

IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF MASSACHUSETTS

L-3 COMMUNICATIONS SECURITY
AND DETECTION SYSTEMS
CORPORATION DELAWARE,

Plaintiff,

v.

AMERICAN SCIENCE &
ENGINEERING, INC.,

Defendant.

CIVIL ACTION NO. 04-10339-RWZ

**L-3'S MEMORANDUM IN SUPPORT OF ITS MOTION FOR PARTIAL
SUMMARY JUDGMENT THAT CERTAIN CLAIMS OF U.S. PATENT
NO. 5,903,623 ARE INVALID UNDER
35 U.S.C. §102(b)**

Plaintiff, L-3 Communications Security and Detection Systems Corporation Delaware ("L-3"), moves for partial summary judgment that claims 1-7, 9, 11-13, 19-21, 23-30, 32, 34-36, 42-48, 50, 52, and 53 of U.S. Patent No. 5,903,623 ("the '623 patent")¹ are invalid under 35 U.S.C. §102(b).

SUMMARY

Over a year prior to the filing of the application that led to the '623 patent, AS&E had contracted to sell an embodiment of the patented invention to the United States

¹ A copy of the '623 patent was provided as Ex. 2 in AS&E's Appendix of Exhibits in Support of Its Motion for Partial Summary Judgment on L-3's Inequitable Conduct Defenses (D.I. 34) ("AS&E App."). The remainder of the exhibits referred to in this memorandum are attached to the Surreply Declaration of Robert M. Abrahamsen in Support of L-3's Opposition to AS&E's Motion for Partial Summary Judgment (D.I. 60) ("Surreply Decl."). As noted in the Surreply Declaration, page numbers were added to the bottom of Exhibits 1, 2, and 7 for ease of reference.

Army (“the Army”). Because the contract preceded the filing by more than a year, the system that was sold constituted prior art to the application under 35 U.S.C. §102(b). The prior art system embodied every limitation of each of claims 1-7, 9, 11-13, 19-21, 23-30, 32, 34-36, 42-48, 50, 52, and 53 of the ‘623 patent. Those claims are thus invalid.

BACKGROUND

The ‘623 patent describes a mobile x-ray inspection system used for inspecting large cargo containers. It claims priority to a provisional application, U.S. Patent App. No. 60/011,495 (“the Provisional Application”), filed on February 12, 1996.

L-3 sued AS&E in February 2004 to clear the air for L-3’s future sales of certain mobile X-ray inspection systems. L-3 alleged, among other things, that AS&E’s patents are invalid in view of AS&E’s sale to the Army of a certain mobile x-ray inspection system (“the Mobile CargoSearch system”). That sale is reflected in contract number DAAB10-95-0001, between AS&E and the U.S. Army C3I Acquisition Center (“the Army Contract”) (Surreply Decl. (D.I. 60), Ex. 1). Because that sale was consummated on October 19, 1994, which was more than one year before the filing date of the Provisional Application, the subject of the sale was prior art to the patents.

ARGUMENT

A. The Subject of the Army Contract Was Prior Art to AS&E's Patents.

35 U.S.C. §102(b) provides that a patent application cannot issue if the subject matter of the application is "on sale in this country, more than one year prior to the date of the application for patent in the United States." This "on sale bar" applies if (1) the invention was the subject of a commercial offer for sale more than one year before the filing date of the earliest application to which the application at issue can claim priority, and (2) the invention was ready for patenting more than one year before the filing of the earliest application. Pfaff v. Wells Electronics, Inc., 525 U.S. 55, 67 (1998). The "on sale bar" thus creates a "critical date," the earliest date the offer for sale could have occurred without anticipating the application, which is one year before the filing date of the application. Robotic Vision Systems, Inc. v. View Engineering, Inc., 249 F.3d 1307, 1309 (Fed. Cir. 2001). The Provisional Application, the earliest application to which the AS&E's patents claim priority, was filed on February 12, 1996. Therefore, the critical date for the AS&E patents was February 12, 1995.

1. The Army Contract Reflected a Commercial Offer for Sale of a Mobile CargoSearch System.

The Army Contract, effective October 19, 1994, indisputably reflected an offer for sale of a particular x-ray inspection system. Under §102(b), "[a] sale is a 'contract between parties to give and pass rights of property for consideration which the buyer pays or promises to pay the seller for the thing bought or sold.'" Zacharin v. United States, 213 F.3d 1366, 1370 (Fed. Cir. 2000).

In Zacharin, the Federal Circuit examined a contract similar to the Army Contract and affirmed the district court's conclusion that the contract was an invalidating offer for

sale. Id. at 1371. The contract in Zacharin was considered a “cost plus fee” contract, i.e., the contractee would recover the costs of manufacturing the described product plus a fee. Id. at 1368 (“A contract to supply goods is a sales contract, regardless of the means used to calculate payment...”). The Army Contract was the same. (Surreply Decl. (D.I. 60), Ex. 1 at 3) (“This is a Cost-Plus-Fixed-Fee (completion) type contract.”).

Furthermore, the contract in Zacharin was for a specific amount of goods made to the specifications provided. 213 F.3d at 1368. Likewise, under the Army Contract, AS&E was to provide one mobile truck x-ray system, made to the specifications AS&E had provided in a proposal it had submitted earlier. (Surreply Decl. (D.I. 60), Ex. 1 at 3) (“The Contractor shall furnish all labor, material, and facilities necessary to perform the effort as described in accordance with AS&E’s proposal dated 31 January 1994, entitled ‘Mobile CARGOSEARCH X-Ray Inspection System,’ which is enclosed as Attachment 1. Ship to: ...”). That earlier proposal, which was “Attachment 1” to the Army Contract (id. at 5, 47-106), provided that AS&E would deliver “[a] fully-operational, prototype Mobile CARGOSEARCH System intended for the non-intrusive x-ray inspection of vehicles and cargo containers....” (Id. at 89). The contract thus indisputably reflected a pre-critical date sale of a Mobile CargoSearch System to the Army.

As such, the sale of the Mobile CargoSearch System was unquestionably a “commercial offer for sale” that would satisfy the first prong of the Pfaff test.

2. The Mobile CargoSearch System Was “Ready For Patenting” Prior to the Critical Date.

The “ready for patenting” prong of the Pfaff test can be met “by proof that prior to the critical date the inventor had prepared drawings or other descriptions of the invention that were sufficiently specific to enable a person skilled in the art to practice

the invention.” 525 U.S. at 67-68. See also Weatherchem Corp. v. J.L. Clark, Inc., 163 F.3d 1326, 1333 (Fed. Cir. 1998). An on sale bar, moreover, would be “triggered by a prior commercial offer for sale and a subsequent enabling disclosure that demonstrated that the invention was ready for patenting prior to the critical date.” Robotic Vision, 249 F.3d at 1313 (“As we have previously explained, ‘completion of the invention prior to the critical date, pursuant to an offer to sell that invention, would validate what had been theretofore an inchoate, but not yet established bar.’”)

The specifications and drawings in the sales contract, which were extremely detailed, by themselves would have provided sufficient information to enable one of ordinary skill in the art to practice the invention. Indeed, the Army Contract indicated that the proposed system was nothing more than a mobile version of a stationary CargoSearch system AS&E had previously built and installed at Otay Mesa, California. The contract further stated that the “re-design” required to make that system mobile would be “minimal” and would involve only simple tasks such as changing cable lengths or replacing mounting brackets:

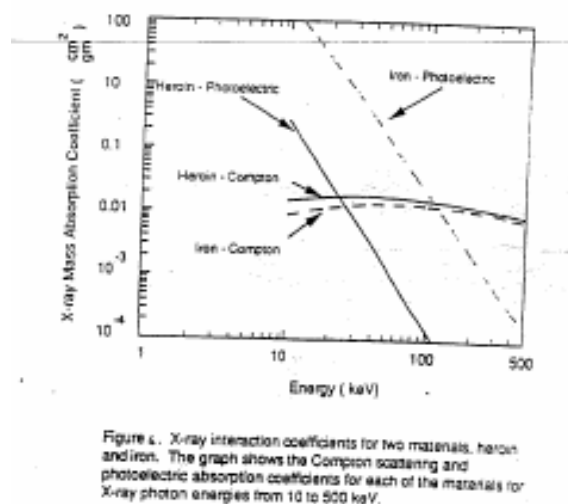
1.2.2 Program Approach

The CARGOSEARCH system for Otay Mesa is configured from modular components: 450 kV source assemblies, modular v-ray high-voltage power supplies, modular detectors, a detector electronics box and an operator’s console, together with their interconnecting cables. The basic approach to develop the Mobile CARGOSEARCH system, therefore, is to reconfigure and install a subset of these already-developed modules onto a mobile platform. In some cases it will be necessary to modify existing module designs, but most redesign will be minimal. For example, cable lengths will be changed and new mounting brackets will be required.

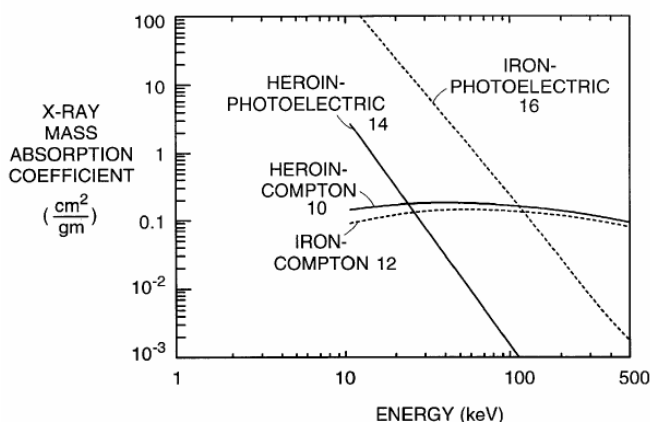
(Surreply Decl. (D.I. 60), Ex. 1 at 60).

Notably, all but one of the drawings AS&E chose to include in its patent application that issued as the '623 patent, ostensibly for the purpose of enabling one of ordinary skill in the art to practice the claimed invention, were virtually identical to the drawings that were included in the Army Contract.² For ease of comparison, drawings from the Army Contract (Surreply Decl. (D.I. 60), Ex. 1) and the corresponding figures from the '623 patent (AS&E App. (D.I. 34), Ex. 2) are juxtaposed below:

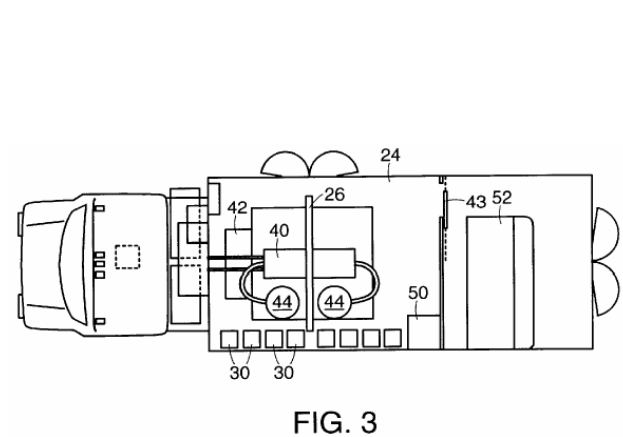
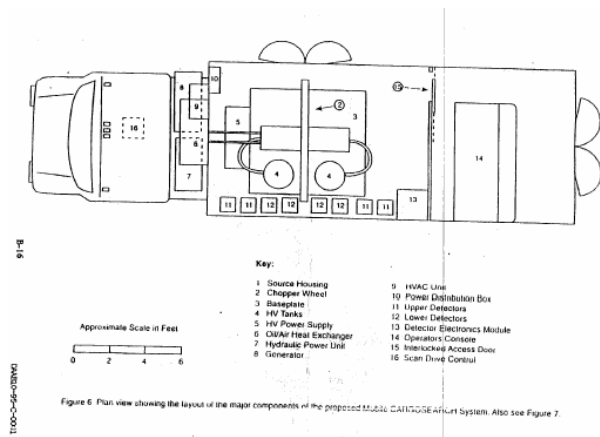
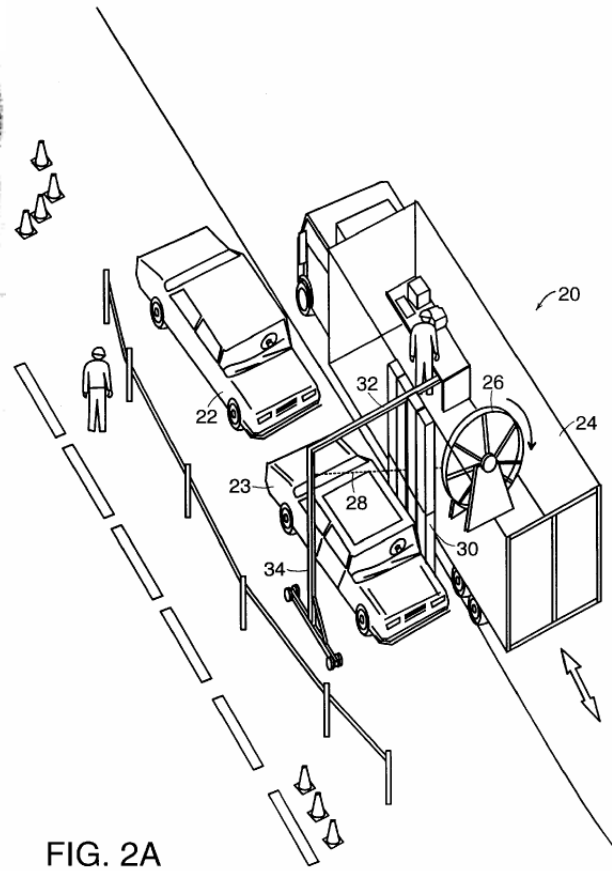
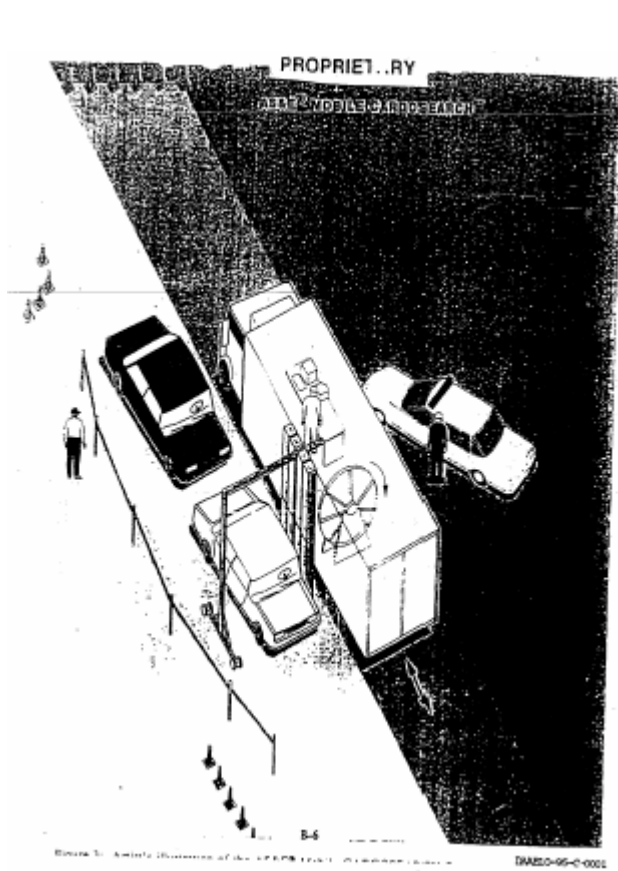
Army Contract Drawings

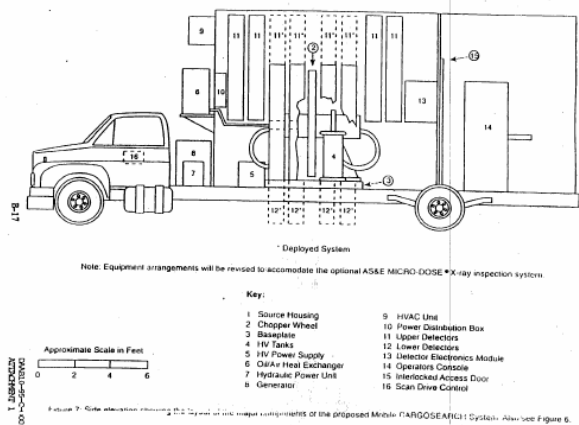


'623 Patent Drawings



² The only figure from the patent that was not included in the Army Contract is Fig. 2B, which shows a system in which a transmission detector is deployed. The absence of that figure is not pertinent to this motion, however, because the claims at issue here do not require transmission imaging. A pre-critical date enabling disclosure of a system employing only backscatter detectors would be sufficient.





PROPRIETARY

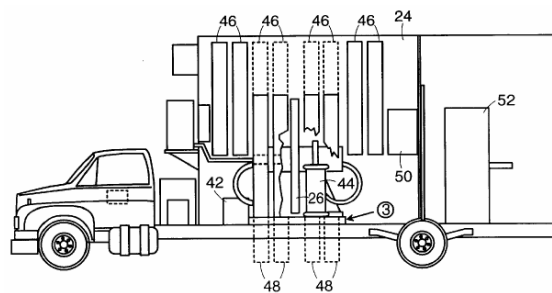


FIG. 4

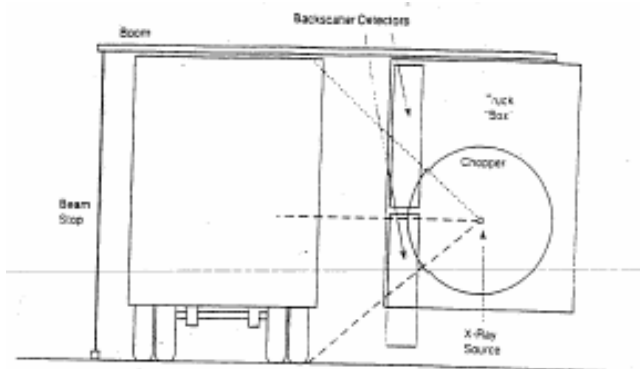


Figure 5(a): Scan geometry of the Mobile CARGOSEARCH System as deployed for inspection of large vehicles.

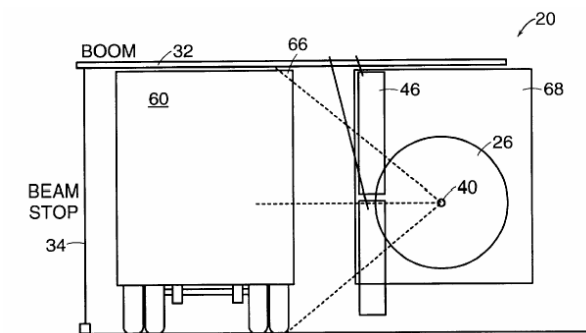


FIG. 5A

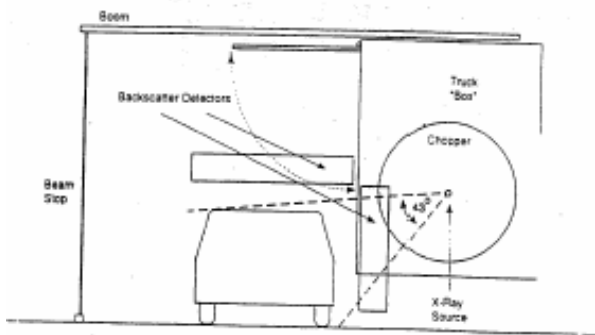


Figure 5(b): Scan geometry of the Mobile CARGOSEARCH System as deployed for inspection of small vehicles. Note the deployment of the upper detector.

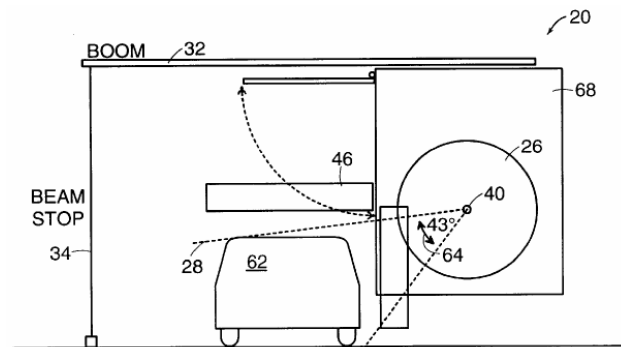


FIG. 5B

The remarkable similarity between the technical drawings in the Mobile CargoSearch Contract and those included in the '623 patent thus, standing alone,

proves that the system was ready for patenting at least by October 19, 1994, the date of the contract.

In addition, both the “Background Art” and “Detailed Description of Specific Embodiments” portions of the patent (AS&E App. (D.I. 34), Ex. 2 at columns 1 and 3-10) were copied almost verbatim from the text of the contract. (See Surreply Decl. (D.I. 60), Ex. 1 at 56, 57, 60, 63, 64, 66-68, 70, 73, 76, 78-82).

In any event, the Federal Circuit has clarified that the invention does not need to be ready for patenting contemporaneously with the sale; all that is required is that the invention must have been ready for patenting at some point in time in advance of the critical date of February 12, 1995. Robotic Vision Sys. v. View Eng’g, 249 F.3d 1307, 1313 (Fed. Cir. 2001) (“Completion of the invention prior to the critical date, pursuant to an offer to sell that invention, would validate what had been theretofore an inchoate, but not yet established bar.”).

In the months between the signing of the contract and the critical date, AS&E had prepared further, painstakingly detailed drawings and specifications for the later patented system. Specifically, it had prepared and compiled a large volume of materials for the purpose of conducting a Preliminary Design Review with its customer on February 14, 1995. (Surreply Decl. (D.I. 60), Ex. 2).³ Although the design review took place two days after the critical date of February 12, 1995, the materials for the review had been completed at least as early as January 27, 1995, the date on which AS&E

³ Although not included in the package of Ex. 2, also presented at the Preliminary Design Review were a number of “E-size” (i.e., 3-foot by 4-foot) engineering drawings that would have provided even more detail concerning the design of the system. (Surreply Decl. (D.I. 60), Ex. 7 at 4, 7). Although requested, AS&E has not made these E-size drawings available for L-3’s inspection.

personnel conducted a “dry run” of the presentation.⁴ (Surreply Decl. (D.I. 60), Exs. 3-5; Ex. 6 at 2).

Notably, the Army Contract specifically contemplated that the materials prepared for the Preliminary Design Review would constitute a “completed” system specification:

1.3.2 System Conceptual Design and Specification

AS&E will develop a system design specification. This specification will establish the design criteria, operational requirements and performance characteristics for the system and sub-systems to be developed. The **completed** system specification will be the basis for the Preliminary Design Review (PDR)....

(Surreply Decl. (D.I. 60), Ex. 1 at 86) (emphasis added).

Consistent with that understanding, the Preliminary Design Review materials indicated in no uncertain terms that the initial system specifications had been “completed”:

PROJECT TECHNICAL STATUS

SYSTEM SPECIFICATIONS

- INITIAL VERSION *COMPLETED*

(Surreply Decl. (D.I. 60), Ex. 2 at 10) (italic emphasis added).

The Preliminary Design Review materials thus establish that AS&E had completed its initial design not just of the claimed invention, but of the entire system being sold, prior to the critical date of February 12, 1995. Accordingly, there can exist

⁴ The Preliminary Design Review was originally-scheduled for January 24, 1995, but to accommodate the Government’s schedule was rescheduled for February 14, 1995. (Surreply Decl. (D.I. 60), Ex. 3; Ex. 6 at 2). AS&E’s documents make clear that the materials included in the Preliminary Design Review packet (Surreply Decl. (D.I. 60), Ex. 2), as well as the E-size engineering drawings that were presented at the Preliminary Design Review (Surreply Decl. (D.I. 60), Ex. 7 at 4, 7), were prepared well in advance of presentation date, and most certainly prior to the critical date of February 12, 1995.

no genuine issue of fact as to whether the claimed invention was “ready for patenting” before the critical date.

B. All Limitations of Claims 1-7, 9, 11-13, 19-21, 23-30, 32, 34-36, 42-48, 50, 52, and 53 of the ‘623 Patent Were Met by the Prior Art Mobile CargoSearch System.

The chart attached to this memorandum as Exhibit A illustrates how all of the limitations of claims 1-7, 9, 11-13, 19-21, 23-30, 32, 34-36, 42-48, 50, 52, and 53 of the ‘623 patent can be read on the Mobile CargoSearch System that was sold to the Army in October 1994. In particular, the limitations of those claims are reproduced in the left-hand column of the chart, and the right-hand column contains examples of portions of the Army Contract that demonstrate the existence of those limitations in the purchased system. To avoid unnecessary repetition of the same portions of the contract, similar claim limitations have been grouped together by subject matter to facilitate their comparison with the corresponding disclosure in the contract.

CONCLUSION

For the above reasons, L-3's motion for partial summary judgment that claims 1-7, 9, 11-13, 19-21, 23-30, 32, 34-36, 42-48, 50, 52, and 53 of the '623 patent are invalid under 35 U.S.C. §102(b) should be GRANTED.

Respectfully submitted,

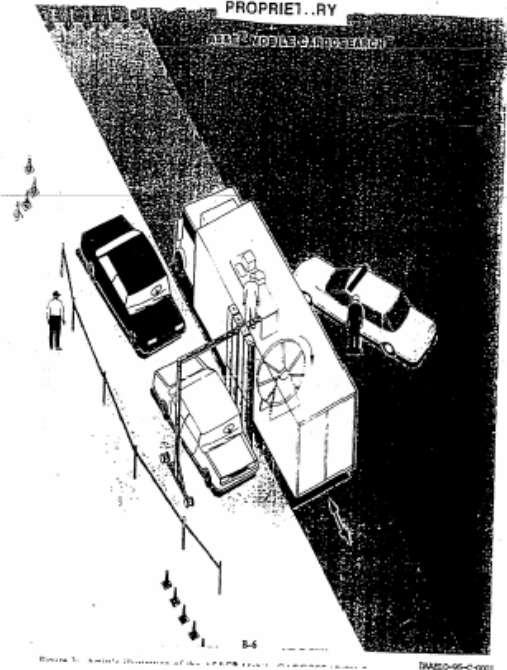
L-3 COMMUNICATIONS SECURITY AND
DETECTION SYSTEMS CORPORATION
DELAWARE

Dated: March 3, 2005

/s/ James J. Foster
James J. Foster, BBO #553285
Michael A. Albert, BBO #558566
Robert M. Abrahamsen, BBO #636635
John L. Strand, BBO #654985
WOLF, GREENFIELD & SACKS, P.C.
600 Atlantic Avenue
Boston, Massachusetts 02210
Tel.: 617.646.8000
Fax: 617.646.8646
JFoster@wolfgreenfield.com

EXHIBIT A

Exhibit A to L-3's Memorandum in Support of Its Motion for Partial Summary Judgment that Certain Claims of U.S. Patent No. 5,903,623 Are Invalid Under 35 U.S.C. §102(b)

Claim Limitation	Examples of Disclosure in Contract
<u>Preambles</u> • A device, for inspecting a large object with penetrating radiation (claims 1, 19) • A method, for producing an X-ray image of a large object (claim 42) • A method, for producing an X-ray image of a large object (claim 43) • A system for inspecting an object with penetrating radiation (claim 44) • A device, for inspecting a large object with penetrating radiation (claim 45)	It is the principal objective of this proposed program to develop a fully-mobile version of the 450 kV CARGOSEARCH system, which can be taken to the location of the planned inspection and set up to scan objects up to the size of a tractor-trailer rig in a matter of minutes. To facilitate this use, it is intended that the proposed system shall have <i>only</i> backscatter imaging capabilities, but that it be possible to upgrade it to include transmission imaging capabilities should they be deemed necessary in the future. Figure 3 [reproduced below] is an illustration of the proposed system in the process of scanning a parked car.  It is also intended that the system be able to inspect other parked vehicles or stationary cargo containers. (Ex. 2 at 63-64)

Limitations Concerning the Vehicle and Its Motors/Drive Trains

- a self-propelled vehicle capable of on-road travel (claims 1, 19, 42, 43, 45);
- a first drive train for propelling the vehicle for on-road travel (claims 19 and 43)
- a second drive train, distinct from the first drive train, for propelling the vehicle in a first direction during inspection of the object (claims 19 and 43)
- a vehicle having wheels and an engine for propelling the vehicle on highways (claim 44)
- a motorized scan drive, distinct from the engine, for moving the vehicle in a scan direction (claim 44)
- wherein the first drive train includes a first source of power and the second drive train includes a second source of power, the second source of power being distinct from the first source of power (claim 20)

The mobile platform will be a commercially available truck, adapted and supplied with a custom-built cargo box to house both the x-ray equipment and the system operators during a scan. The truck will be equipped with both front- and rear-wheel drive. The usual rear-wheel drive train will be used for the “mobile” feature, i.e. normal highway travel to move the truck to the inspection site. The front-wheel drive will be coupled to a special, low speed drive which is clutched in only during an x-ray scan. Scan speeds will be up to nominally 6 inches per second. During a scan, a driver will remain at the normal driving position to adjust the steering as necessary, and to monitor the mechanical process of the scan: The drive will be able to terminate the scan at any time. (Ex. 2 at 63).

The major new development required is the truck and its accessories. The truck will be a custom-built 21’ long x 8’ wide x 10’6” high “box” large enough to house and support the imaging equipment, a power generator, HVAC equipment, a deployable beam stop (not shown in the layout drawings), and a hydraulic slow-speed drive mechanism to provide the scan motion. The truck serves as both the platform on which the mobile system is transported to its intended operating site, and a bi-directional translation stage to produce the relative motion required during a scan. (Ex.2 at 73).

3.2.6 Transport Vehicle and Slow-Drive Mechanism

The proposal assumes the use of a Chevrolet Kodiak LoPro Model C7HO42 with a 261” wheelbase, or equivalent. Alternative vehicles and layouts will be considered during the initial, preliminary design period of the program. The truck will be fitted with a custom-built body (“box”) specified to accommodate the imaging equipment, and to provide the support structures required. The interfaces will be specified by AS&E prior to placement of the order. The body will include HVAC equipment sufficient to handle the anticipated thermal loads. An extension on the forward end of the body will support components that are best located outside of the enclosed volume: a power generator, hydraulic

• wherein the second drive train includes an hydraulic motor (claim 21) • wherein at least one of the first and the second drive trains includes an hydraulic coupling (claim 23) • further including a switchable gearbox for coupling no more than one of the first and second drive trains to wheels of the vehicle (claim 24) • using the second drive train to move the vehicle past the object so as to cause the beam to scan the object (claim 43)	equipment for the slow-drive mechanism, and the x-ray tube heat-exchanger. The truck will be provided with a both front- and rear-wheel drive. Standard rear-wheel drive is used for normal over-the-road travel. Instead of being coupled into a transmission from the truck's engine, the front-wheel drive will be powered by a low RPM hydraulic motor to obtain the very low speeds – 3"/sec and 6"/sec – needed for the scan. Recent tests at AS&E have shown that it is not practical to use the trucks engine to obtain smooth slow speeds required for the x-ray scan. To prevent damage to the hydraulic system, the front-wheel drive will be connected via an interlocked clutch to preclude the possibility of having both connected drives in operation at the same time. The hydraulic motor controls, including speed selection, drive direction, and motion start/stop, are located in the cab of the truck under the control of the driver. As an additional safety feature, actuation of the truck's brake will automatically cause disengagement of the hydraulic clutch. A similar arrangement using a hydraulically-powered front wheel drive is sometimes used for other special applications such as requiring very slow vehicle motion. The hydraulic power unit located adjacent to the generator, on the truck bed just forward of the truck body (pump) will be electrically driven from the system generator. (Ex. 2 at 81-82).
<u>Limitations Concerning Scan Geometry</u> • so that the beam is caused to traverse the object in a first direction as the vehicle is moved and the signal output characterizes the object (claim 1) • so that the beam is caused to traverse the object as the vehicle is moved and the signal output	<u>3.1.2 Scan Geometry, Timing and Display</u> Figure 8 [reproduced below] shows the Mobile CARGOSEARCH scan geometry as deployed for inspection of a full-sized tractor-trailer (top) or a passenger car (bottom).

characterizes the object (claim 19)

- moving the vehicle past the object so as to cause the object to be scanned (claim 42)
- so that the beam is caused to traverse the object as the vehicle is moved in the scan direction and the at least one detector provides a signal for characterizing the object (claim 44)
- so that the beam is caused to traverse the object in a first direction as the vehicle is moved and the signal output characterizes the object (claim 45)
- wherein the beam of penetrating radiation is a pencil beam scanned repeatedly over an angle of regard, the angle having an orientation with respect to the horizontal, the device further comprising: a steering arrangement for steering the orientation of the angle of regard with respect to the horizontal (claims 13, 36, and 53)

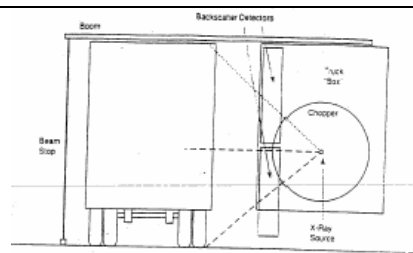


Figure 8(a): Scan geometry of the Mobile CARGOSEARCH System as deployed for inspection of large vehicles.

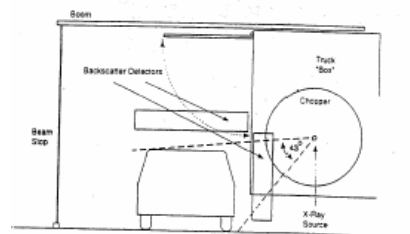


Figure 8(b): Scan geometry of the Mobile CARGOSEARCH System as deployed for inspection of small vehicles. Note the deployment of the upper detector.

The angle of elevation of the 43' scanning beam can be changed depending upon the application. For optimum versatility, the range of limiting angles will extend from at least 55° below horizontal to 55° above horizontal. This corresponds to an angular adjustment of the source axis from -33.5° to +33.5°.

Operationally, one side of a large truck (up to 14' height) can be completely covered in two passes; however, slightly better resolution and significantly better sensitivity can be achieved by scanning as close as possible to the inspected vehicle. To achieve this optimum performance, the system operators must choose between doing a third pass or tolerating a small amount of corner or midline cutoff. A small amount of corner cutoff is shown in Figure 8, but ideally it might be better to sacrifice a little more and to pass 1 or 2 feet closer to the truck. Since the scanning system is bi-directional, alternate passes can be in the forward and reverse directions.

Operationally, one-side of passenger cars and small trucks is scanned in a single pass of the system. Depending upon the situation, it may be necessary to scan

the opposite side as well. The upper set of detectors can be deployed over the top of smaller vehicles as shown in Figure 8, substantially improving the scatter collection efficiency and producing higher quality images.

The Mobile CARGOSEARCH system will have two scan-speed modes: nominally 3"/sec and 6"/sec. The faster speed will result in higher throughput, the slower mode higher image quality. Image data in either mode will be acquired into a 1024 x 4096 x 12 bit image memory and displayed onto a 1024 x 1024 high-resolution display via a continuously-adjustable 12-bit-to-8-bit look-up table. The proposed system is configured with only a single display, therefore only a single scan can be displayed at a time. Optional additional displays can be provided to allow simultaneous viewing of more than one image. (Ex. 2 at 73-76).

3.3.3 Scan Operations

Scan operations are simple and straightforward. The Scan Coordinator directs one or more vehicles to positions along the scan path (up to 65' of total vehicle length may be imaged in a single scan) and instructs the drivers and passengers to exit the vehicles. He then informs the Scan Operator and the Inspector that scanning may commence, and stands by to monitor the scanning process from the "off" side of the scanned vehicles.

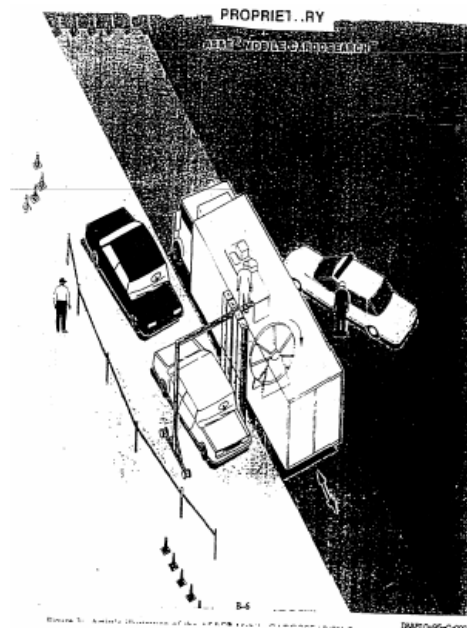
The Console Operator, using menu-driven software, readies the system's computer for image acquisition. This places the computer and data acquisition electronics into a status wherein x-rays will be initiated and image acquisition started upon receipt of a "scan" command initiated by the system's slow-speed drive controls. It also transmits a "ready" status signal to the Scan Drive Control box located next to the Scan Operator's position in the truck cab. The Console Operator then awaits the scan to start and image data to appear for his inspection and analysis. (If there is no Scan Coordinator, the Console Operator must fulfill the exterior monitoring role during the actual scanning process.)

	The Scan Operator, meanwhile, has assured that the truck transmission is out of gear and that the hydraulic drive system is powered up. He has also set the desired scan speed and direction at the Scan Drive Control. When the “ready” status signal is received from the computer he can start the scan at any time by pushing a “Start” button and releasing the truck brakes. “Start: initiates motion via the slow-speed drive. The Scan Operator continues to have control over the truck. He is responsible for steering, and may stop the truck at any time by actuating the brake. Otherwise, the scan will stop automatically after a full data set has been acquired by the computer (the “ready” status is removed). As soon as the Scan Drive Control has initiated (and verified) truck motion, it sends a “scan” signal to the computer. The computer then triggers the x-ray generator to ramp up to its pre-set operating conditions, and upon confirmation that they have been reached (about 5 seconds later) it starts data acquisition. Data acquisition continues until either the “scan” command is interrupted or the image memory is full. The Console Operator can inspect the images both during the acquisition process and after it has been completed. He has at his control the full range of analysis and enhancement tools described in Section 3.2.5, and can mark, annotate and store the image to the system hard disk or to an optical disk. The Scan Operator and Scan Coordinator can prepare for the next scan while the Console Operator is completing these inspection responsibilities. (Ex. 2 at 84-85).
<u>Limitations Concerning the Radiation Source</u> • a source of penetrating radiation, mounted on the vehicle, for providing a beam of penetrating radiation (claim 1) • a source of penetrating radiation,	<u>2.2.1 The Flying Spot Scan</u> AS&E’s proprietary MICRO-DOSE imaging technology is based on the use of mechanically generated flying-spot x-ray beam. In a typical flying-spot system, a thin “pencil beam” of x-rays is rapidly and repetitively swept through a source-centered, vertically-oriented “fan” of beam paths that are arranged to intercept the object under inspection. At the same time, the object is moved at a constant, slower speed along a path perpendicular to the fan, on a horizontally moving conveyor belt for example. In this way, the pencil beam is made to traverse the

mounted on the vehicle, for providing a beam (claims 19 and 44) • a source of penetrating radiation, mounted on the vehicle, for providing a beam incident upon the large object (claims 42 and 43) • a source of penetrating radiation, mounted on the vehicle, for providing a pencil beam of penetrating radiation (claim 45) • wherein the source of penetrating radiation includes a source of penetrating radiation having an energy in substantial excess of 200 keV (claims 3 and 26) • wherein the source of penetrating radiation includes an x-ray tube operating at a voltage in substantial excess of 200 kV (claims 6 and 29) • wherein the source of penetrating radiation is an x-ray source (claims 4, 27, and 47) • wherein the x-ray source is an x-ray tube (claims 5 and 28) • wherein the beam of penetrating radiation is a pencil beam scanned	object in a point-by-point “raster” fashion, and the entire object is scanned as it passes through the fan plane over a period ranging from a few seconds to a few minutes depending upon the length of the object. (Ex. 2 at 70). The proposed Mobile CargoSearch system is based on AS&E’s proprietary MICRO-DOSE flying-spot x-ray imaging ...technolog[y]. (Ex. 2 at 73). <u>3.2.1 X-Ray Source Assembly</u> The CARGOSEARCH x-ray source assembly appears in the right foreground of Figure 9. This assembly requires modification in three ways: (1) Existing provisions for the adjustment about two orthogonal axes, used to align the flying-spot beam with the transmission detector in the current configuration, will be eliminated, since no such alignment is needed for backscatter-only imaging. (2) The mounting base will be reduced to a single, lighter-duty baseplate. This is possible because of the elimination of the alignment requirements and because the truck bed will provide additional structural support. (3) The current, fixed-position source housing supports will be redesigned to incorporate bearings and a manually-actuated drive motor so that the beam elevation angle can be easily changed. A means to indicate the beam elevation will also be provided to aid the operators in making this adjustment. (Ex. 2 at 76). <u>3.2.2 X-Ray Generating System</u> The x-ray generating system used in CARGOSEARCH is commercially procured from Philips Electronics Instrument Co. Although AS&E has investigated alternative sources for this equipment, and will continue to do so, we do not anticipate any change of vendor at this time. The x-ray generating system comprises a high-voltage power supply (HVPS) and its microprocessor control unit, positive and negative high-voltage tanks, a pair of high-voltage cables, a 450 kV x-ray tube (slightly modified by AS&E), an oil-to-air heat exchanger, and miscellaneous interconnecting cables and accessories.
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repeatedly over an angle of regard, the angle having an orientation with respect to the horizontal, the device further comprising: a steering arrangement for steering the orientation of the angle of regard with respect to the horizontal (claims 13, 36, and 53) • wherein the beam is a pencil beam scanned repeatedly along a second direction having a vertical component (claims 11 and 34)	Some of these components are partially in view at the lower, right corner of Figure 9. The only changes anticipated in this equipment is the use of shorter cables and oil hoses, compatible with the planned installation layout. Note that the oil cooler will be mounted exterior to the truck box, so that the heat will be discharged into the outside air. (Ex. 2 at 79).
<u>Limitation Concerning the Beam Stop</u> • a beam stop for absorbing the beam of penetrating radiation after traversal of the object (claims 1 and 42)	3.2.7 <u>Beam Stop</u> In order to assure compliance with FDA-radiation safety requirements as administered by the Center for Devices and Radiological Health (CDRH), the proposed system has provisions for a deployable beam stop device. However, the output radiation of the system is so low that the health and safety requirements for low radiation levels will be met only a few feet away from the source <i>even if no beam stop is used</i>. Actual test data will be required by the CDRH before the system can be certified. At that time, AS&E intends to request authorization to certify the system without a beam stop. If such a certification is granted, and with the concurrence of the Contract Officer, AS&E would cease all additional work on the beam catcher, and would negotiate a price reduction as applicable. The present concept for the beam stop uses two or three layers of leaded-vinyl shielding material (commonly used for baggage x-ray systems in airports) that would be deployed from the end of a boom that extends about 14' from the side of the truck at the location of the x-ray beam – refer to Figure 3 [reproduced

below].



Generation of x-rays will be prevented by interlock circuits unless the boom and the vinyl are properly deployed.

To stow the beam stop for road travel, the vinyl is retracted into the hollow boom, and the boom itself is swung into orientation parallel to the truck axis and lowered into a cradle in the roof of the truck. (Ex. 2 at 82).

Limitations Concerning the Detector

- at least one detector coupled to the vehicle, the at least one detector having a signal output (claims 1, 19, 44, and 45)
- at least one detector coupled to

2.2.3 Z Backscatter Imaging

The flying-spot technology that is the basis of the MICRO-DOSE transmission images also makes possible the acquisition of images using detectors specifically positioned to collect the scattered x-rays. Separate, large-area detectors are deployed adjacent to the beam plane on the x-ray source side of the scanned object, and with their active surfaces oriented toward the scanned object. These detectors need only provide a large solid angle for collection of scattered radiation; no critical alignments are required. In this location these detectors

the vehicle and having a signal output (claims 42 and 43)

- wherein the at least one detector is a backscatter detector (claims 7, 30, and 48)
- wherein the at least one detector is a side scatter detector (claims 9, 32, and 50)
- wherein the at least one detector has a first element and a second element, the first element being movably mounted with respect to the second element, so that in a first position the first element is angularly disposed with respect to the second element and in a second position the first element is substantially coplanar with respect to the second element (claims 12, 35, and 52)

respond to x-rays which are scattered generally back toward the source from the object. These detectors are called "backscatter detectors, and the corresponding images are called backscatter images. (Ex. 2 at 71)

The proposed Mobile CargoSearch system is based on AS&E's proprietary ... Z backscatter technolog[y]. (Ex. 2 at 73).

3.2.3 Backscatter Detectors

Four backscatter detector modules are shown in Figure 9. Two detectors are positioned vertically in mid-frame. Two are located horizontally, below the transport device on which the automobile is placed. Each of these modules are 7 feet long. It will be necessary to shorten the detector modules to 6 feet in length. So as not to exceed the maximum permissible vehicle height.

Instead of the simple brackets currently used in the fixed deployment, the detectors will need to mount onto counter-balanced slide mechanisms that will allow the lower set to be deployed downward, close to the road surface, and the upper set to move in close to the x-ray beam plane. These motions are shown in Figures 6 and 7. [reproduced below]

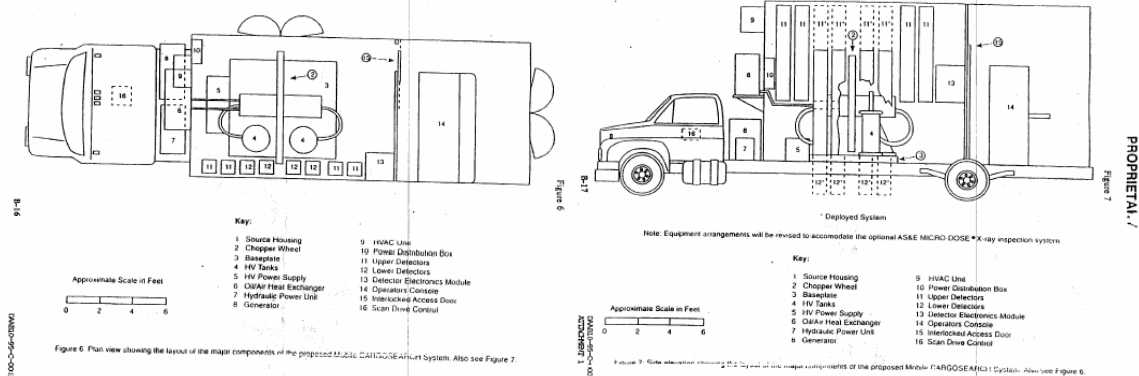
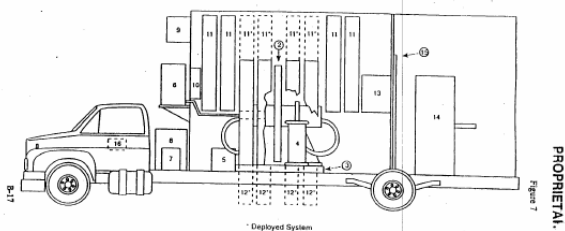


Figure 6: Plan view showing the layout of the major components of the proposed Mobile CargoSearch system. Also see Figure 7.



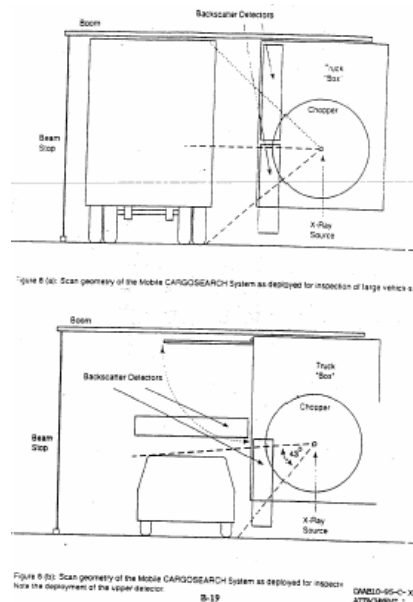
Note: Equipment arrangements will be revised to accommodate the optional AS&E MICRO DOSE X-ray inspection system.

Key:

- 1. Source Housing
- 2. Chopper Wheel
- 3. Baseplate
- 4. HV Tanks
- 5. HV Power Supply
- 6. Oil/Air Heat Exchanger
- 7. Hydraulic Power Unit
- 8. Generator
- 9. HVAC Unit
- 10. Power Distribution Box
- 11. Upper Detectors
- 12. Lower Detectors
- 13. Detector Electronics Module
- 14. Operators Console
- 15. Interchangeable Access Door
- 16. Scan Drive Control

Figure 7: Side elevation showing the layout of the major components of the proposed Mobile CargoSearch system. Also see Figure 6.

A pivot and crank mechanism is required to enable the upper set of detectors to be deployed over a small vehicle, as shown in Figure 8 [reproduced below]. (Ex. 2 at 79).



3.2.4 Detector Electronics Module

The detector electronics (preamps, power supply, etc.) and some of the source mechanisms controls are located in the electronics cabinet at the lower left of Figure 9. Some of the components of this cabinet, specifically the transmission detector preamplifiers, are not required in the proposed backscatter only implementation. (Ex. 2 at 79).

Limitation Concerning Signal Processing and Operator Control

- processing the signal from the signal output of the detector to form an image of the object (claims 42

3.2.5 Control and Display Console

The current Operator's Console, for control of the CARGOSEARCH system and display of the images is shown in Figure 10 [reproduced below].

and 43)

- further including a control mechanism for control of the motion of the vehicle by an on-board operator during traversal by the beam of the object (claims 2, 25, and 46)



The scan controls and display controls are mounted into the writing shelf in the foreground. Four display monitors are shown: the upper displays are for two transmission images (one from each side), and the lower displays are for the corresponding backscatter images. The following display functions are provided:

- Zoom, pan and scroll – Joystick controls allow the operator to display any part of the image at 2x and 4x magnifications.
- Pan trim – This feature, applicable only when double-sided scans are done, allows the operator to adjust the zoomed fields-of-view separately to facilitate comparative analysis of the two images.
- Continuous density expand – This contrast-enhancing feature allows the operator to display any contiguous subset of the 12-bits (4096 digital intensity levels) of image data over the full black-to-white range of grey levels on the display monitors. The implementation is through a set of 10 pre-set push buttons, along with a trackball for fine-tuning.

- Edge enhancement – A mathematical algorithm sharpens the image and extends the effective dynamic range of the display for faster and easier image analysis.
- Reverse video – Operators may select between positive (black-on-white) or negative (white-on-black) image display, depending on personal preference.
- Image archiving – Operators may “mark and annotate” the images from the console keyboard, and store them on optical disk for future recall.

The Mobile CARGOSEARCH Operator's Console will be reduced from a 4-bay rack to a 3-bay rack. The rack will be populated with only a single preamplifier control board, display board and display monitor, instead of the four such units required for the fixed installation. The result reduction in both is a cost and space. (The double-sided scan option will add another set of the above equipment to the third bay, adding cost, but maintaining the bay console.)

Software revisions are also required in several areas to convert the current, four-image CARGOSEARCH configuration into the proposed, one-image, backscatter-only system. The following software modules are affected: main menu, sub-menus, system initialization, data acquisition, pan and scroll, density expand, edge-enhancement, and scan start/stop control. (Ex. 2 at 79-81).