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(54) ELECTROMECHANICAL ROBOTIC SOLDIER

(76) Inventor: **Luther Trawick**, Virginia Beach, VA (US)

Correspondence Address:
BRADLEY D. GOLDIZEN
505 SOUTH INDEPENDENCE BOULEVARD, SUITE 102
VIRGINIA BEACH, VA 23452 (US)

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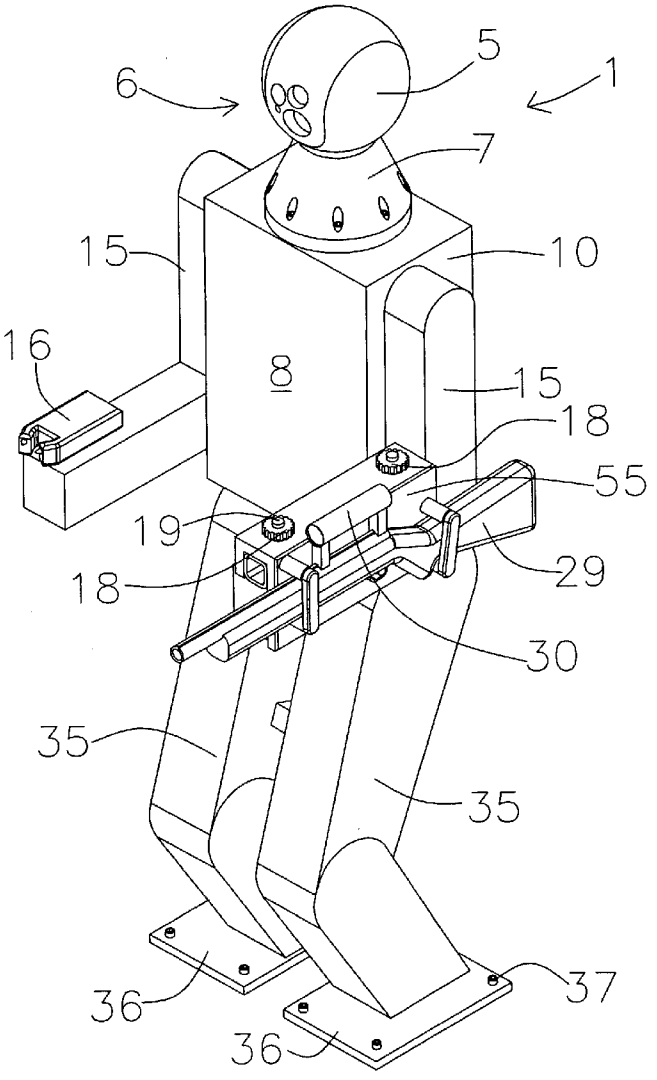
(57) **ABSTRACT**

An electromechanical soldier equipped with standard armament, reconnoiter and data gathering equipment replaces soldiers, police officers and the like in dangerous, and life-threatening situations. The soldier may be equipped with interchangeable weapon systems coupled to a chassis. The chassis rotates the weapons in a 360 degree manner while the altitude of the weaponry may be raised and lowered. A global positioning system may be included for location and control by a remote operator. The soldier may be equipped with omni and vertical direction view cameras for performing surveillance and target acquisition. It may be equipped with titanium armor for withstanding attacks. The chassis is equipped with wheels for maneuvering it across rough terrain and stairs. It may be programmed with facial, voice and other such recognition systems. Duplex communications is provided between the soldier and a remote operator for providing operating instructions and real-time data.



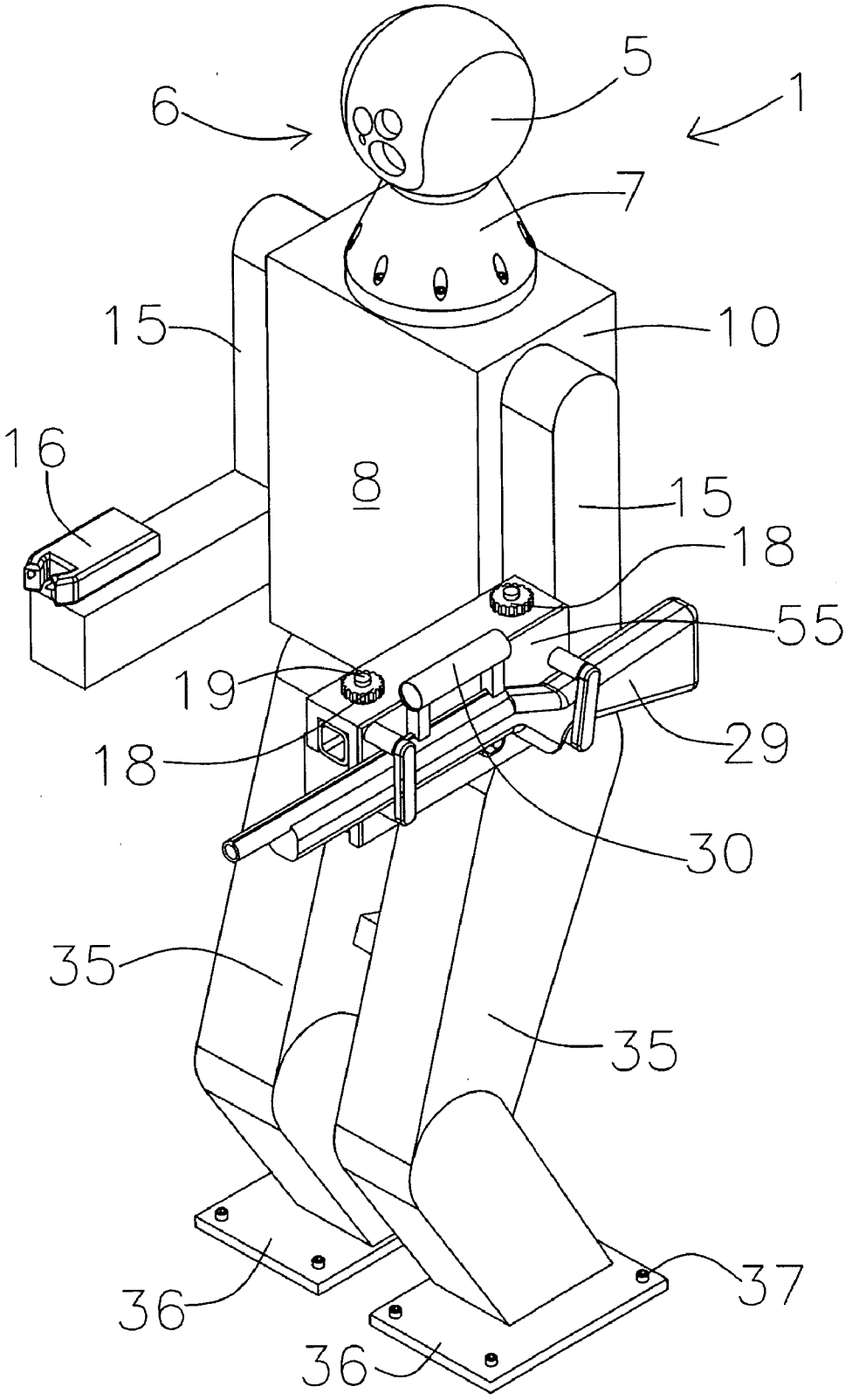


Figure 1A

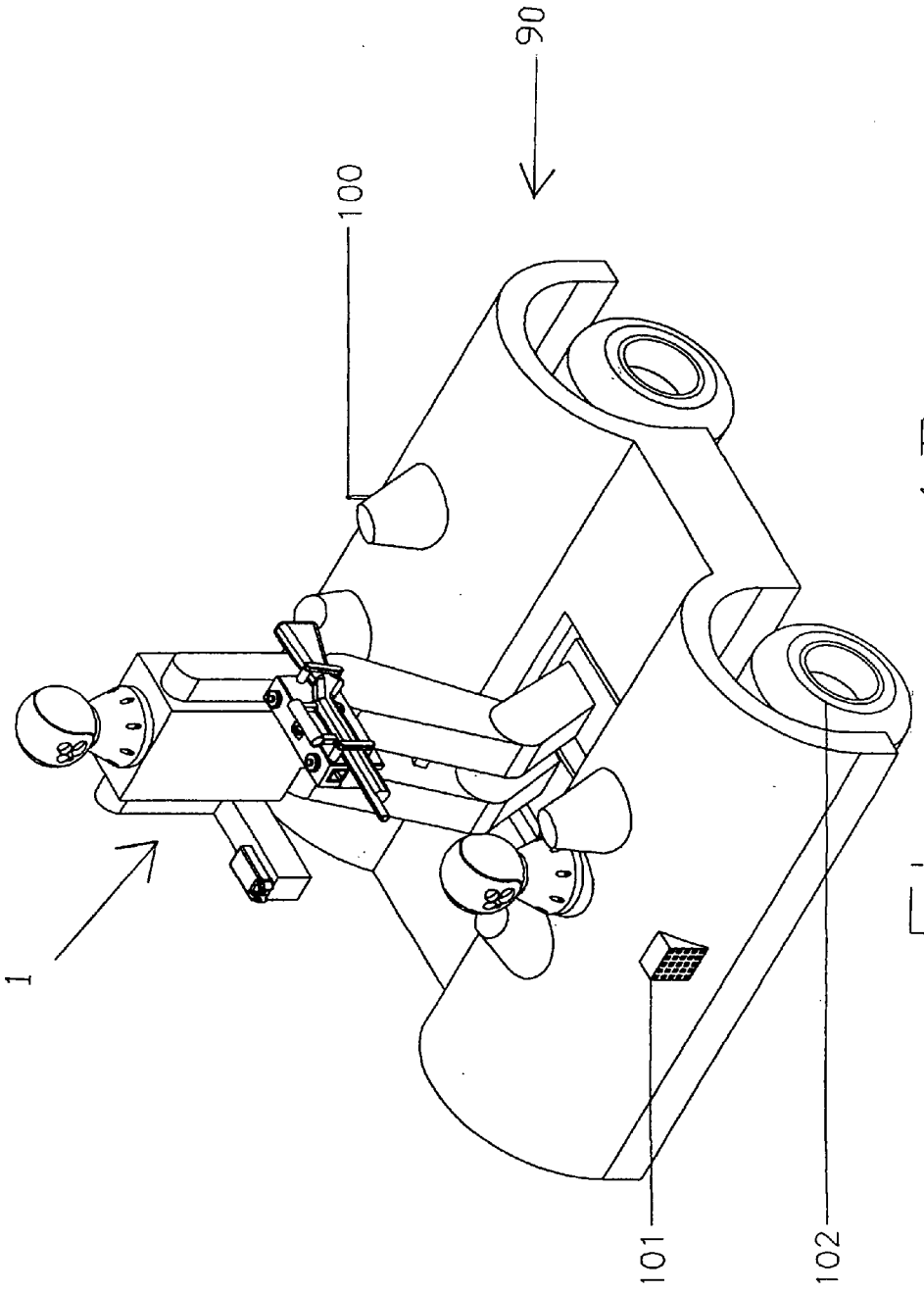


Figure 1B

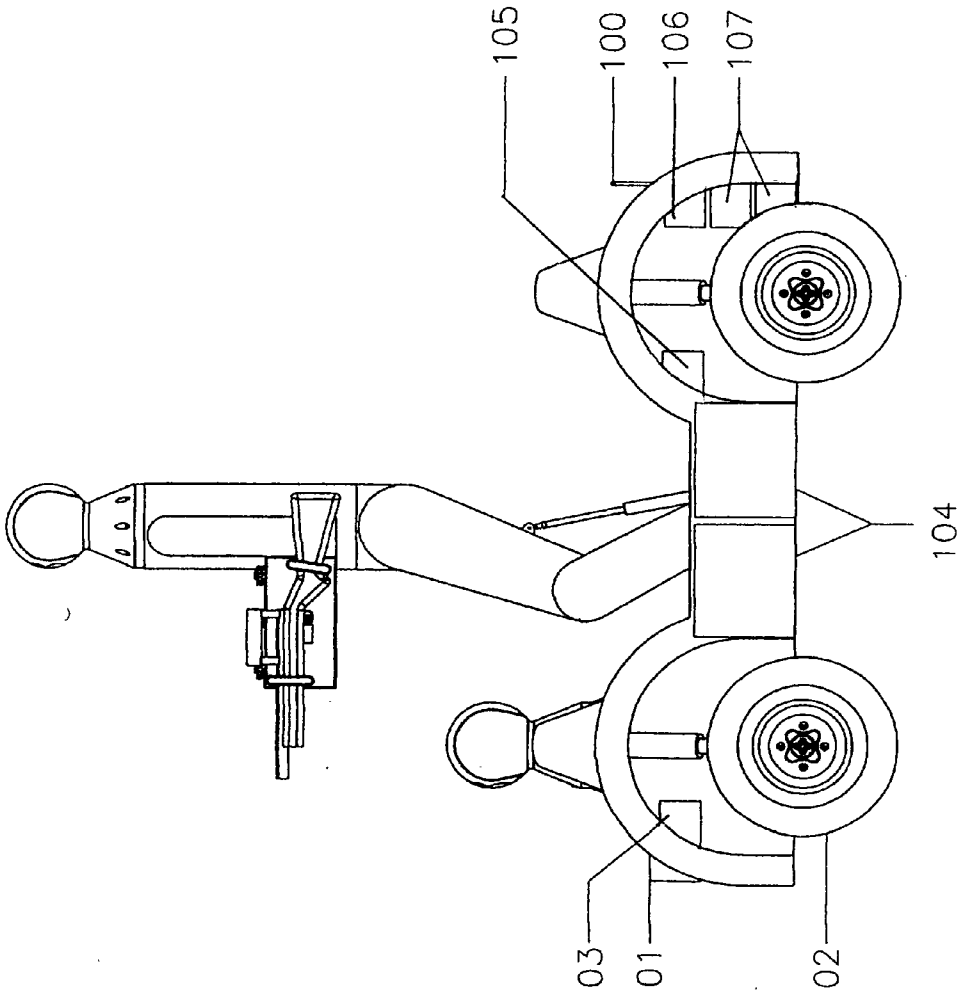


Figure 1C

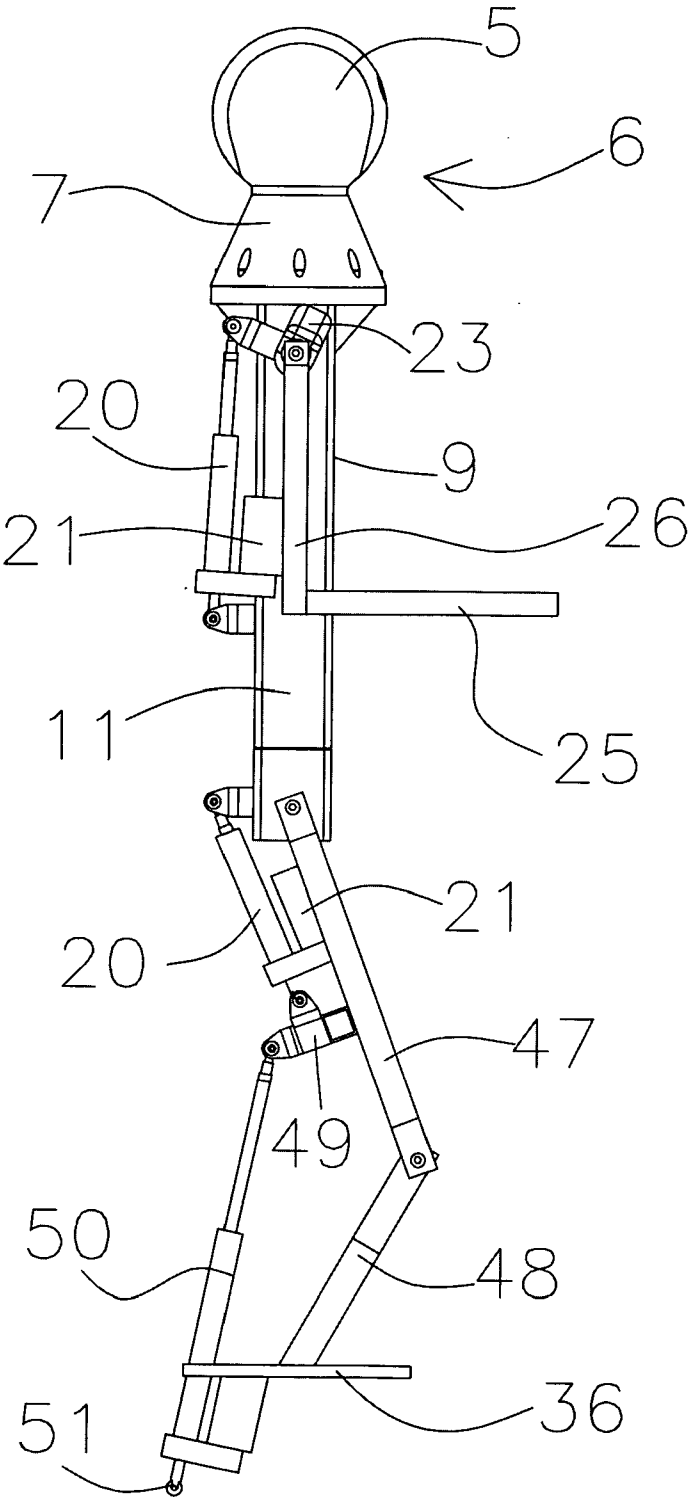


Figure 2

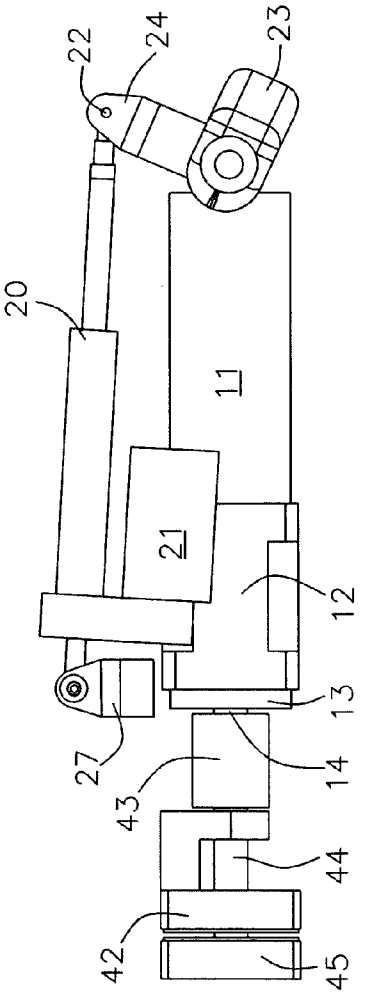


Figure 4

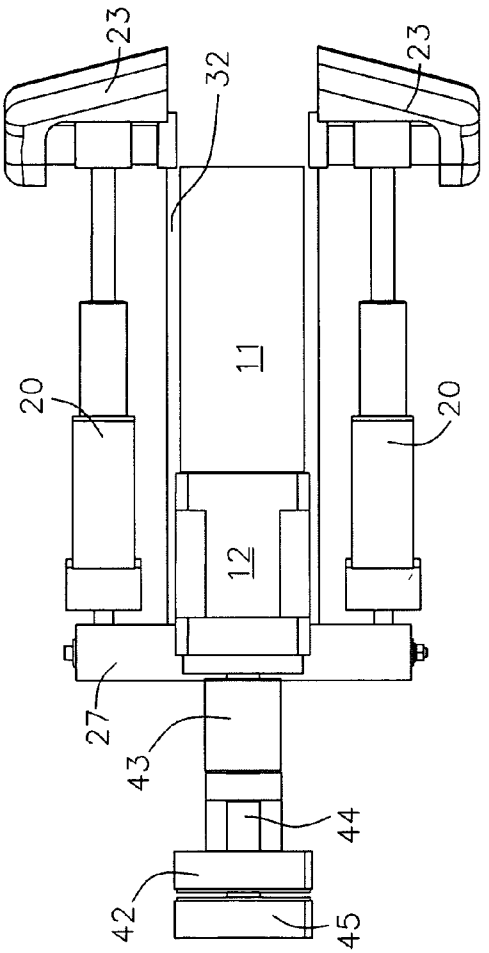


Figure 3

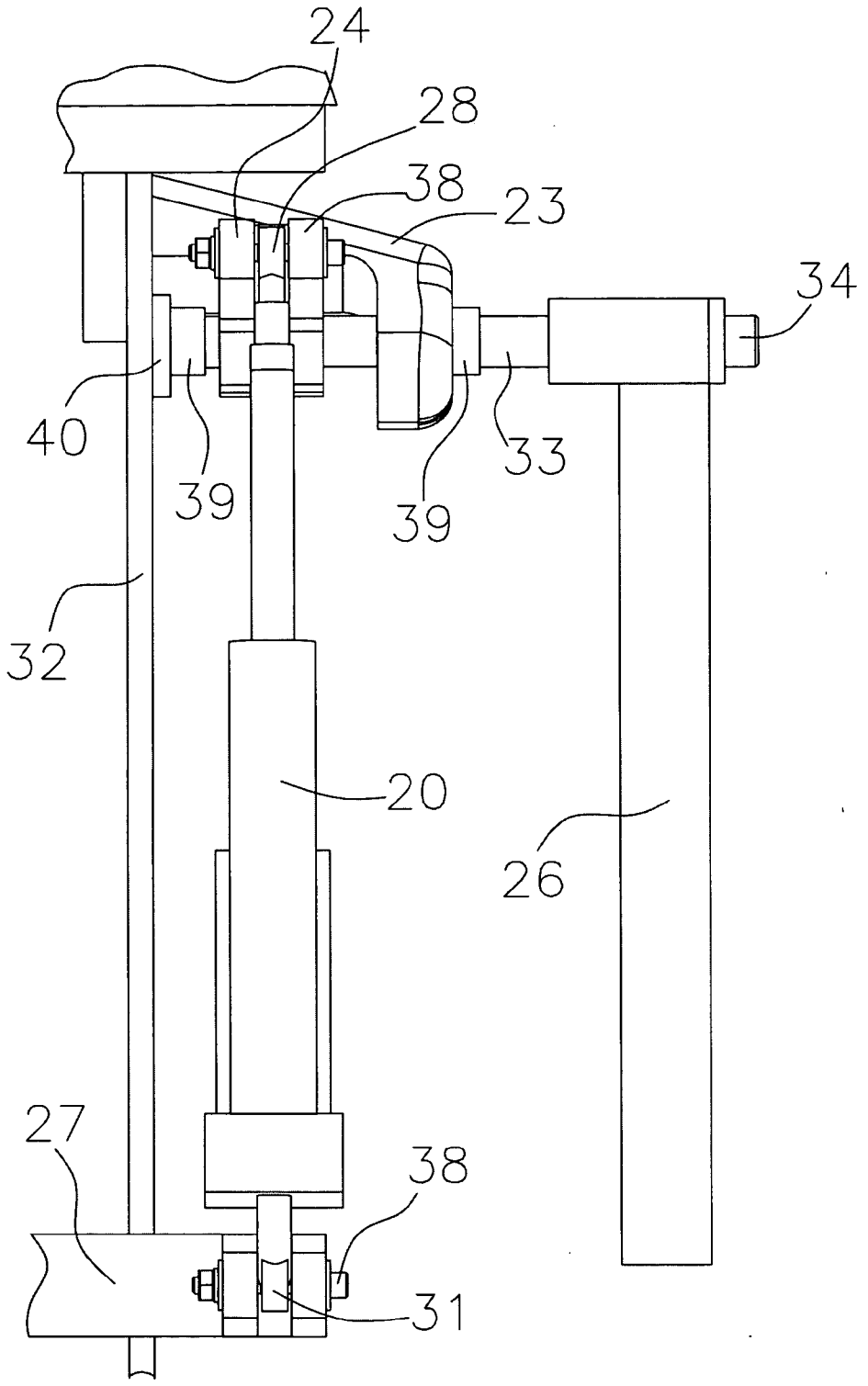


Figure 5

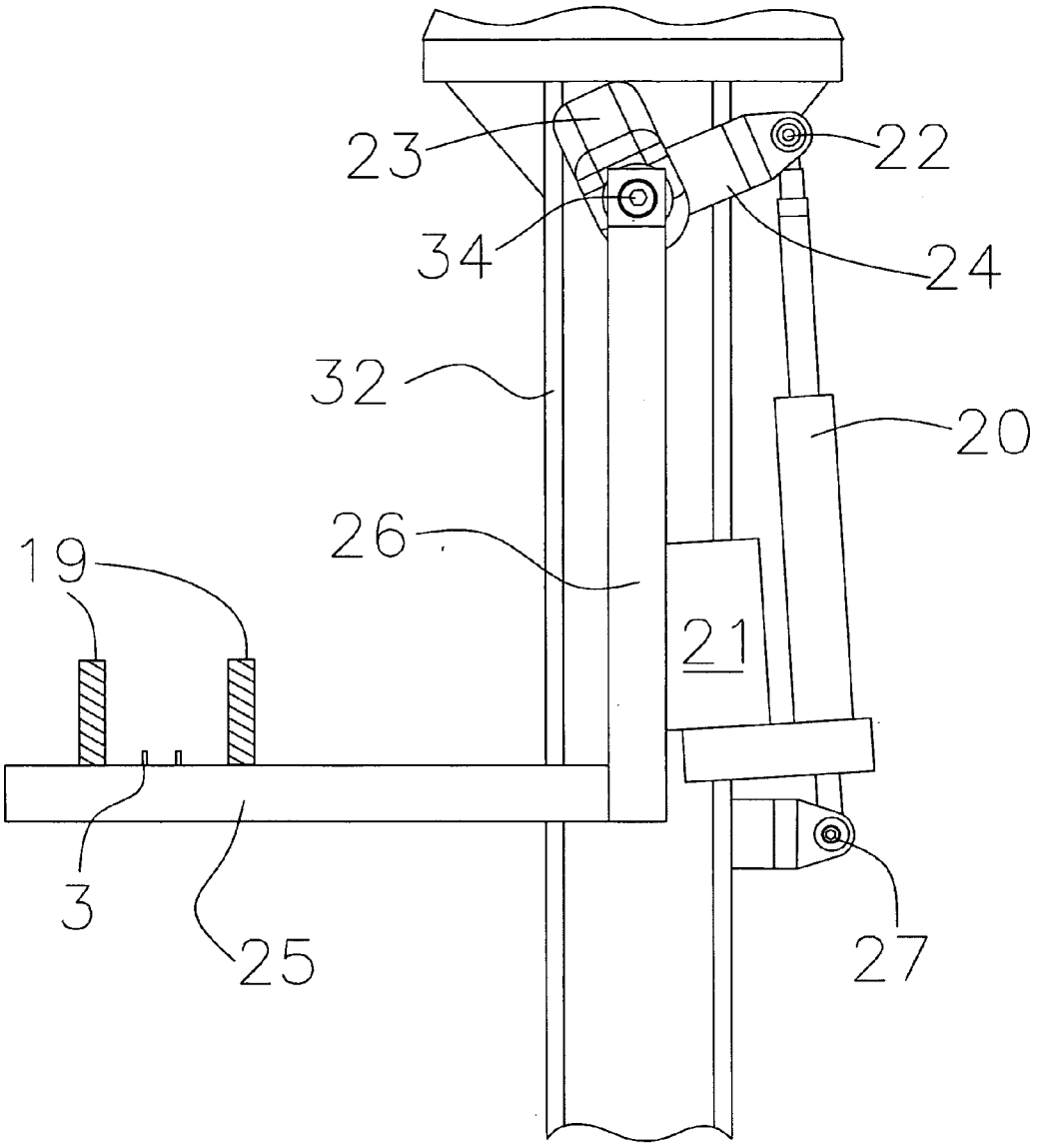


Figure 6

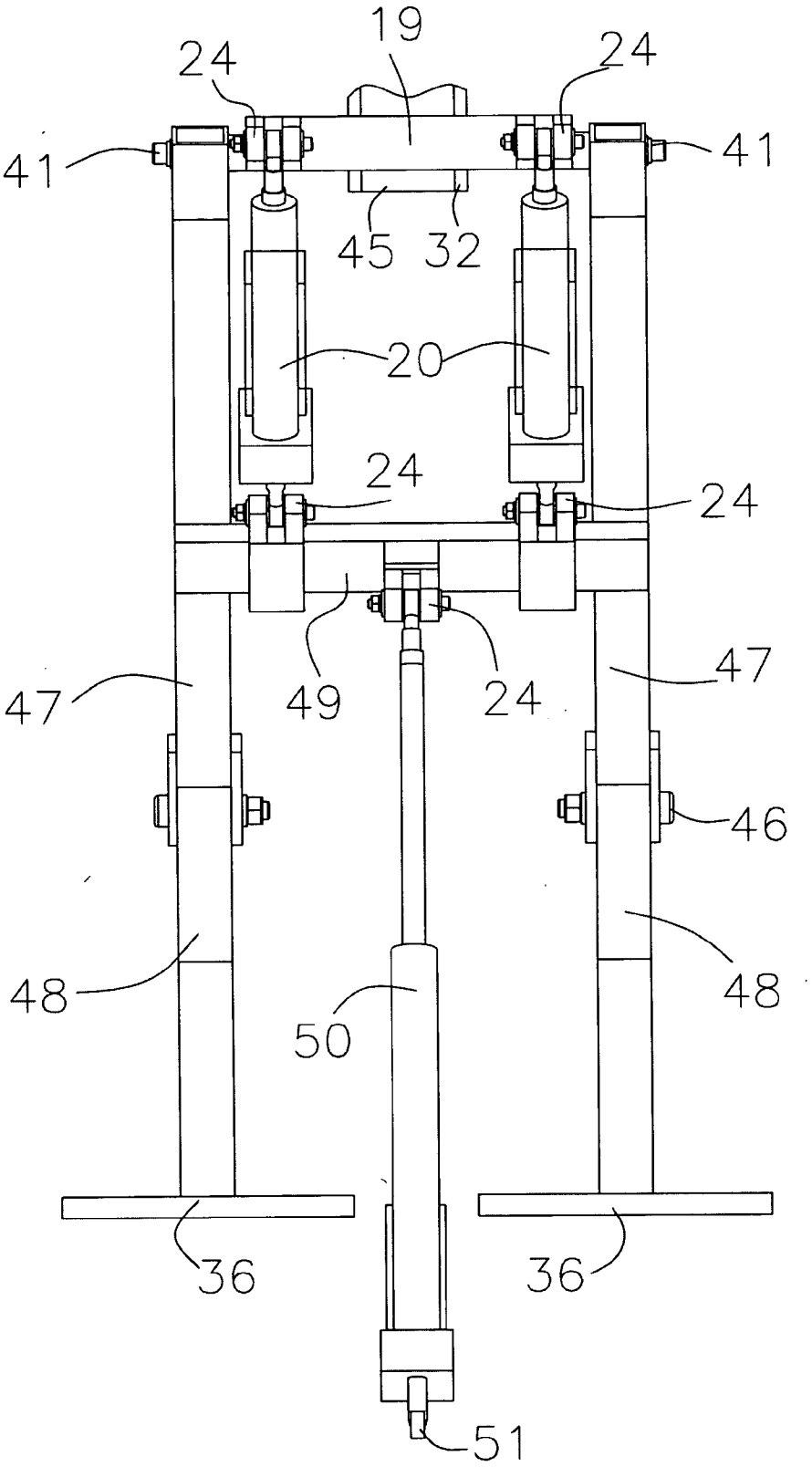


Figure 7

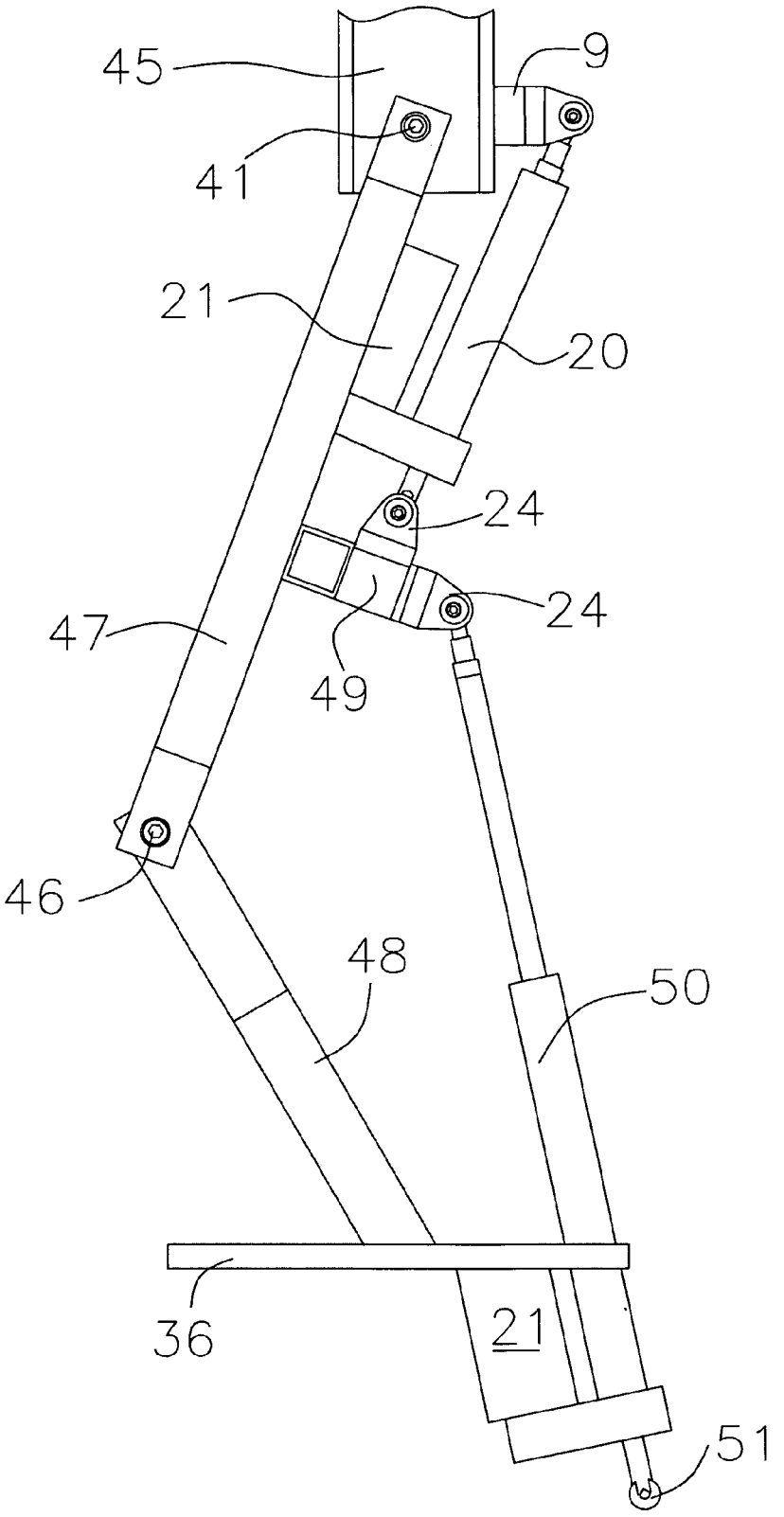


Figure 8.

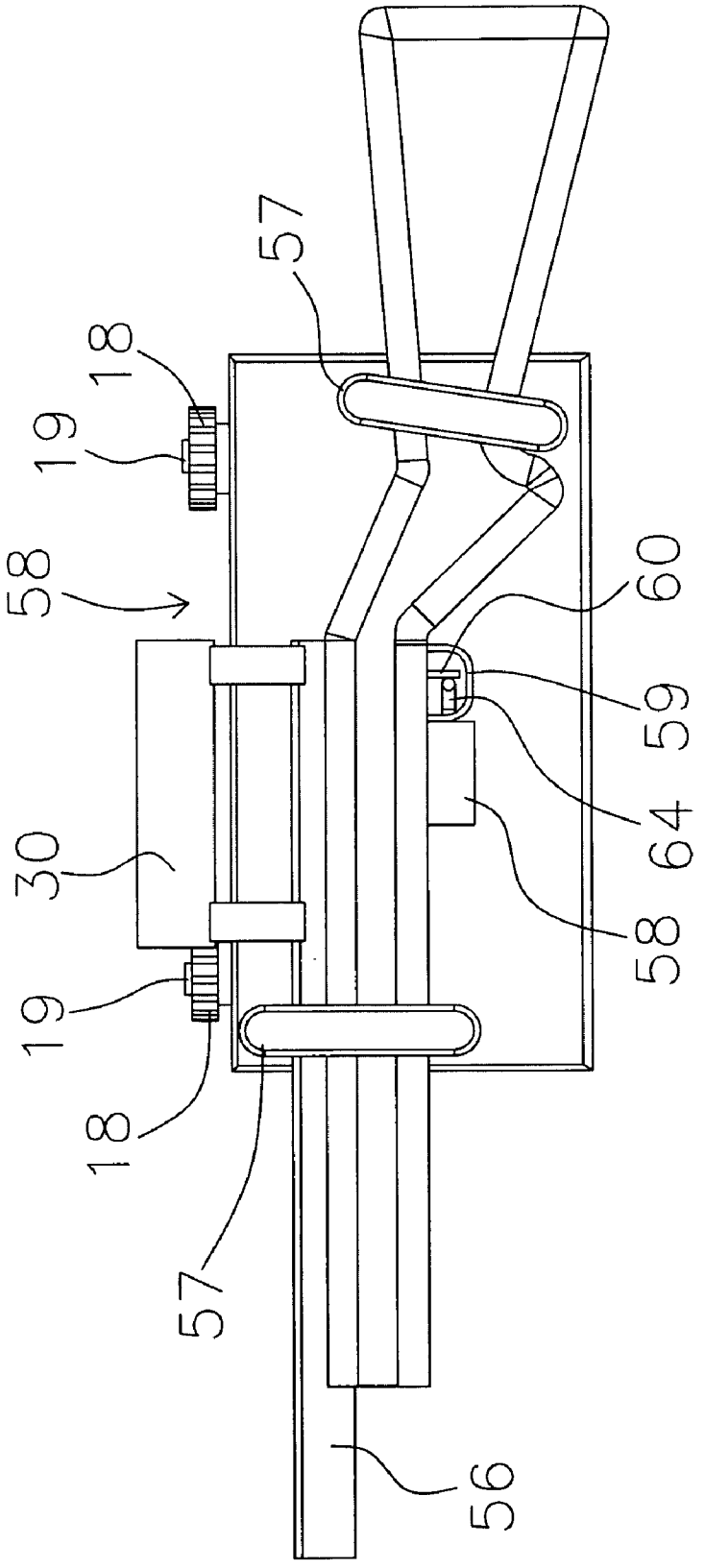


Figure 9

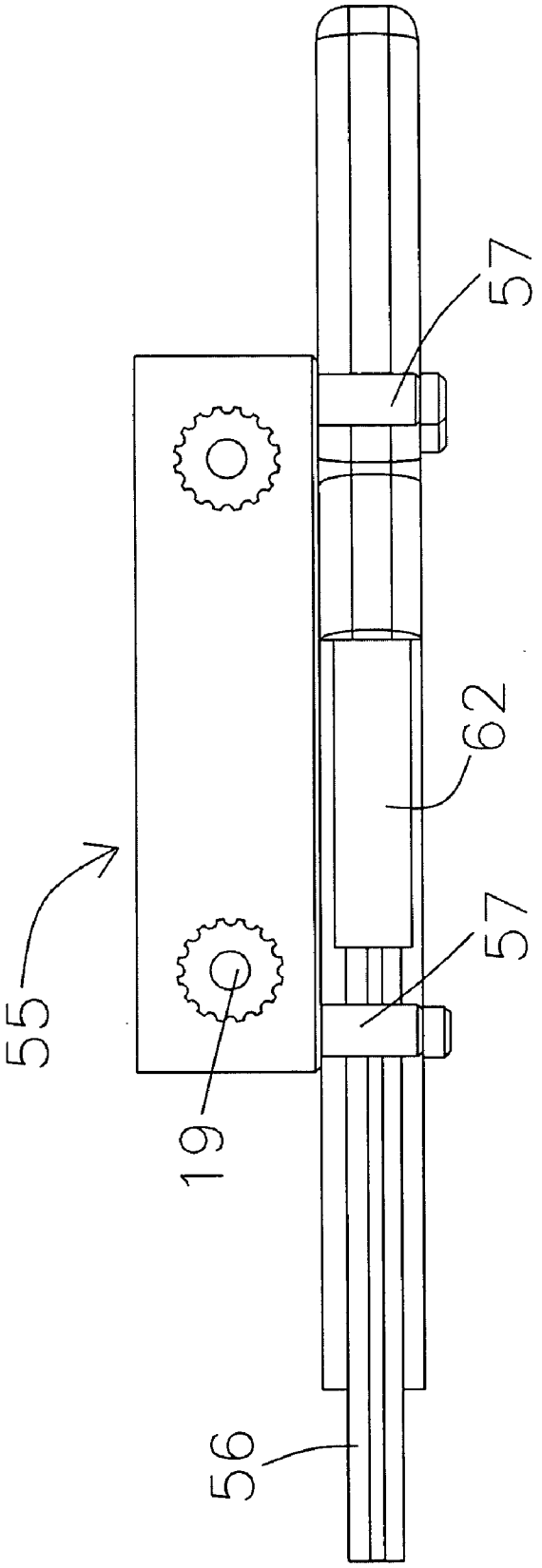


Figure 10

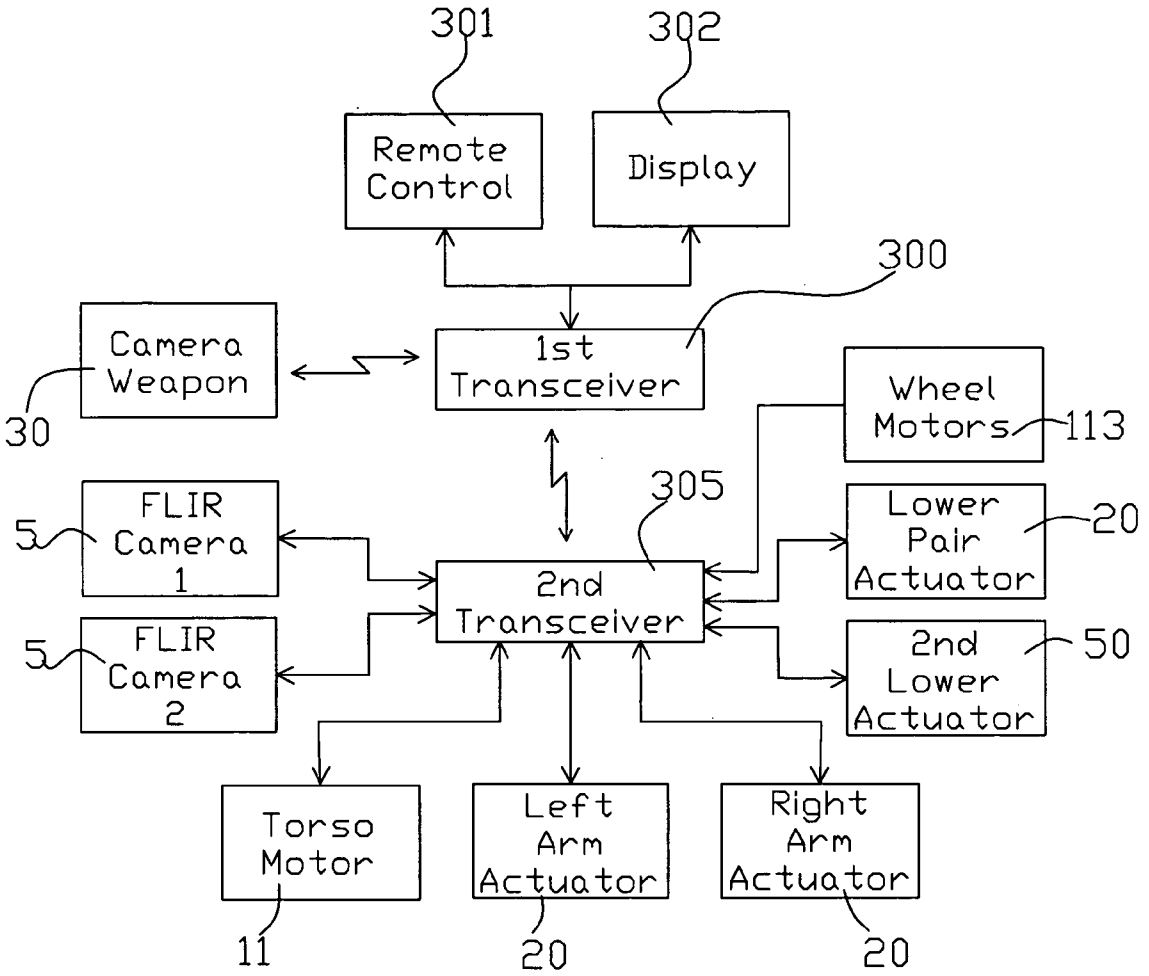

301
302
Remote Control
Display
300
Camera Weapon
30
1st Transceiver
Wheel Motors
113
305
FLIR Camera 1
5
Lower Pair Actuator
20
2nd Transceiver
FLIR Camera 2
5
2nd Lower Actuator
50
Torso Motor
11
Left Arm Actuator
20
Right Arm Actuator
20

Figure 11

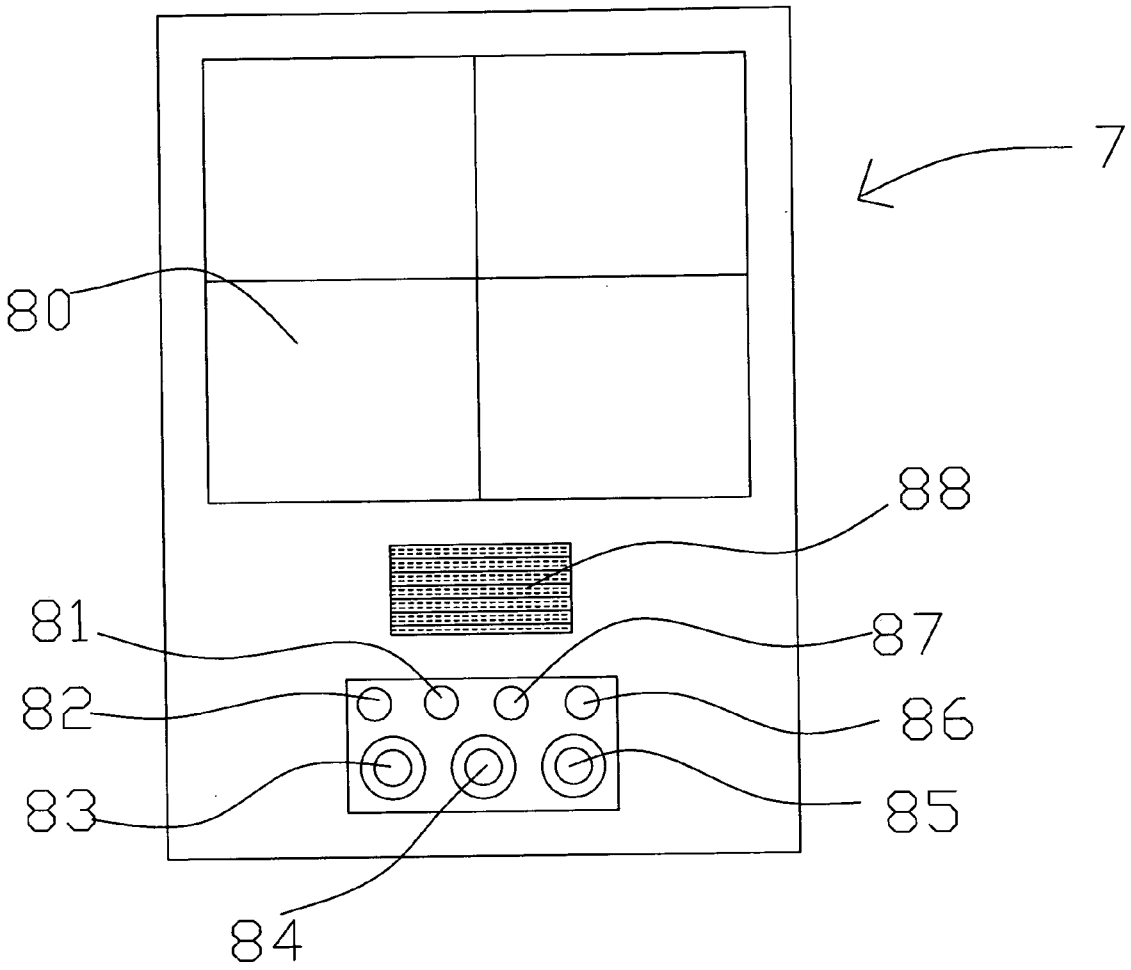


Figure 12

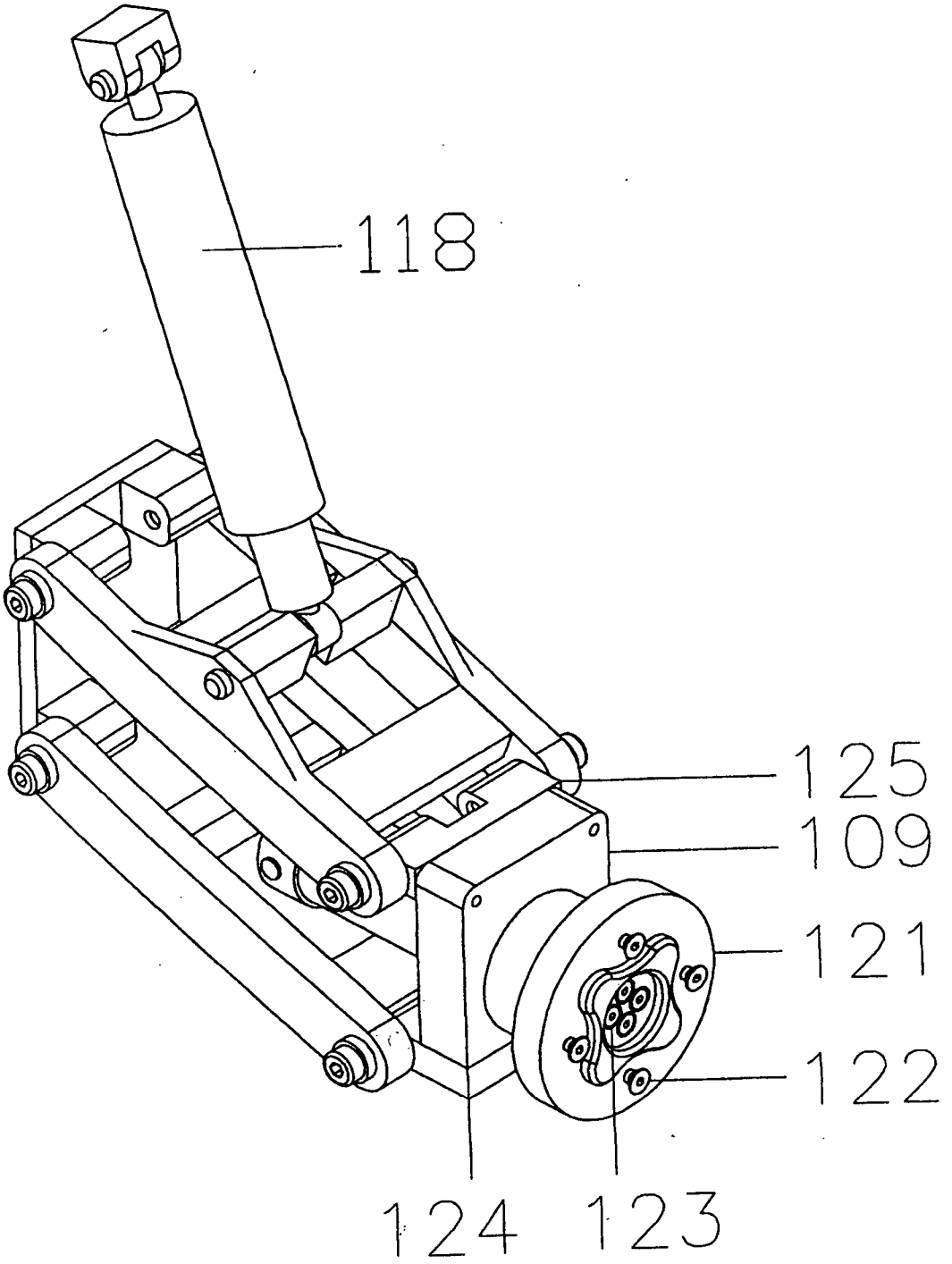


Figure 13A

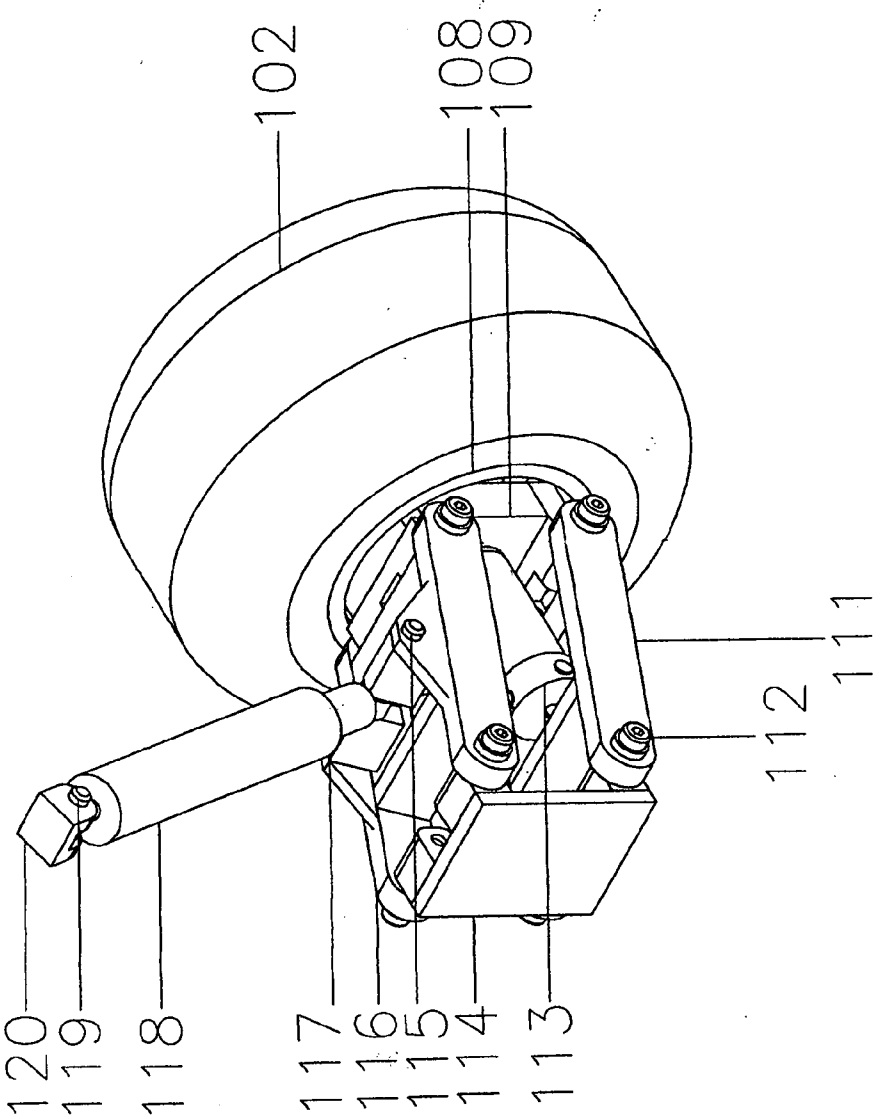


Figure 13B

ELECTROMECHANICAL ROBOTIC SOLDIER

[0001] This patent application relates to the subject matter of U.S. Provisional Patent Application Ser. No. 60/516,374 filed on Nov. 3, 2003 and U.S. Provisional Patent Application Ser. No. 60/624,673 filed on Nov. 3, 2004.

[0002] This patent application did not receive any federal research and development funding.

BACKGROUND OF THE INVENTION

[0003] The invention relates generally to robotic or electromechanical machines that may be utilized in combat, police or other such functions. More specifically, the invention relates to a machine that may be remotely controlled for use in dangerous situations and may include a targeting system for recognizing and handling multiple enemy combatants.

[0004] Previously, robots have been used to perform various tasks such as manufacturing products, cleaning households, mowing lawns, delivering items, providing companionship and the like. Other robots have been tasked with specific duties such as detecting blockages in pipelines and the like. It is believed that no robots have been used to supplement police or military operations as that of the instant invention.

BRIEF SUMMARY OF THE INVENTION

[0005] The invention is an electromechanical soldier equipped with standard armament, reconnoiter and data gathering equipment replaces soldiers, police officers and the like in dangerous and life-threatening situations. The soldier may be used to perform check point security, perform open terrain combat missions, conduct building-to-building search and destroy missions, operate as a combat interpreter, and conduct surveillance patrols and reconnoiter missions. It may include a targeting system for tracking and destroying enemy combatants.

[0006] The soldier may also be used to perform police functions such as building to building searches for criminals, facial recognition and apprehension of criminals, street patrols, raids on drug labs and crack houses, and riot control operations.

[0007] Other uses of the soldier may include performing building security functions, access control to sensitive areas through recognition systems, embassy security and protection services for dignitaries.

[0008] The soldier may be equipped with a guided missile recognition radar system for traversing to avoid missile and artillery attacks. In one embodiment, the soldier is equipped with a laser sighted weapons system and camera. A grenade launcher includes a range and distance guidance system. Rechargable DC motors may allow the soldier to operate for extended periods of time without presenting a thermal target. Other weapons that may be included on the soldier are anti-aircraft weapons systems, anti-tank missiles, flame thrower, a mine sweeper/detector and a jet pack or water operational package. These weapons may be interchangeable.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] FIG. **1**A is a perspective view of the robotic soldier. FIG. **1**B is a perspective view of the robotic soldier mounted atop a mobile platform. FIG. **1**C is a side view of the robotic solder shown in FIG. **1**B.

[0010] FIG. **2** is an elevation view of the invention and showing the protective armor removed.

[0011] FIG. **3** is a front elevation view of the torso assembly of the invention and shown with the protective armor removed.

[0012] FIG. **4** is a side elevation view of the torso assembly of the invention and shown with the protective armor removed.

[0013] FIG. **5** is a rear elevation view of an arm assembly of the invention and shown with the protective armor removed.

[0014] FIG. **6** is a side elevation view of an arm assembly of the invention and shown with the protective armor removed.

[0015] FIG. **7** is a rear elevation view of the leg assembly of the invention and shown with the protective armor removed.

[0016] FIG. **8** is a side elevation view of the leg assembly of the invention and shown with the protective armor removed.

[0017] FIG. **9** is a side elevation view of the weapons cradle of the invention.

[0018] FIG. **10** is a plan view of the weapons cradle of the invention.

[0019] FIG. **11** is a signal flow diagram of the invention.

[0020] FIG. **12** is a perspective view of a remote controller for use in controlling the movements of the various systems of the invention.

[0021] FIG. **13**A is a perspective view of the suspension system for use on the mobile platform. FIG. **13**B is a perspective view of the suspension system and wheel.

DETAILED DESCRIPTION OF THE INVENTION

[0022] The invention comprises a soldier equipped with interchangeable weapon systems coupled to a chassis. The weapons may include a rifle or machine gun firing a standard military round such as a 5.56 mm or 7.62 mm. Alternatively the soldier may include a grenade launcher or missile launcher. A laser sighting system assures accuracy of the weapons.

[0023] The soldier rotates the weapons in a 360 degree manner while the altitude of the weaponry may be raised and lowered. A global positioning system may be included for location and control by a remote operator. The soldier may be equipped with omni and vertical direction view cameras for performing surveillance and target acquisition.

[0024] The outer skin of the soldier is equipped with a total body electrification system to protect it from unauthorized manipulation. This may also be used to stun an enemy and render them unconscious. The soldier may squat down during attacks and movements to lower its center of gravity for stability purposes. It may be equipped with titanium armor for withstanding attacks.

[0025] It may also be programmed with facial, voice and other such recognition systems. It may include a gas deployment system and a nuclear, biological and chemical detec-

tion system. Duplex communications is provided between the soldier and a remote operator for providing operating instructions and real-time data.

[0026] FIGS. 1A through 1C show views of the robotic soldier 1. The robotic soldier is anatomically correct and includes a head 5, mounted atop a torso 10 via a mount 7. The head 5 comprises an imaging and targeting system, preferably a TacFLIR III multi-sensor system 6 that provides stable imagery regardless of vehicle movement or vibration. The TacFLIR III multi-sensor system 6 includes a 450 mm thermal imaging zoom feature that allows the robotic soldier 1 to see targets at distant ranges and through a variety of conditions including smoke, fog and other battlefield obscurants. The TacFLIR III multi-sensor system 6 further includes a laser range finder and may include a laser pointer to pinpoint targets of interest. The TacFLIR III multi-sensor system 6 is sold by FLIR systems of Wilsonville Oreg. Moreover, TacFLIR III multi-sensor system 6 may include a multi-mode auto tracker that tracks and targets multiple targets simultaneously. In a preferred embodiment, the TacFLIR III multi-sensor system 6 is linked to a fire control system of the robotic soldier in series with the smart motors of the robot to control the targeting. The TacFLIR III multi-sensor system 6 includes a motor and gyro for 360 degree rotation and image stabilization.

[0027] Two arms 15 attach to the torso 10. Each arm 15 includes a weapons system. In FIG. 1, the right arm is equipped with a stunning weapon 16, such as a TASER, that delivers a large electrical shock to render an enemy unconscious. The left arm is equipped with a weapons cradle 55 that supports a weapon 29. A camera 30 sits atop the weapon 29. Camera 30 includes an individual power source and wireless transmitter that transmits optical data to a user. The weapons cradle 55 is preferably attached to the arm 15 via a fastening means such as a pair of threaded studs 19 and nuts 18.

[0028] A pair of legs 35 attach to the torso 10 and comprise base plates 36 which include bolts 37 for coupling the base plate 36 to a moveable platform 65. The movable platform 90 comprises an antenna 100 for receiving signals from the remote controller 79. A speaker/microphone 101 is mounted on the front of the platform 90 for establishing communications between the user and another near the soldier 1. The platform 90 is equipped with a plurality of tires 102. The platform includes a speaker amplifier 103. Batteries 104 are included in the base of the platform 90. An additional gyro 105 is provided for stabilizing the platform. Motor controllers 106 and 107 provide control signals for controlling a plurality of motors that drive the tires 102. Each motor operates independent of the others to allow single tires to be locked or move in a forward or rearward direction. Thus, the platform has a tank type steering and independent power to each wheel. The exterior of the robotic solder 1 is covered with body armor 8. Preferably, the body armor 8 comprises titanium, a lightweight aluminum, Kevlar or the like which serves to protect the internal workings.

[0029] FIG. 2 is an elevation side view of the robotic soldier 1 with the body armor 8 removed. A plurality of linear actuators 20 and motors 21 are arranged to operate arms 15 and legs 35, as discussed hereinafter. Another actuator 50 and associated motor 21 connects between the base and the back of the upper leg assembly 47 to cause the robotic soldier 1 to move between a squatting or travel position and an upright position. The linear actuator 20 includes a 4 inch stroke and is sold by Ultra Motion of Mattituck NY under the part number 3-B.125-SM174-1NO-RBC4S/RBC4S. The actuator 20 has a maximum force of 500 lbs with a maximum speed of 6.1 inches/second. Actuator 50 has an 8-inch stroke and is also sold by Ultra Motion of Mattituck NY under the part number d3-B.1 25-SM17-8-1NO-RBC4S/RBC4S.

[0030] Each arm 15 comprises upper arm assembly 26 and lower arm assembly 25 that connects to torso 10 via a shoulder bracket 23. An azmith motor 11 comprising a brake rotates the torso up to 360 degrees and is sold by Animatics of Santa Clara, Calif. under model number SM3450D-BRK. Motor 11 comprises a brushless servo motor, amplifier and controller, along with a fail safe brake. Each leg 35 comprises an upper leg assembly 47 and a lower leg assembly 48 that connects to a leg base plate 36. A base actuator clevis 51 is provided below the leg base plate 36 for connecting the robotic soldier 1 to the base.

[0031] FIGS. 3 and 4 are views of the torso 10 without the arms 15. The torso 10 includes a pair of shoulder brackets 23 for fastening arms 15 onto torso 10. Each bracket 23 fastens onto a tube frame 32 that supports motor 11. A yoke 24 couples to an end actuator 20 via pivot pin 22. An opposite end of actuator 20 connects to actuator base plate 27. A planetary gearbox 12 is provided between upper torso mounting plate 13 and motor 11. Planetary gearbox 12 is sold by Parker Bayside Model PS90-070-SU and is a gear reducer. Shaft coupling 43 connects between upper shaft 14 and lower shaft 44. Lower shaft 44 connects through bearing 42.

[0032] FIGS. 5 and 6 are views of the arm assemblies. A bearing bushing 40 is mounted onto frame 32. Shoulder bracket 23 is also mounted to tube frame 32. An end of arm rod 33 passes through collar 39 and is fastened into bearing bushing 40. Yoke 24 is fixed onto arm rod which also passes through shoulder bracket 23 and collar 39. Upper arm assembly 26 is fastened onto an opposite end of arm rod 33 via bolt assembly 34. The yoke 24 attaches to actuator 20 via rod clevis 28 and clevis retaining bolt 38. Lower arm assembly 25 comprises power pin connectors 3 for operating a solenoid for weapons control, as discussed hereinafter. Threaded studs 19 are provided for securing a weapons cradle 55.

[0033] FIGS. 7 and 8 are views of the leg assemblies. Waist cross member 9 attaches to tube frame 32 via welds or the like. An upper end of each leg assembly 47 attaches at opposite ends of cross member 9 via hip pins 41. Two actuators 20, driven by accompanying motors 21, connect to yokes 24 at one end. An opposite end of the actuator 20 connects to cross member support 49 via yokes 24, as shown. Cross member 49 includes a third yoke 24 for accepting a clevis that couples actuator 50 thereto. As can be appreciated, the pair of actuators 20 cause the torso 10 to be tilted forward and backward by extending and retracting the actuators 20. The actuator 50 causes the soldier 1 to squat or stand depending on whether the actuator is extended or retracted. As the actuator 50 extends, an angle between the back of the upper leg assembly 47 and lower leg assembly 48 becomes greater since the leg assemblies rotate relative to one another via pin 46.

[0034] FIGS. **9** and **10** are views of the weapons cradle **55**. The weapons cradle **55** comprises a pair of supports **57** for securing a weapon **56** to the robotic soldier. A camera **62** is mounted atop the weapon **56**. Camera **30** may include a power supply and transmitter for transmitting optical data including an aiming point for targets to the user. Nut assemblies **18** mate with studs **19** on arm **15** to secure the cradle **55** to the robotic soldier **1**. A solenoid **58** is mounted to the cradle **55** or trigger guard **59** and includes a moveable element **61** that engages trigger **60** causing weapon **56** to fire. Power is supplied to solenoid **58** via power pin connectors **3**.

[0035] FIG. **11** is a signal flow diagram showing a preferred embodiment of the various control and feedback signals. A first transceiver **300** is electrically coupled to a remote control **301** and a display **302**. The first transceiver **300** receives a wireless signal from the weapon camera **30** as well as other optical data from a second transceiver **305**. Control signals are transmitted from the first transceiver **300** to the second transceiver **305**. The second transceiver **305** receives/sends duplex signals from the first and second FLIR cameras, left and right arm actuators, the lower actuators, the motors from the wheels as well as the torso motor.

[0036] FIG. **12** is a perspective view of a remote control **79**. The remote control comprises a video monitor screen **80** for displaying optical data fed back from the cameras onboard the solder **1** and platform **90**. A speaker/microphone combination **88** provides audible input and output to communicate with others near the robot **1**. Switch **81** provides input for controlling a camera on the platform **90**. Fire control switch **82** provides control signals for firing the weapon mounted on the left arm. Joystick **83** provides control signals for the tank style mix steering. Joystick **84** controls upward and downward movements of the torso as well as the clockwise or counter-clockwise rotation of the torso. Joystick **85** controls the elevation of the weapons. Switch **86** controls the weapon fire control switch of the right arm. Knob **87** controls rotation of the camera on the head of the soldier.

[0037] FIGS. **13**A and **13**B shows a shock absorbing system for the platform. The shock absorbing systems include a shock absorber **118** that includes a clevis **119** that attaches to mounting bracket yoke **120**. An opposite end of the shock absorber **118** attaches to a lower shock bracket **117** via clevis pin **115**. Lower shock bracket **117** attaches to upper rocker arm assembly **116**. A chassis mount plate **114** attaches between upper rocker arm assembly **116** and lower rocker arm assembly **111** via bolts **112**. Motor **113** is coupled to tire **102** via gearbox **109**. Gear box **109** is secured between upper rocker arm assembly plate **125** and lower rocker arm assembly plate **124**. Tire **102** is mounted on rim **108** which attaches to hub **121** via lug studs **122** Wheel hub **121** is connected to an output shaft of gearbox **109** via wheel hub attachment bolts **123**.

[0038] It is to be understood that the invention is not limited to the exact construction illustrated and described above, but that various changes and modifications may be made without departing from the spirit and the scope of the invention as defined in the following claims.

I claim:

1. A robotic soldier comprising:

a torso including a frame having a torso motor mounted therein that rotates said torso, said frame also including a pair of shoulder brackets;

a pair of arms, each arm having a connecting rod passing through one of said shoulder brackets and that connects the arm to a linear actuator for causing the arm to rotate relative to the shoulder bracket;

a weapon cradle removeably attached to one of said arms;

a pair of legs attached to said frame and including a cross member that includes a first yoke and a second yoke;

a torso actuator comprising a clevis and connected to said first yoke to cause the torso to tilt forward and backward;

an elevation actuator comprising a clevis and connected to said second yoke to change an elevation of the torso;

a head comprising a camera attached to said frame opposite the pair of legs; and,

a base comprising a plurality of wheels for propelling said robotic soldier in a direction of travel, said base including a power source for supplying power to the robotic soldier.

2. The robotic soldier of claim 1 further comprising a weapon affixed in said weapon cradle and having a camera affixed atop the weapon, said camera including an individual power source and a wireless transmitter that transmits optical data to a user.

3. The robotic soldier of claim 1 wherein the weapon cradle attaches to one of said arms via a fastening means that comprises a pair of threaded studs and nuts.

4. The robotic soldier of claim 1 wherein each of said linear actuators comprise two ends, each end having a clevis through which a pin passes to attach each of said linear actuators to the robotic soldier.

5. The robotic soldier of claim 1 wherein said head comprises a TacFLIR III multi-sensor system.

6. The robotic soldier of claim 1 wherein said torso motor comprises a brushless servo motor, amplifier and controller, along with a fail safe brake.

7. The robotic soldier of claim 1 each wheel for propelling said robotic soldier comprises a motor connected thereto and independent suspension system.

8. The robotic soldier of claim 1 wherein each of said legs comprises an upper leg assembly and a lower leg assembly connected together via a pivot pin, said lower leg assembly connecting to a leg base plate.

9. The robotic soldier of claim 1 wherein said weapon cradle further comprises a solenoid that actuates a trigger on a weapon mounted within the weapon cradle.

10. The robotic soldier of claim 1 further comprising a remote controller that includes a plurality of joysticks and switches, said joysticks providing control signals for steering the robotic soldier, raising and lowering the torso of the robotic soldier, rotating the torso of the robotic soldier, said switches providing control signals for firing a weapon, rotating a camera, and communicating with others.

11. The robotic soldier of claim 1 further comprising exterior armor.

12. A robotic soldier comprising:

a torso including a frame having a torso motor mounted therein that rotates said torso, said torso motor comprising a brushless servo motor, amplifier and controller, along with a fail safe brake, said frame also including a pair of shoulder brackets;

a pair of arms, each arm having a connecting rod passing through one of said shoulder brackets and that connects the arm to a linear actuator for causing the arm to rotate relative to the shoulder bracket;

a weapon cradle removeably attached to one of said arms via a fastening means that comprises a pair of threaded studs and nuts, said weapon cradle comprising a solenoid for actuating a trigger on a weapon mounted in the weapon cradle;

a weapon affixed in said weapon cradle and having a camera affixed atop the weapon, said camera including an individual power source and a wireless transmitter that transmits optical data to a user;

a pair of legs attached to said frame and including a cross member that includes a first yoke and a second yoke, each of said legs comprises an upper leg assembly and a lower leg assembly connected together via a pivot pin, said lower leg assembly connecting to a leg base plate;

a torso actuator comprising a clevis and connected to said first yoke to cause the torso to tilt forward and backward;

an elevation actuator comprising a clevis and connected to said second yoke to change an elevation of the torso;

a head comprising a TacFLIR III multi-sensor system; and,

a base comprising a plurality of wheels for propelling said robotic soldier in a direction of travel, each wheel for propelling said robotic soldier comprises a motor connected thereto and independent suspension system.

13. The robotic soldier of claim 12 further comprising a remote controller that operates the robotic soldier.

14. The robotic soldier of claim 12 further comprising a transceiver for receiving signals from a remote controller and feeding back signals to said remote controller.

15. The robotic soldier of claim 12 further comprising a power supply that comprises a plurality of batteries mounted in said base for providing power to the robotic soldier.

16. An anatomically correct robotic soldier comprising:

a torso having a frame and a torso motor arranged therein to provide rotation to said torso;

a head mounted to said torso, said head including a camera for providing optical data to a user;

a pair of arms mounted to said torso, each arm including a weapon for engaging enemy soldiers;

a pair of legs mounted to said torso for raising and lowering said torso; and

a mobile platform attached to said pair of legs, said mobile platform including a propulsion means for moving said anatomically correct soldier in a direction of travel.

17. The anatomically correct robotic soldier of claim 16 further comprising a targeting system for tracking and engaging multiple targets simultaneously.

18. The anatomically correct robotic soldier of claim 16 wherein said torso motor comprises a brushless servo motor, amplifier and controller, along with a fail safe brake.

19. The anatomically correct robotic soldier of claim 16 further comprising a weapon cradle removeably attached to one of said arms via a fastening means that comprises a pair of threaded studs and nuts, said weapon cradle comprising a solenoid for actuating a trigger on a weapon mounted in the weapon cradle.

20. The anatomically correct robotic soldier of claim 16 wherein said propulsion means for moving said anatomically correct soldier comprises a plurality of wheels, each wheel comprising a motor connected thereto and independent suspension system.

* * * * *