LESSON ASSIGNMENT SHEET

ADA SUBCOURSE 703-3	--Nike Hercules Launching Area.
LESSON 4	--Launcher and Associated Equipment.
CREDIT HOURS	--2.
TEXT ASSIGNMENT	--Attached memorandum.
MATERIALS REQUIRED	--None.
SUGGESTIONS	--See appendix for unfamiliar terms and abbreviations.

TRAINING OBJECTIVES

Listed below are the training objectives for this lesson. These objectives tell you what you should be able to do as a result of your studies. Therefore, you should be familiar with the objectives before you start to study.

When you have completed this lesson, you should be able to:

1. State the physical characteristics of the launching-handling rail.
2. Recognize 10 components of the launching-handling rail and the purpose of each.
3. List the five major components of the launcher.
4. State the physical characteristics of the launcher base and launcher erecting beam.
5. Recognize seven components of the erecting beam and eight components of the hydraulic system and the purpose of each.
6. State the purpose of the erecting strut assembly.
7. State the purpose of the power distribution box, electrical cables, and switches of the electrical system.
8. Recognize the six steps of the launcher-up cycle and seven steps of the launcher-down cycle and the functions performed during each step.
9. State the purpose and recognize the major components of the mobile launcher modification kits and the purpose of the blast deflector.

ATTACHED MEMORANDUM

(This memorandum consists of material approved for resident instruction in the US Army Air Defense School and conforms to current Department of the Army doctrine.)

1. LAUNCHING-HANDLING RAIL

a. General. Equipment associated with the launcher includes the launching-handling rail, launching control-indicator (LCI), and loading and storage racks. The launching-handling rail (fig 4-1) is an oblong, box-type structure supported by two idler and two drive wheels. It is 26-1/2 feet long, 18 inches wide, and weighs 3,000 pounds. Two cable assemblies in the rail interconnect missile circuits with the LCI and section control group through the launcher.

Note. The LCI is discussed in lesson 5, Launching Platoon Control Equipment.

b. Components. The launching-handling rail contains electrical, mechanical, and hydraulic components for supporting the Nike Hercules missile, transporting it along the loading and storage racks, and providing signal paths between the missile and launcher.

(1) Stop bolts, on each side of the rail at the rear, position the missile and support it in the erected (firing) position (fig 3-19).

(2) The MISSILE-AWAY switch inside the rail is activated by an arm extending outside the rail beneath the left stop bolt. An adjusting bolt on the arm is positioned so that the switch is in the closed position when a missile is properly positioned on the rail (fig 3-19). At lift-off (launch), the switch opens, providing a missile-away indication at the section control-indicator (SCI) and launching control console.

(3) Inverted T-sections at the rear and forward ends of the rail (fig 4-1) provide a means for locking the rail to the launcher erecting beam.

(4) Snubber channel and spring clips on the left side of the rail, to the rear of the outrigger (fig 3-24), hold the rocket-motor igniter cable and shorting plug prior to firing. When the missile is prepared for firing, the shorting plug is removed and the cable is connected to a receptacle on the launcher erecting beam. When the missile is fired, the igniter cable, which is looped around two bolts on the snubber channel, breaks, thereby preventing damage to the receptacle.

(5) Outrigger assemblies (two on each side of the rail) provide mobility for the rail (fig 4-1). Two outriggers contain idler wheels and two contain drive wheels. The four wheels ride on the T-tracks of the loading and storage racks and launcher erecting beams. The drive wheels are powered by two inching devices, manually-operated handwheels geared to the drive wheels. Two hooks at the bottom of each outrigger hold the rail to the T-tracks.

(6) A stop and positioning mechanism slows down and stops the rail as it moves across the launcher erecting beam or loading or storage rack. This mechanism (one at each pair of outriggers) consists of two decelerators (fig 4-2) and a brake tube linked to positioning handles (one on each side of the rail).

(a) Each pair of decelerators is connected to a hydraulic reservoir. A decelerator consists of a hydraulic cylinder, piston, piston spring, piston rod, and lug (attached to the end of the piston rod). As the rail moves across the erecting beam (or rack), the lug of the leading decelerator engages a stop on the launcher erecting beam. The piston rod and piston are forced outward, compressing the oil in the cylinder and thereby exerting a braking force on rail movement.

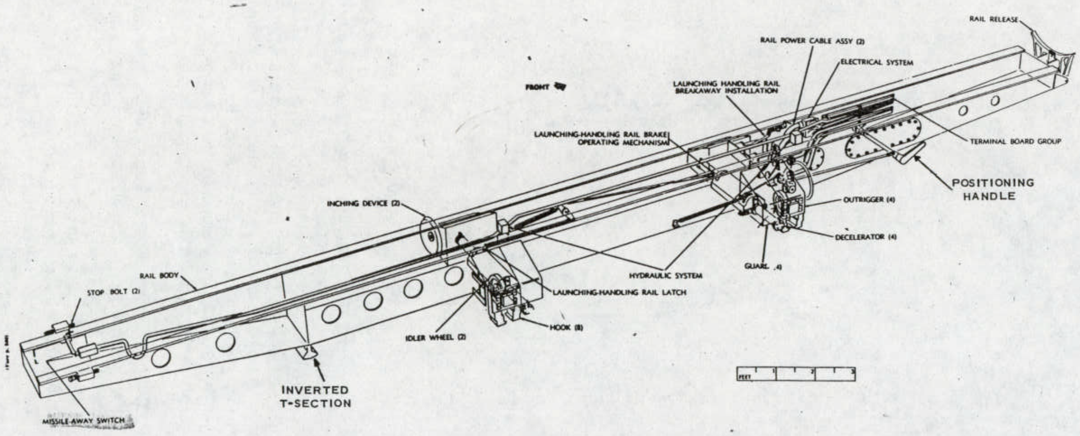


Figure 4-1. Launching-handling rail.

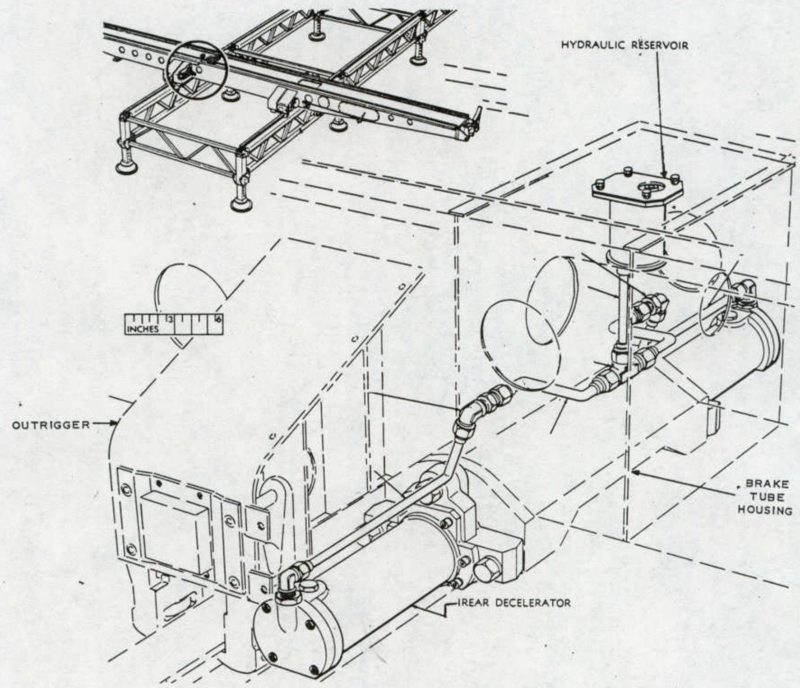
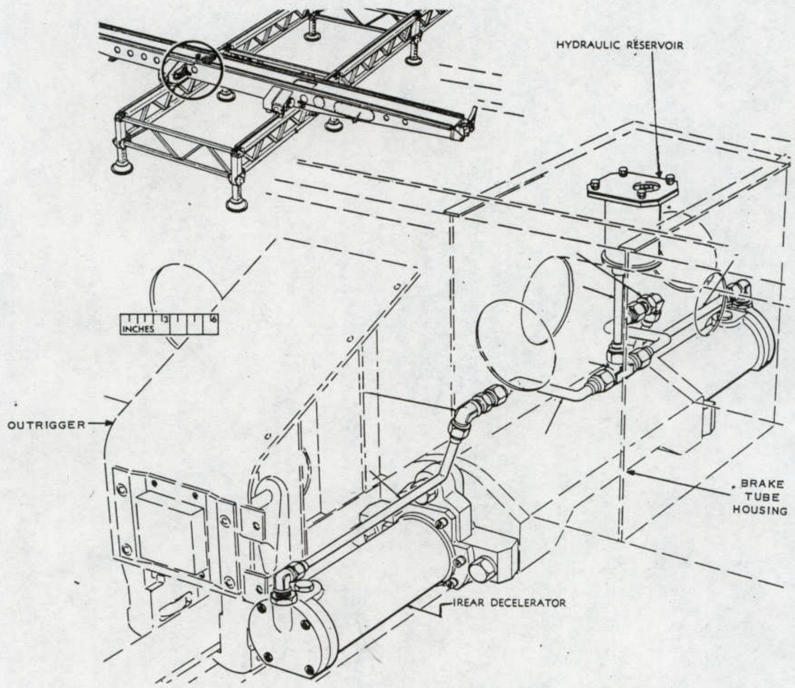


Figure 4-2. Decelerator.

(b) The brake tube consists primarily of a tube, two stop and positioning latches, and two control cams (fig 4-3). As the rail moves across the launcher erecting beam, and while the leading decelerator lug is still engaged by the stop, the leading stop and positioning latch contacts the erecting beam stop and is cammed out of the way. The trailing latch then engages the erecting beam stop, bringing the rail to an abrupt halt while the leading latch snaps down on the other side of the stop. The rail is thereby held in position on the erecting beam or rack.

(c) The positioning handle, when turned downward, rotates the brake tubes at the forward and rear outriggers. This action swings the decelerator lugs, which ride in the slots in the brake tubes, and the stop and positioning latches away from the stops. The rail is now free to move. As the lugs and latches swing upward, two control cams on the forward brake tube swing down. As the rail starts to move, the trailing cam engages the stop, causing the decelerator lugs and stop and positioning latches to return to their



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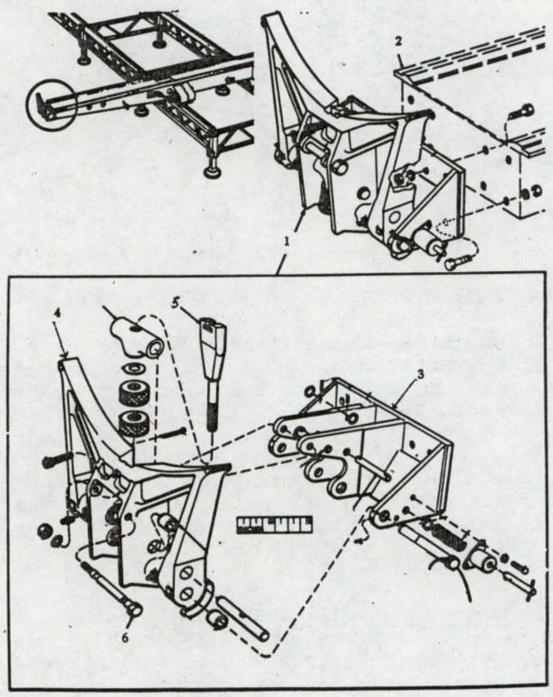
(10) Guidance set cooling system (fig 4-7) at the forward end of the rail provides air-cooling for the missile guidance set, thereby permitting operation of the guidance set for extended periods of time. It consists of a blower assembly, pipe, and two hoses. One hose connects the blower assembly to the pipe. The other hose, which is flexible, provides a connection between the forward end of the pipe to another flexible hose on an access door in the underside of the missile forward body section. At lift-off, the flexible hose pulls free of the access door, which then closes by spring action.

Note. The cooling system is not shown in figure 4-1. The pipe can be seen seen in figure 1-7.



1 - Rail release assembly
2 - Launching-handling rail
3 - Bracket assembly
4 - Yoke assembly
5 - Holder
6 - Shear bolt

Figure 4-6. Rail release.

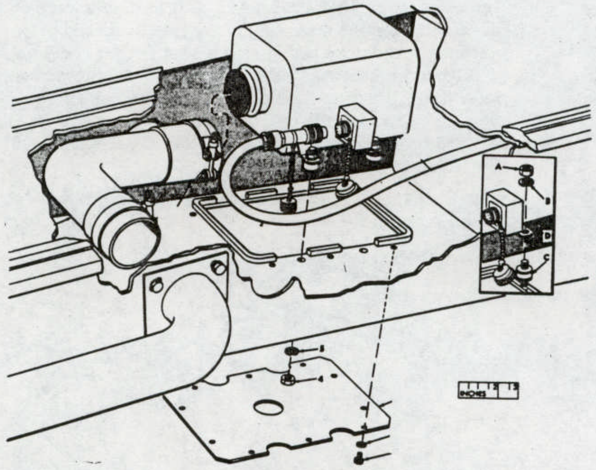


Figure 4-7. Guidance set cooling system.

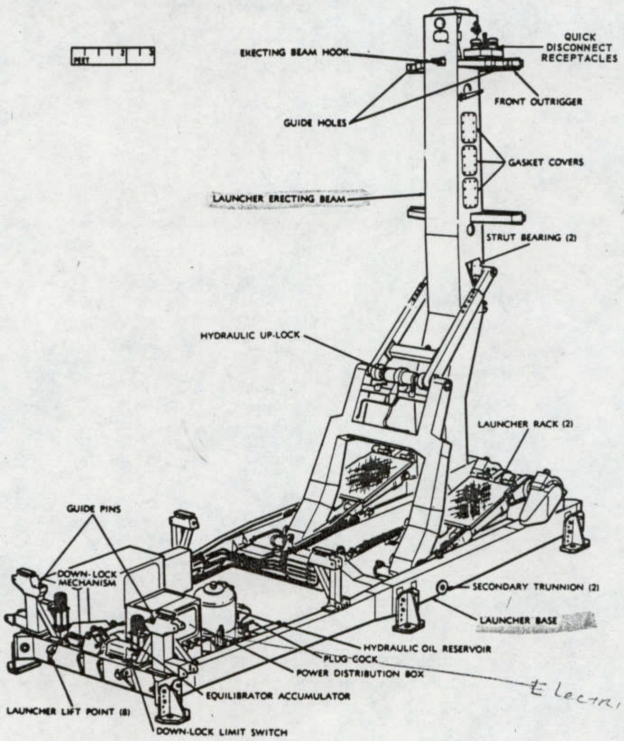
2. DESCRIPTION OF THE NIKE HERCULES LAUNCHER

The Nike Hercules launcher erects the Nike Hercules missile for firing and provides electrical connections between the LCI and launching-handling rail. The launcher consists of a launcher base, launcher erecting beam, erecting strut assembly, hydraulic system, and electrical system (figs 4-8 and 4-9).

a. Launcher base. The launcher base supports the erecting beam, erecting strut assembly, and hydraulic and electrical components of the launcher. The base is a welded, rectangular, steel structure (base frame). It has a main trunnion (fig 4-9) and four bearings that support the erecting beam and two secondary trunnions (fig 4-8) that support the launcher strut. The base is supported at six points, three on each side. It is 8 feet wide, 22 feet long, and weighs approximately 12,000 pounds.

b. Launcher erecting beam. The launcher erecting beam (figs 4-8 and 4-9) is the major moving part of the launcher. It pivots on the main trunnion to erect the Nike Hercules missile. The erecting beam is 22 feet long and 16 inches wide. The rear 7 feet of the beam is stepped down to provide clearance for the rocket-motor cluster fins during loading and handling operations. The beam is raised and lowered by two power and two equilibrator cylinders connected to the main trunnion and launcher strut. The main trunnion has a hollow center and serves as a conduit for all hydraulic lines and electrical cables between the launcher base and the erecting beam. The following components are on or in the erecting beam.

(1) Locking lugs (fig 4-9) and wedge-lock mechanisms (fig 4-10) at the front and rear of the erecting beam lock the launching-handling rail to the beam whenever the electrical circuits for raising the beam are energized. The wedge-lock mechanisms beneath the locking lugs each contain a hydraulic clyinder, locking wedge, and locking piston. When the cylinders are energized, they retract the locking wedges, which, in turn, force the locking pistons up through openings in the beam against the inverted T-sections of the launching-handling rail. The T-sections are forced up against the locking lugs, thereby securing the rail to the erecting beam.



Electrical System

Figure 4-8. Nike Hercules launcher - front view.

(2) Two T-tracks (fig 4-9), welded across the erecting beam front and rear outriggers accommodate the two drive and two idler wheels of the launching-handling rail when the rail is moved onto or across the launcher erecting beam.

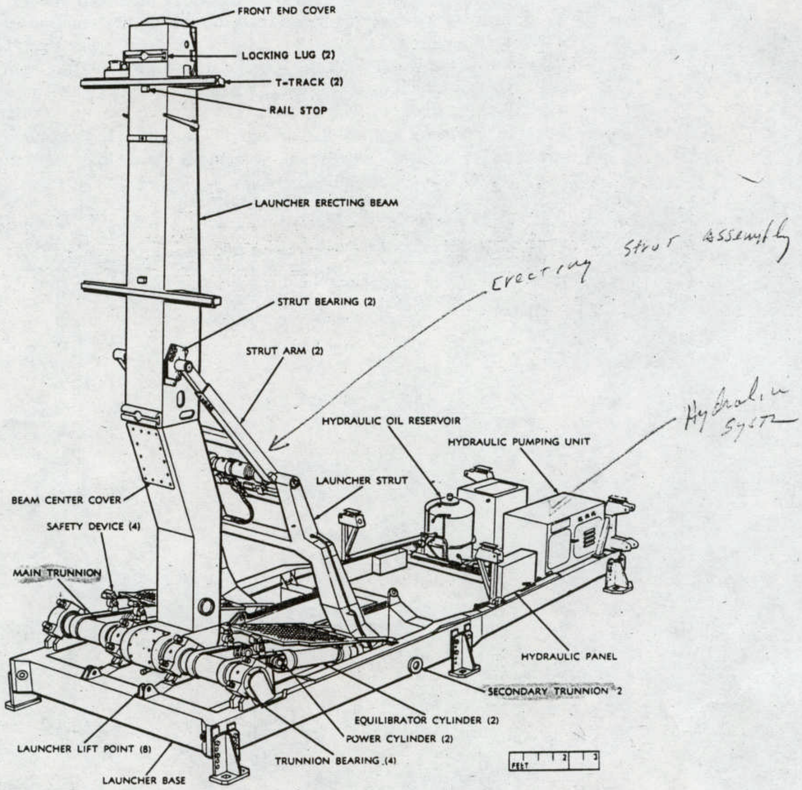


Figure 4-9. Nike Hercules launcher - rear view.

(3) Two guideholes in the front outriggers (fig 4-8) accommodate two guide pins on the launcher base front support for properly positioning the beam in its down-lock position.

(4) Two stops (steel blocks) (fig 4-9) provide the means for stopping and centering the launching-handling rail on the erecting beam (para 1b(6)(b)).

(5) Two quick-disconnect receptacles (fig 4-8) similar to those on the launching-handling rail provide connections for the launching-handling rail electrical cables (para 1b(8)).

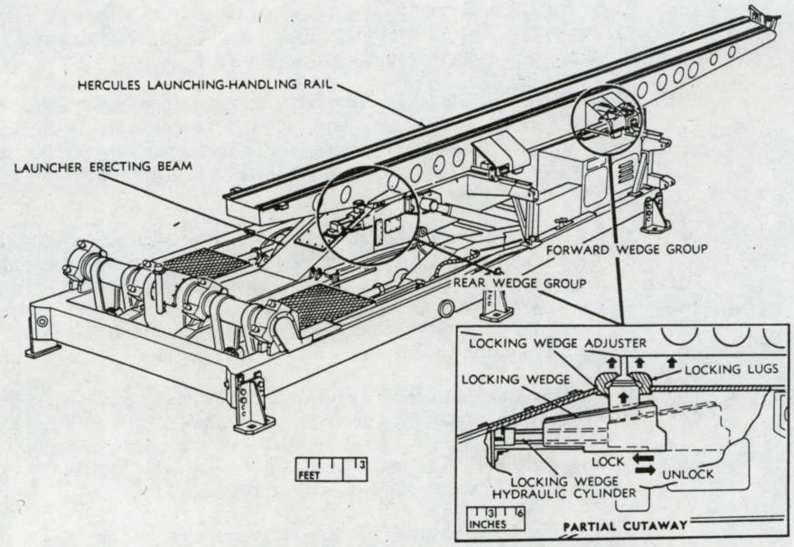


Figure 4-10. Wedge-lock mechanism.

(7) An igniter cable receptacle on the left side of the erecting beam (not shown in fig 4-8) provides a connection for the rocket-motor cluster igniter cable.

(8) An erecting beam hook at the bottom front of the erecting beam latches into the down-lock mechanism to lock the beam in the down position.

c. Erecting strut assembly. The erecting strut assembly, when actuated by the power and equilibrator cylinders, raises and lowers the erecting beam. It consists of a launcher strut and two strut arms (fig 4-9). A hydraulic up-lock mechanically holds the strut and strut arms rigid when the beam is in the up position. The angle of elevation of the beam may be set at 85°, 87.5°, or 90° by positioning the strut bearings on the beam and the telescoping connections of the strut arms.

d. Hydraulic system. The launcher hydraulic system raises and lowers the erecting beam and operates the wedge-lock, up-lock, and down-lock mechanisms. It also provides hydraulic fluid under pressure for the missile HPU and the test stations at the storage racks adjacent to the launcher. Major components of the hydraulic system are a hydraulic oil reservoir, HPU, equilibrator accumulator, hydraulic panel, two power cylinders, two equilibrator cylinders, two wedge-lock cylinders, a hydraulic up-lock cylinder, and a hydraulic down-lock cylinder.

(1) A hydraulic oil reservoir stores approximately 14 gallons of hydraulic fluid for use by the launcher HPU. The oil is pressurized with air at 20 psi prior to use by a compressed gas cylinder in the HPU.

(2) The HPU furnishes high-pressure hydraulic fluid to the launcher hydraulic components. A 20-hp, 3-phase, 400-Hz, ac motor drives a pump in the HPU. The pump design enables it to deliver a nonpulsating flow of hydraulic fluid under continuous working pressure in varying volume as required by system operation.

(3) An equilibrator accumulator furnishes high-pressure hydraulic fluid to the two equilibrator cylinders to provide additional erecting power up to 70° elevation. At this point, a cam-operated valve bypasses hydraulic fluid from the equilibrator accumulator to the hydraulic oil reservoir. When the erecting beam is lowered, the cam-operated valve permits hydraulic fluid to flow from the equilibrator cylinders into the equilibrator accumulator, repressurizing it.

(4) A hydraulic panel serves as the distribution center of the launcher hydraulic system. Hydraulic fluid under pressure flows from the HPU to the panel where it is directed to the power and equilibrator cylinders and the up-lock and down-lock cylinders. The panel contains two speed control valves, four check valves, two priority valves, and two safety valves.

(5) Power and equilibrator cylinders raise and lower the erecting beam. To raise the beam, all four cylinders are used. Power for the equilibrator cylinders is supplied by the equilibrator accumulator. Power for the power cylinders is provided by the HPU. Between 70° and the up-lock position, only the power cylinders furnish power for erecting the beam. To lower the beam, the HPU supplies power to the rear of the equilibrator cylinders. As the beam lowers, return fluid leaves the power cylinders through internal dashpots that close off progressively and through a speed control valve, thereby preventing rapid lowering of the beam. When the beam is down to 70°, the cam-operated valve closes and the hydraulic fluid from the equilibrator cylinders is directed into the equilibrator accumulator, repressurizing it.

(6) Wedge-lock cylinders (fig 4-10) are actuated by two solenoids that control the direction of hydraulic fluid through the cylinders.

(7) Hydraulic up-lock locks the erecting beam struts and strut arms when the beam is in the up position by means of two locking nuts attached to the cylinder pistons. Two helical (coil) compression springs hold the pistons and locking nuts in the extended position to lock the struts and strut arms. At the start of the down cycle, hydraulic fluid enters the cylinder and moves the two pistons inward, compressing the springs, retracting the piston rods and locking nuts, and unlocking the struts and strut arms.

(8) Hydraulic down-lock holds the erecting beam in the down position. Near the end of the down cycle, a helical compression spring holds the down-lock cylinder

piston and rod in the extended position. A clevis attached to the rod engages the erecting beam hook as the beam is lowered to the down position. At the start of the up cycle, hydraulic fluid enters the cylinder, retracting the piston, piston rod, and clevis, releasing the beam hook.

e. Electrical system. The electrical system provides signal paths between the SCI and LCI and between the LCI and launching-handling rail and power for operating the HPU and the launcher relays. The electrical system consists of a power distribution box, electrical cable assemblies, switches, relays, and the HPU motor.

(1) A power distribution box (fig 4-8) distributes 400-Hz ac power from the SSG or section generator to launcher electrical components and the LCI and -28-volt dc from the LCI to the missile. Also, it provides connections for the control and monitoring circuits. It contains a main power breaker switch, circuit breakers, and relays. One relay controls power to the ac motor in the HPU, two relays control power for missile heat and booster heat, two relays control power to the solenoids of the wedge-lock mechanisms, and one relay is a spare.

(2) Electrical cables transfer power from the distribution box, through the launcher base, and into the erecting beam. These cables are connected to the up-lock limit switch, down-lock limit switch, and four terminal boards in the erecting beam. The erecting beam terminal boards, in turn, provide cable connections to the wedge-lock solenoids, squib cable, and to the two launching-handling rail power cable assemblies. The rail power cables are connected to the launching-handling rail through the two quick-disconnect receptacles (fig 4-8).

(3) Electrical switches include the forward and rear lock and unlock switches of the wedge-lock mechanisms and the up-lock and down-lock limit switches. The forward and rear lock and unlock limit switches are mechanically opened and closed by the movement of the wedge-lock mechanism locking wedges. Two up-lock limit switches are actuated by two up-lock limit switch mechanical linkages connected to the hydraulic up-lock assembly. The down-lock limit switch is actuated by a trip latch when the erecting beam hook is engaged by the down-lock clevis. (The trip latch and down-lock clevis are part of the down-lock and latch clevis group.)

3. LAUNCHER OPERATION

Launcher operation may be divided into two phases, the up cycle and the down cycle.

a. Launcher-up cycle. When a launching-handling rail is properly positioned on the launcher erecting beam, the launcher-up cycle is prepared for operation. Electrical circuits for the up cycle are energized when the LAUNCHER ELEVATION switch on the SCI or the LAUNCHER switch on the LCI is set at UP. The following actions take place:

(1) The wedge-lock relay is energized, causing the wedge-lock solenoid valve circuit to be energized to lock and the ac motor relay to be energized.

(2) When the ac motor relay is energized, it causes the ac motor in the HPU to be energized. The ac motor actuates the HPU pump, causing hydraulic fluid under pressure to flow through the wedge-lock solenoid valve in the HPU to the wedge-lock cylinders. The wedge-lock cylinder pistons move the locking wedges to the lock position. The wedge-lock limit switches close, causing the up-down solenoid valve circuit to be energized to up.

(3) When the up-down solenoid valve circuit is energized to up, hydraulic fluid flows through the up-down valve (in the HPU) to the down-lock cylinder, retracting the clevis and releasing the erecting beam hook. Hydraulic fluid also flows through the up-down solenoid valve to the power cylinders.

(4) When the beam hook is released, equilibrator accumulator pressure, applied to the equilibrator cylinders, and HPU pump pressure, applied to the power cylinders (through the up-down valve), raise the erecting beam.

(5) When the erecting beam elevation is approximately 70°, the cam-operated valve (on the left side of the launcher base) opens and ports equilibrator accumulator pressure to the hydraulic oil reservoir. The power cylinders continue to raise the erecting beam.

(6) When the erecting beam reaches its maximum elevation, the hydraulic up-lock mechanically locks the launcher strut and strut arms. The up-lock limit switch linkages activate the up-lock limit switches. The up-lock limit switches deenergize the launcher-up circuits and the ac motor in the HPU.

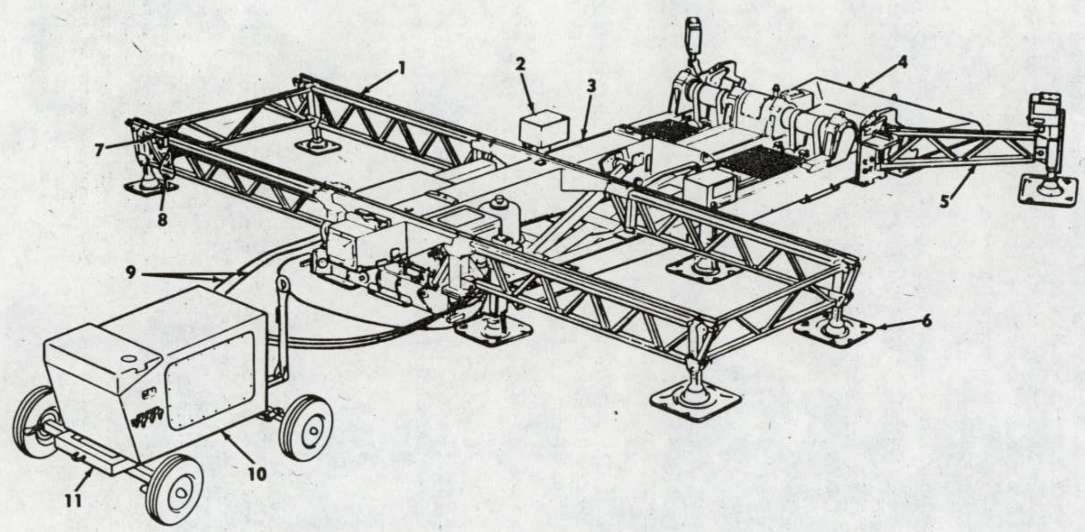
b. Launcher-down cycle. With the erecting beam in the raised position, the launcher-down cycle is initiated by setting the LAUNCHER ELEVATION switch on the SCI or the LAUNCHER switch on the LCI at DOWN. The following actions take place:

(1) The wedge-lock unlock relay is energized, the ac motor relay is energized, and the up-down solenoid valve circuit is energized to down.

(2) When the ac motor relay is energized, it causes the ac motor to be energized. The ac motor actuates the HPU pump, causing hydraulic fluid under pressure to flow through the up-down valve to the hydraulic up-lock cylinder and to the rear of the equilibrator cylinders.

(3) When hydraulic pressure is applied to the up-lock cylinder, both pistons retract, unlocking the launcher strut and strut arms. At the same time, the hydraulic pressure applied to the equilibrator cylinders causes the erecting beam to start its downward movement.

(4) As the erecting beam lowers, the pressure from its weight is absorbed primarily by the power cylinders. At approximately 70°, the cam-operated valve ~~opens~~,closes CAUSING ~~porting~~ hydraulic fluid from the equilibrator cylinders to FLOW INTO the accumulator, repressurizing the accumulator, and also absorbing the weight of the erecting beam.



1 - Loading rack (2)
2 - Hydraulic jack (7)
3 - Launcher
4 - Blast shield
5 - Outriggers
6 - Mounting plates
7 - Electrical test station
8 - Hydraulic test station
9 - Cable assembly
10 - Launcher control-indicator
11 - Dolly

Figure 4-11. Nike Hercules mobile launcher.

(5) After the erecting beam is in the fully down position, the down-lock and latch clevis group engages the erecting beam hook and actuates the down-lock limit switch. The switch energizes the wedgelock solenoid circuit to unlock. Hydraulic fluid flows through the wedge-lock solenoid valve to the wedge-lock cylinders. The cylinder pistons move the locking wedges to the unlock position, releasing the launching-handling rail.

(6) When the locking wedges move to the unlock position, they activate the wedge-unlock limit switches. The switches deenergize the launcher-down circuits and the ac motor.

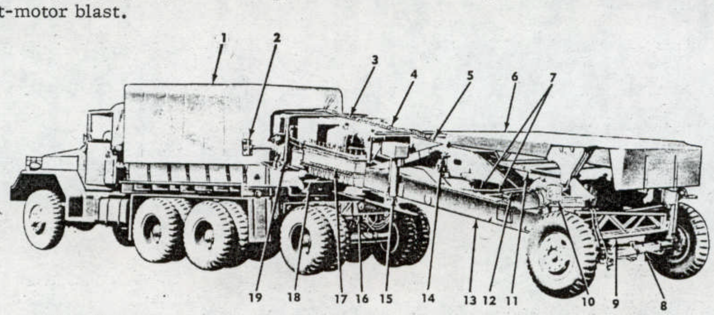
4. NIKE HERCULES MOBILE LAUNCHER

The Nike Hercules mobile launcher (fig 4-11) is used with the Nike Hercules ADA battery (field army). It consists of two launcher modification kits (field adaption and transport) and a launcher shield (blast deflector) in addition to the launcher.

a. Field adaption kit. This kit permits emplacement and march order of the mobile launcher without the use of hoisting equipment. It consists of loading racks, hydraulic jacks, outriggers, mounting plates, electrical and hydraulic test stations (fig 4-11).

b. Transport kit. This kit permits towing the launcher with a standard military prime mover. It consists of a mobile launcher axle, kingpin support, marker lights, a tie-down linkage (for the blast deflector), stop lights/taillights, and hose assemblies (fig 4-12). When towed by truck M54, an M197A1 dolly is required to support the forward end of the launcher as shown in figure 4-12. When towed by truck tractor M52, the dolly is not required.

c. Blast deflector. The blast deflector (figs 4-11(4) and 4-12(6)) stabilizes the launcher during firing by properly distributing the thrust load. Also, it reduces soil erosion caused by rocket-motor blast.



1—Truck M54
2—Marker light (2)
3—Cable assy (5)
4—Cable clamp (4)
5—Electrical test station
6—Blast deflector
7—Hose assy
8—Mobile launcher axle
9—Outrigger (2)
10—Stop light-taillight (2)
11—Emplacement linkage
12—Mounting plate (2)
13—Launcher
14—Tie-down linkage
15—Center jack (2)
16—Dolly M197A1
17—Stake stowage box
18—Kingpin support
19—Forward jack (2)

Figure 4-12. Mobile launcher prepared for travel.