

RFID-ENABLED CONTAINER SEAL HOLDER - DESCRIPTION**1. FIELD OF THE INVENTION**

Radio Frequency Identification (RFID) is an advanced wireless technology. This invention proposes an effective, secure, and efficient RFID-enabled cargo container seal to ensure the container's doors securely locked in a closed orientation, and such that the door cannot be opened without destructively removing the seal which identifies the shipment, thereby substantially protecting the contents of the cargo container, while also identifying when the tampering occurred. While this invention relates to a door seal designed for use on cargo container doors, it could be put to many other uses.

The invention also relates to supply chain visibility for the real-time tracking of goods, whereby the RFID-enabled cargo container seal is an essential component for automated tracking of containers without significant latency.

2. BACKGROUND TO INVENTION / RELATED ART**2.1 Securing and Monitoring Cargo Container**

It is desired that a cargo/freight container be secured against theft/pilfering and monitored from point of origin, through the supply chain, to its final destination.

A conventional, single-use, single end seal is the common article used to secure the container door handle/latch in a door closing orientation.

2.2 RFID System

A RFID system carries data in suitable transponders, generally known as tags, and retrieves data, by machine-readable means, at a suitable time and place to satisfy particular application needs.

Data within a tag identify the item tagged. Additional data support applications through item specific information or instructions immediately available on reading the tag. For example, a record of the processes that the item has passed through.

A system requires means of reading or interrogating the tags and communicating the data to a host computer or information management system. A system will also include a facility for entering or programming data into the tags, if this is not undertaken at source by the manufacturer. Figure 1 shows the RFID system components. In addition to non-contact data transfer, wireless communication also allows non-line-of-sight communication and simultaneous reading of multiple tags. Tags may be passive or active (i.e. with own power source, usually a battery).



A tag reader may be used to scan a tag when one of several events occurs. These events may include shipment, receipt, placement into storage, removal from storage, loading into a conveyance, unloading from a conveyance, or replacement of a battery.

2.3 The Problems

When transported over long distances, containers are often left unattended at some time before reaching their final destination. To protect the goods from theft, the storage container may be locked shut. Unfortunately, thieves have found ways to break the seal, unlatch the doors and remove the container contents without being noticed. And because many shippers might handle a container before it reached its destination, blame for lost goods was difficult to assess.

Available technologies and methods for tracking and monitoring the container's integrity and contents usually only detect the broken seal after some time. These seals are not sufficient.

Accordingly, what is needed is a locking device for sealing containers that is inexpensive, disposable, applied without tools, and designed to quickly indicate unauthorized entry into a container.

In addition, it is desired that containers be enabled with automatic data collection technologies that provide an accurate description of their contents as well as allow the network to track their progress and status through the supply chain. For this purpose, RFID is vastly superior to bar code.

3. SUMMARY OF THE INVENTION

3.1 Current Configuration

The current single-use, disposable seal comprises of a steel insertion bolt and a mating receptacle.

The insertion bolt is an elongated, substantially-cylindrical piece of steel having one large end knob for ease of handling, and with a plastic mid-section. The opposite end of the bolt forms an insertion end.

To use, the container doors are closed and the door levers turned and latched into shut position. The bolt is then inserted through the opening of the locking hasps and pushed into the receptacle until the bolt is seated firmly inside the receptacle. Locking flanges inside the receptacle allow one-way insertion of the insertion bolt wherein a biasing ring that encircles the flanges permanently locks the bolt into a non-retractable position. The bolt then cannot be removed unless it is cut into two, usually at its plastic mid-section. Thus the door lever and the container are secured.

Once the bolt has been cut off, it and the receptacle are destroyed and may not be used again.

A commerce visibility network allows for the collection and distribution of real-time accurate location and status information regarding the movement of RFID-tagged containers through a supply chain. However, the exact placement of the tag on the container itself is not fixed.

3.2 The Proposed Solution (Invention)

We propose a holder for the bolt and receptacle that embeds an RFID-tag and a micro-switch.

3.3 How the Invention Differs from Current Configuration

This invention differs from the current system with the introduction of active monitoring of the status of the seal bolt and instant alert / transmission of any attempt at removing it.

Further, the RFID tag and bolt/receptacle assembly are self-contained as a single unit.

4. BRIEF DESCRIPTION OF THE DRAWINGS

[Refer to Patent Application Drawings]

Figure 1 shows the components of a RFID system. These are the Reader/Programmer with Antenna, communicating with the Transponder (or Tag) with Antenna via the air interface.

Figure 2 shows a sketch of the RFID-enabled Container Seal Holder.

Figure 3 shows the base of the Holder uncovered as the detachable cover is lifted, revealing the RFID tag embedded in it.

Figure 4 shows isometric drawings of the RFID-enabled Container Seal Holder.

Figure 5 shows the seal bolt, mating receptacle and holder in open and locked positions.

Figure 6 shows the process flow and operating principle of how the RFID-enabled Container Seal Holder can be used.

Figure 7 shows the likely location of the RFID-enabled Container Seal Holder on Container Door.

5. DESCRIPTION OF THE PREFERRED EMBODIMENT

When / How to Use

The invention can immediately complement the current single-use container door seal.

The holder is designed to hold and contain a commercially available mechanical container seal (as shown in Figure 2). The mechanical container seal is meant to lock the container by

sliding through the latches of the container doors, while the specially designed tag holder is meant to hold the container seal along with a radio frequency identification (RFID) tag/transponder contained in the base of the holder (as shown in Figure 3).

In use, the receptacle is placed into the larger opening of the holder housing. The insertion end of the insertion bolt is then fed, through the smaller opening of the holder housing, into the entry aperture of the receptacle. The bolt is pushed into the receptacle until the insertion end is locked within the receptacle which is now fully inside the housing. The bolt, however, may rotate while locked within the receptacle.

In addition to secure the container seal in place, the tag holder is designed with a concealed micro-switch (as shown in Figures 4 and 5). The micro-switch is connected to the active RFID tag. Thus, a closed circuit is completed and the tag is allowed to send a signal. In this manner, once the lock is sealed, the circuit will never be opened unless it is broken. The tag does not send a signal in the normal state, or sends an "normal" signal to indicate the seal is operational.

Should the bolt be cut and the bottom half of the bolt and receptacle be removed/detached from the tag holder, an alert signal from the RFID tag will be transmitted to the RFID reader/interrogator. This in turn can activate an alarm, or alert the Control and Monitoring Centre through wireless means. Figure 6 shows the workflow using this invention.

Figure 7 shows where the RFID-enabled container seal holder may be used, on the doors of a cargo container.

When the mechanical container seal is disposed after the completion of a mission, the container seal holder can be reused in another new trip with a new low cost mechanical container seal, or reused if it is an empty return trip to prevent smuggling of illegal goods in the container.

The RFID-enabled container seal holder houses a RFID tag that has a unique identity number which was preset at point of manufacturing. No two RFID-enabled container seal holders will bear the same ID.

The tag housed in the RFID-enabled container seal holder can also provide the zonal location of container within the yard, port or warehouse. With the installation of readers at strategic locations or important zones, the container is tracked and monitored within the specific premises. This is useful for especially high-value items being transported in the containers. With a handheld reader device, the operator will also be informed when the tamper signal is transmitted to the device.

In addition, the control station can locate a specific container by zoning down to their last identified area. This is useful as specific containers may not be easily recognised as they are of standard sizes and shapes. This speeds up locating the container, especially for large yard or port.

The tag housed in the RFID-enabled container seal holder can provide access control of the container into the specific premises within the yard, port or warehouse. The access control

module can configure selective access by different containers. The start-end journey can be clocked and monitored for efficient management.

Data received by the receivers/reader can be transmitted via RS485, LAN, wireless LAN, GSM/GPRS to the control centre. Thus real time reporting is facilitated and operation efficiency & competition will be enhanced. The above mentioned features can be operated independently, by modules or can be integrated as a total system.

Fabrication

The holder's base and housing can be easily fabricated from corrosion-resistant metal alloy or hard plastic. The mechanical seal bolt and receptacle may be procured commercially off-the-shelf. Likewise, the RFID tag and micro-switch are standard components.

In the preferred embodiment, the housing is a single-piece, elongated, hollow tube glued or welded to the base. The base comprises of a detachable flat cover and a bottom piece on which the RFID tag is placed or embedded.

Industrial Applicability

The invention will enhance container security in the entire logistics supply chain as information such as when the container seal has been tampered is available almost real-time.

With the integration of RFID tag and the container seal holder, the container movements can be traced, tracked and monitored on a 24 hours basis. Meaningful reports on the status and the time and place and zonal location of the container can be provided. A hand-held terminal can be programmed to check the container seal.

It is an object of this invention to provide a cargo container seal which cannot be removed without noticeably breaking the seal, and whose removal is required in order to open the cargo container doors.

Another object of this invention is to provide a container door lock seal which is substantially cost-effective to implement on a cargo container on a single use basis.

A further object of this invention is to provide a tamper evident container door lock which will readily identify a stage of transport at which the cargo container was opened.

Yet a further object of this invention is to provide a non-reusable locking device for sealing containers that requires no tools for installation.

Still another object of this invention is to provide a non-reusable locking device for sealing containers which is self-contained and distributed as an all-inclusive unit.

A still further object of the present invention is to provide a non-reusable locking device for sealing containers that may be used to seal a wide variety of container doors, which may or may not include designated for a locking seal.

Since many modifications, variations, substitutions and changes in detail can be made to the described preferred embodiment of the invention, it is intended that all matters in the foregoing description and shown in the accompanying drawings be interpreted as illustrative and not in a limiting sense. Thus, the scope of the invention should be determined by the appended claims and their legal equivalents.

RFID-ENABLED CONTAINER SEAL HOLDER - CLAIMS

We claim:

1. An radio frequency identification (RFID)-enabled container seal holder comprising:
 - a. A housing for a single-use mechanical bolt and receptacle seal assembly, formed of a substantially strong, cut resistant material;
 - b. A base of the holder, formed of a substantially strong, cut resistant material;
 - c. A programmable RFID tag and antenna embedded in the base of the holder;
 - d. Micro-switch, located within the housing, electrically linked to the tag.
2. The system of claim 1, where the functions of the invention include, but are not limited to:
 - a. Confirming the integrity of the seal when the bolt and receptacle are in locked (operative) position;
 - b. Automatic and continuous tracking of the status of the locked seal;
 - c. Detecting and raising an alert if the bolt is cut or otherwise tampered with.
3. The system of claim 1, wherein the housing can accommodate most commercial single-use mechanical bolt and receptacle seal assemblies.
4. The system of claim 1, wherein the tag can be active (i.e. powered by an on-board battery) or passive (i.e. battery-less).
5. The system of claim 1, wherein the tag can transmit information wirelessly to RFID readers located in the vicinity.
6. The system of claim 1, wherein each seal is intended to have a unique identifier associated with a corresponding RFID tag.
7. The system of claim 1, wherein the housing and base are welded or glued together as a single unit.
8. The system of claim 1, wherein the housing permits the seal bolt to be easily inserted into one end, and the mating receptacle into the other end.
9. The system of claim 1, when the seal bolt and receptacle are locked together in the housing, the micro-switch is activated.
10. The system of claim 1, wherein the housing and base can be re-used after the mechanical seal is cut or disposed of at the end of the trip.

11. The system of claim 1, wherein if active tag is used and thus offering a longer read range, the invention then requires only simple installation of the RFID readers, such as connecting these readers to the access control computer server through multi-drop network.
12. The system of claim 1, wherein if passive tag is used, the invention allows automatic capturing of the data stored in the tag when the tagged container passes through a gantry with strategically placed RFID reader antenna, or when the tagged container is manually scanned with portable handheld RFID terminals.