 filed Nov. 5, 2001; all incorporated fully herein for all purposes.) In many of these systems a radio frequency identification tag or "RFIDT" is used on pipe at such a location either interiorly or exteriorly of a pipe, that the RFIDT is exposed to extreme temperatures and conditions downhole in a wellbore. Often an RFIDT so positioned fails and is of no further use. Also, in many instances, an RFIDT so positioned is subjected to damage above ground due to the rigors of handling and manipulation.

The present inventors have realized that, in certain embodiments, chain links can be provided with effective identification apparatus; and that substantial usefulness for a tubular identification system can be achieved by divorcing the desire for effective above-ground

identification and operation from the goal of downhole accessibility.

According to a first aspect of the present invention, there is provided a method in the handling of links in the construction and maintenance of an oil or gas well, the method comprising the steps of having a link having a body with an exterior surface with a wave-energizable identification apparatus, the method comprising the steps of energizing the wave-energizable identification apparatus by directing energizing energy to the antenna apparatus, the wave-energizable identification apparatus upon being energized producing a signal, positioning sensing apparatus adjacent the link and sensing with the sensing apparatus the signal produced by the wave-energizable identification apparatus.

Preferably, the wave-energizable identification apparatus is wrapped in fabric material. Advantageously, the fabric material comprises heat-resistant non-conducting material on the exterior surface. Preferably, the fabric material is positioned so that the wave-energizable identification apparatus does not contact the body. Advantageously, the wave-energizable identification apparatus has antenna apparatus.

Preferably, the link comprises a ring defining an opening and a stud spanning the opening, the wave-energizable identification apparatus arranged on an exterior surface of the stud.

In accordance with a second aspect of the present invention, there is provided a link comprising a body having an exterior surface and wave-energizable identification apparatus on the exterior surface of the body, positioned on the body so that the wave-energizable identification apparatus does not contact the body.

Advantageously, the wave-energizable identification apparatus is wrapped in fabric material comprising heat-resistant non-conducting material. Preferably, the wave-energizable identification apparatus is wrapped in a plurality of layers of fabric material.

Preferably the link further comprises a wrap over the wave-energizable apparatus wrapping the wave-energizable identification apparatus wrapped to the body.

Advantageously, the body forms a ring having an opening, a stud extending across the opening, the stud having a stud exterior surface, and the wave-energizable apparatus on the stud exterior surface. Preferably, the wave-energizable apparatus is wrapped on the stud and positioned on the stud so that the wave-energizable apparatus does not contact the stud.

Advantageously, the fabric material in which the wave-energizable apparatus is wrapped is a folded portion of the fabric material folded over on the wave-energizable apparatus. Preferably, the wave-energizable apparatus and the fabric material in which the wave-energizable apparatus is wrapped, is located in heat shrink material. Advantageously, the at least one outer layer of fabric material is placed over the heat shrink material.

Preferably, the wave-energizable apparatus is in a shield. Advantageously, the shield has a curved top and a recess for the wave-energizable apparatus. Preferably, an amount of adhesive is used to adhere the wave-energizable apparatus. Advantageously, the wave-energizable apparatus is radio frequency apparatus with integrated circuit apparatus and antenna apparatus.

Advantageously, the body comprises a shaft, with two spaced-apart shaft ends, each end of the two spaced-apart

ends of the body at a shaft end of the shaft, the two spaced-apart ends including a first end and a second end, a first link opening in the first end, and a second link opening in the second end. Preferably, the link in use depends from a top drive, swivel, powered swivel, main elevator or pipe handling apparatus. Advantageously, the wave-energizable apparatus is on one of the first end and the second end. Alternatively or additionally, the wave-energizable apparatus is on the shaft. It has been found that having two wave-energizable apparatus facilitates reading with the sensor reading apparatus and provides redundancy in case of damage to one of the wave-energizable apparatus.

Preferably, the wave-energizable apparatus includes a further wave-energizable apparatus both the wave-energizable apparatus and the further wave-energizable apparatus on the body.Preferably, the stud has two spaced-apart ends, a wrap securing the wave-energizable apparatus to the stud, and the wrap also on a portion of the link body adjacent each end of the stud.

Advantageously, the wave-energizable apparatus is in a mass, the mass has a recess, and the mass is on the body with a portion of the body in the recess. Preferably, the body includes a stud between sides of the link body and the mass is on the stud. Advantageously, the body includes a shaft between the two spaced-apart ends and the mass is on the shaft. Preferably, the mass comprises a first mass, the link further comprising a second mass with a wave-energizable apparatus on the link body. Advantageously, the link body includes a stud between sides thereof and the first mass is on the link body apart from the stud and the second mass is on the stud. The mass or other item securing the wave-

energizable apparatus to the body

Preferably, the link is one of: a chain link; and an elevator link.

According to a third aspect of the present invention, there is provided a method for sensing a wave-energizable identification apparatus of a member, the member comprising a link with a body, the body having an exterior surface and two spaced-apart ends, wave-energizable identification apparatus on the exterior surface of the body, the wave-energizable identification apparatus wrapped in fabric material, the fabric material comprising heat-resistant non-conducting material, and the wave-energizable identification apparatus wrapped and positioned on the body so that the wave- energizable identification apparatus does not contact the body, the wave-energizable identification apparatus having antenna apparatus, the method including energizing the wave-energizable identification apparatus by directing energizing energy to the antenna apparatus, the wave-energizable identification apparatus upon being energized producing a signal, positioning the member adjacent sensing apparatus, and sensing with the sensing apparatus the signal produced by the wave-energizable identification apparatus.

According to a fourth aspect of the present invention, there is provided a method for sensing a wave-energizable apparatus of a link, the link comprising a link with a body, the body having an exterior surface and two spaced-apart ends, wave-energizable apparatus on an exterior surface of the body, the method including energizing the wave-energizable apparatus by directing energizing energy thereto, the wave-energizable apparatus upon being energized producing a signal, and sensing with a sensing

apparatus the signal produced by the wave-energizable apparatus.

The present invention discloses, in certain aspects, a link (e.g., but not limited to a chain link or an elevator link) which has: a body; the body having an exterior surface and two spaced-apart ends; wave-energizable identification apparatus (one or a plurality) on the exterior surface of the body; the wave-energizable identification apparatus wrapped in fabric material; the fabric material including heat-resistant non-conducting material; and the wave-energizable identification apparatus wrapped and positioned on the body so that the wave-energizable identification apparatus does not contact the body.

The present invention discloses, in certain aspects, methods for sensing a wave-energizable apparatus of a member which is a link with a body, the methods including; energizing the wave-energizable identification apparatus by directing energizing energy to it; the wave-energizable identification apparatus upon being energized producing a signal; positioning the link adjacent sensing apparatus; and sensing with the sensing apparatus the signal produced by the wave-energizable apparatus.

The method according to embodiment(s) of the present invention may be for tracking, inventory and control. One or more RFIDT and/or one or more SAW tags may be used as the wave-energiable apparatus. Exteriorly affixed RFIDT's and/or one or more recesses into which one or more identification devices are placed, with filler material and/or a cap ring is installed permanently or releasably over a recess to close it off and protect identification device(s) combined in a nonobvious and new manner with existing apparatuses to provide dual redundancy identification;

a sensing-containing member (flexible or rigid) is placed within or on an item; and a system on, in, or under a rig floor, and/or on equipment, for sensing identification device apparatus according to embodiment(s) of the present invention.

A radio frequency identification tag either affixed exteriorly to the link, apparatus or tubular or in a recess in an end thereof so that the RFIDT is protected from shocks (pressure, impacts, thermal) that may be encountered in a wellbore or during drilling operations. In one particular aspect one or more RFIDT's are covered with heat and/or impact resistant materials on the exterior of an item. In one particular aspect, the present invention discloses systems and methods in which a piece of drill pipe with threaded pin and box ends has one or more circumferential recesses formed in the pin end into which is emplaced one or more radio frequency identification tags each with an integrated circuit and with an antenna encircling the pin end within A recess. The RFIDT (OR RFIDT'S) in a recess is protected by a layer of filler, glue or adhesive, e.g. epoxy material, and/or by a cap ring corresponding to and closing off the recess. Such a cap ring may be made of metal (magnetic; or nonmagnetic, e.g. aluminum, stainless steel, silver, gold, platinum and titanium), plastic, composite, polytetrafluoroethylene, fiberglass, ceramic, and/or cermet. The RFIDT can be, in certain aspects, any known commercially-available read-only or read-write radio frequency identification tag and any suitable known reader system, manual, fixed, and/or automatic may be used to read the RFIDT.

The present invention, in certain aspects, provides chain links or links with one or more radio frequency identification tags wrapped in heat and impact resistant

materials; in one aspect, located in an area 2 - 3" in length beginning 2 from the 18 degree taper of the pin and drill pipe tool joint so that the RFIDT (or RFIDT's) is protected from shocks (pressure, impacts, thermal) that may be encountered on a rig, in a wellbore, or during wellbore (e.g. drilling or casing) operations. In one particular aspect, the present invention discloses systems and methods in which a piece of drill pie with threaded pin and box ends has one or more radio frequency identification tags each with an integrated circuit and with an antenna encircling the pin end upset area located exteriorly on the pipe, e.g. in an area 2" - 22" from a pin end 18 degree taper. The RFIDT (or RFIDT's) is protected by wrapping the entire RFIDT and antenna in a heat resistant material wrapped around the circumference of the tube body and held in place by heat resistant glue or adhesive, e.g. epoxy material which encases the RFIDT. This material is covered with a layer of impact resistant material and wrapped with multiple layers of wrapping material such as epoxy bonded wrap material. Preferably this wrapping does not exceed the link body OD. The RFIDT can be (as can be any disclosed herein), in certain aspects, any known commercially-available read-only or read-write radio frequency identification tag and any suitable know reader system, manual, fixed, and/or automatic may be used to read the RFIDT. Such installation of RFIDT's can be carried out in the field, in a factory, on a rig, with no machining necessary. Optionally, a metal tag designating a unique serial number of each item, apparatus, or length of drill pipe located under the wrap with the RFIDT(s) insures "Traceability" is never lost due to failure of the RFIDT(s). Replacement of failed RFIDT's can be carried

out without leaving a location, eliminating expensive transportation or trucking costs. Optionally the wrap is applied in a distinctive and/or a bright color for easy identification. Determining whether an item, apparatus, or a tubular or a length of drill pipe or a drill pipe string is RFID-tagged or not is visibly noticeable, e.g. from a distance once the RFIDT's are in place.

In certain particular aspects an RFIDT is encased in a ring of protective material whose shape and configuration corresponds to the shape of the link body and the ring is either permanently or removably positioned in the recess. Such a ring may be used without or in conjunction with an amount of protective material covering the ring or with a cap ring that protectively covers the RFIDT. Two or more RFIDT's may be used in one recess and/or there may be multiple recesses at different levels. In other aspects a ring is provided which is emplaceable around a member, either a generally cylindrical circular member or a member with some other shape.

With an RFIDT located in a link as described herein. The mass of disclosed herein enclosing the RFIDT also protects it from the temperature extremes of materials within and outside of the pipe.

In other aspects [with or without an RFIDT in a recess] sensible material and/or indicia are located within a recess and, in one aspect, transparent material is placed above the material and/or indicia for visual inspection or monitoring; and, in one aspect, such sensible material and/or indicia are in or on a cap ring.

It has also been discovered that the location of an RFIDT or RFIDT's according to embodiment(s) of the present invention can be accomplished permits exterior wrapping of RFIDT(s) or

circumferential installation of antenna apparatus including

In certain aspects the present invention discloses a rig with a rig floor having thereon or embedded therein or positioned therebelow a tag reader system which reads RFIDT's in pipe or other apparatus placed on the rig floor above the tag reader system. All of such rig-floor-based reader systems, manually-operated reader systems, and other fixed reader systems useful in methods and systems according to the present invention may be, in certain aspects, in communication with one or more control systems, e.g. computers, computerized systems, consoles, and/or control system located on the rig, on site, and/or remotely from the rig, either via lines and/or cables or wirelessly. Such system can provide identification, inventory, and quality control functions and, in one aspect, are useful to insure that desired tubulars, and only desired tubulars, go downhole and/or that desired apparatus, and only desired apparatus, is used on the rig. In certain aspects one or more RFIDT's is affixed exteriorly of or positioned in a recess. In certain aspects antennas of RFIDT's according to the present invention have a diameter between one quarter inch to ten inches and in particular aspects this range is between two inches and four inches. Such systems can also be used with certain RFIDT's to record on a read-write apparatus therein historical information related to current use of an item, apparatus or of a tubular member.

In other aspects, a link has emplaced therein or thereon a member or ring with or without an RFIDT and with sensible indicia, e.g., one or a series of signature cuts, etchings, holes, notches, indentations, alpha and/or numeric characters, raised portion(s) and/or

voids, filled in or not with filler material (e.g. but not limited to, epoxy material and/or nonmagnetic or magnetic metal, composite, fiberglass, plastic, ceramic and/or cermet), which indicia are visually identifiable and/or can be sensed by sensing systems (including, but not limited to, systems using ultrasonic sensing, eddy current sensing, optical/laser sensing, and/or microwave sensing). Similarly it is within the scope of the present invention to provide a cap ring (or a ring to be emplaced in a recess) as described herein (either for closing off a recess or for attachment to a pin end which has no such recess) with such indicia which can be sensed visually or with sensing equipment.

It is within the scope of this invention to provide an item, apparatus, or tubular member as described herein exteriorly affixed (RFIDT(s) and/or with a circular recess as described above with energizable identification apparatus other than or in addition to one or more RFIDT's; including, for example one or more surface acoustic wave tags ("SAW tags") with its antenna apparatus in the circular apparatus.

For a better understanding of the present invention, reference will now be made, by way of example, to the accompanying drawings, in which:

Figure 1A is a schematic diagram of drilling rig incorporating a prior art system for handling drill pipe including the step of reading RFIDTs in joints of drill pipe;

Figure 1B is a scrap sectional view of an end of a joint of drill pipe used in the system shown in Figure 1A;

Figure 1C is a schematic view of a prior art system for identifying pipe;

Figure 2A is a schematic view of a prior art system for identifying drill pipe;

Figure 2B is a scrap view of an end of a joint of drill pipe;

Figure 2C is a schematic view of a system for identifying drill pipe;

Figure 3A is a schematic view of a drilling rig incorporating a prior art system for handling drill pipe including the step of reading RFIDTs in joints of drill pipe;

Figure 4A is a perspective view showing some hidden parts of a ring incorporating an RFIDT which may be used in the method of the present invention;

Figure 4B is an side view of the ring shown in Figure 4A;

Figure 4C is a perspective view of the ring shown in Figure 4A shown in an open position;

Figure 4D is a top view of the ring shown in Figure 4A;

Figure 4E is a top view showing some hidden parts of a ring incorporating an RFIDT which may be used in the

method of the present invention;

Figure 5 is a chart setting out steps in a method of making a tubular;

Figure 6 is a chart setting out steps in a process for reading an RFIDT on a chain link;

Figure 7 is a side view of a prior art end of a joint of drill pipe with some hidden parts shown;

Figure 8 is an enlarged view of part of the joint of drill pipe shown in Figure 7;

Figure 9 is a perspective view of the end of the joint of drill pipe shown in Figure 7 in a first step in a method of applying an RFIDT thereto;

Figure 10 is a perspective view of the end of the joint of drill pipe shown in Figure 7 in a second step in a method of applying an RFIDT thereto;

Figure 11 is a perspective view of the end of the joint of drill pipe shown in Figure 7 in a third step in a method of applying an RFIDT thereto;

Figure 11A is a schematic diagram indicating the location of parts about the tubular;

Figure 12 is a perspective view of the end of the joint of drill pipe shown in Figure 7 in a fourth step in a method of applying an RFIDT thereto;

Figure 13A is a perspective view of a chain link in accordance with the present invention in a chain in accordance with the present invention;

Figure 13B is a is a front view of the chain link shown in Figure 13A;

Figure 13C is a cross-view of the chain link shown in Figure 13A taken along the line 13C-13C of Figure 13B;

Figure 14A is a view in cross-section of a shield for use in a link in accordance with the present invention;

Figure 14B is a side view of the shield shown in Figure 14A;

Figure 14C is an underneath view of the shield shown in Figure 14A;

Figure 14D is an end view of the shield shown in Figure 14A;

Figure 14E is a perspective view of the shield shown in Figure 14A;

Figure 15 shows a view in cross-section of five shields for use in a link in accordance with the present invention;

Figure 16 shows a view in cross-section of four shields for use in a link in accordance with the present invention;

Figure 17A is a side view of a chain comprising at least one link in accordance with the present invention;

Figure 17B is a cross-sectional view taken along line 17B-17B of Figure 17A;

Figure 18A is a top view of a link in accordance with the present invention;

Figure 18B is a cross-sectional view taken along line 18B-18B of Figure 18A;

Figure 18C is a cross-sectional view taken along line 18C-18C of Figure 18A;

Figure 19A is a top view of a link in accordance with the present invention;

Figure 18B is a cross-sectional view taken along line 19B-19B of Figure 19A;

Figure 19C is a cross-sectional view taken along line 19C-19C of Figure 19A;

Figure 20A is a top view of a link in accordance with the present invention;

Figure 20B is a cross-sectional view taken along line 20B-20B of Figure 18A;

Figure 20C is a top view of a prior art link;

Figure 20D is a cross-sectional view taken along line 20D-20D of Figure 20C;

Figure 21 is a side view of a link in accordance with the present invention;

Figure 22A is a perspective view of an apparatus in accordance with the present invention;

Figure 22B is a perspective view of an apparatus in accordance with the present invention;

Figure 22C is a perspective view of an apparatus in accordance with the present invention;

Figure 23 is a front view of a link in accordance with the present invention; and

Figure 24 is a front view of a link in accordance with the present invention.

Fig. 1A shows a prior art system 70 with a rig 60 which has in a rig floor 61 a reading system 65 (shown schematically) for reading one or more RFIDT's in a drill pipe 66. The reading system 65 incorporates one or more known reading apparatuses for reading RFIDT's, including, but not limited to suitable readers as disclosed in the prior art and readers as commercially available from MBBS Co. of Switzerland. This provides improvements of the apparatuses and systems disclosed in U.S. Patent Application Ser. No. 09/906,957 filed July 16, 2001 and published on February 7, 2002 as Publication No. 2002/0014966. In an improved system 70 according to the present invention a drill pipe 66 (Fig. 1B) is like the drill pipes 16 in U.S. Patent Application Ser. No.

09/906,957, but the drill pipe 66 has a recess 67 with a torus 68 therein having at least one RFIDT 69 (shown schematically in Fig. 1B) and a cap ring 68a over the torus 68. The drill pipe 66 may be connected with a tool joint 76 to other similar pieces of drill pipe in a drill string 77 (see Fig. 4A) as in U.S. Patent Application Serial No. 09/906,957 (incorporated fully herein) and the systems and apparatuses associated with the system 70 (Fig. 1A and Fig. 1C) operate in a manner similar to that of the systems 10 and the system of Fig. 1B of said patent application. Drill string 77 includes a plurality of drill pipes 66 coupled by a plurality of tool joints 76 and extends through a rotary table 78, and into a wellbore through a bell nipple 73 mounted on top of a blowout preventer stack 72. An identification tag (e.g. an RFIDT) 71 is provided on one or more drilling components, such as illustrated in Fig. 1A, associated with the system 70, or the drill pipe 66. An electromagnetic signal generator system 74 that includes an antenna and a signal generator is positioned proximate to an identification tag, for example just below rotary table 78 as illustrated in Fig. 1A. Electromagnetic signal generator system 74 establishes a communications link with an identification tag 71 to energize the antenna, interrogate it, and to convey information relating to the equipment or drill pipe.

The drilling system 70 includes the rig 60 with supports 83, a swivel 91, which supports the drill string 77, a kelly joint 92, a kelly drive bushing 93, and a spider 79 with an RFIDT sensor and/or reader 79a. A tool joint 76 is illustrated in Fig. 1A as connecting two drilling components such as drill pipes 66. The identification tag 71 (or the RFIDT 69 read by the system

65) is operated to communicate a response to an incoming electromagnetic signal generated by electromagnetic signal generator system 74 (or by the system 65) that includes information related to the drilling component with the identification tag. The information may be used, for example, to inform an operator of system 70 of a drilling component's identity, age, weaknesses, previous usage or adaptability. According to the teachings of the present invention, this information may be communicated while drill system 70 is in operation. Some or all of the information provided in an identification tag may assist an operator in making a determination of when drilling components need to be replaced, or which drilling components may be used under certain conditions. The electromagnetic signal communicated by an identification tag or RFIDT may provide general inventory management data (such as informing an operator of the drilling components availability on the drilling site, or the drilling component's size, weight, etc.), or any other relevant drilling information associated with the system.

Additional drill string components 84, which are illustrated in Fig. 4A in a racked position, may be coupled to drill pipe 66 and inserted into the well bore, forming a portion of the drill string. One or more of drill string components may also include identification tags or RFIDT's.

Fig. 1C shows typical information that may be included within an identification tag's or RFIDT's, antenna as the antenna cooperates with electromagnetic signal generator 74 and/or the system 65 to transmit an electromagnetic energizing signal 85 to an identification tag 71 (or 69). The electromagnetic signal generators

use an antenna to interrogate the RFIDT's for desired information associated with a corresponding pipe or drilling component.

The electromagnetic signal 85 is communicated to an RFIDT that responds to the transmitted electromagnetic signal by returning data or information 86 in an electromagnetic signal form that is received by one of the antennas, and subsequently communicated to a reader 87 which may subsequently process or simply store electromagnetic signal 86. The reader 87 may be handheld, i.e. mobile, or fixed according to particular needs.

The RFIDT's 69 and 71 may be passive (e.g. requiring minimal incident power, for example power density in the approximate range of 15 25 mW/cm2) in order to establish a communications link between an antenna and the RFIDT. "Passive" refers to an identification tag not requiring a battery or any other power source in order to function and to deriving requisite power to transmit an electromagnetic signal from an incoming electromagnetic signal it receives via an antenna. Alternatively, an RFIDT (as may any in any embodiment herein) may include a battery or other suitable power source that would enable an RFIDT to communicate an electromagnetic signal response 86.

Antennas are coupled to reader 87 by any suitable wiring configuration, or alternatively, the two elements may communicate using any other appropriate wireless apparatus and protocol. The reader 87 is coupled to a control system which in one aspect is a computer (or computers) 88 which may include a monitor display and/or printing capabilities for the user. Computer 88 may be optionally coupled to a handheld reader 89 to be used on

the rig or remote therefrom. Computer 88 may also be connected to a manual keyboard 89a or similar input device permitting user entry into computer 88 of items such as drill pipe identity, drill string serial numbers, physical information (such as size, drilling component lengths, weight, age, etc.) well bore inclination, depth intervals, number of drill pipes in the drill string, and suspended loads or weights, for example.

The computer 88 may be coupled to a series of interfaces 90 that may include one or more sensors capable of indicating any number of elements associated with drill rig derrick 83, such as: a block travel characteristic 90a, a rotation counter characteristic 90b, a drill string weight 90c, a heave compensator 90d, and a blowout preventer (BOP) distance sensor 90e. A micro controller may include one or more of these sensors or any other additional information as described in U.S. Application Ser. No. 09/906,957. The control system may be or may include a microprocessor based system and/or one or more programmable logic controllers.

A drill pipe 66 with an RFIDT 69 and an RFIDT 71 provides a redundancy feature for identification of the drill pipe 66 so that, in the event one of the RFIDT's fails, the other one which has not failed can still be used to identify the particular drill pipe. This is useful, e.g. when the RFIDT 71, which has relatively more exposure to down hole conditions, fails. Then the RFIDT 69 can still be used to identify the particular piece of drill pipe. It is within the scope of the present invention for any item according to the present invention to have two (or more RFIDT's like the RFIDT 69 and the RFIDT 71. Optionally, or in addition to the RFIDT 69, an RFIDT 69a (or RFIDT's 69a) may be affixed exteriorly of

the pipe 66 with wrap material 69b.

The reader 79a may be used to read an RFIDT in or on a link or chain comprising links as shown in any of Figures 13 to 23.

Figs. 2A, 2C and 2D show an oilfield equipment identifying apparatus 100 according to the present invention for use with pipe or equipment as in Fig. 2B with two (or more) RFIDT's on respective pieces 114 of oilfield equipment. The RFIDT's may be any disclosed or referred to herein and those not mounted in a recess according to the present invention may be as disclosed in U.S. Patent 6,480,811 B2 indicated by the reference numerals 112a and 112b on pieces of equipment 114a and 114b with RFIDT's in recesses according to the present invention shown schematically and indicated by reference numerals 109a, 109b; and/or one or more RFIDT's may be affixed exteriorly (see e.g., Figs 13 to 23) to either piece 114 of oilfield equipment. Each of the identifier assemblies 112 and RFIDT's like 109a, 109b are capable of transmitting a unique identification code for each piece of pipe or oilfield equipment.

The oilfield equipment identifying apparatus 100 with a reader 118 is capable of reading each of the identifier assemblies and RFIDT's. The reader 118 includes a hand held wand 120, which communicates with a portable computer 122 via a signal path 124. In one embodiment, each identifier assembly 112 includes a passive circuit as described in detail in U.S. Patent No. 5,142,128 (fully incorporated herein for all purposes) and the reader 118 can be constructed and operated in a manner as set forth in said patent or may be any other reader or reader system disclosed or referred to herein.

In use, the wand 120 of the reader 118 is positioned

near a particular one of the identifier assemblies 112 or RFIDT's. A unique identification code is transmitted from the identifier assembly or RFIDT to the wand 120 via a signal path 126 which can be an airwave communication system. Upon receipt of the unique identification code, the wand 120 transmits the unique identification code to the portable computer 122 via the signal path 124. The portable computer 122 receives the unique identification code transmitted by the wand 120 and then decodes the unique identification code, identifying a particular one of the identifier assemblies 112 or RFIDT's and then transmitting (optionally in real time or in batch mode) the code to a central computer (or computers) 132 via a signal path 134. The signal path 134 can be a cable or airwave transmission system.

Fig. 2C shows an embodiment of an oilfield equipment identifying apparatus 100a according to the present invention which includes a plurality of the identifier assemblies 112 and/or RFIDT's 109 which are mounted on respective pieces 114 of pipe or oilfield equipment as described above. The oilfield equipment identifying apparatus includes a reader 152, which communicates with the central computer 132. The central computer 132 contains an oilfield equipment database (which in certain aspects, can function as the oilfield equipment database set forth in U.S. Patent 5,142,128). In one aspect the oilfield equipment database in the central computer 132 may function as described in U.S. Patent 5,142,128. In one aspect the oilfield equipment identifying apparatus 100a is utilized in reading the identifier assemblies 112 (and/or RFIDT's 109) on various pieces 114 of pipe or oilfield equipment located on a rig floor 151 of an oil drilling rig.

The reader 152 includes a hand held wand 156 (but a fixed reader apparatus may be used). The hand held wand 156 is constructed in a similar manner as the hand held wand 120 described above. The wand 156 may be manually operable and individually mobile. The hand held wand 156 is attached to a storage box 158 via a signal path 160, which may be a cable having a desired length. Storage box 158 is positioned on the rig floor 151 and serves as a receptacle to receive the hand held wand 156 and the signal path 160 when the hand held wand 156 is not in use.

An electronic conversion package 162 communicates with a connector on the storage box 158 via signal path 164, which may be an airway or a cable communication system so that the electronic conversion package 162 receives the signals indicative of the identification code stored in the identifier assemblies 112 and/or RFIDT's, which are read by the hand held wand 156. In response to receiving such signal, the electronic conversion package 162 converts the signal into a format which can be communicated an appreciable distance therefrom. The converted signal is then output by the electronic conversion package 162 to a buss 166 via a signal path 168. The buss 166, which is connected to a drilling rig local area network and/or a programmable logic controller (not shown) in a well known manner, receives the converted signal output by the electronic conversion package 162.

The central computer 132 includes an interface unit 170. The interface 170 communicates with the central computer 132 via a signal path 172 or other serial device, or a parallel port. The interface unit 170 may also communicates with the buss 166 via a signal path

173. The interface unit 170 receives the signal, which is indicative of the unique identification codes and/or information read by the hand held wand 156, from the buss 166, and a signal from a drilling monitoring device 174 via a signal path 176. The drilling monitoring device 174 communicates with at least a portion of a drilling device 178 (Fig. 5D) via a signal path 179. The drilling device 178 can be supported by the rig floor 151, or by the drilling rig. The drilling device 178 can be any drilling device which is utilized to turn pieces 114 of oilfield equipment, such as drill pipe, casing (in casing drilling operations) or a drill bit to drill a well bore. For example, but not by way of limitation, the drilling device 178 can be a rotary table supported by the rig floor 151, or a top mounted drive ("top drive") supported by the drilling rig, or a downhole mud motor suspended by the drill string and supported by the drilling rig. Optionally, the drilling device 178 has at least one RFIDT 178a therein or t hereon and an RFIDT reader 178b therein or thereon. The RFIDT reader 178a is interconnected with the other systems as is the reader 152, e.g. via the signal path 173 as indicated by the dotted line 173a.

The drilling monitoring device 174 monitors the drilling device 178 so as to determine when the piece 114 or pieces 114 of oilfield equipment in the drill string are in a rotating condition or a non rotating condition. The drilling monitoring device 174 outputs a signal to the interface unit 170 via the signal path 176, the signal being indicative of whether the piece(s) 114 of oilfield equipment are in the rotating or the non rotating condition. The central computer 132 may be loaded with a pipe and identification program in its

oilfield equipment database which receives and automatically utilizes the signal received by the interface unit 170 from the signal path 176 to monitor, on an individualized basis, the rotating and non rotating hours of each piece 114 of oilfield equipment in the drill string.

The reader 152 and/or hand held wand 156 may be used to read an RFIDT in or on a chain link as shown in any of Figures 13 to 23.

Fig. 3 shows a system 400 according to the present invention which has a rig 410 that includes a vertical derrick or mast 412 having a crown block 414 at its upper end and a horizontal rig floor 416 at its lower end. Drill line 418 is fixed to deadline anchor 420, which is commonly provided with hook load sensor 421, and extends upwardly to crown block 414 having a plurality of sheaves (not shown). From block 414, drill line 418 extends downwardly to travelling block 422 that similarly includes a plurality of sheaves (not shown). Drill line 418 extends back and forth between the sheaves of crown block 414 and the sheaves of travelling block 422, then extends downwardly from crown block 414 to drawworks 424 having rotating drum 426 upon which drill line 418 is wrapped in layers. The rotation of drum 426 causes drill line 418 to be taken in or out, which raises or lowers travelling block 422 as required. Drawworks 424 may be provided with a sensor 427 which monitors the rotation of drum 426. Alternatively, sensor 427 may be located in crown block 414 to monitor the rotation of one or more of the sheaves therein. Hook 428 and any elevator 430 is attached to travelling block 422. Hook 428 is used to attach kelly 432 to travelling block 422 during drilling operations, and elevators 430 are used to attach drill

string 434 to traveling block 422 during tripping operations. Shown schematically the elevator 430 has an RFIDT reader 431 (which may be any reader disclosed or referred to herein and which is interconnected with and in communication with suitable control apparatus, e.g. as any disclosed herein, as is the case for reader 439 and a reader 444. Drill string 434 is made up of a plurality of individual drill pipe pieces, a grouping of which are typically stored within mast 412 as joints 435 (singles, doubles, or triples) in a pipe rack. Drill string 434 extends down into wellbore 436 and terminates at its lower end with bottom hole assembly (BHA) 437 that typically includes a drill bit, several heavy drilling collars, and instrumentation devices commonly referred to as measurement while drilling (MWD) or logging while drilling (LWD) tools. A mouse hole 438, which may have a spring at the bottom thereof, extends through and below rig floor 416 and serves the purpose of storing next pipe 440 to be attached to the drill string 434. With drill pipe having an RFIDT 448 in a pin end 442, an RFIDT reader apparatus 439 at the bottom of the mouse hole 438 can energize an antenna of the RFIDT 448 and identify the drill pipe 440. Optionally, if the drill pipe 440 has an RFIDT in a box end 443, an RFIDT reader apparatus can energize an antenna in the RFIDT 446 and identify the drill pipe 440. Optionally, the drill bit 437 has at least one RFIDT 437a (any disclosed herein) (shown schematically). Optionally, or in addition to the RFIDT 448, the drill pipe 440 has one or more RFIDT's 448a affixed exteriorly to the drill pipe 440 (see, e.g., Figs. 25, 26) under wrap layers 448b.

During a drilling operation, power rotating means (not shown) rotates a rotary table (not shown) having

rotary bushing 442 releasably attached thereto located on rig floor 416. Kelly 432, which passes through rotary bushing 442 and is free to move vertically therein, is rotated by the rotary table and rotates drill string 434 and BHA 437 attached thereto. During the drilling operation, after kelly 432 has reached its lowest point commonly referred to as the "kelly down" position, the new drill pipe 440 in the mouse hole 438 is added to the drill string 434 by reeling in drill line 418 onto rotating drum 426 until traveling block 422 raises kelly 432 and the top portion of drill string 434 above rig floor 416. Slips 445, which may be manual or hydraulic, are placed around the top portion of drill string 434 and into the rotary table such that a slight lowering of traveling block 422 causes slips 444 to be firmly wedged between drill string 434 and the rotary table. At this time, drill string 434 is "in slips" since its weight is supported thereby as opposed to when the weight is supported by traveling block 422, or "out of slips". Once drill string 434 is in slips, kelly 432 is disconnected from string 434 and moved over to and secured to new pipe 440 in mouse hole 438. New pipe 440 is then hoisted out of mouse hole 438 by raising traveling block 422, and attached to drill string 434. Traveling block 422 is then slightly raised which allows slips 445 to be removed from the rotary table. Traveling block 422 is then lowered and drilling resumed. "Tripping out" is the process where some or all of drill string 434 is removed from wellbore 436. In a trip out, kelly 432 is disconnected from drill string 434, set aside, and detached from hook 428. Elevators 430 are then lowered and used to grasp the uppermost pipe of drill string 434 extending above rig floor 416.

Drawworks 424 reel in drill line 418 which hoists drill string 434 until the section of drill string 434 (usually a "triple") to be removed is suspended above rig floor 416. String 434 is then placed in slips, and the section removed and stored in the pipe rack. "Tripping in" is the process where some or all of drill string 434 is replaced in wellbore 436 and is basically the opposite of tripping out. In some drilling rigs, rotating the drill string is accomplished by a device commonly referred to as a "top drive" (not shown). This device is fixed to hook 428 and replaces kelly 432, rotary bushing 442, and the rotary table. Pipe added to drill string 434 is connected to the bottom of the top drive. As with rotary table drives, additional pipe may either come from mouse hole 438 in singles, or from the pipe racks as singles, doubles, or triples. Optionally, drilling is accomplished with a downhole motor system 434a which has at least one RFIDT 434b (shown schematically in Fig. 3) and chain links in accordance with the present invention.

Figs. 4A to 4D show a portable ring 530 which has a flexible body 532 made, e.g. from rubber, plastic, fiberglass, and/or composite which has two ends 531a, 531b. The end 531a has a recess 536 sized and configured for receiving and holding with a friction fit a correspondingly sized and configured pin 533 projecting out from the end 531b. The two ends 531a, 531b may be held together with any suitable locking mechanism, latch apparatus, and/or adhesive. As shown, each end 531a, 531b has a piece of releasably cooperating hook-and-loop fastener material 534a, 534b, respectively thereon (e.g. VELCROJ material) and a corresponding piece of such material 535 is releasably connected to the pieces 534a, 534b (Fig. 17C) to hold the two ends 531a, 531b together.

The body 532 encases an RFIDT 537 which has an IC 538 and an antenna 539. Ends of the antenna 539 meet at the projection 533 - recess 536 interface and/or the projection 533 is made of antenna material and the recess 536 is lined with such material which is connected to an antenna end. Optionally, as shown in Fig. 17D the ring 530 may include one or more (one shown) protective layers 532a, e.g. made of a durable material, e.g., but not limited to metal, KEVLARJ material or ARAMIDJ material. A hole 532b formed when the two ends 531a, 531b are connected together can be any desired size to accommodate any item or tubular to be encompassed by the ring 530. The ring 530 may have one, two or more RFIDT's therein one or both of which are read-only; or one or both of which are read-write. Such a ring may be releasably emplaceable around a member, e.g., but not limited to, a solid or hollow generally cylindrical member. Any ring or torus herein according to the present invention may have an RFIDT with an antenna that has any desired number of loops (e.g., but not limited to, five, ten, fifteen, twenty, thirty or fifty loops), as may be the case with any antenna of any RFIDT in any embodiment disclosed herein.

Fig. 4E shows a portable ring 530a, like the ring 530 but without two separable ends. The ring 530a has a body 530b made of either rigid or flexible material and with a center opening 530f so it is releasably emplaceable around another member. An RFIDT 530c within the body 530b has an IC 530e and an antenna 530d.

Any of the links or chain links such as those shown in Figures 13 to 23, may be provided with such portable rings 530, 530a wrapped around the body making up the links. The portable rings 530,530a may be protected by a

shield as shown in Figures 14A to 16 to inhibit damage. In particular, the links may be extremely large and heavy, being used to lift strings of tubulars that weigh up to 1000 tonnes or more, or may simply be able to lift a single joint or stand of drill pipe.

Fig. 5 shows schematically a method 620 for making a drill pipe or chain link according to the present invention. A chain link is made - "MAKE chain link" - using any suitable known process. An end recess is formed - "FORM RECESS" - in one or both ends of the chain link. An identification device is installed in the recess - "INSTALL ID DEVICE" (which may be any identification apparatus, device, torus ring or cap ring according to the present invention). Optionally, a protector is installed in the recess - "INSTALL PROTECTOR" (which may be any protector according to the present invention). This method may be used in the manufacture of a link and chain link in accordance with the present invention.

Fig. 6 shows schematically a system 650 which is like the systems described in U.S. Patent 4,698,631 but which is for identifying an item 652 according to the present invention which has at least one end recess (as any end recess disclosed herein) and/or within a ring or torus according to the present invention with at least one SAW tag identification apparatus 654 in the recess(es) and/or ring(s) or torus(es) and/or with an exteriorly affixed RFIDT according to the present invention.

The system 650 (as systems in U.S. Patent 4,698,631) has an energizing antenna apparatus 656 connected to a reader 658 which provides radio frequency pulses or bursts which are beamed through the antenna apparatus 656

to the SAW tag identification apparatus 654. The reader 658 senses responsive signals from the apparatus 654. In one aspect the responsive signals are phase modulated in accord with code encoded in the apparatus 654. The reader 658 sends received signals to a computer interface unit 660 which processes the signals and sends them to a computer system 662.

This system 650 may be used to identify and retrieve data on the chain link and links of the present invention, which allow the driller to ensure that the chain or link is suitable for the purpose for which the driller would like to use it. The data retrieved may be sent directly to the driller and/or to the rig hand using the identifying reader 656.

Figs. 7 and 8 show a tool joint 700 with RFIDT apparatus 720 applied exteriorly thereto. The tool joint 700 has a pin end 702 with a threaded pin 704, a joint body portion 706, an upset area 707 and a tube body portion 708. The joint body portion 706 has a larger OD than the tube body portion 708. The "WELDLINE' is an area in which the tool joint is welded (e.g. inertia welded) by the manufacturer to the upset area.

Although RFIDT's encased in a non-conductor or otherwise enclosed or protected can be emplaced directly on a tubular (or other item or apparatus according to the present invention, as shown in Figs. 7 and 7 the RFIDT's to be applied to the tool joint 700 are first enclosed within non-conducting material, e.g. any suitable heat-resistant material, e.g., but not limited to, RYTON (Trademark) fabric membrane wrapping material, prior to emplacing them on the tool joint 700. In one particular aspect, one, two, three, or four wraps, folds, or layers of commercially available RYT-WRAP (Trademark) material

commercially from Tuboscope, Inc. a related company of the owner of the present invention is used which, in one particular aspect, includes three layers of RYT-WRAP (Trademark) fabric membrane material adhered together and encased in epoxy. As shown, three RFIDT's 720 are wrapped three times in the RYT-WRAP (Trademark) material 722 so that no part of any of them will contact the metal of the tool joint 700. In one aspect such a wrapping of RYT-WRAP (Trademark) material includes RYTON (Trademark) fabric membrane material with cured epoxy wrapped around a tubular body (initially the material is saturated in place with liquid epoxy that is allowed to cure).

Prior to emplacing the wrapped RFIDT's 720 on the tool joint 700, the area to which they are to be affixed is, preferably, cleaned using suitable cleaning materials, by buffing, and/or by sandblasting as shown in Fig. 9. Any desired number of RFIDT's 720 may be used. As shown in Fig. 11A, in this embodiment three RFIDT's 720 are equally spaced apart around the exterior of the tool joint 700.

RFIDT's may be applied exteriorly to any exterior location thereon with any or all of the layers and/or wraps disclosed herein for a chain link. In the particular tool joint 700 as disclosed in Fig. 7, the RFIDT's 720 are applied about two to three inches from a thirty-five degree taper 709 of the joint body portion 706 to reduce the likelihood of the RFIDT's contacting other items, handling tools, grippers, or structures that may contact the portion 706.

Optionally, as shown in Fig. 8, either in the initial layers or wraps which enclose the RFIDT's 720 or in any other layer or wrap, an identification tag 724 is included with the RFIDT's, either a single such tag or

one tag for each RFIDT. In one aspect the tag(s) 724 are plastic or fiberglass. In another aspect the tag(s) 724 are metal, e.g. steel, stainless steel, aluminum, aluminum alloy, zinc, zinc alloy, bronze, or brass. If metal is used, the tag(s) 724 are not in contact with an RFIDT.

As shown in Fig. 10, an adhesive may be applied to the tool joint 700 to assist in securing a layer 723, "FOLDED MEMBRANE," (e.g., a double layer of RYT-WRAP (Trademark) wrap material.

As shown in Fig. 11, the three RFIDT's 720 are emplaced on the layer 723 and, optionally, the identification tag or tags 724.

Optionally, as shown in Fig. 12, part 723a of the layer 723 is folded over to cover the RFIDT's 720 and the tag(s) 724. If this folding is done, no adhesive is applied to the tool joint under the portion of the layer 723 which is to be folded over. Optionally, prior to folding adhesive is applied on top of the portion of the layer 723 to be folded over. Optionally, prior to folding the part 723a over on the RFIDT's 720 and the tag(s) 724 an adhesive (e.g. two part epoxy) is applied over the RFIDT's 720 and over the tag(s) 724.

After allowing the structure of layer 723a as shown in Fig. 12 to dry (e.g., for forty minutes to one hour), the folded layer 723 with the RFIDT's 720 and tag(s) 724 is, optionally, wrapped in a layer 726 of heat shrink material and/or impact resistant material (heat resistant material may also be impact resistant). In one particular optional aspect, commercially available RAYCHEM (Trademark) heat shrink material or commercially available RCANUSA (Trademark) heat shrink material is used, centered over the folded layer 723, with,

preferably, a small end-to-end overlap to enhance secure bonding as the material is heated.

Optionally, the layer 726 is wrapped with layers 728 of material [e.g. RYT-WRAP (Trademark) material] (e.g. with two to five layers). In one particular aspect the layer(s) 728 completely cover the layer 726 and extend for one-half inch on both extremities of the layer 726. Preferably, the final wrap layer of the layers 728 does not exceed the OD of the joint body portion 706 so that movement of and handling of the tool joint 700 is not impeded.

Curing can be done in ambient temperature and/or with fan-assisted dryers.

The system disclosed with reference to Figures 7 to 12 may be used to attach an RFIDT to a link and chain link. Additionally, a shield may be provided for extra protection to inhibit other links or other large moving masses from damaging the RFIDT.

Any known wave-energizable apparatus may be substituted for any RFIDT herein.

Figure 13A shows a chain 809 with links 801 and with one link 800 having a link body 802. Figs. 13B and 13C show the link 800. A stud 804 extends across a link opening 805 from one side of the link body 802 to the other.

A wave-energizable apparatus 810 (any disclosed herein) housed in a shield 812 is held against the stud 804 with material 806 wrapped around the stud 804. Optionally a second wave-energizable apparatus 814 in a shield 813 is also held in place by the material 806.

As shown the material 806 covers the entire exterior surface of the stud 804 and a small portion of the exterior surface of the link body 802. As shown, the

stud 804 has an hexagonal cross-section, but it may be of any suitable cross-sectional shape. The apparatus 810 may be encased in protective material, e.g. vulcanized rubber 818.

Figs. 14A to 14C show a shield 812 which has a recess 822 for housing a wave-energizable apparatus (any disclosed herein). In one aspect a shield 812 is made of plastic, e.g. polyoxymethylene (e.g., in one particular aspect, Dupont DELRIN (trademark) material). The recess 822 can be machined into the material.

In one aspect, as shown in Fig. 14D, a wave-energizable apparatus 810 is placed in a recess 822 of a shield 812 and then the shield apparatus combination is inserted into or wrapped with a tube 824, e.g. a tube of shrink wrap material. The resulting assembly is then placed on and/or taped to the stud of a chain link. Then the assembly is wrapped with heat shrink material which encompasses the stud. In one aspect any material described herein is used for the tube and for the wrap. In one aspect crosslinked polyethylene shrink wrap material (or AXLPE@) is used. Heat is applied to the material which heats and shrinks and the is allowed to cool. One, two or more additional wrap layers can be applied.

In one aspect the shield with the wave-energizable apparatus is set on the stud and material is wrapped around the shield and the stud to connect the shield and its wave-energizable apparatus to the stud (without initially making the assembly previously described).

A shield (like the shield 812) according to the present invention can be of any desired cross-sectional shape and a wave-energizable apparatus can be of any desired cross-sectional shape (or encasing material

around such an apparatus can be of any desired shape). Fig. 15 illustrates shields 812a, 812b, 812c, 812d and 812e of different cross-sectional shapes with wave-energizable apparatuses, respectively, 810a, 810b, 810c, 810d, 810e, and 810f of different cross-sections. On shield may house mutliple wave-energizable apparatuses.

Fig. 16 shows shields 812f, 812g, 812h and 812i with, respectively, recesses 822f, 822g, 822h and 822i for housing a wave-energizable apparatus. A wave-energizable apparatus may be held in a shield recess by a friction-fit and/or with adhesive. Optionally a shield recess may have holding lips like the lips 8221 of the shield 812h and the lips 822m of the shield 812i.

Fig. 17A shows a chain 830 according to the present invention with links 831, 832 and 833 (partial). A stud 834 projects across a link opening 835 of each link. As shown in cross-section, a wave-energizable apparatus 836 is held to a stud 834 of the link 832 with wrap material 838. The wave-energizable apparatus 836 projects into the link opening 835.

Optionally (or instead of the apparatus 836), a wave-energizable apparatus 837 is held on the link 832 with wrap material 839. The wave-energizable apparatus 837 also projects into the opening 835.

Figs. 18A to 18C show a chain link 840 according to the present invention with a body 842 and a stud 844 extending across a link opening 845. A wave-energizable apparatus 846 is held on the stud 844 with wrap material 848. The wrap material 848 does not project beyond outer limits 849a, 849b of the body 842.

Figs. 19A to 19C show a chain link 850 according to the present invention with a body 852 and a stud 854 extending across a link opening 855. A wave-energizable

apparatus 846 is held on the stud 854 with wrap material 858. The wrap material 858 does not project beyond outer limits 859a, 859b of the body 852.

Figs. 20A and 20B show a chain link 860 according to the present invention which has a body 862 and a stud 864 extending across a body opening 865. The link itself, without additions according to the present invention, including its stud, is prior art. The stud 864 is of a cross-shaped cross-section and a wave-energizable apparatus 866 is placed between two arms of the stud 864. Wrap material 868 is then wrapped around the stud 864 and the wave-energizable apparatus 866.

Fig. 21 shows a link 870 with a body 872 having a shaft 878 and two loop or open ends 873, 874. The loop 873 has a body 873b with an opening 873a. A wrap 879 secures a wave-energizable apparatus 875 to the body 873b.

The loop 874 has a body 874b with an opening 874a.

A wrap 876 secures a wave-energizable apparatus 871 to the shaft 878.

According to the present invention an energizable identification apparatus can be applied to, connected to, or disposed on a member using a solid mass within which is located the energizable identification apparatus. Fig. 22A shows a mass 951 of material within which is an energizable identification apparatus 959. The mass 951 is sized and configured for insertion into a recess, notch, hollow, channel or opening of a member to facilitate installation of the energizable identification apparatus 959. The mass 951 can be held in place with a friction fit and/or adhesive, glue, welding, and/or tape. The material of the mass 951 can be metal, plastic, composite, wood, ceramic, cermet, gel, aerogel, silica

aerogel, fiberglass, nonmagnetic metal, or polytetrafluoroethylene. The material can be rigid and relatively unbending or it can be soft and/or flexible. An enlarged end 951a of the mass 951 is optional.

Fig. 22B shows a mass 1151 (made, e.g. of any material mentioned for the mass 951) with an energizable identification apparatus 1159 therein. The energizable identification apparatus 1159 has an antenna 1158 extending from the energizable identification apparatus 1159 and disposed within the mass 1551. With a flexible or sufficiently non-rigid mass 1151 (and with the mass 951) a slit or recess 1157 of any desired length within the mass 1151 may be provided for inserting the energizable identification apparatus 1159 and antenna 1158 into the mass 1151 and/or for removable emplacement of the energizable identification apparatus 1159.

Fig. 22C shows a mass 1141 (e.g. like the masses 951, 1151 and made of the materials mentioned above) with an energizable identification apparatus 1142 therein (or it may, according to the present invention, be thereon). The mass 1141 has a recess 1143 sized, located, and configured for receipt therein of a part or a portion of a member so that the mass 1141 is easily installable thereon. A friction fit between the mass 1141 and the part or portion of the member can hold the mass 1141 in place (e.g. on a frame, plate, mount, hookstrip, or support of a screen or screen assembly) and/or connectors, fasteners and/or adhesive may be used to hold the mass 1141 in place.

Fig. 23A shows a link 880 with a body 882 having an opening 884. A stud 881 is located between sides 882a, 882b of the body 882. A mass 883 housing a wave=energizable apparatus 889 (any disclosed herein) is

placed on the stud 881 with a portion 881a of the stud 881 in a recess 883a of the mass 883. The mass 883 may be any desired shape and, in one aspect, is like the mass of Fig. 22C. Optionally, instead of, or in addition to the mass 883, a mass 885 with a wave-energizable apparatus 887 is placed on the body 882 with a portion 882a of the body 882 in a recess 885a of the mass 885. The mass 885 may be any desired shape and, in one aspect, is like the mass of Fig. 22C.

Fig. 23B shows a link 890 with a body 892 having end openings 894a, 894b. A shaft 891 is located between the ends of the body 892. A mass 893 housing a wave-energizable apparatus 899 (any disclosed herein) is placed on the shaft 891 with a portion 891a of the shaft 891 in a recess 893a of the mass 893. The mass 893 may be any desired shape and, in one aspect, is like the mass of Fig. 22C. Optionally, instead of, or in addition to the mass 893, a mass 895 with a wave-energizable apparatus 897 is placed on the body 892 with a portion 892a of the body 892 in a recess 895a of the mass 895. The mass 895 may be any desired shape and, in one aspect, is like the mass of Fig. 22C.

Any wave-energizable apparatus and/or shield disclosed herein may be used with any of the embodiments of the present invention, including, but not limited to, those of Figs. 13A - 21. Without limitation a wave-energizable apparatus in a link according to the present invention may contain the following type or types of information: identity; model number; manufacturer identity; date of manufacture; date of service (first, all, last, current); date of inspection(s); next scheduled inspection date; history of rigs and/or vessels used on; and/or stresses applied to the link and/or to a

chain of which it is a part. Any chain link or links according to the present invention may be used in any chain. In one aspect links according to the present invention are used several (one, two, three or more) at one or at each end of a chain and several (one, two, three or more) in the middle.

Any structure, item, and/or mass according to the present invention disclosed herein may have a sufficient recess, e.g. but not limited to, the subject matter of Fig. 40C and/or of Fig. 32E (with a sufficiently large recess), can be used as a connector to secure a wave-energizable apparatus to an item, e.g., a link and, when sized and configured appropriately, as a Aclip-on@ connector.

This application is a continuation-in-part of U.S. Application Serial No. 11/255,160 filed 10/20/2005, which is a continuation in part of U.S. Application Serial No. 11/059,584 filed 02/16/2005 which is a continuation-in-part of U.S. Application Serial No. 10/825,590 filed 04/15/2004 - from all of which the present invention and application claim the benefit of priority under the Patent Laws and all of which are incorporated fully herein for all purposes.

What is claimed is:

1. A link comprising

a body, the body having an exterior surface and two spaced-apart ends,

wave-energizable identification apparatus on the exterior surface of the body,

the wave-energizable identification apparatus wrapped in fabric material,

the fabric material comprising heat-resistant non-conducting material, and

the wave-energizable identification apparatus wrapped and positioned on the body so that the wave-energizable identification apparatus does not contact the body.

2. A link comprising

a link body, the link body having a link body exterior surface, two spaced-apart ends, and a link opening through the link body, and

wave-energizable apparatus on the exterior surface of the link body.

3. The link of claim 2 further comprising a wrap over the wave-energizable apparatus wrapping the wave-energizable identification apparatus wrapped to the link body.

4. The link of claim 2 further comprising

the link body including a stud extending across the link opening, the stud having a stud exterior surface, and

the wave-energizable apparatus on the stud exterior surface.

5. The link of claim 4 wherein the wave-energizable apparatus is wrapped on the stud and positioned on the stud so that the wave-energizable apparatus does not contact the stud.

6. The link of claim 3 wherein the wrap comprises fabric material, the fabric material comprising at least one layer of material wrapped around the wave-energizable apparatus.

7. The link of claim 6 wherein the at least one layer of material is a plurality of layers.

8. The link of claim 6 wherein a layer of body fabric material is on the body, the wave-energizable apparatus located adjacent and exteriorly of the body fabric material, and the fabric material in which the wave-energizable apparatus is wrapped is a folded portion of the body fabric material folded over on the wave-energizable apparatus.

9. The link of claim 6 wherein the wave-energizable apparatus and the fabric material in which the wave-energizable apparatus are wrapped in heat shrink material.

10. The link of claim 9 wherein outside the heat shrink material, at least one outer layer of fabric material is placed over the heat shrink material.

11. The link of claim 10 wherein the at least one outer layer of fabric material is a plurality of outer layers.

12. The link of claim 6 wherein the wave-energizable apparatus is in a shield.

13. The link of claim 12 wherein the shield has a curved top and a recess for the wave-energizable apparatus.

14. The link of claim 2 further comprising an amount of adhesive on the wave-energizable apparatus.

15. The link of claim 2 wherein the wave-energizable apparatus is radio frequency apparatus with integrated circuit apparatus and antenna apparatus.

16. The link of claim 2 further comprising the link body including a shaft, with two spaced-apart shaft ends, each end of the two spaced-apart ends of the link body at a shaft end of the shaft, the two spaced-apart ends including a first end and a second end, the link opening in the first end, and a secondary opening in the second end.

17. The link of claim 16 wherein the wave-energizable apparatus is on one of the first end and the second end.

18. The link of claim 16 wherein the wave-energizable apparatus is on the shaft.

19. The link of claim 16 wherein the wave-energizable apparatus is on one of the first end and the second end and a second wave-energizable apparatus is one the shaft.

20. The link of claim 2 wherein the wave-energizable apparatus includes a first wave-energizable apparatus and a second wave-energizable apparatus, the link further comprising both the first wave-energizable apparatus and the second wave-energizable apparatus on the link body.

21. The link of claim 2 further comprising

the link body including a stud extending across the link opening, the stud having a stud exterior surface, and

the wave-energizable apparatus on the stud exterior surface.

22. The link of claim 21 further comprising the stud having two spaced-apart ends, a wrap securing the wave-energizable apparatus to the stud, and the wrap also on a portion of the link body adjacent each end of the stud.

23. The link of claim 2 wherein the wave-energizable apparatus is in a mass, the mass has a recess, and the mass is on the link body with a portion of the link body in the recess.

24. The link of claim 23 wherein the link body includes a stud between sides of the link body and the mass is on the stud.

25. The link of claim 23 wherein the body includes a shaft between the two spaced-apart ends and the mass is on the shaft.

26. The link of claim 23 wherein the mass comprises a first mass, the link further comprising a second mass with a wave-energizable apparatus on the link body.

27. The link of claim 26 wherein the link body includes a stud between sides thereof and the first mass is on the link body apart from the stud and the second mass is on the stud.

28. The link of claim 2 wherein the link is one of a chain link and an elevator link,

29. A method for sensing a wave-energizable identification apparatus of a member, the member comprising a link with a body, the body having an exterior surface and two spaced-apart ends, wave-energizable identification apparatus on the exterior surface of the body, the wave-energizable identification apparatus wrapped in fabric material, the fabric material comprising heat-resistant non-conducting material, and the wave-energizable identification apparatus wrapped and positioned on the body so that the wave-energizable identification apparatus does not contact the body, the wave-energizable identification apparatus having antenna apparatus, the method including

energizing the wave-energizable identification apparatus by directing energizing energy to the antenna apparatus, the wave-energizable identification apparatus upon being energized producing a signal,

positioning the member adjacent sensing apparatus, and

sensing with the sensing apparatus the signal produced by the wave-energizable identification apparatus.

30. A method for sensing a wave-energizable apparatus of a link, the link comprising a link with a body, the body having an exterior surface and two spaced-apart ends, wave-energizable apparatus on an exterior surface of the body, the method including

energizing the wave-energizable apparatus by directing energizing energy thereto, the wave-energizable apparatus upon being energized producing a signal, and

sensing with a sensing apparatus the signal produced by the wave-energizable apparatus.