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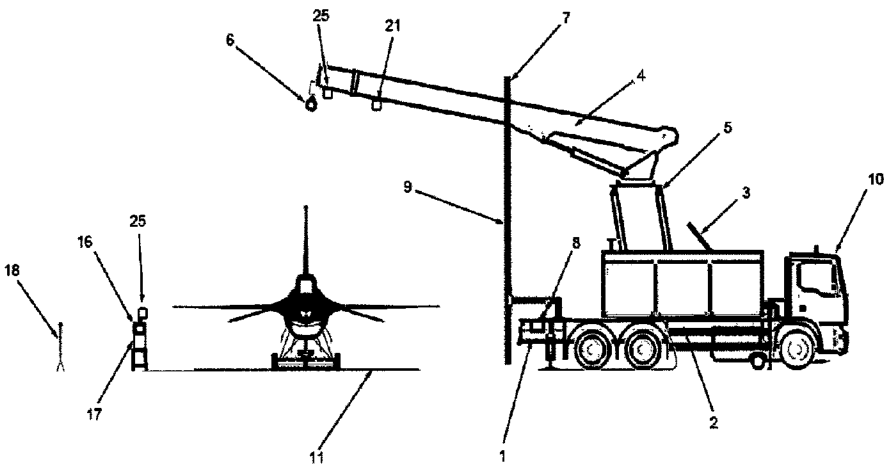

(57) Abrégé/Abstract:
The present invention consists of a method and a scanning system for nonintrusive inspection, through radiography of inspected aircrafts from at least two different perspectives. The complete scanning system for nonintrusive inspection of aircrafts according to the invention is a mobile nonintrusive scanning ensemble, installed on a vehicle chassis with a superstructure, on which a deformable parallelogram profile and a mechanical boom are mounted with a penetrating radiation source at one end. A detector line assembly is installed on the ground. A hinged boom is fitted with an array of detectors and positioned opposite a relocatable radiation source. The scanning system for nonintrusive inspection include a mobile tugging device to tow the inspected aircraft at constant speed through the scanning frames. A mobile control center is placed outside the exclusion area a.

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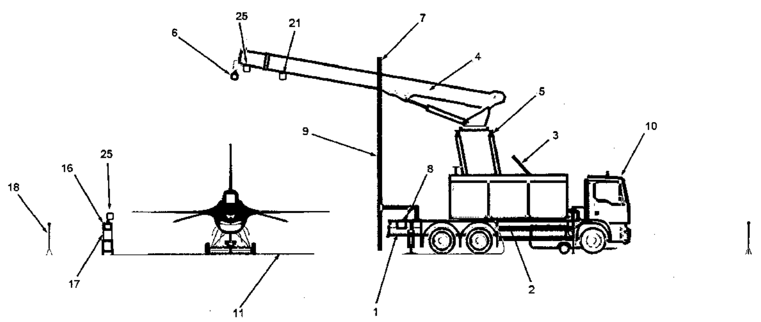

Figure 3

(57) Abstract: The present invention consists of a method and a scanning system for nonintrusive inspection, through radiography of inspected aircrafts from at least two different perspectives. The complete scanning system for nonintrusive inspection of aircrafts according to the invention is a mobile nonintrusive scanning ensemble, installed on a vehicle chassis with a superstructure, on which a deformable parallelogram profile and a mechanical boom are mounted with a penetrating radiation source at one end. A detector line assembly is installed on the ground. A hinged boom is fitted with an array of detectors and positioned opposite a relocatable radiation source. The scanning system for nonintrusive inspection include a mobile tugging device to tow the inspected aircraft at constant speed through the scanning frames. A mobile control center is placed outside the exclusion area a.

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System and method for nonintrusive complete aircraft inspection

The present invention consists of a system and method for rapid, complete and nonintrusive inspection of aircrafts using penetrating radiation. The inspection is achieved without direct human intervention on the inspected aircraft, thus eliminating time consuming activities such as actual physical control performed by authorized personnel to detect smuggling or threatening items on board or anomalies in the structure of mechanisms of the aircraft.

By using the present invention radiographic images of the inspected aircraft are obtained, images upon which an operator can evaluate the shape, amount (quantity) and nature of the goods and objects present in the scanned aircraft and structural defects of the aircraft. The system generates radiographic images of the inspected aircraft from two different perspectives, one substantially vertical and one substantially horizontal, thus obtaining accurate information on the positioning in space of the objects or areas of interest.

In civil aviation applications, the radiographies obtained with the system that implements the current invention can be used in order to discover smuggling, illegal transports of prohibited, or undeclared goods (drugs, explosives, weapons, large amount of money in cash, even hidden persons, etc.) using aircrafts as means of transportation, especially in cases when the contraband is placed inside the empty technical cavities of the fuselage or wings.

The system according to the present invention is a mobile one, being easily relocated from one airport area to another, the time required for transport/assembly/ disassembly being a matter of hours. Authorities using such a system can create the surprise element in security screening, relocating the entire system in areas where carriers of illegal air transport do not expect. The deterrence effect of such a mobile system is therefore significantly higher, compared to fix screening systems.

In military applications, the system provides information about the integrity of inspected military aircraft, necessary to detect any faults, bullets or projectiles penetrating the body of the aircraft, or structural damages after combat mission. Military aircrafts are inspected upon return from combat missions. A military aircraft even if it is hit and damaged during the flight by a war projectile or by the shrapnel's of a projectile explosion, can sometimes operate if the damages are not severe enough to affect vital components for a safe flight. In this situation, in order to maintain combat capability and efficiency, it is necessary for the ground staff to identify correct, complete and rapid the damages suffered. According to the present invention, the inspection system provides information about the structure and vital components of the aircraft, therefore about any possible damages in just a few minutes, which significantly reduces the diagnosis time; in normal circumstances, this time being a matter of days, or weeks, depending on the complexity of the aircraft, when classical methods based on disassembling the damaged aircraft are used. It is well known the fact that, in military applications, shortening the time for most operations is critical.

Currently the global market offers several scanning systems and methods for scanning of aircrafts using penetrating radiation. Some of these are non-destructive control systems that only scan certain areas of interest, using radiation detectors and x-ray generators located conveniently on one side and the other of the inspected area.

Usage of such systems for full inspection of the aircraft is limited on one side by the difficult positioning of the systems in certain areas and on the other side by the very long time required for repositioning the scanning system components that can take long hours even for partial inspection.

Other known systems scan the aircrafts in their integrity for security purposes and applications, using a radiation generator placed on a boom or frame, above the aircraft and a mobile detector system placed at ground level obtaining a single image of the aircraft. These systems obtain a radiographic image from a substantially vertical perspective, analyzed objects in the image being difficult to locate in space and can't provide any radiography of the landing gear area.

Such example is the system described by the 5014293/07.05.1991 patent. This system consist of a "C" shaped boom frame which has on one side the detector area and on the opposite side the radiation source. The system is used for generating computer tomography of components of an aircraft in order to detect damages of critical elements. The major disadvantage of this system consists of the shape of the boom and its size thus leading to the incapacity of inspecting the entire aircraft, scanning only some parts in a sequential manner. For example, the system will inspect initially the cabin of an airplane, then the wings one at a time, and then the rest of the fuselage, each sequence is accompanied by mounting/dismantling times.

Another disadvantage of the system is that the boom has an optimal shape and size for inspecting a reduced size aircraft, being totally unsuitable for larger aircrafts.

In addition, the time for positioning/repositioning the scanning system for the various components is very long, significantly limiting the state of operability. The system is fixed, generally mounted in hangars, and so it has the disadvantage of lack of mobility.

Another inspection system described by the 6466643/15.10.2002 patent proposes a solution in which the radiation source is placed inside the fuselage and the detectors are placed on the exterior of the fuselage then moved synchronously in order to achieve radiographic image. The system and method have the disadvantage of inspecting only the fuselage without the wings. Furthermore, the inspection is an intrusive one, requiring access in the aircraft.

The system proposed in U.S. patent no. 8483356 B2 consists in the use of a boom or a mobile framework that supports the radiation generator and a mobile detector placed at ground level, these being aligned and moving synchronously to scan an aircraft that has a fixed position. The main disadvantages of this solution consists in the fact that the scanning system needs to bypass some obstacles such as the wheels, these not being scanned, and also permanently maintain a perfect synchronization between the two mobile subsystems. Furthermore the movement of mobile detectors under the structure of the aircraft, bypassing the wheels leads to long scan times and difficulties in generating a unified radiographic image.

Another non-intrusive scanning system is described in the patent application A/2012/00443 (PCT/RO2012/000030), system however this does not give a complete radiographed image from two perspectives, but only a single perspective on the scanned aircraft, insufficient to accurately discriminate objects that are prohibited or undeclared on board and especially insufficient to identify damages to the onboard system and the aircraft structure generated by projectiles of war.

The technical issue solved by the present invention is the non-intrusive and complete inspection of aircrafts using an inspection system, with high capacity, that generates at least two complete radiographic images of the aircraft from different perspectives, while said aircraft is towed by a tugging device located on the runway, through two scanning frames. The present patent application also relates to a method for non-intrusive inspection of aircraft that uses this system.

In order to clarify the presentation of the system and method according to the present invention, a number of terms are used:

- The penetrating radiation source refers to a source of ionizing radiation that can be natural sources of radioactive material (such as Co60 or Se75), X-ray generators or linear accelerators (LINAC), or other sources of penetrating radiation in the solid medium. When using a natural source, the choice of radioactive material shall be made depending on the desired penetration depth and size of the exclusion area available in the site where the scanning takes place.

- The scanning frame refers to the assembly consisting of a penetrating radiation source and an array of radiation detectors located at a predefined distance, through which the scanned object travel, in this case, an aircraft.

- The array of detectors refers to a set of penetrating radiation detectors aligned in one or more rows.

- The detection module assembly refers to an ensemble of multiple identical arrays of detectors aligned one after another.

The nonintrusive inspection system implies the irradiation of two or more arrays of detectors, typically one set located on aircraft runway and the second set on a substantial vertical support. Electrical signals generated by the detectors are processed analogue/digitally in order to generate a radiographic image, which will appear on the monitor of a workstation. The processing of information generated from a large number of detectors, usually a few thousand, implies complex electronic blocks and a network of wires with a large number of parallel connections between the boom and the subsystems that generate a radiographic image.

The complete and non-intrusive inspection system of the aircrafts according to the present invention comprises of a mobile scanner unit, which may be a truck chassis on which it is installed a metal superstructure, carrying the inspection system components, a mobile aircraft towing unit, a computer system for acquisition, processing and display of data provided by the array of radiation detectors and for scanning process control, a first scanning frame that is used to obtain a radiographic image of the aircraft inspected by a substantially vertical projection, a second scanning frame used to obtain a radiographic image of the aircraft inspected by a substantially horizontal projection, a mechanical boom consisting of one or more segments connected to the mobile scanning unit on which is mounted an array of radiation detectors, which during scanning is in the extended position along the frame of the mobile scanning unit to the side of the inspected aircraft as well as a relocated radiation source positioned on the side of the inspected aircraft, on the opposite side of the mechanical boom so that its beam of radiation is directed to the mechanical boom and exposing the radiation detector array.

The scanning frame that generates a substantially vertical projection (top view) consists of a mechanical boom made up of one or more segments, which is connected at one end to the mobile scanning unit, and having at the other end mounted a penetrating radiation source which in scanning mode is positioned above the inspected aircraft, thus the beam of radiation emitted by the radiation source is directed towards the ground, in a substantial vertical plane and from an array of detectors installed on the ground, positioned under the inspected aircraft, so that the detectors are exposed to the radiation source beam over which the inspected aircraft is passing, towed by the mobile unit.

The scanning frame which produces a substantially horizontal projection (side view) consists of another hinge mechanical arm, consisting of one or more segments connected to the mobile scanning unit on which is mounted another array of radiation detectors and which in scanning process has a substantially vertical position, on the side of the inspected aircraft and a relocatable radiation source placed at the side of the inspected aircraft on the opposite side of the mechanical boom so that its beam of radiation is directed towards the mechanical boom and exposes the radiation detector array.

In operating the system, the tugging device is towing the inspected aircraft through the two scanning frames, the movement is synchronized with the start of penetrating radiation sources and data acquisition from radiation detectors in order to obtain at least two radiographic images of the aircraft from different perspectives.

In the transport mode of the system, the mechanical boom and the hinged boom are folded in order to ensure a minimum overall dimensions, allowing classification of the vehicle in legal dimensions for transport on public roads. In scanning mode, the mechanical boom extends forming variable angle with the chassis of the mobile scanning unit, in its extension, angle dependent on the size (height and wingspan) of the aircraft to be scanned, and hinged boom is brought in substantial vertical position, oriented towards the rear side of the chassis, by a rotation movement against an axle at least 90 degrees.

The movement of the mechanic boom and the hinged boom are executed automatically by the hydraulic cylinders, servomechanism or electromechanical actuators according to commands received from a PLC through hydraulic valves or command components.

The mobile scanning unit (MSU) is equipped with a position monitoring subsystem of scanned aircraft from the scanning frames, which contains at least one proximity sensor that detects the presence of the aircraft in the proximity of the first scanning frame, in the direction of movement of the aircraft, which is used to automatically start the emission of radiation at the beginning of the scan and stop the emission of radiation at the end of the scan.

The scanning system includes a mobile remote control center (MRCC), which is positioned outside the exclusion area and its purpose is to manage remotely wireless or by cable all the processes involved in the nonintrusive inspection through an IT system interconnected with a computer system. Inside the mobile remote control center there is an acquisition, processing, storage and display subsystem of the scanned image. The scanning system also includes a perimeter protection subsystem.

The mobile scanning unit, in this case a truck chassis, is equipped with an supplementary chassis, on which the boom that holds the first source of radiation is mounted, on an intermediar deformable parallelogram-shaped support system, or a rigid intermediar segment, which in transport mode is folded on the platform of the mobile unit, while in scanning mode is extended up towards vertical position, so the mechanical boom attached can be raised to a proper height for easy scanning of the aircraft, boom wherein another implementing variant can have a fixed construction, or in an alternative implementing variant can be made of telescopic sections, extendable in length, depending on the size of the scanned aircraft.

The detector line (Modular Detection Assembly) is located on the running surface of the aircraft and is mounted in a metal housing made from an alloy with low weight, easy to handle, the whole assembly can be easily handled by the operator of ~~a~~ the mobile scanning unit.

The detector line (Modular Detection Assembly) of penetrating radiation placed at ground level, is made of solid blocks, each module being composed of an array of radiation detectors mounted in a sealed technical socket, made from an upper half-housing, a lower half-housing, between which there is a support network of contact points between the two half-housings.

The subsystems are combined complementary, so that the support points ensure the mechanical resistance required to allow the towing of a heavy aircraft over them, while providing the passage of unshielded penetrating radiation through the wall of the upper half-housing, to the array of radiation detectors.

Along the supplementary chassis the hinged boom is mounted in a rotary joint around an axis, boom that is equipped with at least two arrays of radiation detectors.

In transport mode, the mechanical boom and the hinged boom are folded along the chassis, and the modular detection assembly, the relocable source, of penetrating radiation as well as the mobile tugging device are loaded onto the chassis, more exactly on the superstructure, the entire system going through the following sequence for the conversion ~~of~~ from the transport mode into the scanning mode:

- The detector line (modular detection assembly) is unloaded from the chassis and is assembled on the runway by the operator along the longitudinal axis of the chassis so that the vertical line lowered from the penetrating radiation source placed on end of the mechanical boom to fall to the center of the detector line (modular detection assembly);

- The chassis is locked to the ground through the 4-point hydraulically actuated supports; outriggers.

- The mobile penetrating radiation source is unloaded from the chassis and placed at a corresponding distance from the mobile scanning unit, so that through it and the mobile source radiation can pass the aircraft to be scanned.

- The tugging device is unloaded from the chassis and placed by the exclusion area's entrance, before the detector line, in order to be attached to the scanned aircraft;

- The mechanical boom execute a movement of elevation from the laid down position along the chassis towards the upward position, forming a variable angle to the plane of the chassis, angle determined by the size of the aircraft to be scanned;

- In the implementing version with telescopic boom, the mechanical boom executes a movement to extend up to a predefined length, depending on aircraft wingspan, and the folding boom executes a rotation movement of at least 90 degrees, from the driver's cabin to the rear side of the chassis, finally to be placed at a convenient angle, according to the size and wingspan of the aircraft to be scanned;

The nonintrusive control method, according to the invention, eliminates the disadvantages of previous systems in that, the mobile tugging unit is coupled to an inspected aircraft which is brought into the scanning area, in the proper position and is trailed through the two scanning frames synchronized with the start of the two radiation sources and synchronized with the transmission of the data from the detector arrays to the subsystem for acquisition, processing and display of data from the radiation detectors where are acquired, stored and processed in order to generate and display radiographic images.

The aircraft is towed through the two scanning frames with a recommended scanning speed, depending on the type of the aircraft and the cargo declared, the speed being measured by a speed measurement subsystem, located on the mobile tugging device. The position monitoring subsystem of the scanned aircraft contains at least ~~a~~ one proximity sensor that detects the presence of the aircraft in the proximity of the first scanning frame in the traveling direction of the aircraft and determine the start of the radiation sources.

The scanning process automatically stops in the following cases: when the aircraft has passed entirely through the two scanning frames, when intruders breach the exclusion area; at triggering of a sensor, signaling that the aircraft has lost its predefined trajectory; or when the aircraft is dangerously close to any of the components of the scanning system, when the aircrafts' speed fluctuates dangerously outside the predefined limits, said limits which the system cannot manage. The emergency stop of the scanning process can be initiated manually by the operator at any time during the scanning process. During the scanning process, the radiographed images are displayed on the operator's screen simultaneously and synchronized with the movement of the aircraft.

The advantages of the invention:

- Large number of aircrafts inspected in a short period of time (up to 20 per hour);
- Complete Inspection of the aircraft, including the cockpit, the aircraft body and baggage hold, the wings and any objects attached to the aircraft;
- Achieving a complete image of the scanned aircraft by viewing an radiographic image from 2 different perspectives, top view and side view, generated by the two sources of penetrating radiation located on top and on the side of the inspected aircraft;
- Avoiding unfavorable cases of obtaining inconclusive radiographic images generated by unfavorable positions of the elements sought to be discovered by generating simultaneous two views from different perspectives, of which only one may be inconclusive;
- Eliminating the risk of professional irradiation of operators and the risk of accidental irradiation of potential intruders into the exclusion area;
- Using operating personnel limited to one person per shift;
- Mobility, flexibility and maneuverability of the system;
- High degree of automation;
- Increased productivity, increased numbers of aircraft inspected per unit of time, by automating the processes and reducing dead times due to ICT management processes;

Further, an example of implementing the invention is presented in connection with the figures from 1 to 4 that describe:

Figure 1: perspective view of nonintrusive inspection system in a scanning mode

Figure 2: top view of the nonintrusive inspection system, according to the invention, placed within the exclusion area;

Figure 3: Side view (aircraft) of the nonintrusive inspection system in scanning mode;

Figure 4: perspective view of detection modules.

In an implementing variant, the complete and nonintrusive inspection system according to the invention is a mobile nonintrusive scanning ensemble, installed on a vehicle chassis **1**, with low total weight, onto there is a supplementary chassis, referred to from this point on as superstructure **2**, onto which a deformable parallelogram profile **3 is fixed**, which has mounted a mechanical boom **4**, in a double joint joint**5**, supporting at the end the penetrating radiation source **6.** Along the superstructure **2**, a hinged boom **7** is installed, into a joint **8,** with one degree of freedom, boom fitted with an array of detectors **9.** The mechanical boom **4** and the hinged boom **7** are made of steel and lightweight alloys, and both fold from the driver cabin **10** towards the aircraft to be scanned.

The detector line (modular detection assembly) **11,** consists of identical modules which are assembled one along of the other, each module is manufactured by machining in solid blocks of metal material, each block consisting of an upper half-housing **12** and a lower half-housing **13** which combine complementary, sealed connection, providing an acclimatized technical cavity, in which an array of detectors **14** is mounted, providing an unshielded passage through the wall of the upper half-housing towards the array of detectors, while supporting the weight of an aircraft, towed over the detector line **11.**The half-housings combine complementary, so that the network of support points ensure the mechanical strength required for discharging the forces applied by the aircraft wheels to the upper half-housing, through the support points, to the lower half-housing and then to the ground, at the passing of an aircraft over the detector line (modular detection assembly) through modular ascending and descending ramps, which are designed to generate inclined planes between the track surface and upper surface of the detectors line.

The detector line (assembly) **11**, will be unloaded from the chassis **1** by modules, and assembled onto the running track inside the exclusion area **a**, the tugging device **15** is also unloaded from the chassis **1** and ready to be attached to the drivetrain of the aircraft, in order to tow the aircraft through the scanning frames. The relocatable penetrating radiation source **16** is unloaded from the chassis and placed following the detector line (modular detection assembly) **11.** In a variant of implementation, the relocatable penetrating radiation source **16** is fitted on an adjustable support **17** that allows adjusting the height of the source from the ground, to obtain a convenient geometric projection in the scanned image depending on the type and size of the aircraft to be scanned.

Because in the scanning area of aircrafts must be provided active radiological protection against accidental irradiation of possible intruders, a perimeter protection subsystem 18 was provided, which result in a rectangular exclusion area **a**.

A computerized management subsystem **19,** remotely commands and controls the whole subsystem: the direction and speed of the tugging device, the position in the exclusion area, and the other peripherals connected to the system according to the invention, including extension and folding controls of the two booms and the four points stalling subsystem of the chassis, and communicating with all the components by a local computer network cabled or wireless.

All physical components of the computerized management subsystem **19**, and the operator's workstation are installed in mobile control center **22** which, during transport, is towed by the chassis **1,** and during scanning is placed outside the exclusion area **a.** In another implementation variant, the mobile control center **22** can be achieved in a compact version, where all the hardware components are installed in a suitcase type box.

The mobile scanning unit, according to the invention, has two modes of presentation, such as: "scanning mode" and "transport mode". Conversion from one mode to another is done through the operation of hydraulic cylinders, actuators, electromechanical actuators which makes a reconfiguration of the position of the mechanical boom **4** by deformation of the parallelogram and/or changing the angle of the mechanical boom to the horizontal and boom **7,** by rotating the boom compared to the axis of rotation where is mounted.

In transport mode, the mechanical boom **4** and hinged boom **7** are folded along the chassis **1** to ensure enrollment of the overall dimensions of the assembly in legal limits for driving on public roads, and to ensure proper distribution of loads on wheels. Scanning system components: the detector line (modular detection assembly) **11**, mobile tugging device **15**, and relocatable penetrating radiation source **16** are loaded on the platform of the chassis **1** and secured by fixing them on the transport positions.

In scanning mode, the detector line (modular detection assembly) **11** is placed on the runway, the relocatable penetrating radiation source **16** is placed in continuation of the detector line (modular detection assembly) 11 and the tugging device **15** is attached to the aircraft to be scanned. Mechanical boom **4** performs an ascending movement of the deformable parallelogram shape support **3**, and a tilt angle from driver's cabin **10** in height, forming a variable angle from horizontal, depending on the size of the aircraft to be scanned, then can execute a movement of extension, by telescoping, up to a predefined length; the hinged boom **7** equipped with the second array of detectors **9**, executes a folding motion, a rotation of at least 90 degrees from the driver's cabin **10** to the back end of the chassis **1**, in scanning mode.

After the system components are installed, it can proceed to the scanning procedure by initiating a command through the interface command on the mobile command center, at which moment the mobile tugging device, that is attached to the powertrain of the aircraft starts to move through the scanning frames, first frame being defined by the detector line (modular detection assembly) **11** placed on runway and the penetrating radiation source **6**, carried by the mechanical boom **4**, on the mobile scanning unit and the second scanning frame defined by detectors array **9**, mounted on hinged boom **7** and the penetrating radiation source **16** , placed in continuation of the detector line **11** . Mobile scanning unit is equipped with a position monitoring subsystem of the scanned aircraft **20**, comprising of at least one proximity sensor **21** that detects the presence of the aircraft in the proximity of the scanning frame and is used to automatically start the emission of radiation at the beginning of the scanning process and to stop the emission of radiation at the end of the scan of the aircraft.

The scanning can be stopped automatically when the scanned aircraft entirely passed through the two scanning frames, when comes dangerously close to any of the scanning system components, if intruders enter the exclusion area **a**, when triggering the sensor that sends a signal when the mobile tugging device **15** is not following the preset trajectory when passing over the detector line (modular detection assembly) **11**, when detecting a dangerous speed variation, during this phase the scanned images of the aircraft are being displayed on the operator's monitor, at the same time being created and archived an unique file containing the scanned image of the aircraft and the live recording of the whole scanning process, and at the end of the scanning phase, the radiation sources **6** and **16** automatically stops, perimeter protection of the exclusion area **a** is automatically deactivated, the mobile tugging device **15** detaches from the aircraft drivetrain, and after that the aircraft may leave the exclusion area and the scanning cycle may restart.

The mobile tugging device **15** can be done in various embodiments in the present invention, either by a tractor unit driven by a human operator sitting in a cabin protected from radiation by lead or other shielding materials walls, or remotely by radio frequencies or wired.

The mobile control center **22** is placed outside the exclusion area **a**, area delimited by the perimeter protection subsystem **18**.

The chassis **1** has an additional steel chassis referred to as superstructure **2**, onto which are assembled all the components of the mobile scanning unit such as: the hydraulic system's related parts: oil tank, distributors, control and safety circuits, the cabinets with the electric and electronic circuits. Some of these latter subassemblies are not figured, considering that they are components by itself, known and unclaimed.

The penetrating radiation source **6** is fixed to the upper end of the mechanical boom **4**, so the radiation beam to be collimated on the detector line (modular detection assembly) **11** located on the runway with the purpose of converting the received penetrating radiation to electrical signals that are then processed and transformed into a radiography (top view) of the scanned aircraft. Similarly, the mobile penetrating radiation source **16** is placed opposite from the hinged boom **7,** so that a beam of radiation to be collimated over the detectors area **9**, installed on hinged boom **7**, with the role of turning the penetrating radiation received to electric signals, which are then processed and converted into a radiography (side view) of the scanned aircraft.

Arrays of detectors **9** and **14**, may contain hybrid detectors for an X-ray source, with scintillation crystals and photodiodes or monolithic detectors with charge coupled devices. For a gamma-ray source hybrid detectors with scintillation crystals coupled to photomultiplier tubes are used. Detector layout can be done, depending on the source-detector combination and the design of the detectors chosen, in one line, two lines or in arrays of different shapes.

The exclusion area perimeter protection subsystem **18** is an active subsystem of radiological protection, that acts directly on the penetrating radiation sources **6** and **16**, so that the sources **6** and **16** are automatically closed or stopped if intruders enter the exclusion area, to protect them against accidental irradiation. The active sensors that are part of perimeter protection subsystem are placed so as to determine a rectangular perimeter, called exclusion area **a**. These sensors are permanently connected through wireless or wired connection to the mobile control center **19**, where they send an alarm signal if intruders enter the area, which automatically turns off the sources **6** and **16** and activates a text, vocal, and graphic message on the software graphic interface for the operator, indicating the penetrated side. The subsystem has been designed to operate in harsh weather conditions respectively, rain, snow, wind, extreme temperatures, etc. Perimeter protection is disabled to allow entry/exit to/from the exclusion area for scanned aircraft.

The mobile control center **22** manages all components and peripherals that are part of the mobile scanning system providing process automation, including a subsystem for acquisition, processing, storage and display of the radiographed image **23**, through wireless or wired connection.

In an alternative embodiment of the present invention, the detector line (modular detection assembly) **11** is positioned on the ground and connected with modular access platforms **14** placed on both sides of the detection modules and mechanically connected to these. The incline of these platforms allow the tugging device and the aircraft to run over the detectors.

In an alternative embodiment of the present invention, the detector line (modular detector assembly) **11** is seated in a trench in the runway, with its top at the ground level, eliminating the need for platforms.

For optimal use of the non-intrusive inspection mobile system of aircrafts, at least one alignment system **24** is required, placed on the penetrating radiation sources and oriented towards the radiation detectors arrays in order to facilitate the alignment of the radiation beam with the detector lines of detector arrays.

In an alternative implementation, the system **24** may be a laser transmitter **25** whose laser beam is parallel to the radiation beam or superimposed on it allowing an operator to adjust the relative position of the radiation source to the corresponding detector array.

What is claimed:

1. A mobile nonintrusive inspection system for an aircraft comprising:

a. mobile scanning unit that is carrying components of the inspection system and which is used for unloading and positioning of the components in order to scan an inspected aircraft;

b. a tugging device;

c. a mobile remote control center which is placed outside of an exclusion area;

d. a first scanning frame used to obtain a first radiographic image of the inspected aircraft through a vertical projection, comprising:

i. a mechanical boom, comprising one or more telescopic segments that are assembled in a variable angle in the mobile scanning unit having at a free end mounted a first penetrating radiation source and in a scanning mode the mechanical boom is positioned above the inspected aircraft so that a beam of radiation from the first penetrating radiation source is oriented towards the ground, passing through a fuselage of the inspected aircraft, in a vertical plane; and

ii. a detector line, installed on the ground, provided with a first array of radiation detectors positioned under the inspected aircraft so as to be exposed to the beam of radiation, and aligned with the beam of radiation, over which the inspected aircraft is towed;

e. a second scanning frame used to obtain a second radiographic image of the inspected aircraft through a horizontal projection, comprising:

i. a hinged boom comprising one or more segments of linear sections, bends, or a combination thereof, mechanically oscillatingly coupled with the mobile scanning unit, wherein the hinged boom is installed with a second array of radiation detectors, and in the scanning process, the hinged boom has a vertical position, at a variable angle, on the side towards the aircraft, and during transport, the hinged boom is folded along a platform of the mobile scanning unit; and

ii. a relocatable second penetrating radiation source, located on the side toward the inspected aircraft on the opposite side from the hinged boom, so its beam of radiation is directed towards the hinged boom, passing through the fuselage of the inspected aircraft, and expose to radiation the second array of radiation detectors, aligned with the beam of radiation from said relocatable second penetrating radiation source; and

f. wherein said mobile remote control center is configured to control all components of the mobile nonintrusive inspection system and includes a subsystem programmed for acquisition, processing and displaying of data provided by the first and second arrays of radiation detectors and to control the scanning process wherein the tugging device is towing the inspected aircraft through the first and second scanning frames, the movement is synchronized with activation of the first and second penetrating radiation sources and data acquisition from the first and second arrays of radiation detectors, in order to obtain said first and second radiographic images of the aircraft from different angles.

2. The mobile nonintrusive inspection system for an aircraft according to claim 1, wherein the mechanical boom of the first scanning frame is connected to the scanning unit through a deformable parallelogram shaped support, which in transport mode is folded on the platform of the mobile unit, and in the scanning mode is raised, so the attached mechanical boom is positioned at an appropriate height for easy scanning of the aircraft and for collision avoidance with a wingtip of the aircraft.

3. The mobile nonintrusive inspection system for an aircraft according to claim 1, wherein the mobile scanning unit further comprises a supplementary platform, wherein the hinged boom comprises one or more linear segments or bends, and is mounted in a joint, with one degree of freedom, the hinged boom equipped with the second array of radiation detectors being foldable for transport by rotation towards a driver's cabin by at least 90 degrees, until the hinged boom reaches a parallel position to the supplementary platform.

4. The mobile nonintrusive inspection system for an aircraft according to claim 1, wherein the mobile remote control center is positioned outside the exclusion area and is designed to remotely manage all the processes involved in nonintrusive inspection.

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5. The mobile nonintrusive inspection system for an aircraft according to claim 1, wherein a computerized management subsystem is contained in the mobile remote control center, interconnected with an external computerized system for monitoring and operating the inspection system, in order to oversee the process from another geographic location relative to a place of scanning.

6. The mobile nonintrusive inspection system for an aircraft according to claim 1, wherein the tugging device has a synchronized movement with the scanning process and controlled by a computerized management subsystem.

7. The mobile nonintrusive inspection system for an aircraft according to claim 1, comprising at least one alignment system between the first or second penetrating radiation source and the first or second array of radiation detectors corresponding to the first or second scanning frame, said at least one alignment system comprising an optical emitter whose beam is parallel, or superimposed to the beam of radiation.

8. The mobile nonintrusive inspection system for an aircraft according to claim 1, comprising at least a proximity sensor, that detects the presence of the aircraft in the proximity of the first and second scanning frames which is used to automatically turn on emission of penetrating radiation in the beginning of the scan and to stop the emission of penetrating radiation at the end of the scan.

9. The mobile nonintrusive inspection system for an aircraft according to claim 1, wherein the relocatable second penetrating radiation source is fitted in an adjustable support which is positioned on the ground at a distance and orientation relative to a size of the aircraft to be scanned, and whose height from the ground is adjusted to obtain an optimized geometric projection in the radiographic image, in relation to a type of the aircraft and areas of interest.

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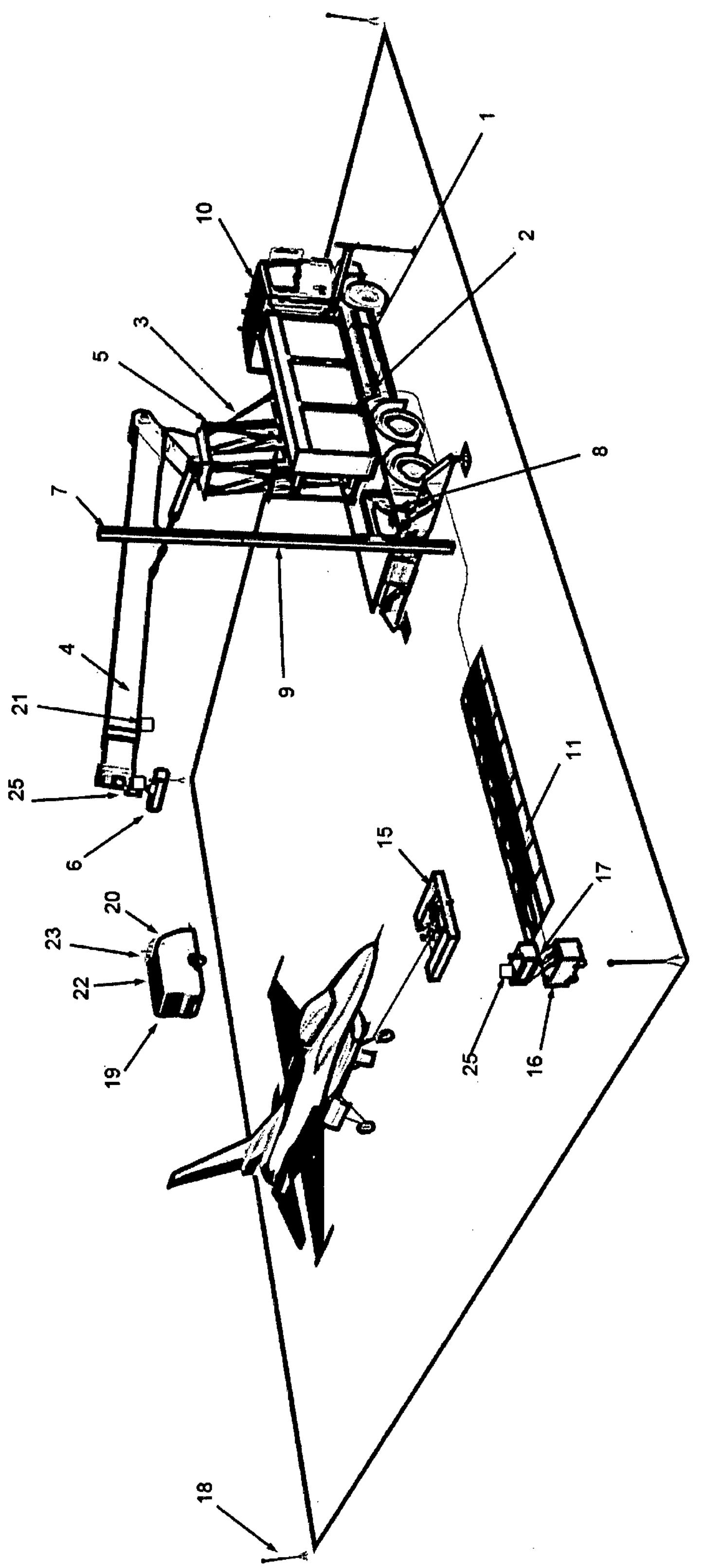


Figure 1

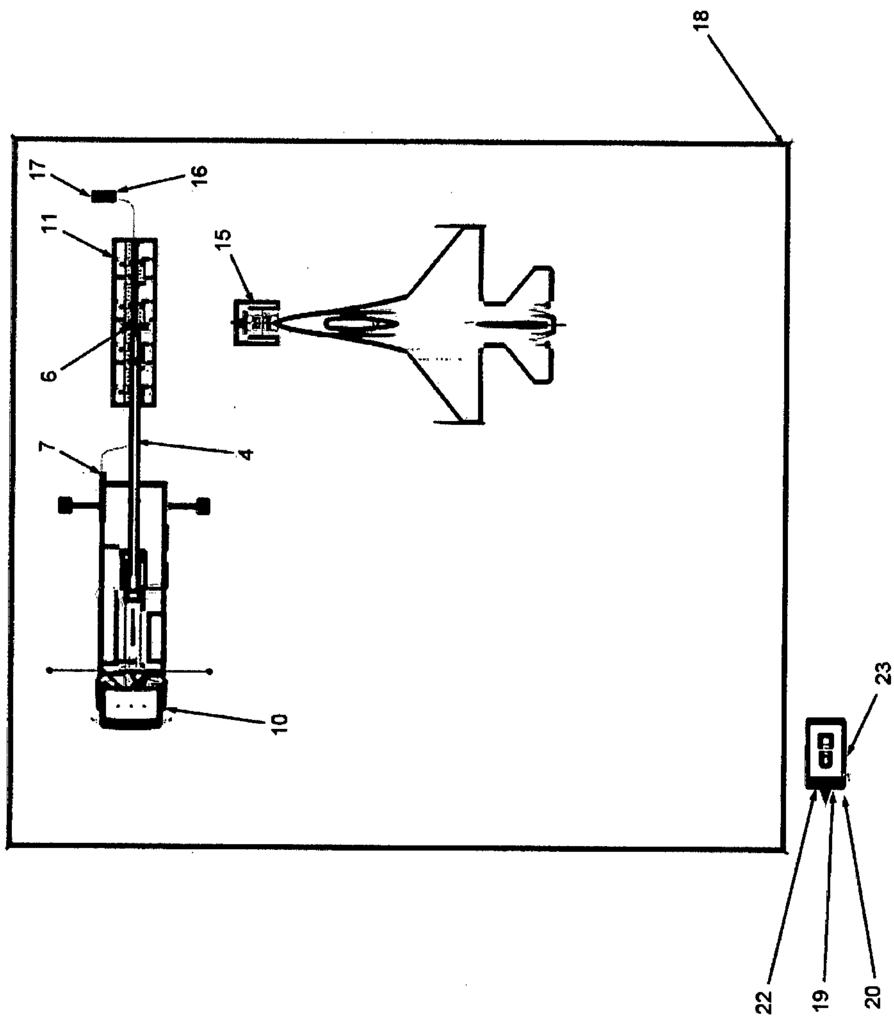


Figure 2

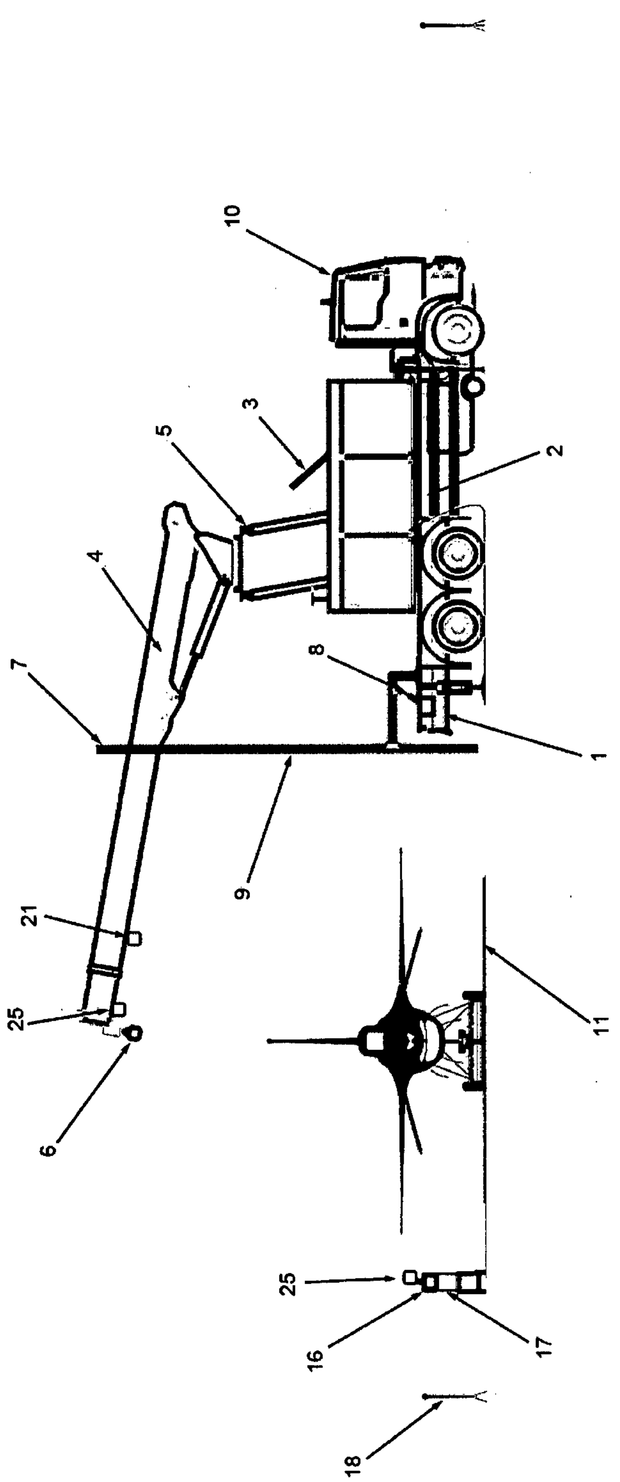


Figure 3

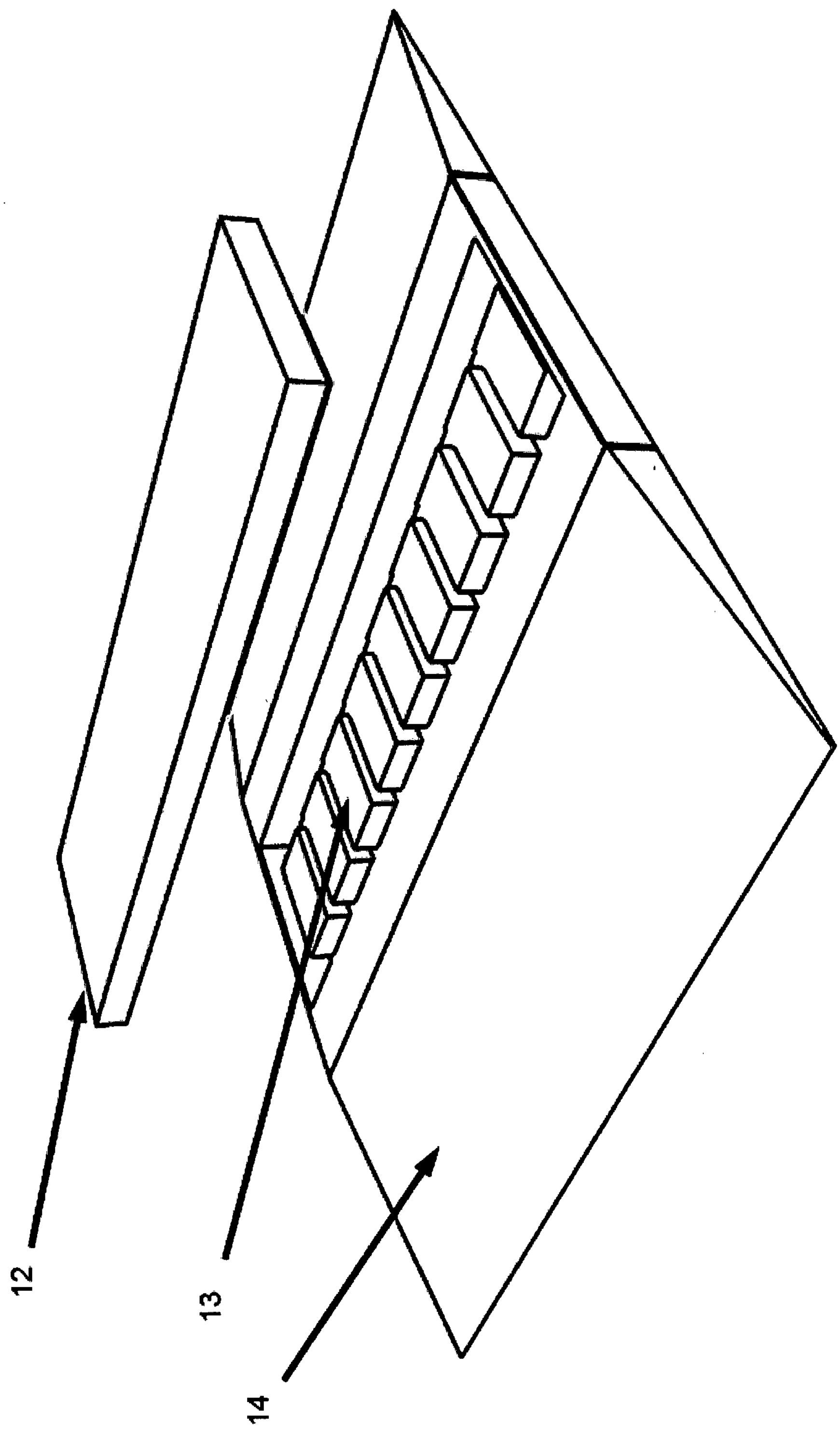
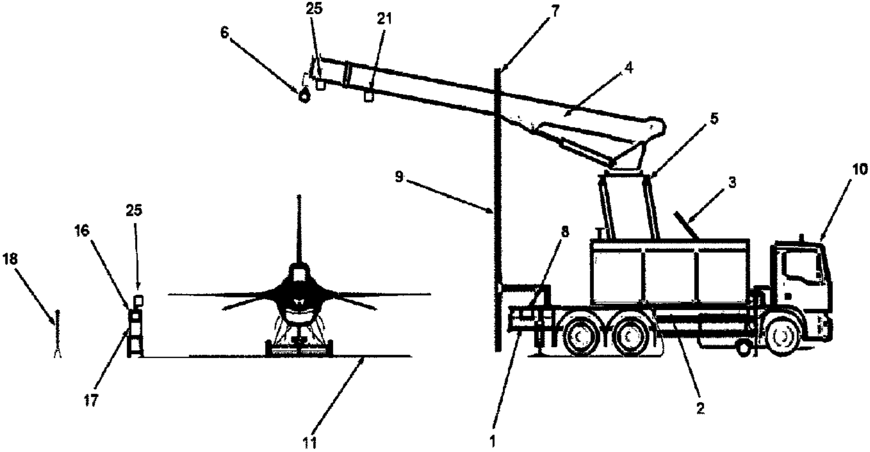


Figure 4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