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Innovative system of visualization in hot cells

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Abstract

In today's nuclear industry R&D and production shielded boxes, operators generally work with two remotely-controlled manipulator arms, following their actions through a viewing window. One of the common issues they have is the poor or only partial visibility of the box interior and of the instruments and objects to be handled within it.

At present, the main way to see inside nuclear cells or shielded boxes is through a window.

During everyday operations, operators have to be able to see into zones which are invisible from the window. Different devices have been used to try to overcome this issue.

Mirror enables the operator to see behind a piece of equipment or any other item blocking a direct view. It requires a certain time of familiarization for the operator as all the actions must be carried out in the opposite direction to what is seen. One remotely-controlled arm must also be monopolized by the mirror, which can itself be a bulky obstacle within a cluttered space.

Periscope, set up between the two arms, enables the operator to see into shielded cell areas which are hard to view through the window. One disadvantage is that the periscope is located between the two remotely-controlled arms. Thus while a periscope can be very useful, it does not solve the problem of seeing into certain partly or totally hidden parts of a shielded box. It only helps to see a limited pre-defined part of the interior.

Inspection cameras are usually equipped with motors. They can be mounted in a set position within a shielded area to enable monitoring of the equipment's operations, or be attached to a carrier to give views from different positions within the box or cell. However because of their size and weight (on average, around ten kilograms), these cameras cannot be employed in all shielded lines.

Portable cameras, much smaller cameras can be nuclearized in order to be easily managed inside a shielded box. This sort of camera system is able to send an image back via a connection to a screen set up outside the box. Operators can move the camera around inside a box as well as manually adjust its settings, and thus be able to see the details of their experiments close-up or view a hidden zone within the box.

Such cameras can be used in two different ways:

- Set up on a special base. The camera itself does not move and it is possible to position it facing the zone to be monitored. However, the entire unit has to be moved whenever the work space is no longer located within the camera's field of vision.
- Attached to the end of a gripper. The camera is held in place by a remotely-controlled arm gripper attachment. This gives the best conditions for viewing into zones of interest, whether it be for macroscopic observation or a more general overview of a cell. When an operator is using the camera at the end of the gripper, the arm cannot be used for any other purpose.

On-board cameras and lighting units are built onto robot arms or heavy remotely-handled equipment.

An on-board camera setup means that the gripper is free for other uses. The disadvantage of such systems is that if a camera or a light should break down, the entire arm must be retrieved from the work space for operators to carry out the necessary maintenance work.

Description of the invention

This invention has solved the different problems described above by placing the camera on top of the remotely-handled arm gripper rather than between its gripping fingers.

This means an operator can use the gripper while profiting from a detailed close-up view of the work area. Freedom of movement is possible, without needing to pause for camera adjustments during a handling task. The settings are prepared at the beginning of any intervention, using the setting ring to focus either close-up on the end of the gripper to view the immediate working area (the objects to be handled) or on “infinity”, for a general view of a cell or for more precise inspections of otherwise inaccessible spaces. The image below gives an example of what the operator can see on the control screen.

Snapshot taken by the new system

A final advantage is that this system is detachable, meaning that operators can carry out maintenance and/or change all or part of the system without having to retrieve the arm from the cell. The apparatus has been designed for operators to be able to set it up and to remove it simply by using another remotely-controlled arm.

The invention will enable considerable simplification of certain high-precision operations (e.g. handling small objects) and of inspections or more complicated interventions within zones which are difficult to access and have poor or no visibility.

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