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DST-1130S-200-86-VOL 3  
6 May 1986

FIELD ARTILLERY, WORLDWIDE (U)

VOLUME 3. FIELD ARTILLERY ROCKET SYSTEMS (U)

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DST-1130S-200-86-VOL 3

6 May 1986

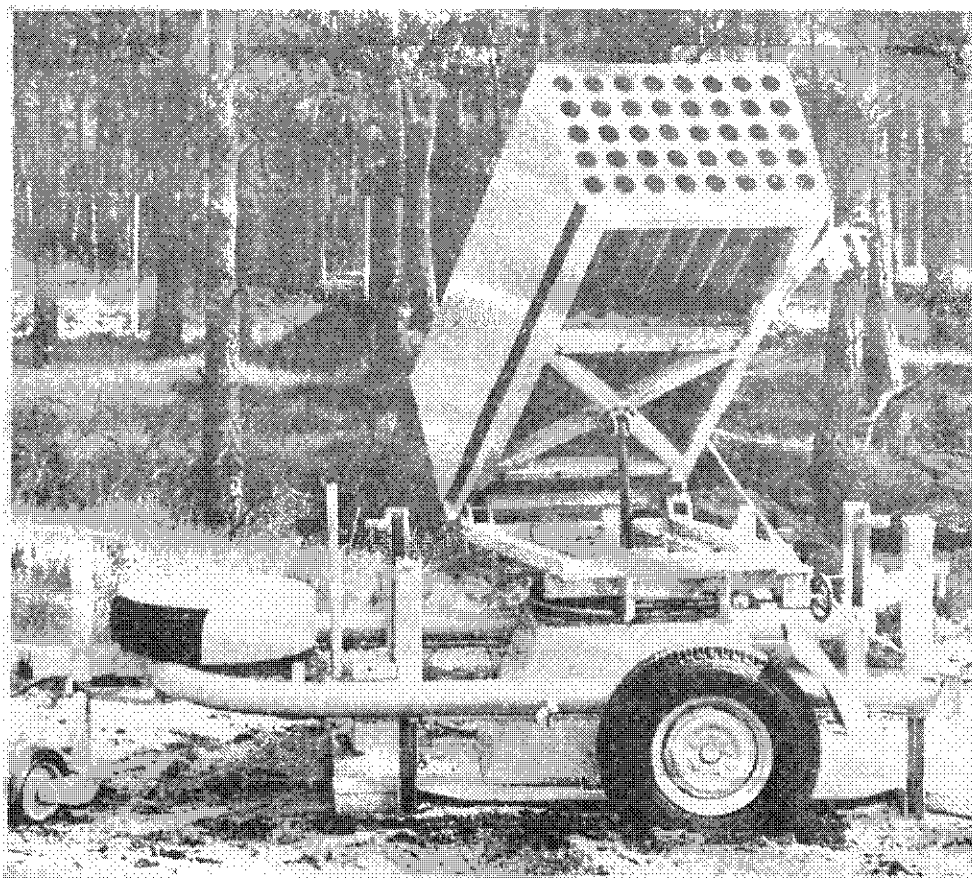
## SECTION II

## BELGIUM (U)

I. General (U)

(U) The Belgian firm Les Forges de Zeebrugge SA has developed and is introducing on the market a new light MRLS designated the LAU 97 (fig II-1). Basically, this is a 40-tube launcher that could be placed on a variety of mounts and fires a 70-mm (2.75-inch) rocket that is a common air-to-ground munition. Unidentified customers in the Far and Middle East reportedly have ordered this system.

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Figure II-1. (U) Belgian LAU 97 70-mm MRL

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DST-1130S-200-86-VOL 3  
6 May 1986

## 2. Launcher (U)

(U) The launcher has been shown mounted on a light single-axle trailer, but it could be mounted on virtually any vehicle with a 1-tonne capacity. The trailer offered by the manufacturer as a platform for the launcher has a tubular chassis with torsion-bar suspension and a small third wheel near the front. The trailer, which has a vertically adjustable tow bar on which a handbrake is mounted, can be adapted to virtually any towing vehicle. A 24 V, long-life, cadmium-nickel (Cd-Ni) battery is mounted in the base of the mount to provide power to the firing controls and to operate the launcher. Azimuth and elevation are adjusted using a two-speed electric motor (fast speed for rapid changes and slow speed for final adjustment), and manual backup controls are provided. The trailer weighs 500 kg and is designed to carry a 1000-kg payload. Data from sales brochures are as follows:

Number of tubes .....	40
Traverse .....	360°
Elevation (maximum) .....	55°
Firing method .....	Electrically/remote device
Fire control (onboard) .....	BR2 mortar sight
Elevation/traverse power ...	Electrical two-speed motor
Length of mount base .....	1.00 meter
Width of mount base .....	0.72 meter
Height of launcher .....	1.45 meters
Weight unloaded .....	565 kg

In travel mode, the trailer-mounted version of the LAU-97 is 4.115 meters long, 1.96 meters wide, and 1.90 meters high.

## 3. Rockets (U)

(U) Originally, the rockets had a maximum range of 6000 meters, but the current rockets achieve 8000 meters, and a new motor that was to be developed in 1983 would extend this to 10 000 meters. The rocket can be armed with any of several interchangeable warheads (13 or 14, according to two different sources) which include HE, smoke, antipersonnel, antitank, illumination, incendiary, antirunway, and flechette. A description of advertised warheads is as follows:

- FZ-32: Training warhead that produces smoke upon impact and weighs 2.9 kg.
- FZ-49: Shaped-charge warhead that penetrates 400-mm armor, produces 1200 fragments, and weighs 3.0 kg.

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DST-1130S-200-86-VOL 3

6 May 1986

- FZ-58: Warhead used against any target that requires penetration before explosion; it has a base fuze and nose-mounted antiricochet plug and weighs 4.52 kg.
- FZ-63: Warhead loaded with white phosphorus for incendiary and smoke and weighing 4.15 kg.
- FZ-71: Antipersonnel warhead producing more than 8000 effective fragments, achieving a 21-meter radius of destruction, and weighing 4.3 kg.
- FZ-85: Controlled-fragmentation warhead producing more than 300 fragments and weighing 4.3 kg.
- FZ-86: Smoke round that produces dense smoke for more than 4.5 minutes and weighs 4.3 kg.
- FZ-100: Warhead containing nine shaped-charge submunitions and weighing 6.7 kg.
- M-257: Warhead that illuminates throughout its trajectory and weighs 4.9 kg.

#### 4. Firing Characteristics (U)

(U) A ripple of 40 rockets can be fired in 5.85 seconds to cover an area of 200 meters by 300 meters at a range of 8000 meters. When the rocket with the HE warhead is fired at an elevation of 40°, the achieved range is 8093 meters, the angle of fall is 64°, the terminal velocity is 197 m/s, and the time of flight is 45 seconds. Also, the circular error probable (CEP) is 170 meters at this firing angle.

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DST-1130S-200-86-VOL 3

6 May 1986

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Figure III-9. (U) ASTROS-II Reload Operation

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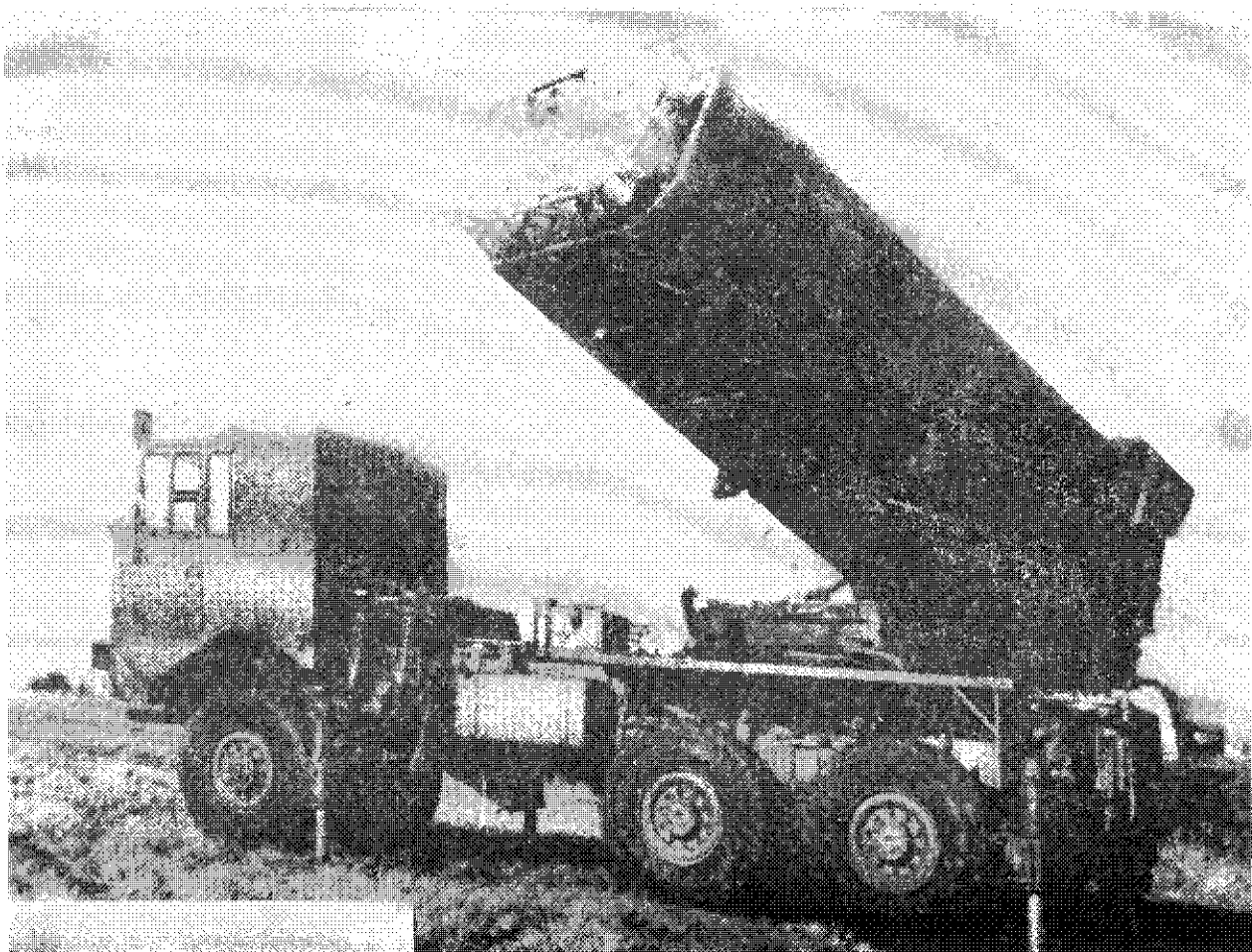
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DST-1130S-200-86-VOL 3  
6 May 1986

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Figure IX-3. (U) Prototype of French MRL SYRA

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6 May 1986

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Figure XV-3. (U) Firos-25 With 40-Tube Configuration

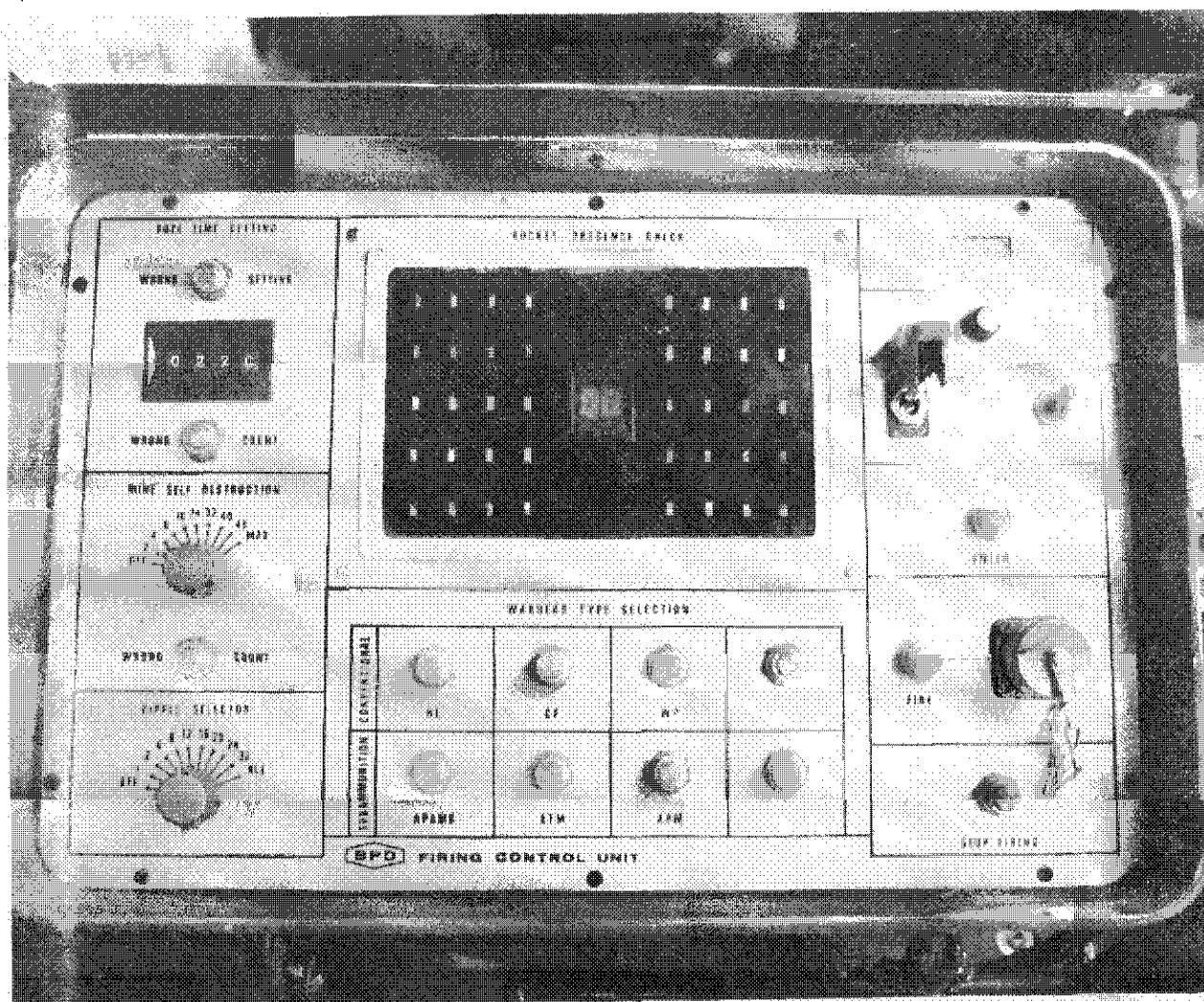
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DST-1130S-200-86-VOL 3

6 May 1986

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Figure XV-4. (U) Firos-25 Fire-Control Panel

(2) (U) Open source literature states that the Ferranti navigation system PADS (position- and azimuth-determining system) MK2 and the FIN1111 attitude-reference system have been selected for use in fire-control system of the improved Firos-25 system. The new fire-control system will use the PADS unit to provide position and orientation data to the battery command vehicle, while the FIN1111 will be offered as an option to allow the individual launchers to be aimed more accurately.

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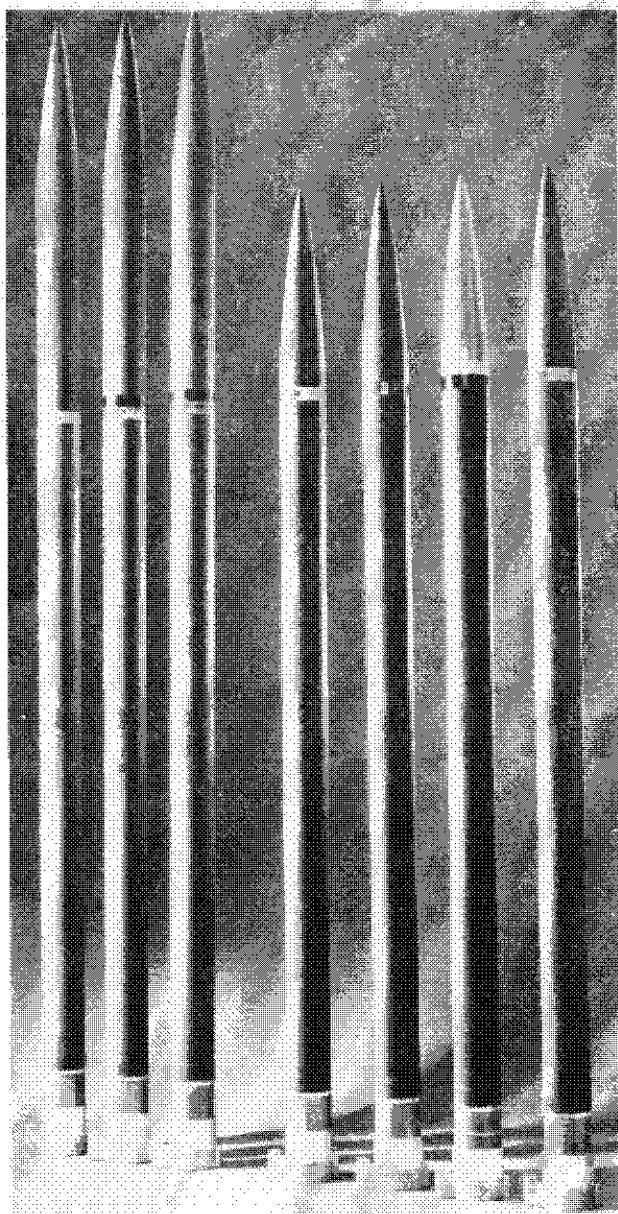
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DST-1130S-200-86-VOL 3  
6 May 1986

e. Description of the Rocket (U).

(1) (U) The 122-mm rocket is available in two versions (fig XV-5) which, according to the type of warhead, differ in relation to the length/diameter ratio.

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Figure XV-5. (U) Family of  
Rockets of Firs-25

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DST-1130S-200-86-VOL 3

6 May 1986

(2) (U) The rocket motor with a double-base solid propellant grain provides a maximum range of not less than 25 km for conventional warheads (HE and perforated fragment--PFF), and a maximum range of not less than 22 km for submunition warheads. Technical data are as follows:

- Caliber: 122 mm
- Length: 2005 mm
- Weight at firing: 35.1 kg
- Weight of propellant: 22 kg
- Specific impulse: 228 seconds
- Maximum pressure: 190 kg/cm<sup>2</sup>
- Average thrust: 5122 kg
- Combustion time: 0.96 second (at 50% max pressure)

(3) (U) The currently available conventional warheads are identical in external configuration and weight and are fitted with the same type of impact fuze. The two types of warheads are:

- An HE natural-fragmentation warhead, which on impact projects fragments against mixed targets.
- A PFF warhead, for use mainly against soft targets. The perforated fragments are spherical and have the optimal size and weight to obtain maximum antipersonnel effectiveness.

Technical data for the warheads are as follows:

- Total weight: 17.3 kg
- Weight of fuze: 0.25 kg
- Weight of explosive: 3.3 kg
- Diameter: 122 mm
- Overall length: 555 mm
- Length of fuze: 50 mm

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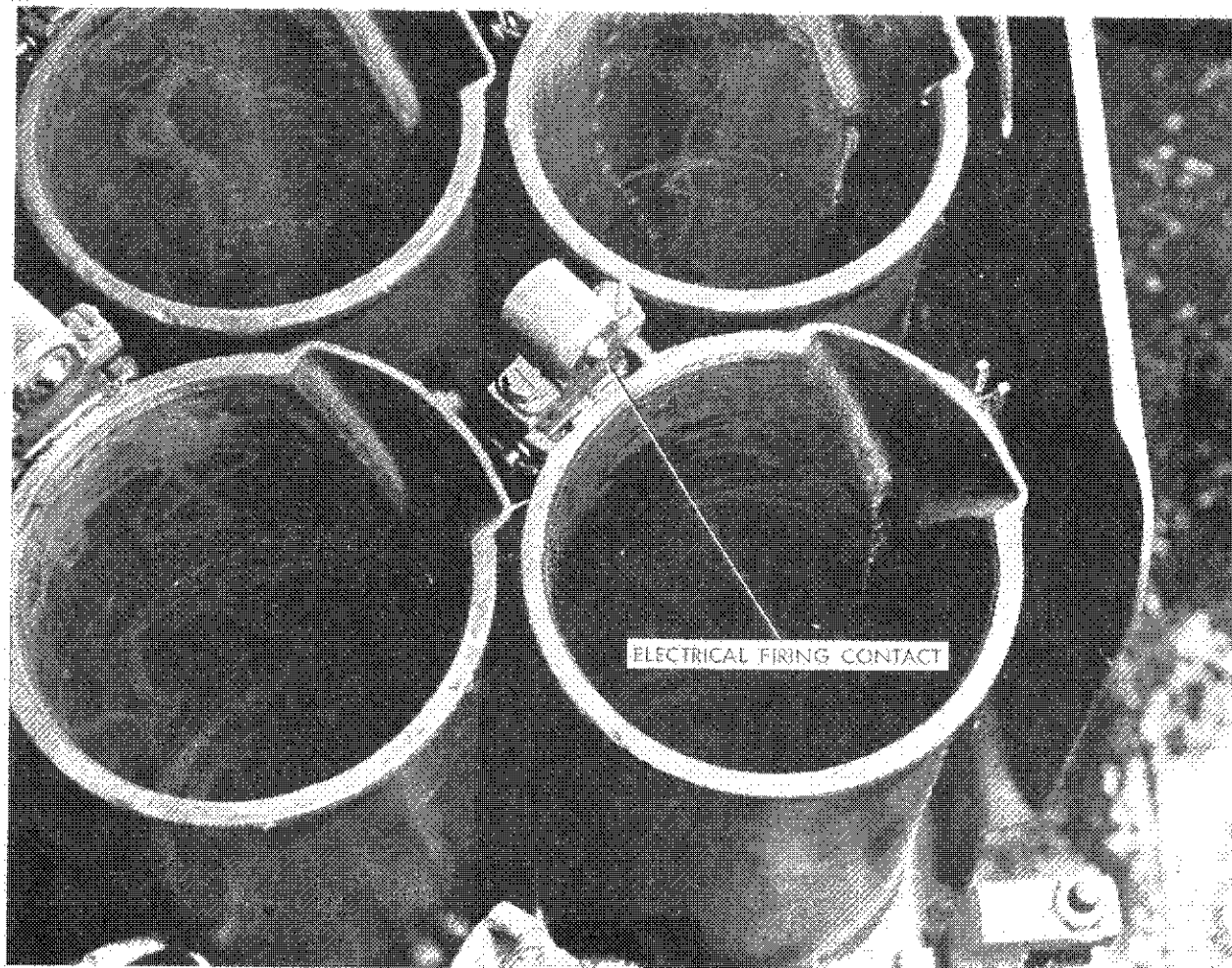
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DST-1130S-200-86-VOL 3

6 May 1986

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Figure XXVIII-13. (U) BM-21 MRL  
Electrical Firing Control

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DST-1130S-200-86-VOL 3  
6 May 1986

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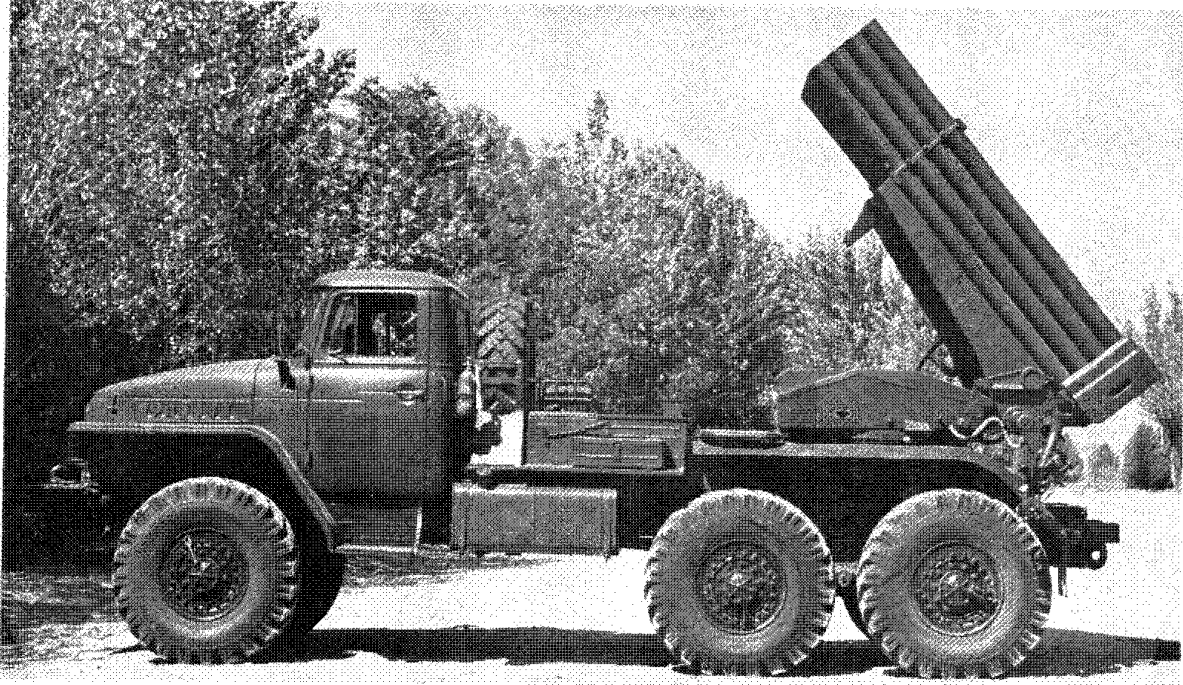


Figure XXVIII-14. (U) Left-Side View of BM-21 MRL

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DST-1130S-200-86-VOL 3

6 May 1986

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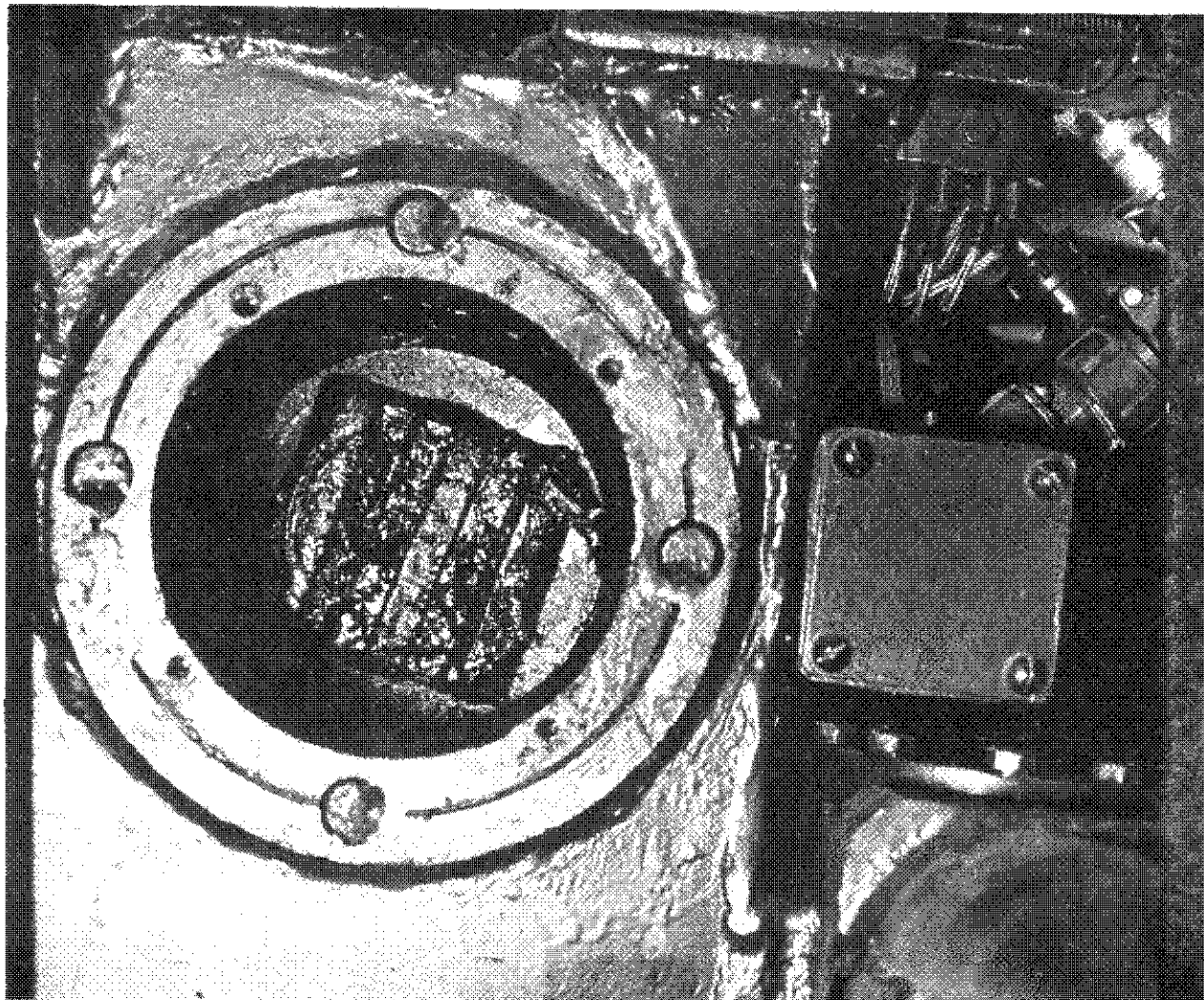


Figure XXVIII-15. (U) Equilibrator  
Torsion Bars on BM-21

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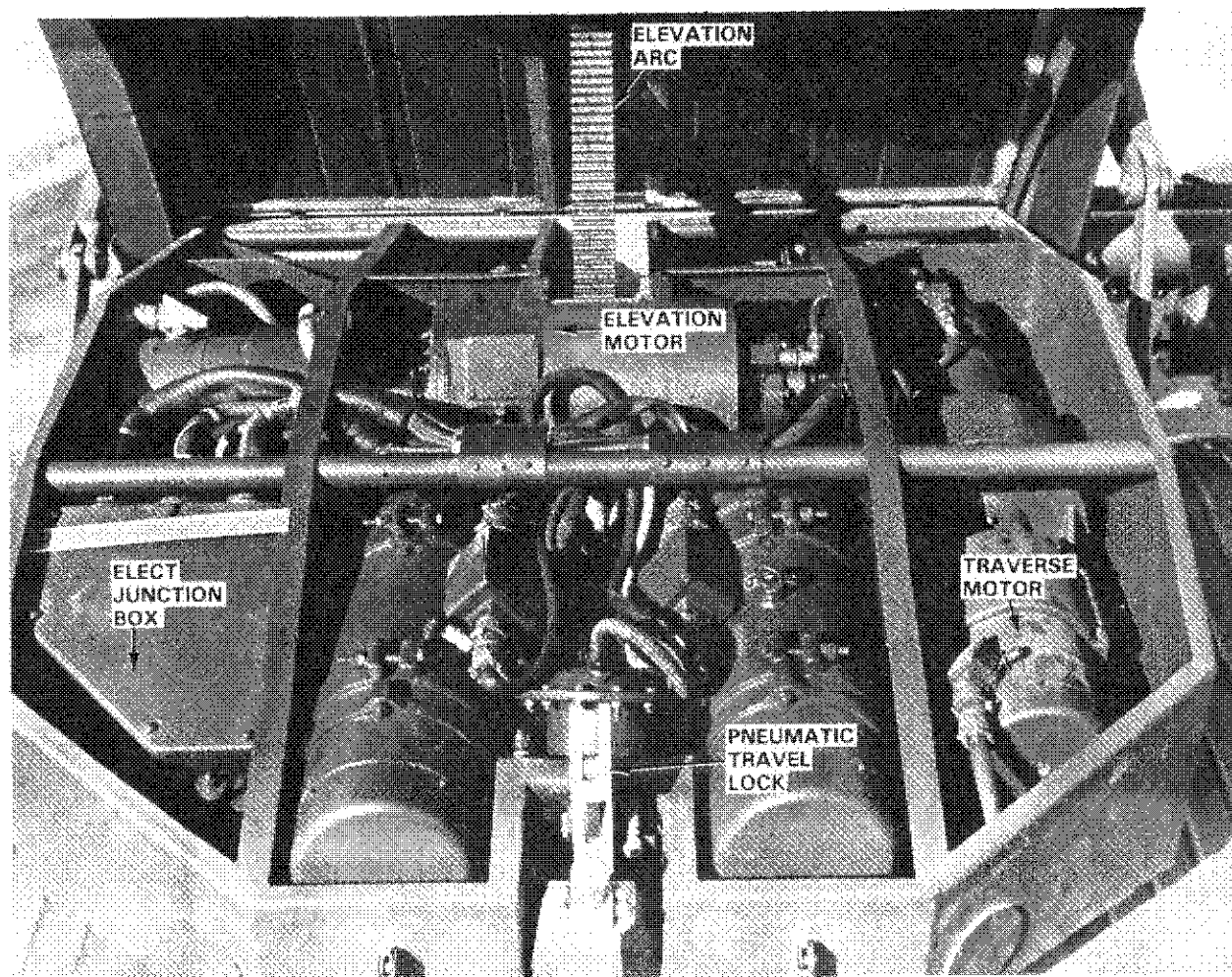


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DST-1130S-200-86-VOL 3

6 May 1986

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Figure XXVIII-16. (U) BM-21 Launcher Power Section

d. Components (U).

(1) (U) Electrical system (U). The BM-21 is basically an electrically operated launcher with a manual backup system. The power source is a 5-kW, 28-V DC generator. The generator, located beneath the vehicle cab, is driven by a power takeoff from the vehicle's transmission gear box. The generator is engaged, controlled, and regulated from the cab of the vehicle. It must be operated at a prescribed revolution-per-minute rate and should produce 27- to 29-V DC. A tachometer and voltmeter mounted on the instrument panel of the vehicle assist in controlling and regulating the system. The generator is cooled by forced air during operation. In the upper carriage, the power is used to elevate and traverse the launcher.

28-16

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DST-1130S-200-86-VOL 3

6 May 1986

(2) (U) Electrical elevations and traversing mechanisms (U).

Both of the mechanisms are essentially the same and will be discussed together, with dissimilarities noted. Direction and rate of traverse or elevation are controlled from the gunner's station by activating the traverse or elevation potentiometer. When power is received in the launcher, it is amplified by an amplidyne and fed to a slave motor (fig XXVIII-16). One amplidyne, one slave motor, and one potentiometer are provided for each mechanism. The only difference in the elevating and traversing mechanism is the manner in which the slave motor is geared to perform its function. The traversing slave motor is connected, through a reduction gear assembly, to a large ring gear attached to the base ring assembly which rotates the upper carriage. The elevating slave motor, through a reduction gear assembly, is connected to an arc gear affixed to the bottom of the tube cluster. Activation of the elevation slave motor elevates and depresses the tube cluster. The elevating and traversing mechanisms are constrained by limiting switches that slow the rate of movement as a limit is approached and break the circuit when the limit is reached.

(3) (U) Mechanical elevating and traversing mechanisms (U).

The manual elevating and traversing mechanisms are driven by a single handwheel located at the gunner's position (fig XXVIII-17). A shifting knob is used to switch from the elevating to the traversing mode, and vice versa. The launcher cannot be operated manually when the launcher is receiving power from the power-supply generator. The electric system has automatic magnetic clutches that block out the mechanical linkage and a lock for the handwheel shaft. The manual system is a linkage of handwheel, shafts, chains, and gears that can perform the same function as the electrically powered system in turning the elevation and traverse gears. Actually, the manual system is an adjunct to the electrical system and provides a backup capability to the electrical system in case of a malfunction in the electrical components. It is also used for fine adjustments in orienting the launcher. The manual system operates in the following manner: When pushed in (outboard), it engages the handwheel for elevation, and when it is pulled out (inboard), it engages the same handwheel for traversing. The manual system cannot be operated unless the sight mount arm is fully extended and locked in the firing position.

(4) (U) Pneumatic system and locking devices (U).

The BM-21 has a pneumatic system with two functions: To operate the launcher travel locks and to operate two lockout devices that stabilize the launcher during firing. A belt-driven air compressor mounted in the vehicle's engine compartment supplies the air. A single control lever mounted in the cab of the vehicle (fig XXVIII-18) has two positions: Travel and combat. In the travel position, the launcher's upper carriage is rigidly locked to the base and the lockout devices are deactivated. Upon arrival at the firing position, the vehicle driver moves the pneumatic control lever to the combat position. The system unlocks the launcher (so it can be elevated and traversed) and activates the lockouts. The lockouts consist of a piston and cylinder device

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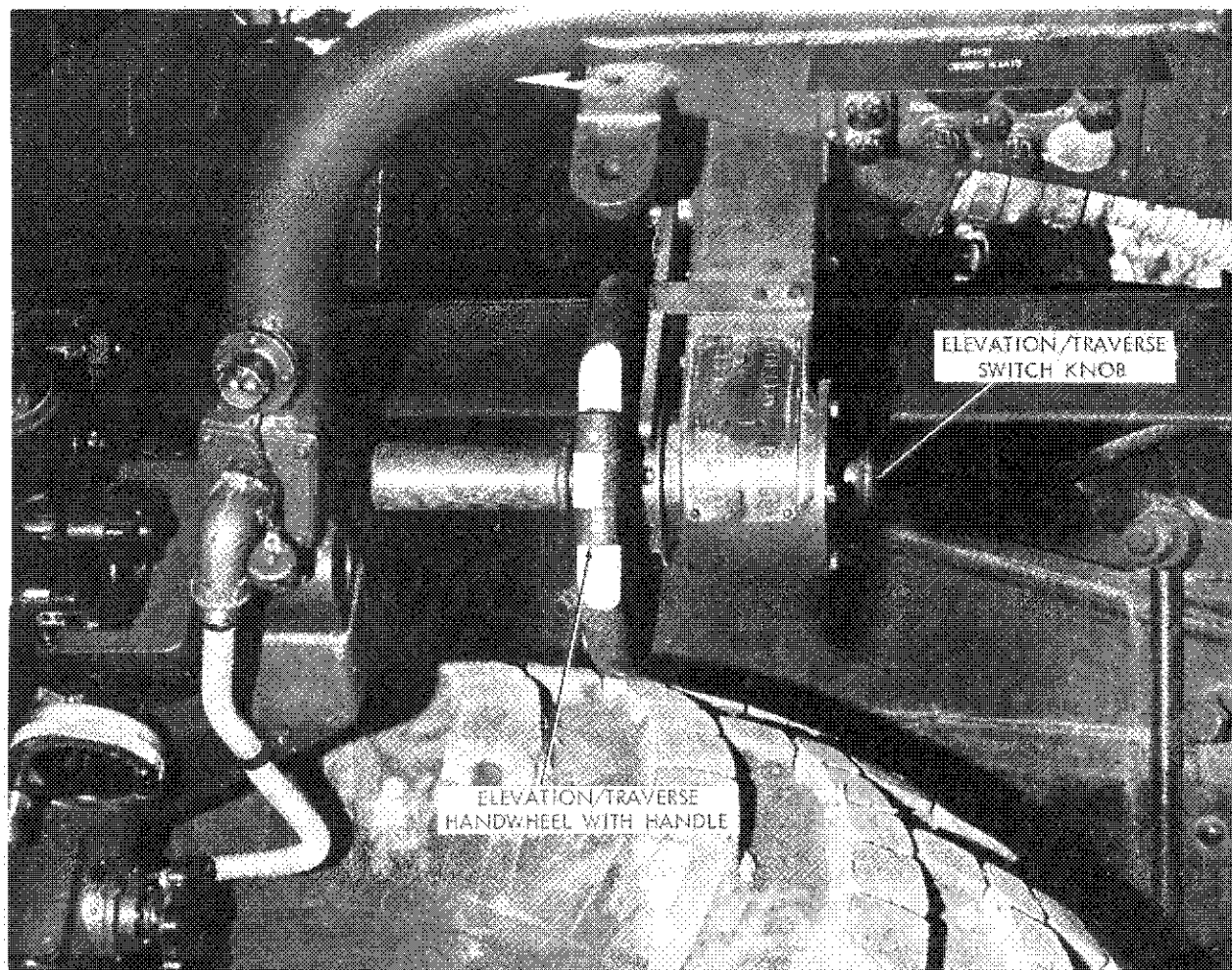
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DST-1130S-200-86-VOL 3

6 May 1986

(the cylinder attached to the base of the launcher and a piston attached to the vehicle axle). The piston floats freely in the cylinder in the travel mode. When activated by the pneumatic system in the combat position, a clamping device locks the piston in the cylinder and forms a rigid connection between the base of the launcher and the vehicle axles.

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Figure XXVIII-17. (U) Manual Controls at Gunner's Station

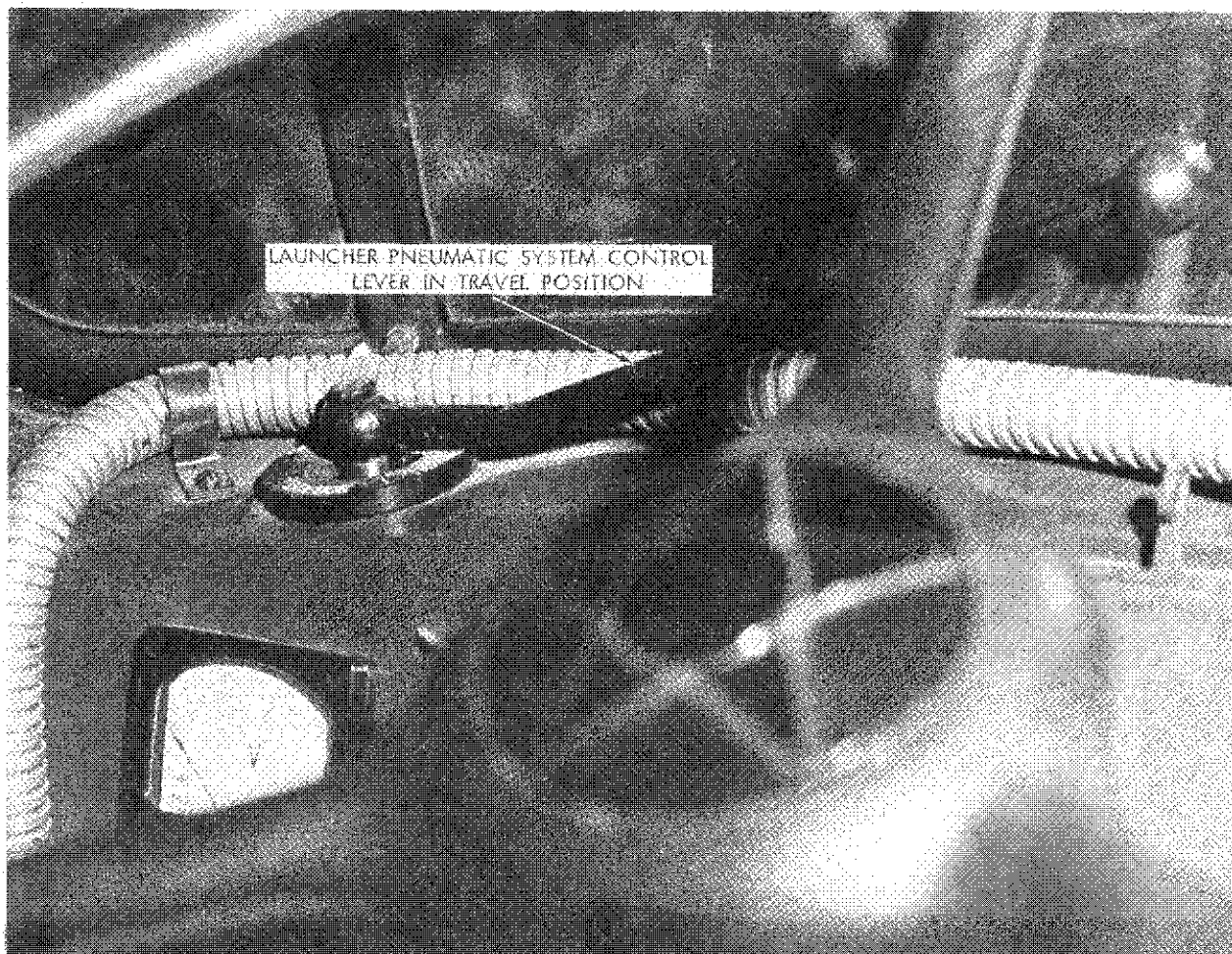
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DST-1130S-200-86-VOL 3

6 May 1986

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Figure XXVIII-18. (U) Pneumatic Control Lever

e. Rocket-Firing Devices (U).

(1) (U) The BM-21 has two firing devices and can be fired from either the cab of the vehicle or from a remote position nearby. The principal device is located in the vehicle cab, and the remote device is attached to it by an electrical cable. Essentially, the principal device (fig XXVIII-19) is an "intervalometer" that fires a set number of rockets (1 to 40) in a fixed sequence, at a fixed 0.5-second interval automatically or at any desired interval if each successive rocket is triggered manually. The remote device (fig XXVIII-20) is basically a component to trigger the principal firing device, which is located near the center of the vehicle cab

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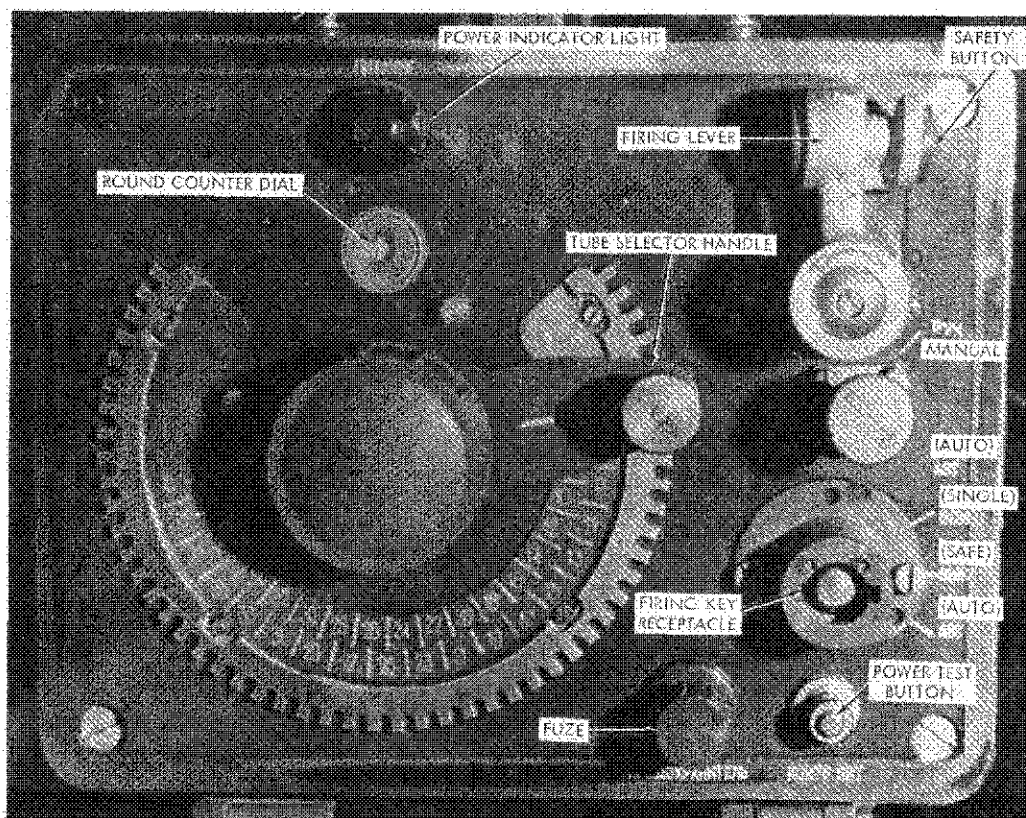
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DST-1130S-200-86-VOL 3

6 May 1986

(fig XXVIII-21). The vehicle's 12-V electrical system provides the current to operate the principal firing device and to fire the rockets. Terminals are located on top of the device to connect an external power source if required. The principal firing device is operated in the following manner: The power test button is depressed, and the power indicator light comes on to indicate the receipt of current. The type-of-fire switch is set in one of the two positions, either automatic or single. The tube-selector handle is rotated clockwise until the number on the dial corresponds to the number of tubes to be fired. The firing key is inserted in the firing key receptacle and turned to either the single or automatic position. The safety button is depressed, and the firing lever is rotated about one-eighth of a turn to the right. To fire automatically, the lever must be held in this firing position until the desired number of rockets has been fired. To fire manually or to fire single shots, the handle must be moved to the right each time a rocket is to be fired. The number of rockets fired is shown on the round-counter dial. The dial is illuminated, and the light comes on when the firing key is turned to one of the fire positions.

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Figure XXVIII-19. (U) BM-21 Firing Device

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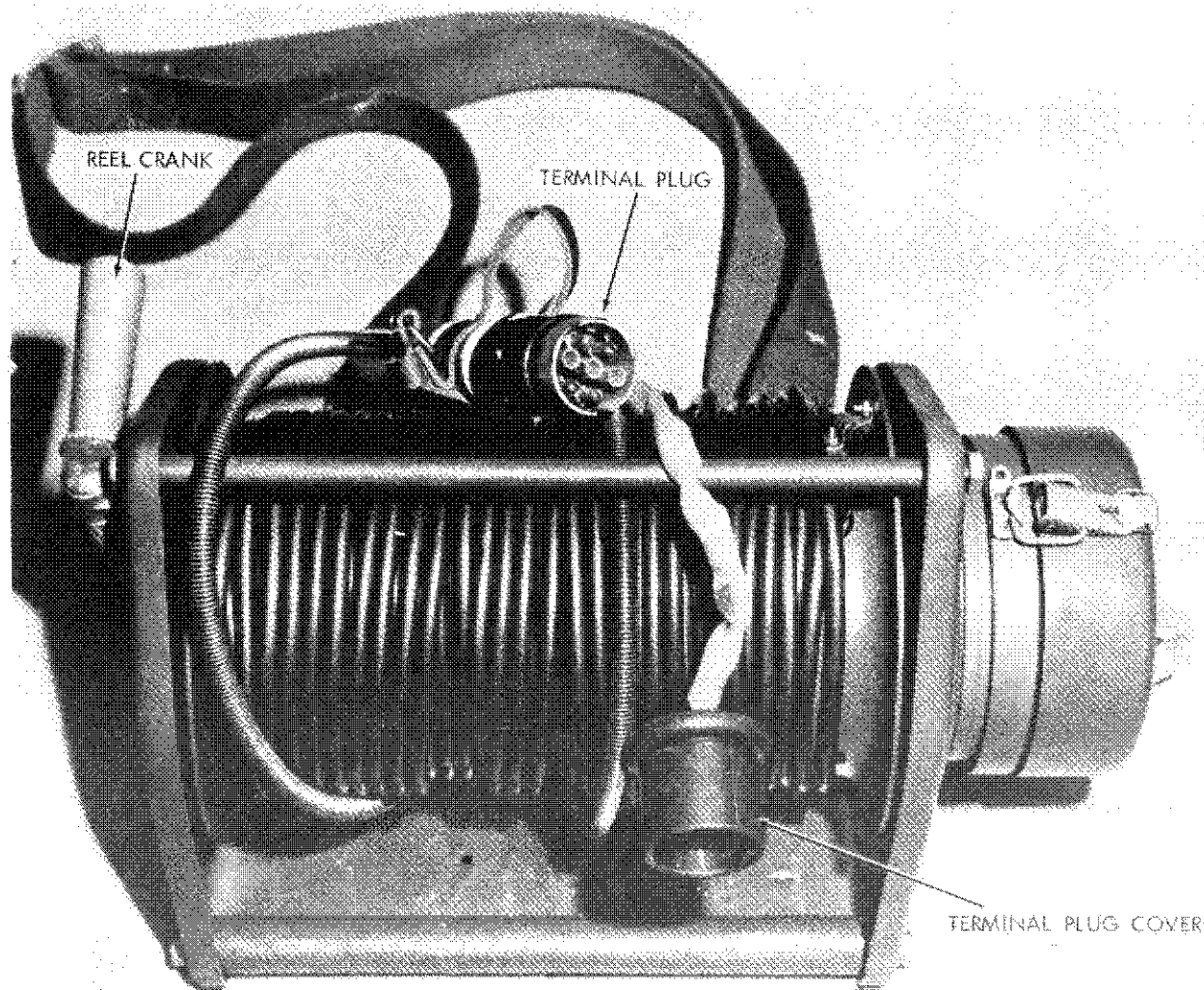
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DST-1130S-200-86-VOL 3

6 May 1986

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Figure XXVIII-20. (U) Remote Firing Device

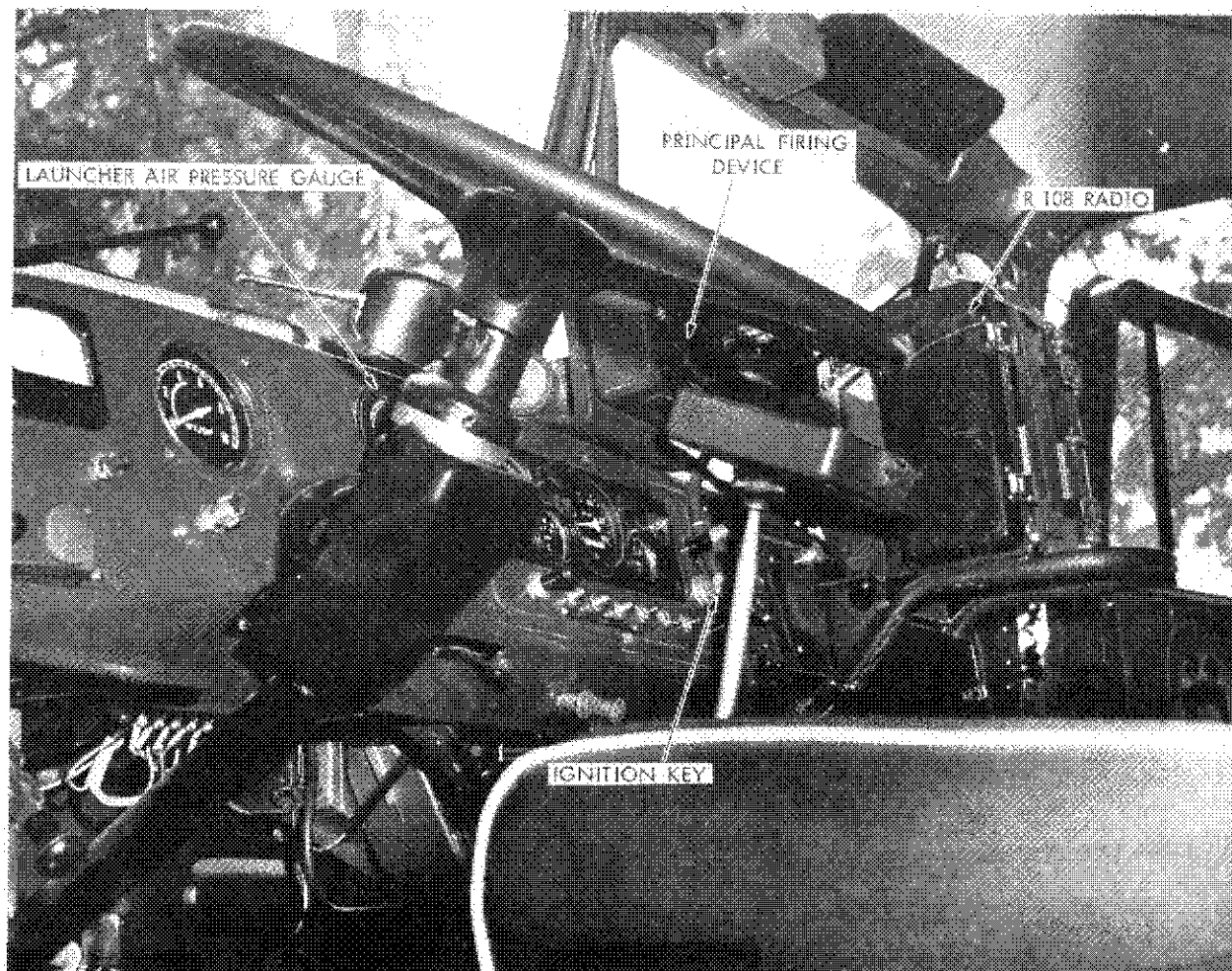
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6 May 1986

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Figure XXVIII-21. (U) Firing-Device Location in Vehicle Cab

(2) (U) The remote device is carried in a storage bin on the vehicle and operated in the following manner: The cable is attached to the firing circuit receptacle mounted on the outside rear of the right side of the vehicle engine compartment, and a few feet of the cable are unrolled. The principal firing device is programmed for the number of rockets to be fired and the type of fire, i.e., automatic or manual-single shots. The power test button on the principal device is depressed, and if power is received in the remote element, the signal light comes on. The remote firing device is then moved to the selected position within the limits of the cable length of 64 meters. When ready to fire, the firing key is inserted and turned to either the automatic or single-shot position. The firing crank is

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