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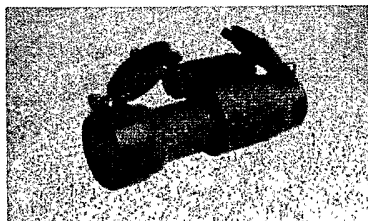
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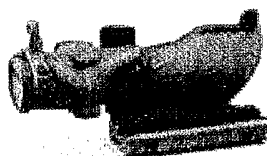
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(54) Title: EMBEDDED MARKSMANSHIP TRAINING SYSTEM AND METHOD



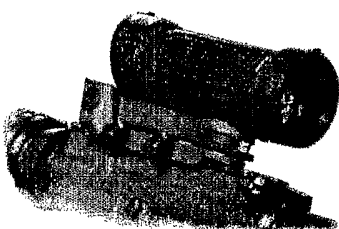
A

100



B

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C

120

(57) Abstract: A weapons-mounted marksmanship training system comprises a system adapted to be a replacement device for the sighting system of a conventional weapon. The training system includes a high resolution display controlled by an embedded CPU and graphics processor, with video training images maintained in a mass storage unit. A motion tracking unit is also provided to detect motion of the weapon on which the training system is mounted. Personnel being trained in the use of the weapon are able to select a training scenario, which is then realistically portrayed in the image display, without the need for any special environment or external devices.



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**Embedded Marksmanship Training System and Method****CROSS-REFERENCE TO RELATED APPLICATION**

[0001] The present application claims the benefit of priority under 35 U.S.C. § 119(e) from U.S. Provisional Patent Application No. 60/568,122 filed on May 3, 2004, entitled "Embedded Marksmanship Training System and Method".

**FIELD OF THE INVENTION**

[0002] The present invention relates to training systems, and in particular relates to weapon-mounted training systems.

**BACKGROUND OF THE INVENTION**

[0003] Training armed forces personnel, police, guards and others in the efficient, effective and safe use of rifles and similar weapons has, in the past, primarily involved the use of special facilities such as firing ranges. However, obtaining access to such facilities, as well as organizing sufficient time to use them, has limited the utility of such facilities.

[0004] These limitations have been particularly true for armed personnel deployed in the field. For these individuals, access to such facilities is typically very limited, even though it is just such personnel who would benefit most from extensive and frequent training opportunities.

[0005] Likewise, in the past, it has been difficult to maintain a relatively complete record of the training exercises and results for the personnel being trained. Frequently

the only record is handwritten in a log somewhere, with very little opportunity to analyze the trainee's progress in the context of historical progress.

[0006] As a result, there has been a need for a weapons training system which provides the opportunity for personnel using such weapons to train regularly without the need for special facilities or the time to get to such facilities. In addition, there has also been a need for a weapons training system which maintains efficiently a record of the trainee's progress.

### **SUMMARY OF THE INVENTION**

[0007] The present invention provides the ability for armed personnel to develop and maintain skills in the use of rifles or other sighted weapons without the need for special facilities.

[0008] The invention provides a weapon-mountable imaging system which requires replaces the sighting system on the weapon and, in at least some embodiments, requires no connection to any other systems. The personnel being trained are able to engage in a complete training session, with life-like visuals, seen through the sighting system, where such sessions may include a plurality of training scenarios. As a result, the personnel using the weapon are able to engage in a realistic training exercise which may be conducted essentially anywhere, without the need for special facilities or other special circumstances extending beyond the amount necessary to maintain weapon safety.

[0009] The imaging system of the present invention includes a display, a processor, a memory system, a input controller which may take the form of a joystick, and, in some embodiments, one or more programmable inputs which may take the form of I/O buttons. The system is capable of independent operation, and, in some embodiments, can also allow wired or wireless connection either to a computer system

carried by the user or to a central computer system. In a typical arrangement, the system is battery or solar powered. Further, in at least some embodiments a gyroscope is provided to ensure that the imaging system can receive data regarding location and motion. It will also be appreciated that a GPS receiver or transmitter may also be provided in some embodiments of the invention.

[0010] These and other aspects of the present invention can be better appreciated from the following Detailed Description of the Invention, taken in conjunction with the appended Figures.

### **THE FIGURES**

[0011] Figures 1A-1C illustrate typical weapons-mounted sighting systems which are replaced, for training purposes, with the imaging system of the present invention.

[0012] Figure 2A-2H illustrate various examples of training scenarios available with the training system of the present invention.

[0013] Figure 3 illustrates another example of a training scenario for the present invention, and is particularly well-suited to sniper training.

[0014] Figure 4 illustrates a weapon-mounted imaging system in accordance with the present invention.

[0015] Figure 5 illustrates, in system block diagram form, the details of a weapons system in accordance with the present invention.

### **DETAILED DESCRIPTION OF THE INVENTION**

[0016] Embedded training for dismounted soldiers offers the potential for profound improvement in training of at least forward deployed units. Soldier-worn or -carried, untethered training systems offer the opportunity to create individual and squad level training environments for The research performed under the DAGGERS program

sought to provide a complete squad level virtual training environment for soldiers to operate within Army Databases with combined arms and to allow squad level training for urban operations and rural combat zones.

**[0017]** Recent events, such as those in Iraq and elsewhere, suggest that individual marksmanship is taking on a new level of importance. The present invention provides a system, device and method to permit those using weapons in combat situations to train anywhere and at any time with their combat weapon system. The present invention provides the ability to equip every soldier, for example, with their own personal record of marksmanship progress from boot camp to retirement. Further, the present invention is intended to provide more combat capable soldiers and to help improve marksmanship and marksmanship training methods.

This system of the present invention provide an embedded training system that would travel with every soldier as part of their basic pack out. During operational pauses, the soldiers can maintain a high level of readiness and familiarity with their weapon system. It could rapidly accelerate the marksmanship of soldiers that do not have the opportunity to train at a facility on a regular basis. The system of the present invention is highly portable, relatively low cost, and offers value to improving a soldier's ability to fight.

**[0018]** As witnessed during the combat operations phase of Operation Iraqi Freedom and during the peace-keeping duties, it is evident that all forward deployed US forces, regardless of MOS, are subject to attack by insurgent or terrorist forces. Forces in the area of operation must maintain their marksmanship skill sets in order to adequately defend themselves. The present invention is directed at devices, systems and methods which offer an intuitive and effective approach for providing such maintenance and improvement of such skills.

**[0019]** In particular, the present invention is directed to a system which includes an image generator capable of being mounted on a soldier's weapon which permits independent marksmanship and related training without the need for a firing range, laptop, or other specialized environment. For example, three typical sights presently

used for weapons issued to soldiers are shown in Figures 1A-1C, and designated 100, 110 and 120 for reference. The present invention is, in one aspect, a system which will provide image generation for training purposes in a module which, in at least some embodiments, can be substituted for a typical battleground sight, such as the above, for example. The present invention provides in some embodiments, a combination of advances in display devices (AMCLD & OLED), low power CPU & graphics subsystems (for example, the NVIDIA AR10 Graphics System on a chip), MEMs gyros, and mass storage devices. When used with compressed air simulation rounds, the present invention provides a complete marksmanship training device that every soldier can utilize throughout his/her career. In a sense, the present invention provides a device and system which can become a soldier's individual training record that will be with them throughout their career with the armed forces. It will be appreciated that the present invention also offers the potential for improved training for police departments, security forces, and related applications.

**[0020]** In some embodiments, the present invention provides a limited field of view ("FOV") and a reticle or aiming dot. By restricting the FOV of the training device to what the soldier would see while looking through their optical device, the ability to run fairly detailed marksmanship trainers with adequate fidelity is readily achievable

**[0021]** In one embodiment, the embedded marksmanship training system (EMTS) or device (EMTD) of the present invention is a small form factor image generator designed to allow the soldier to change out their combat sight with the EMTD on their individual weapon (appended) when they are conducting their training exercise. Once the soldier is cleared to begin their exercise, the soldier peers through their EMTS just as though using a conventional combat sight, and engages in a "Hogan's Alley" type course of fire. For example, the soldier might typically be put through a course of fire that would include "shoot-no shoot" situations, track how they acquire targets, monitor how fast the soldier engages hostile threats, and provide basic muzzle and trigger control. At the end of the exercise, the soldier's exercise record is downloaded for review and record-keeping. For example, the downloading might be performed by a

Squad or Platoon leader for After Action Review, and might be downloaded by mounting the EMTS on a cradle or by any other suitable means including wireless or similar functionality. A typical review might include Hit and Miss percentage, friendly fire & civilian casualty reports and other data to help the soldier develop the necessary skills to make sound judgments in today's asymmetric warfare environment.

**[0022]** By coupling existing compressed air bullet technology with this training device, the present invention permits simulation of the loss of sight picture due to the recoil effect of the compressed air cartridge. During the exercise, it is also possible to drill the soldier on magazine reloading skills and weapon stoppages should one naturally occur with the compressed air round. Furthermore, such training also familiarizes soldiers not normally accustomed to drilling with firearms to the sights, sounds and smells associated with combat.

**[0023]** Figures 2A-2H illustrate various training scenarios 200 through 270 which can be implemented in an EMTS of the present invention. It will be appreciated that the field of view shown in Figures 2A-2H are for purposes of illustration only; the FOV of each particular implementation is typically adjusted to match the FOV provided by the combat or other sight being emulated, although such matching is not required in all embodiments. For example, the scenario of Figure 2A shows at image 200 conveying an "all clear – move in", while image 210 at Figure 2B shows an ambush – target hit. Figure 2C, image 220, shows a scenario of multiple target engagement, while Figure 2D, image 230, shows a target emerging from cover. Figure 2E, image 240, shows a scan scenario, in which the personnel being trained must scan for targets. Figure 2F, image 250, shows a target hit.

**[0024]** In contrast, image 260 in Figure 2G shows a civilian, which requires the personnel being trained to exercise caution and judgment. Figure 2H, image 270, illustrates a longer range target scan.



**[0025]** The EMTS of the present invention is, in an exemplary military embodiment, designed to cover four (4) primary types of combat soldier: Rifleman, Machine Gunner, Grenadier, and Sniper. As noted previously, police, security forces, EOD disposal crews and others who face any formed of armed antagonist may also benefit from this training device.

**[0026]** Figure 3 illustrates a sniper example of the invention. In an exemplary arrangement shown at 300, the Sniper embodiment might, for example, be fashioned after the current M24 Sniper Weapon System and allow for optical zoom and basic wind calculations and bullet drop compensation. Depending on the particular embodiment, the EMTS could be based on a complete rifle, or could be based on swapping out optics.

**[0027]** In one exemplary embodiment which illustrates certain basic elements of the invention as in Figures 4A-4D, an EMTS in accordance with the present invention may include the functionality of a THERMITE™ or other computer for image generation shown at 400, but in the present invention mounted directly on the weapon 410 as shown in Figure 4B, a small form factor flat panel display such as an AMLCD panel or other similar device offering appropriate resolution and speed as shown in Figure 4C at 420, and a tracking device as shown on the weapon 410 at Figure 4B, which might for example be based on a Bluetooth tracking device, a gyroscope or a GPS receiver. EMTS may be housed in ABS plastic or other similar material with a flat panel (e.g., AMLCD) placed at the end of the optic. The Thermite or other computer provides the image generation through a direct or other suitable video connection to the flat panel display, and is preferably configured in a form factor which permits it to be housed within the housing. Weapon position is tracked via the Bluetooth tracking devices. The ABS housing may be, for example, the same diameter as the Aimpoint Optical Combat Sight (30mm) and can be mounted on a simulated weapon. A small trigger sensor is to monitor and track student trigger pull input. The software to provide the simulated environment can be leveraged from the DAGGERS program or commercial

developments, for example a scenario similar to the Novalogic Blackhawk down PC game.

[0028] In some embodiments, movement through the scene may be limited to left and right movement only. If more freedom of movement is desired, a further weapon mounted input device, also using Bluetooth or similar wireless protocols, may be provided as a means for the soldier to "walk" through the Hogan's Alley shooting gallery. The additional complication of such systems, while desirable in some situations, may not be desirable in all situations. It should be noted, that while movement may be desirable, it may overwhelm the system by making it too overly complicated. Such complication may not be necessary in instances involving pure marksmanship and decision-based training.

[0029] It should be appreciated that the present invention, in itself, does not provide a complete virtual environment, since the user will be peering through his optical sight for then entire training period if only the EMTS is used. If desired, a further virtual environment can be implemented in which a combination of an EMTS in accordance with the present invention, together with a large scale image generator, can be constructed which would allow the soldier to shift from peering through the EMTS and then shifting his focus to the "real world" of the large scale image generator. Such a combination permits the consideration of life-like training exercises, although such training must be conducted in a constrained environment rather than in the field as may be achieved by use of the EMTS by itself.

[0030] Referring particularly to Figure 4D, an embodiment 430 of the EMTD of the present invention may be better appreciated. In particular, the EMTD 430 includes a housing 440 which may be mounted particularly to the rail mount for the sighting system of a weapon, such as shown in Figure 4B. Within the housing is, in at least most embodiments, a joystick I/O device 450 for selecting and controlling the training scenarios, together with a plurality of programmable I/O buttons 460A-C which may, for example, control specific operations within the training scenario such as jump, open

door, and so on as required for the training scenario. A battery holder 470, which may alternatively be solar cells, is also provided.

**[0031]** Referring next to Figure 5, the operation of the present invention is illustrated in system block form. In particular, an EMTD 500 comprises, in an exemplary embodiment, a motion tracker 510 for detecting weapon position and movement. The motion tracker 510 communicates with an embedded CPU 520, which may for example be any of suitable general purpose CPU adapted for low power operation.

**[0032]** The CPU 520 retrieves stored information, including program instructions and video image data, from a mass storage device 530. A power subsystem 540 is also typically provided, and may for example be batteries, solar power, or other portable power source. The CPU 520 typically communicates with a graphics processor 550, although in some embodiments the CPU 520 and graphics processor 550 may be a single unit, and from an external function standpoint may be considered a single unit in at least some embodiments. The graphics processor 550 generates data suitable for being displayed by a display unit 560, which may be an AMLCD or LED. Optics 570 can, optionally, be provided for at least some embodiments to allow ease of use by the personnel being trained.

**[0033]** In some embodiments, it may be desirable to permit communication with a host computer, either to permit interaction with a virtual environment or to record data associated with the training exercise. In such embodiments, a wireless data interface 580 is provided for communication with appropriate external support systems 590. Such external subsystems may include a host computer carried on the personnel being trained, or a central host computer adapted to work with more than one person.

**[0034]** Having fully described a preferred embodiment of the invention and various alternatives, those skilled in the art will recognize, given the teachings herein, that numerous alternatives and equivalents exist which do not depart from the invention.

It is therefore intended that the invention not be limited by the foregoing description, but only by the appended claims.

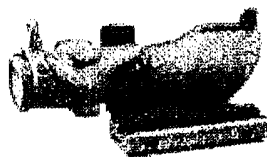
We claim:

1. A weapon-mounted marksmanship training system comprising  
mass storage for maintaining a store of video images representing a weapons training scenario,  
a motion tracker adapted to detect movement of the weapon,  
a processor responsive to the motion tracker and capable of addressing the mass storage for managing the store of video images and providing display information in accordance therewith,  
a display responsive to the display information for displaying a weapons training scenario,  
a housing enclosing the mass storage, processor and display and adapted to be mounted as a replacement for a sighting system on a weapon appropriate for the weapons training scenario.
2. The weapon-mounted marksmanship training system of claim 1 further including a wireless interface for communicating with a host system.
3. The weapon-mounted marksmanship training system of claim 2 wherein the host system is remote from the personnel being trained.
4. The weapon-mounted marksmanship training system of claim 2 where the host system is carried on the personnel being trained.
5. The weapon-mounted marksmanship training system of claim 1 wherein the motion tracker is a gyroscope.
6. The weapon-mounted marksmanship training system of claim 1 wherein the motion tracker is a GPS receiver.



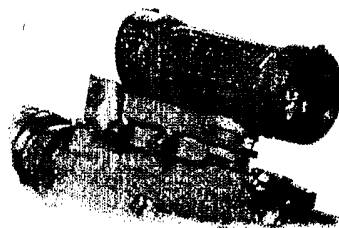
100

Figure 1A



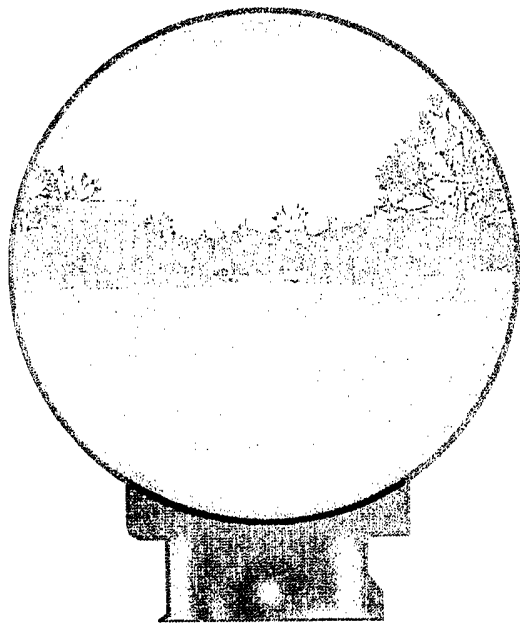
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Figure 1B



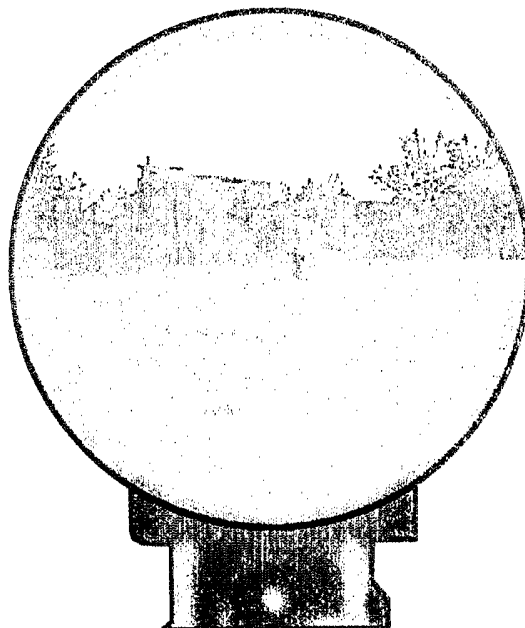
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Figure 1C



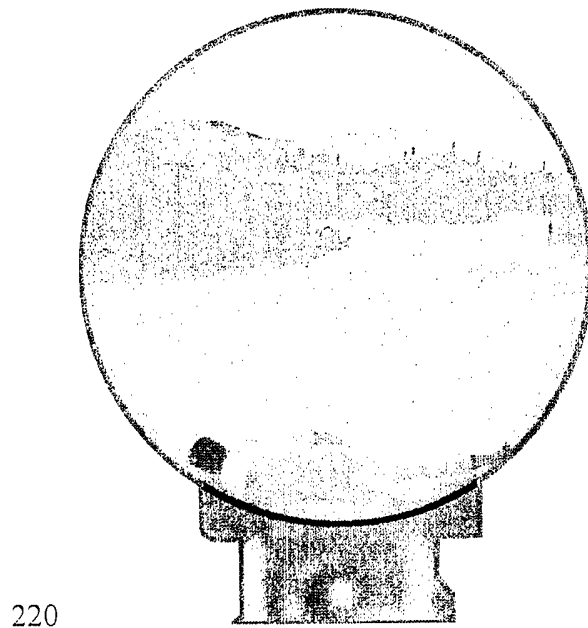
200

Figure 2A



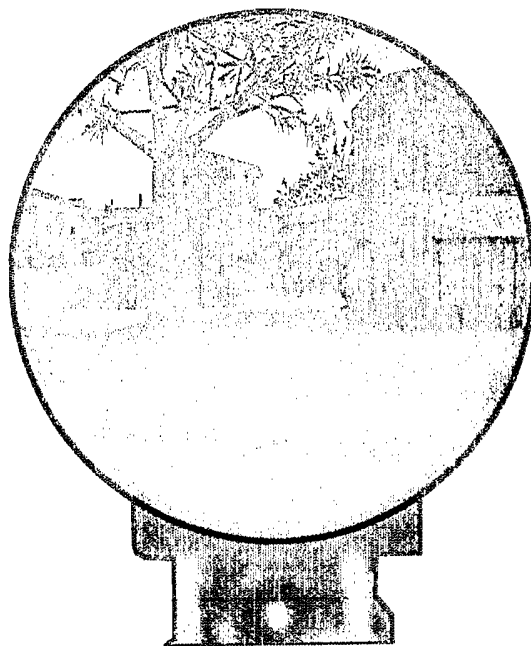
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Figure 2B



220

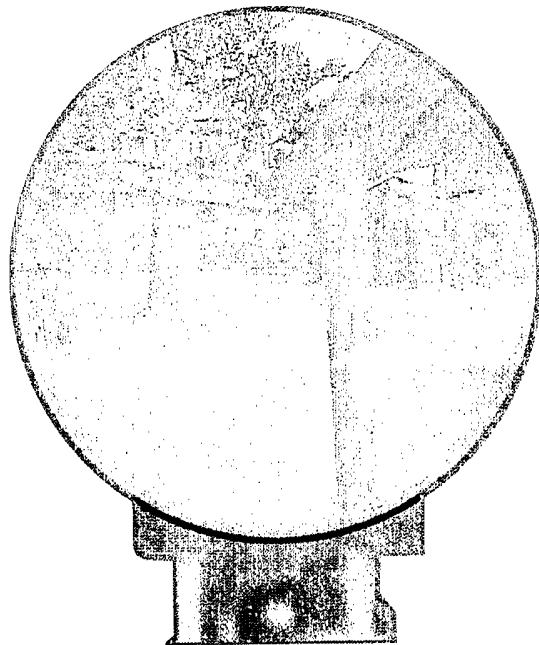
Figure 2C



230

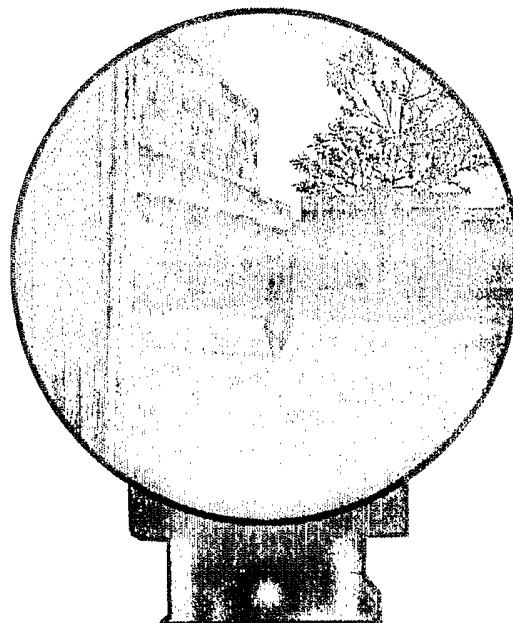


Figure 2D



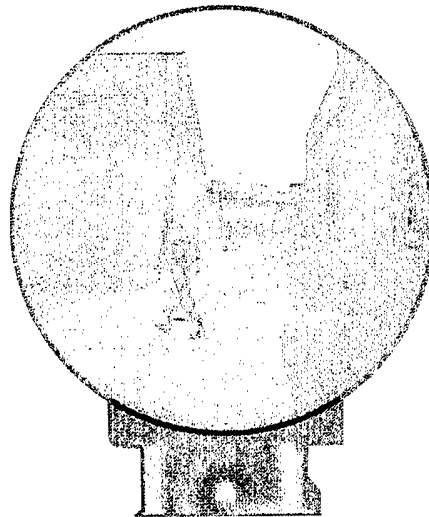
240

Figure 2E



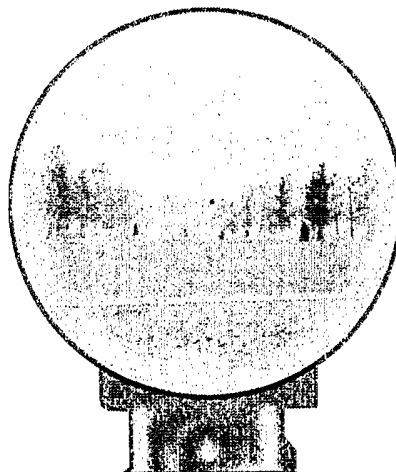
250

Figure 2F



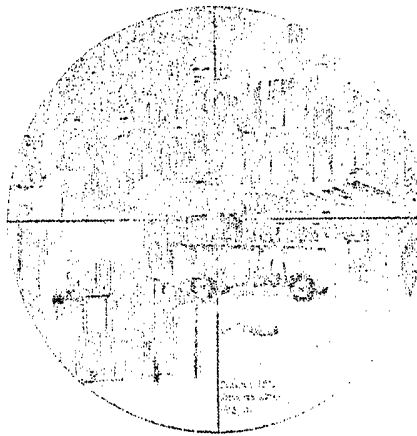
260

Figure 2G



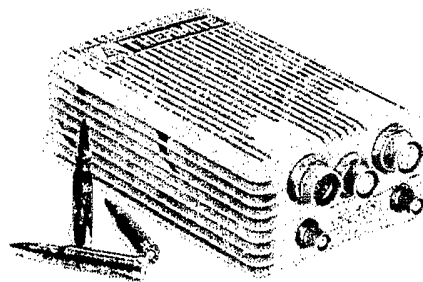
270

Figure 2H



300

Figure 3



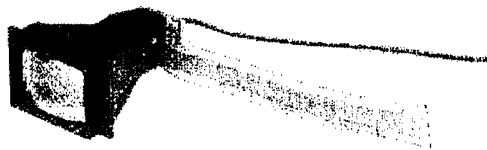
400

Figure 4A



410

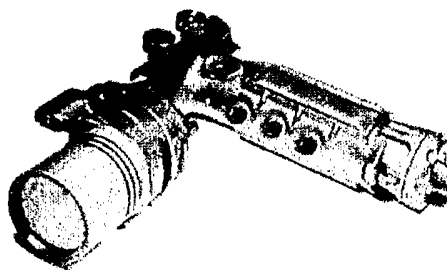
Figure 4B



420

Figure 4C

440 450 460A-460C 470



430

Figure 4D

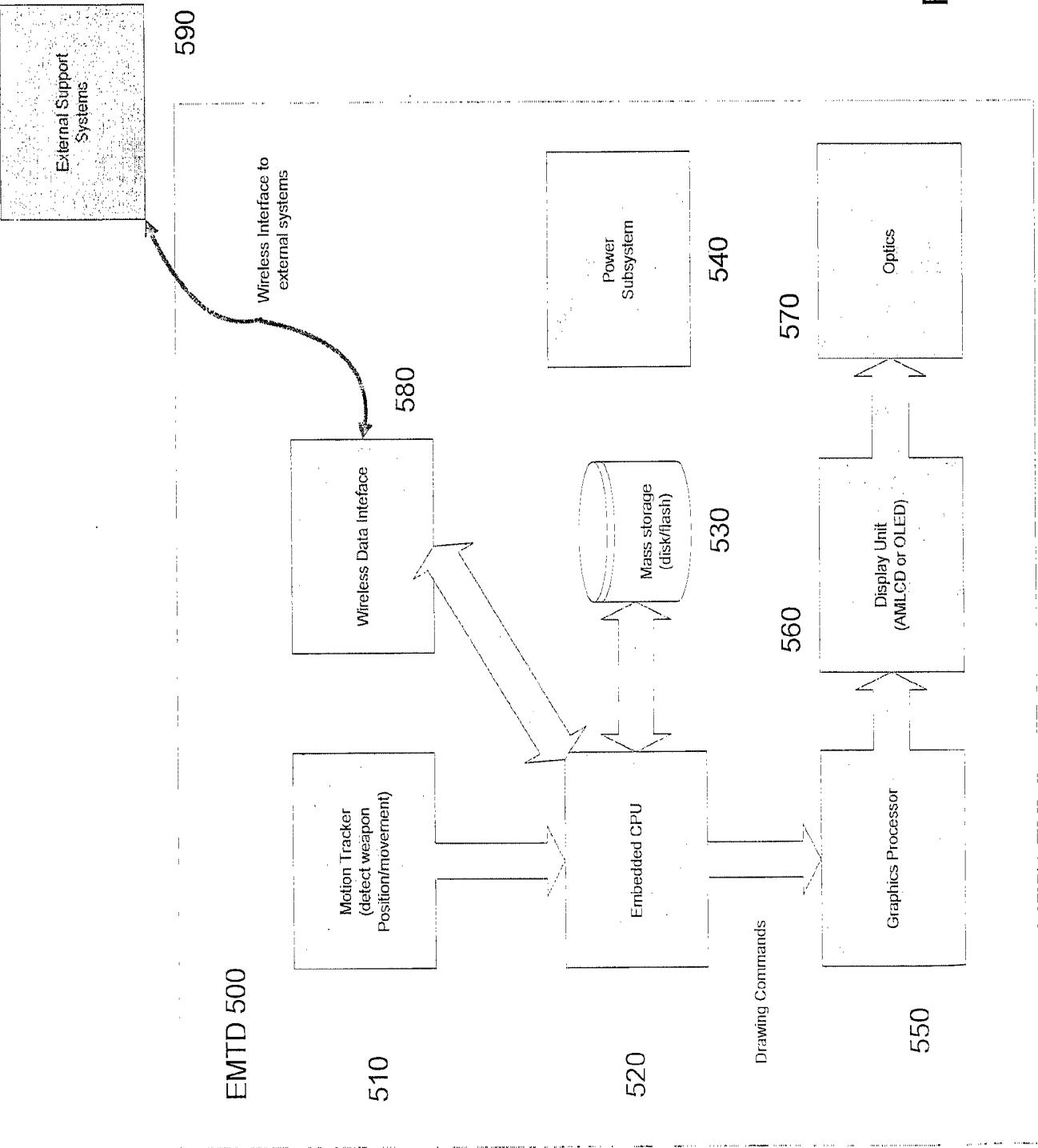


Figure 5