A lightweight military vehicle (12) is provided with an unmanned turret (10) for interchangeably supporting large weapon (14) stations. Elastomer (48) filled stanchions (32-38) connected to a turret platform (30) serve to isolate weapon (14) impulse forces from the vehicle (12) frame. Driver, commander and gunner seats (16, 18, 20) are located externally to the turret (10) and provided with side doors (22-28) to enable quick exiting. Both powered (70) and manual (98) backup drives are external to the rotating turret disk (76) and are accessible from the gunner’s seat. The elevation drive employs a ball and socket joint (68) connecting an upper yoke (64) mounted to the weapon (14) with a fixed lower portion (66) controlling vertical movement of the yoke (64) and thereby the elevation of the gun (14).
FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

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TURRET SYSTEM FOR LIGHTWEIGHT MILITARY VEHICLE

Description

Technical Field

This invention relates to ordinances and, more particularly, to weapon turret systems for a military vehicle.

Background Art

It is highly desirable to be able to employ a basic vehicle design that can be adapted to be used in various configurations for different military purposes. Examples of such desirable configurations include vehicles for transporting cargo or personnel, ambulances, command vehicles and as a weapons carrier.

In order to provide this versatility where speed is important in most configurations and to facilitate transport by airlifts and the like, the basic vehicle must normally be relatively light.

When used as a weapons carrier these lightweight vehicles have generally been restricted in the size of the weapon that it can support. It has been conventional to mount manually operated machine guns on a ring connected to the roof of the vehicle. The gunner
is required to stand up in the vehicle with his upper torso exposed while aiming and firing the weapon. These types of weapon mounts have several drawbacks. One is that they expose the gunner to enemy fire, toxic gases, radiation and the like. The other is that only relatively small caliber weapons could be used with reasonable success. This is because the impulse forces generated by many larger caliber weapons (e.g. larger than .50 caliber) create such impulses that damage to commonly used lightweight vehicles could occur.

It has been normal practice to use heavier vehicles such as tanks, half-tracks or the like to support medium to large caliber weapons. Typically, the tanks include a turret having a protected personnel compartment which carries the gunner and is rotated with the turret. This approach keeps the gunner shielded but adds substantial weight and increased silhouette to the vehicle. Consequently, these heavier vehicles sacrifice mobility and transportability in order to protect the gunner and support the weapon. Additionally, many of the known tank configurations are characterized by cramped quarters which are uncomfortable and hard to quickly exit in emergency situations. Many tanks include hatches in the hull roof
structure thereby requiring that the turret be indexed to a position that will allow the hull hatch to open to allow exiting by the crew.

Power drives are normally used for controlling the elevation and azimuth of the weapon. The power drives are often located in the turret thereby requiring slip rings or the like to transfer power from a fixed external electrical or hydraulic source to the drive motors. These slip rings are subject to corrosion and general deterioration thereby posing a threat of drive failure. It would be advantageous to provide manual backup systems that can maneuver the weapon in the event of power failure. The inclusion of manual backup drives has been difficult to obtain in an efficient manner with some of the turret constructions used in the past.

Summary of the Invention

The present invention incorporates several features that may be used alone or in combination but when combined cooperate to provide an optimum lightweight vehicle construction capable of supporting relatively large weapon systems.

The preferred embodiment employs a turret construction having a disk rotatably mounted on a platform. The platform is connected to the vehicle frame by
way of a plurality of stanchions. Preferably, the stanchions are potted or filled with a elastomeric material to help isolate the vehicle from impulse forces generated by the weapon. The crew sits in chassis/hull mounted seats, one of the seats being reserved for a gunner. The crew is thus provided with comfortable quarters and are preferably provided with exterior side doors adjacent each seat for quick exit if required. Both powered and manual backup drives are provided for moving the weapon in elevation and azimuth. The elevation drive includes a stationarily mounted lower portion having a manually actuable member accessible by the gunner from his seat. The upper portion of the elevation drive is rotatably coupled to the lower portion so that the upper portion may rotate with the turret during azimuth positioning and yet still provide elevation control.

Among the advantages of the turret construction of this invention is that the crew members are located comfortably within the protected interior of the vehicle. Since the gunner does not ride in the turret, the turret construction is simplified, of minimal silhouette and comparatively lightweight. As will appear, the construction of the present invention
enables various weapons and/or weapon stations to be interchangeably used in an easy manner. All of these advantages and more are provided while employing a basic lightweight vehicle design that can be used in a variety of other configurations as desired.

Brief Description of the Drawings

These and other advantages of the present invention will become apparent to those skilled in the art after reading the following specification and by reference to the drawings in which:

FIGURE 1 is a side view of a military vehicle incorporating the teachings of the preferred embodiment of this invention;

FIGURE 2 is a top view thereof;

FIGURE 3 is a view similar to FIGURE 1 of the vehicle showing the gun in various orientations;

FIGURE 4 is a rear view thereof;

FIGURE 5 is a perspective view with parts cut away of the turret construction preferably employed;

FIGURE 6 is a perspective view diagrammatically illustrating flexure of the turret stanchions during firing of the weapon;

FIGURE 7 is a cross sectional view along the lines 7-7 of FIGURE 6; and
FIGURE 8 is a cross sectional view illustrating in detail the turret bearing and sealing arrangements.

**Description of the Preferred Embodiment**

Referring now to the drawings, the present invention employs a turret system \( T \) that may be used in connection with a lightweight vehicle \( L \). Vehicle \( L \) is designed to meet requirements for a high mobility, multi-purpose wheeled vehicle. For purposes of this invention a lightweight vehicle means a wheeled vehicle having a gross vehicle weight of less than 10,000 pounds including payload. These drawings illustrate the "Hummer" vehicle manufactured by the assignee of the present invention, although other lightweight vehicles can be employed. Such lightweight vehicles are capable of being used in various configurations. One configuration is as a weapon carrier. The present invention is drawn to this configuration. More particularly, it is directed to a turret construction capable of supporting large weapons such as gun \( G \) which is a 25 millimeter M242 chain gun. Large weapons will be defined for purposes of this invention as weapons characterized by impulse forces (recoil force \( x \) duration) of at least about 50 pounds-seconds during firing. Generally,
weapons of this type are of the variety greater than .50 caliber. By way of illustration the M242 chain gun 14 exhibits an impulse force of about 60 pounds-seconds.

The exterior of vehicle 12 is provided with armor for protecting the crew seated in the interior of the vehicle. As can be seen most clearly in FIGURE 2, a plurality of forward mounted, forward looking seats 16, 18 and 20 are provided in the interior of the vehicle 12. Seat 16 is for the driver, seat 18 for the commander and seat 20 for the gunner. Each member of the crew is provided with his own access door immediately adjacent to his respective seat. In this example there are four doors 22 - 28.

The crew's seating arrangement of this invention provides comfort and safety for the personnel. The crew members are seated in normal passenger car fashion with 360 degree visibility through windows surrounding the crew seating area. The gunner's seat is located outside of the turret 10 in a comfortable vehicle seat from which he can perform the gunner functions while seated and protected.

Turn now to the construction of turret 10 which is best illustrated in FIGURE 5. A platform 30 having a generally rectangular periphery extends
horizontally above the crew near the top of the vehicle 12. A plurality of vertically extending stanchions 32 - 38 are employed to support the platform 30. Upper ends of stanchions 32, 38 are connected to lower portions of platform 30 and their lower ends are bolted to side rails 40 and 42 which are part of the vehicle frame. As can be seen most clearly in FIGURES 6 and 7, each stanchion includes a rectangular extruded aluminum casing 44 and an inner hollow aluminum tube 46. The space between outer casing 44 and tube 46 is filled with an energy absorbing elastomeric material 48. In the preferred embodiment, elastomeric material 48 is a polysulfide available from 3m Corporation as EC 801, which may be suitably mixed and poured within the space between casing 44 and tube 46 and allowed to cure. Suitable other energy absorbing materials such as sand may be used.

Gun 14 is located centrally to the stanchions 32 - 38 so that the horizontal component of the gun impulse force is distributed amongst the stanchions. As shown in FIGURE 6, the stanchions are designed to flex or deflect in response to the forces during firing of the gun and thereby isolate the vehicle frame from damage to a great extent. The elastomeric material 48 in each stanchion serves to absorb energy created by the
weapon and prevents much of it from being transferred directly to the vehicle frame.

The platform 30 is free to move in the horizontal direction independently of the roof 50. As best shown in FIGURE 8, there is a gap between roof 50 and platform 30. Weather seal 52 includes a resilient lip portion 53 riding on roof 50 that provides a friction joint with the roof or vehicle superstructure. The lower portion of weather seal 52 is fixed to platform 30 by way of suitable fasteners such as fastener 55.

Gun 14 is mounted in a cradle 60 which is pivotable about a pair of trunnions 62. Ammunition is fed to the gun 14 by way of dual ammunition feeds 63 and 65. The cradle 60 includes a rearwardly reasonably extending portion connected to vertically extending struts of a yoke 64 through bearings 67 and 69. The lower portion of yoke 64 is pivotally connected to a shaft 66 by way of a ball and socket joint 68. Elevation of gun 14 is controlled by the vertical movement of shaft 66 likewise causing motion in the vertical direction of yoke 64 thereby pivoting the gun about its trunnions 62. Power drive is provided via motor 70 controlling rotation of a pinion 72 in engagement with rack 74.

Azimuth control of gun 14 is provided by way of a rotating disk 76 to which cradle 60 is connected by
way of trunnion mounts 71 and 73. As shown most clearly in FIGURE 8, disk 76 is located within an opening in roof 50 and is bolted to a ring gear 78 which is incorporated in the outer race of the turret bearing whose inner race 75 is bolted to platform 30. Ring gear 78 includes radially extending teeth on its outer periphery. The teeth of gear 78 are meshed with a pinion 80 (FIGURE 5) whose rotation is controlled by drive motor 82. In addition to its energy absorbing function, weather seal 52 bridges the gearing arrangement protecting it from adverse environmental conditions and also serving as a ballistic shield.

Added stability for the elevation drive is provided by way of a basket 77. Basket 77 includes a plurality of struts whose upper ends are connected to the lower portions of platform 30 and whose lower ends are connected to a bearing guide 79 surrounding shaft 66.

As noted before, the gunner sits externally of the turret 10 in a comfortable and protected position within the vehicle. The gunner is provided with a suitable joy stick-type controller 88 for activating elevation motor 70 and azimuth motor 82 to aim the gun. A video camera 90 coaxially mounted to gun 14 is advantageously employed as a sighting device. An auxiliary
laser beam sight 91 may also be employed. Camera 90 is connected to display 92 for viewing by the gunner. Other crew members such as the commander may also be provided with their own display and controller 94 and 96, respectively, so that they can also operate the weapon system, if desired.

The turret system of the present invention also preferably includes manual backup drives to control the gun in the event of power failure. To this end, a wheel 98 is connected by way of a clutching arrangement to drive pinion 72 in the event of power loss. Additionally, a wheel 100 suitably connected to pinion 80 via a belt or chain is employed for effecting azimuth movement of the gun.

Among the advantages of the present invention is that various weapon stations can be interchangeably used with this construction. Each weapon station would include a particular type of weapon mounted on its own disk in a manner like that described above. Each weapon station can be easily removed from the vehicle by unbolting the disk 76, disconnecting yoke 64, and disconnecting the cables coupling camera 90 to the video displays and controllers 92, 96 to the weapon firing mechanisms (not shown). The weapon station can then be
lifted from the vehicle and a new weapon station with a similar mounting scheme reattached. The video displays, gunner controls, manual and power drives all remain fixed and are common to all weapon variants. This system is ideally suited, but not limited to weapons such as a 30 mm chain gun, Tow family of missiles, 40 mm grenade launcher, .50 caliber machine guns, 7.62 mm machine guns and other high velocity guns including the illustrated 25 mm chain gun.

The unmanned turret system of this invention extends the capability of lightweight conventional vehicles to support high impulse weapons. This allows the light vehicle to employ high impulse cannons designed to deliver ammunition at extended ranges.

Various other advantages and modifications of the illustrated embodiment of this invention will become apparent to those skilled in the art after a study of the drawings, specification and following claims.
Claims

1. In a lightweight military vehicle, an improved turret system adapted for use with large weapons, said turret system comprising:

   a platform;

   a plurality of vertically extending stanchions connected at their upper ends to the platform and at their lower ends to side rails of the vehicle frame;

   a disk mounted for rotation about a vertical axis on said platform;

   mounting means connected to the disk for receiving a large weapon and being adapted to pivot the weapon in elevation about a pair of horizontally disposed trunnions;

   elevation drive means vertically extending upwardly from central interior portions of the vehicle for controlling elevation of the weapon, said drive means having a lower fixed actuator portion rotatably coupled to an upper portion, said upper portion being connected to the weapon mounting means offset from the trunnions whereby vertical motion thereof controls elevation of the weapon, with said upper portion being capable of rotating with the weapon during azimuth posi-
tioning thereof;

a plurality of forward looking seats within the interior of the vehicle, one seat being for a gunner;

power drive control means accessible from the gunner's seat for activating the elevation drive means and for rotating the disk to move the weapon in elevation and azimuth, respectively; and

manual control means accessible from the gunner's seat for manually actuating the elevation drive means and for rotating the disk as a backup to the power drive control means.

2. The vehicle of claim 1 wherein said stanchions are filled with an energy absorbing material and are adapted to absorb impulse forces generated during firing of the weapon.

3. The vehicle of claim 1 wherein said elevation drive means includes:

an upper yoke member connected by a way of ball and socket joint to a shaft, upper ends of the yoke being connected to the weapon mounting means and lower portions of the shaft being engaged with a gearing
arrangement for controlling verticle movement thereof.

4. The vehicle of claim 3 wherein said gearing arrangement includes a rack connected to the shaft, and a pinion driven by a motor activated by the power drive control means or alternatively by the manual control means.

5. The vehicle of claim 1 which further includes exterior side doors adjacent each seat.

6. The vehicle of claim 1 which further includes:

   bearing means having a ring gear with teeth;

   means for removably mounting said disk to the ring gear; and

   a pinion engaging said gear ring for rotating the disk and moving the weapon in azimuth.

7. The vehicle of claim 6 wherein the vehicle includes a roof spaced from said platform and including an opening in which said disk is located, and weather seal means between upper portions of said disk
and said roof bridging said ring gear.

8. The vehicle of claim 7 wherein said weather seal means includes a resilient portion contacting the roof whereby friction energy created by relative motion between the platform and roof serves to absorb a portion of the weapon energy during firing and isolates the vehicle roof from weapon impulse forces.

9. The vehicle of claim 6 wherein said pinion is rotatable either by a motor actuated by the power drive control means or by said manual control means.

10. The vehicle of claim 1 which further includes:
   a camera mounted coaxially with the weapon adapted to be used as a sighting device, and a video display connected to the camera and located in view of the gunner.

11. In a vehicle having a frame, the improvement comprising:
   a platform, a weapon mounted to the platform, and a plurality of vertically extending stanchions
connected at their upper ends to the platform and at their lower ends to the vehicle frame, with the stanchions being filled with an energy absorbing material whereby said stanchions are adapted to flex during firing of the weapon with the material absorbing energy created by the weapon impulse force to thereby minimize the transfer of such energy to the vehicle frame.

12. The improvement of claim 11 wherein each of said stanchions comprises:

a metallic outer casing and an interior hollow tube, and energy absorbing elastomeric material filling the space between the tube and inner walls of the casing.

13. The improvement of claim 11 wherein said vehicle frame includes a pair of side rails running parallel to the length of the vehicle, and wherein said weapon is about centrally located with respect to the stanchions so that the impulse force created thereby is distributed to the stanchions.

14. A lightweight military vehicle
comprising:

an unmanned turret having a weapon located on top of the vehicle;

a plurality of forward looking seats within the interior of the vehicle, one of the seats being for a gunner; and

means for allowing the gunner to aim and fire the weapon while seated in his seat.

15. The vehicle of claim 14 wherein said means includes a camera mounted on or coaxially to the weapon, and a video display adjacent the gunner's seat for displaying images of the scene viewed by the camera.

16. The vehicle of claim 14 which further includes:

side doors adjacent each of the seats for permitting easy entrance and exit of the vehicle by the personnel.

17. A military vehicle adapted to permit interchangeability of different weapon stations where each weapon station includes a weapon mounted on a disk, the vehicle comprising:
a platform located adjacent the top of the vehicle;
azimuth drive means on the platform; and
means for removably attaching the disk of the desired weapon station to the drive means.

18. The vehicle of claim 17 wherein said azimuth drive means includes:
turret bearing means having a ring gear to which the disk is removably attached, and a pinion for engaging radially extending teeth on the surface of the ring gear.

19. The vehicle of claim 18 wherein said weapon station includes cradle means for receiving a weapon in such manner so as to pivot the weapon in elevation about a pair of trunnions, and wherein said vehicle further includes:
a vertically movable member removably attached to the cradle means, and drive means within the vehicle for controlling vertical movement of said member to thereby move the gun in elevation.
20. The vehicle of claim 19 wherein said member is rotatably connected to the drive means to permit said member to rotate with the disk during azimuth positioning thereof.
**INTERNATIONAL SEARCH REPORT**

**I. CLASSIFICATION OF SUBJECT MATTER**

According to International Patent Classification (IPC) or to both National Classification and IPC:
- INT. CL. F41D 11/26; F41F 21/02, 21/04, 23/06, 23/10; F41G 37/02, F41H 7/72
- US. 89/41M, 42R, 41TV, 40B

**II. FIELDS SEARCHED**

**Minimum Documentation Searched**

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**Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched**

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<td>FR, A, 849,186 (APPLICATIONS INDUSTRIELLES NOUVELLES) 15 NOVEMBRE 1939, see Fig's 7 and 8.</td>
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<td>US, A, 641,897 (STIMMS) 23 JANUARY 1900, see page 1, lines 21-71.</td>
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<td>X</td>
<td>US, A, 3,504,122 (RATLIFF) 31 MARCH 1970</td>
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<td>N, POPULAR MECHANICA, MAY 1945, see Remote-Control Gun is Fired From Inside Car.</td>
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**IV. CERTIFICATION**

- **Date of the Actual Completion of the International Search**: 29 AUGUST 1984
- **Date of Mailing of this International Search Report**: 31 AUG 1984

Form PCT/ISA/210 (second sheet) (October 1981)
FURTHER INFORMATION CONTINUED FROM THE SECOND SHEET

X  GB, A, 489,059 (AEROPLANT CAPRONI
SOCIETA ANONIMA) 19 JULY 1938  17-20
X  GB, A, 1,019,430 (KELLER & KNAPPICH
G.m.b.H.) 9 FEBRUARY 1966  17-18

V. OBSERVATIONS WHERE CERTAIN CLAIMS WERE FOUND UNSEARCHABLE

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:
1. Claim numbers ... ... because they relate to subject matter not required to be searched by this Authority, namely:

2. Claim numbers ... ... because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

VI. OBSERVATIONS WHERE UNITY OF INVENTION IS LACKING

This International Searching Authority found multiple inventions in this international application as follows:

Invention I: Claims 1-10, turret elevation drive
Invention II: Claims 11-13, vehicle frame
Invention III: Claims 14-16, weapon aiming and firing
Invention IV: Claims 17-12, weapon disk and azimuth drive

As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims of the international application.

As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims of the international application for which fees were paid, specifically claims:

No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claim numbers:

As all searchable claims could be searched without effort justifying an additional fee, the International Searching Authority did not invite payment of any additional fee.

Remark on Protest

The additional search fees were accompanied by applicant's protest.
No protest accompanied the payment of additional search fees.