

CHAPTER 6

M61A1 GUN INSTALLATION

Gun systems installed in high-speed aircraft must meet demanding performance requirements and provide firepower. The General Electric M61A1 20-mm automatic gun system, installed in the F-14 and F/A-18 aircraft, meets these requirements.

The M61A1 (fig. 6-1) is a six-barrel, rotary-action, automatic gun based on the machine-gun design of Richard J. Gatling. The gun consists of a revolving cluster of barrels. Each barrel is fired once per revolution. The M61A1 automatic gun is hydraulically driven, electrically controlled, and can fire M50 and PGU-series ammunition at 4,000 to 7,200 rounds per minute. As installed in Navy aircraft, the gun has a pilot selectable firing rate of either 4,000 (GUN LOW) or 6,000 (GUN HIGH) rounds per minute. It is designed for either air-to-ground or air-to-air gunnery missions.

Ammunition is supplied to the M61A1 gun by an ammunition handling and storage system that functions within a specific aircraft. The system uses an endless conveyor that transports 20-mm ammunition from the ammunition drum to the gun. The conveyor then returns the expended cases and unfired rounds to the ammunition drum.

Although the physical location of components varies between different aircraft gun installations, the function and description of the components are essentially the same.

M61A1 AUTOMATIC GUN

LEARNING OBJECTIVE: *Identify the components of the M61A1 automatic gun and recognize the operating principles.*

The primary parts of the gun are the barrels, housing assembly, and rotor assembly. The following paragraphs contain a description of each gun component and an explanation of how each component works. Figure 6-2 shows an exploded view of the gun components, and figure 6-3 shows the gun component locations. As each component is discussed, you should look at these figures.

GUN COMPONENTS

The primary parts of the gun are described in the following paragraphs.

Muzzle clamp assembly. The muzzle clamp assembly is positioned at the outer end of the barrels. It restrains individual barrel movement during firing. It is positioned against the flange on the barrels and secured by the pressure of the self-locking nut assembly against the opposite side of the shoulders.

Mid-barrel clamp assembly. The mid-barrel clamp assembly is positioned near the center of the barrels. The clamp tabs are engaged in the slots of the stop shoulders on the barrels. Secure the clamp in this position by rotating the locating disk to the locked position. The direction of rotation of the gun and barrel hue prevents the clamp from unlocking. Insert a cotter pin through the locking disk and clamp plate as an additional safety measure.

Barrels. The M61A1 automatic gun has six rifled barrels. The stub rotor attached to the rotor body supports them. The three rows of interrupted locking lugs on the barrel engage similar interrupted locking lugs in the rotor to secure the barrel. There are three

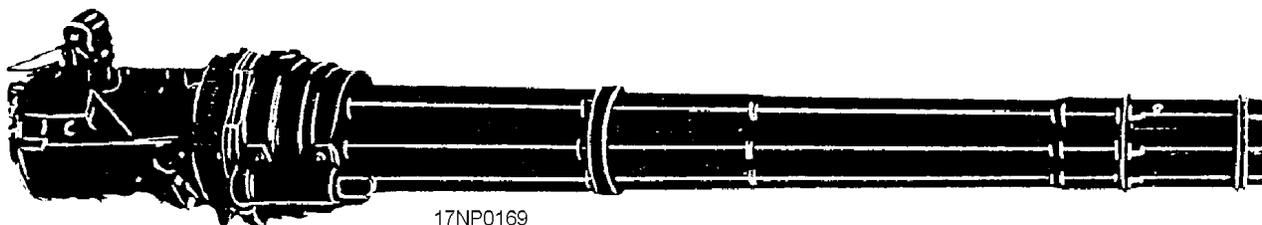
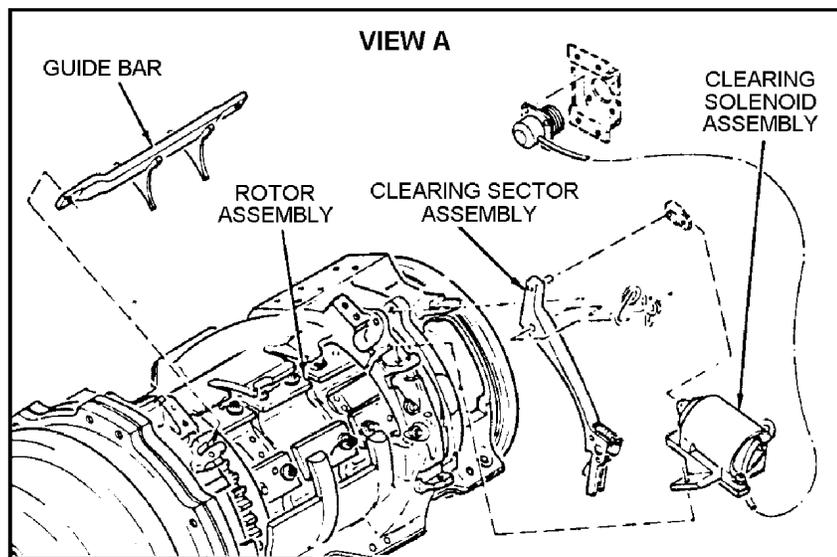
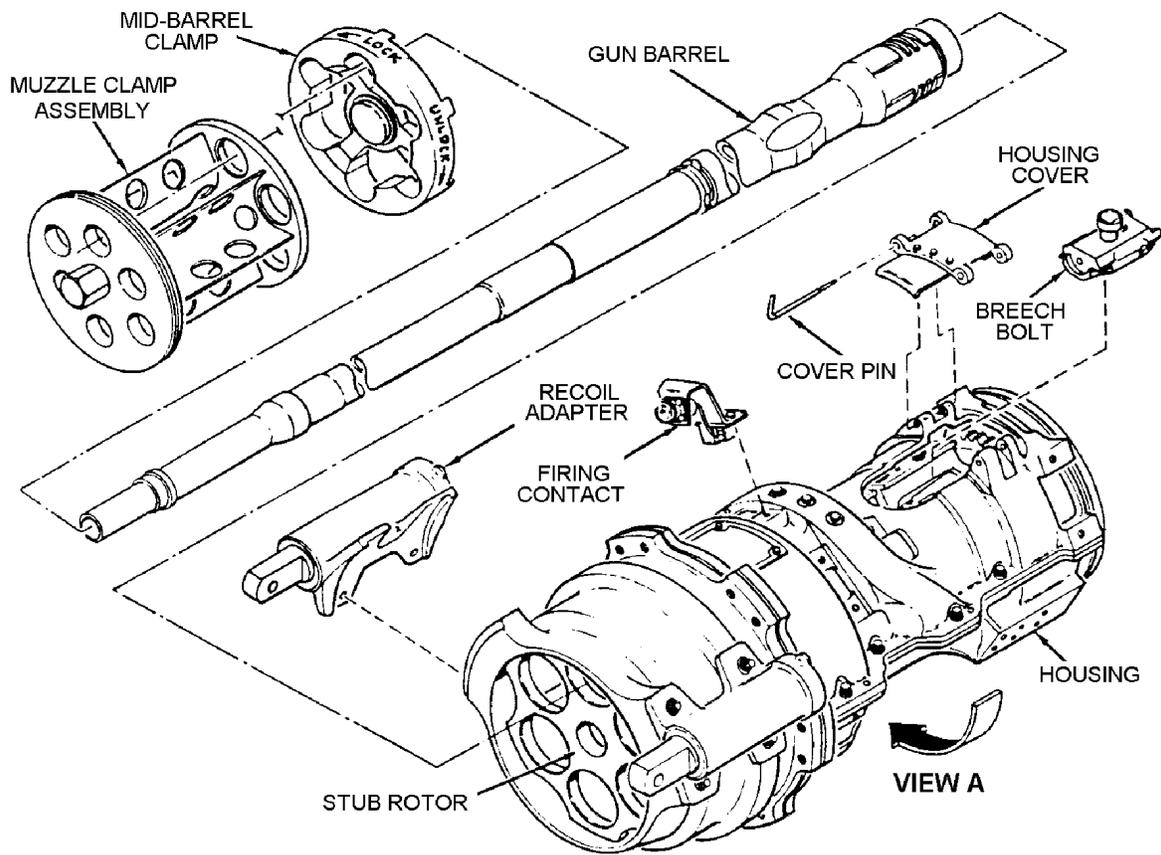


Figure 6-1.—M61A1 automatic gun.



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Figure 6-2.—Gun components (exploded view).

knurled bands near the center of the barrels. These bands give you a gripping surface for easy installation and removal of the barrels from the rotor.

Recoil adapters. The recoil adapters are mounted on the bearing retainer and provide the front mounting for the gun. There are alternate locations for the recoil

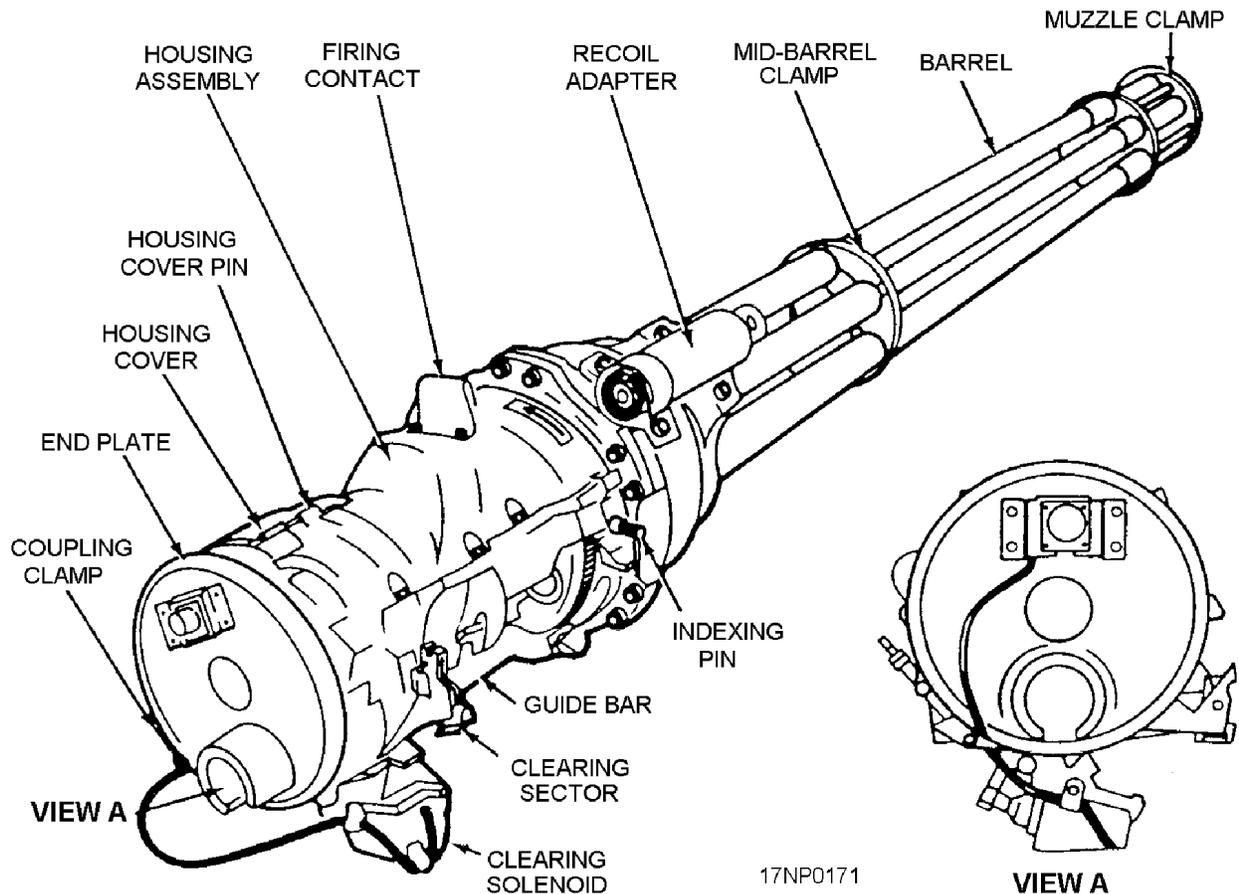


Figure 6-3.—Gun component locations.

adapters with respect to the gun's axis. These locations are possible because the bearing retainers can be mounted to the housing in increments of 60 degrees. The adapters reduce the amount of recoil and counter-recoil forces transmitted to the supporting structure when the weapon is fired.

Firing contact assembly. The firing contact assembly is mounted to the housing so that the connector is outside the housing, and the spring-loaded cam is inside the assembly. The contact assembly provides the necessary path for the current to enter the housing and reach the breech-bolt assembly. This path goes through the connector to the conductor, to the insulated insert in the contact cam assembly, and then to the breech-bolt assembly.

Clearing solenoid assembly. The clearing solenoid assembly is mounted near the back of the gun housing. It is linked to and controls the movement of the clearing sector assembly.

Clearing sector assembly. The clearing sector assembly is linked to and controlled by the clearing

solenoid assembly. When the solenoid is activated, the sector arm diverts the bolt assemblies into the clearing cam path.

Guide bar. The guide bar is located on the gun housing. It guides the rounds into and out of the extractor lip that is located on each of the six breech-bolt assemblies.

Breech-bolt assembly. The breech-bolt assembly picks up a round as it enters the gun, transports it to the firing chamber, locks it into the firing position, transmits the firing voltage to the primer of the round, and returns the empty case to the guide bar, where it is cammed out of the gun. An extractor lip on the front of each bolt assembly engages the rim of a round throughout these actions.

There are six breech-bolt assemblies in the gun. Guide slots or grooves on the side of the bolt body permit it to slide on the rotor tracks. The bolt roller shaft determines the position of the bolt as it follows the main cam path or the clearing cam path in the housing.

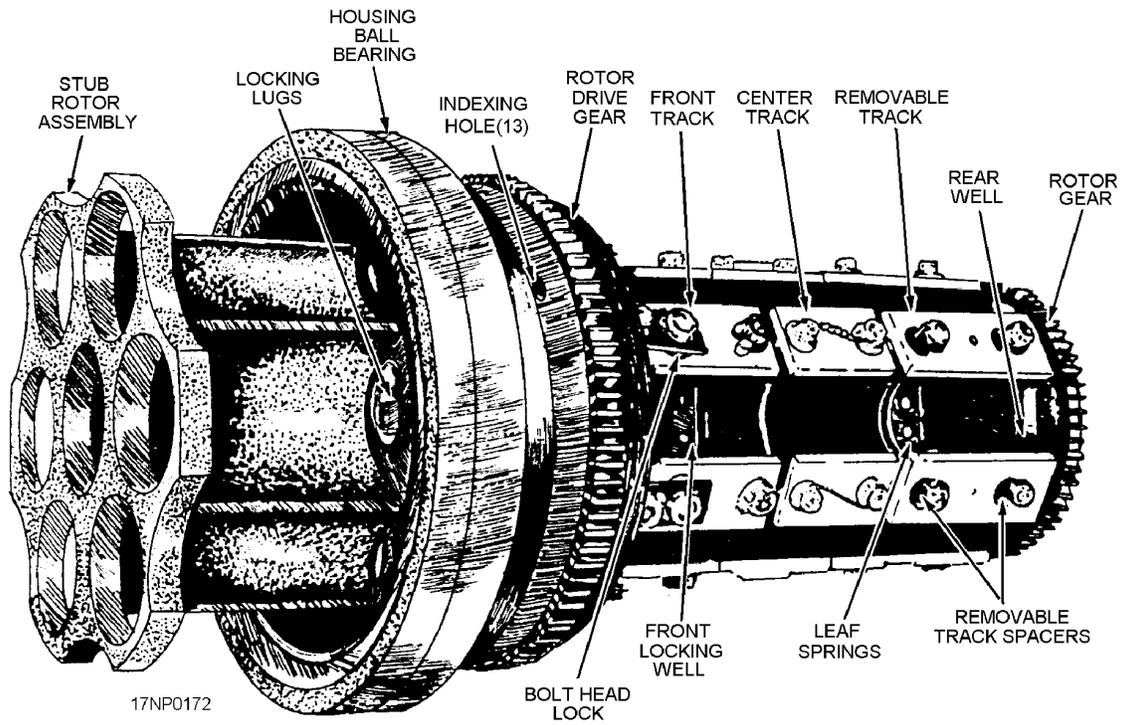


Figure 6-4.—Rotor assembly.

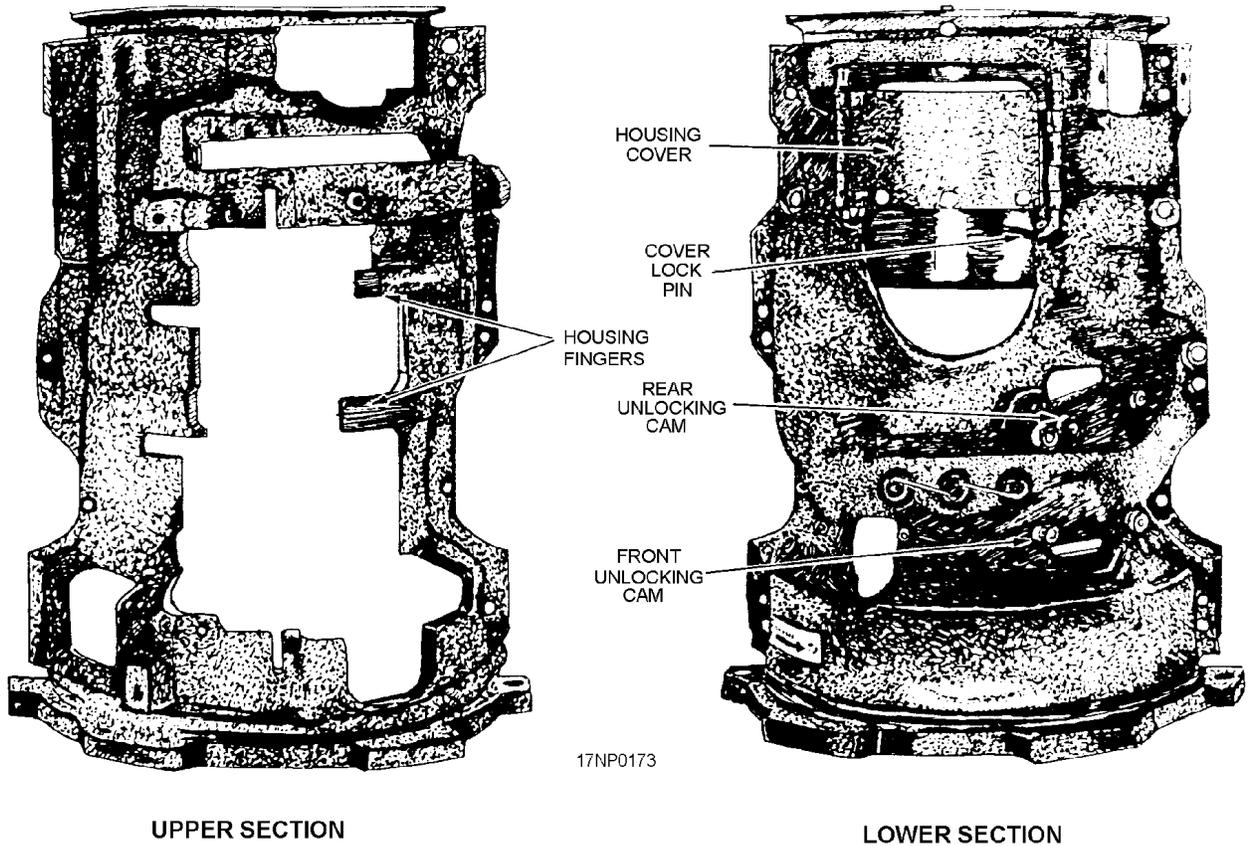


Figure 6-5.—Rear housing assembly and related parts (external view).

Rotor assembly. The rotor assembly (fig. 6-4) is a major unit of the M61A1 gun. The front section or stub rotor supports the six barrels. The main body of the rotor assembly contains the rotor tracks, rotor drive gear, and the locking lugs to lock the barrels in place.

The rotor tracks support the breech-bolt assemblies and provide a guide for the forward and backward movement of the bolt. There are six sets of rotor tracks attached to the ribs along the rotor body. Each set contains a front, center, and rear removable track. The removable track lets you install or remove a bolt assembly for servicing or replacement. The necessary front support for the rotor assembly consists of a double row of ball bearings. The rear is supported by needle

bearings located inside the rotor body. The end plate provides the inner race for the needle bearings, and it also provides for the gun's rear support.

Rear housing assembly and associated parts. The rear housing assembly (figs. 6-5 and 6-6) is a major unit of the gun. It consists of an upper section and a lower section assembled as one unit. The rear housing assembly provides the main cam path that controls the movement of the breech-bolt assemblies. The elliptical (oval) shape of the main cam path causes the forward and backward movement of the bolt assemblies. The clearing-cam path is circular and located at the rear of the housing. It provides a path for the bolt assemblies during the gun's clearing cycle. The housing cover,

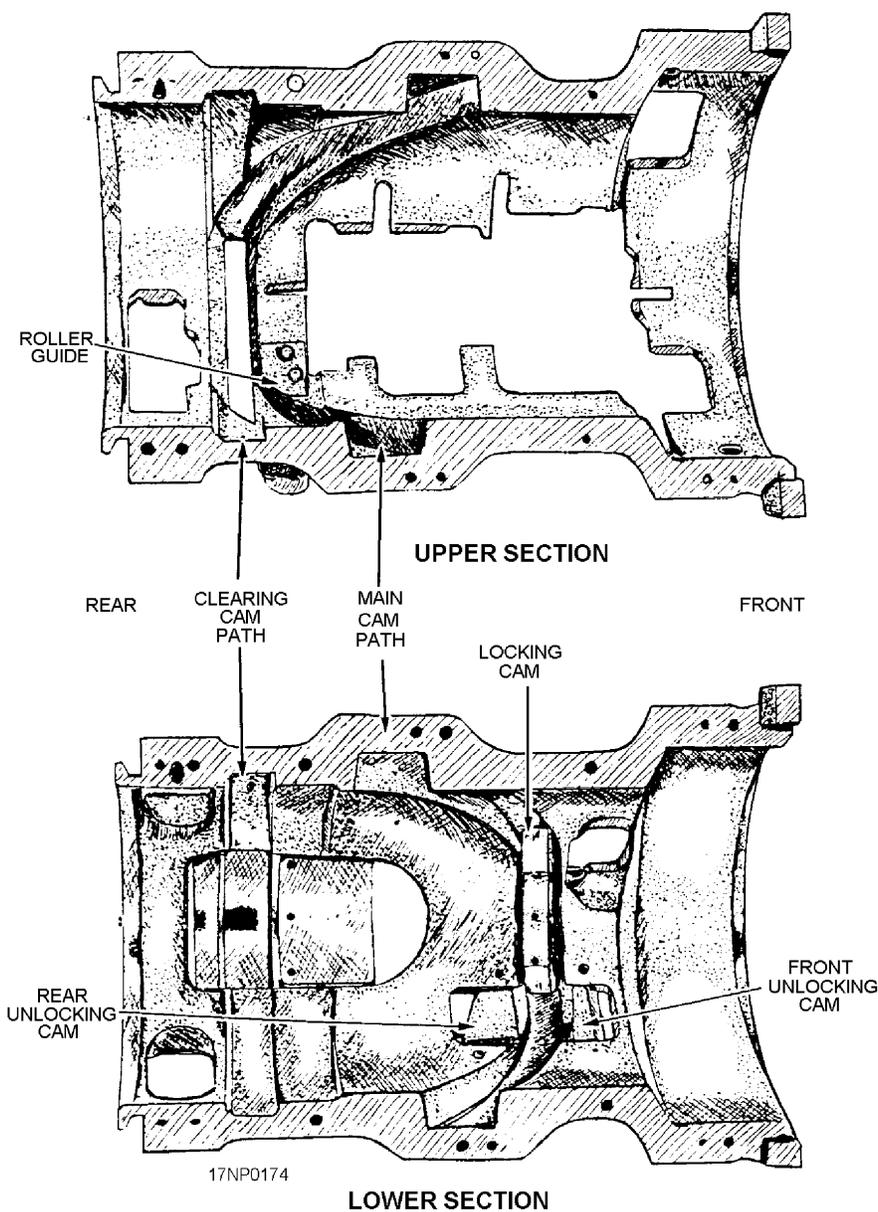


Figure 6-6.—Rear housing assembly and related parts (internal view).

when in the closed position, forms a part of the clearing cam path. You may remove the housing cover to install or remove the bolt assembly.

The locking and unlocking cams are part of the housing assembly. The gun-indexing pin (timing pin) is located on the housing (fig. 6-3). It is used to time the gun when it is mated with the ammunition handling system, or when you perform loading/unloading procedures.

Lubricator assembly. A lubricator assembly (fig. 6-7) is attached externally to the gun housing assembly. It is used to lubricate the bolt assemblies during gun operation. During gun acceleration/deceleration and when the gun is firing, an inertia-actuated pump located within the lubricator assembly pumps the lubricant (DOD-L-85336) through a metal tube to the gun housing assembly. You can refill the lubricator assembly when performing normal maintenance procedures.

REVIEW NUMBER 1

- Q1. List the naval aircraft that carry the M61A1 20-mm automatic gun.
- Q2. When installed in naval aircraft, the M61A1 gun has a pilot selectable firing rate of _____.
- Q3. List the primary parts of the M61A1 gun.
- Q4. What is the purpose of the muzzle clamp assembly?
- Q5. The M61A1 gun has six rifled barrels that are secured to the rotor by _____.
- Q6. What component has front mounting points so the gun can be mounted in the aircraft?
- Q7. The rounds are guided into and out of the extractor lip of the breech-bolt assemblies by _____.

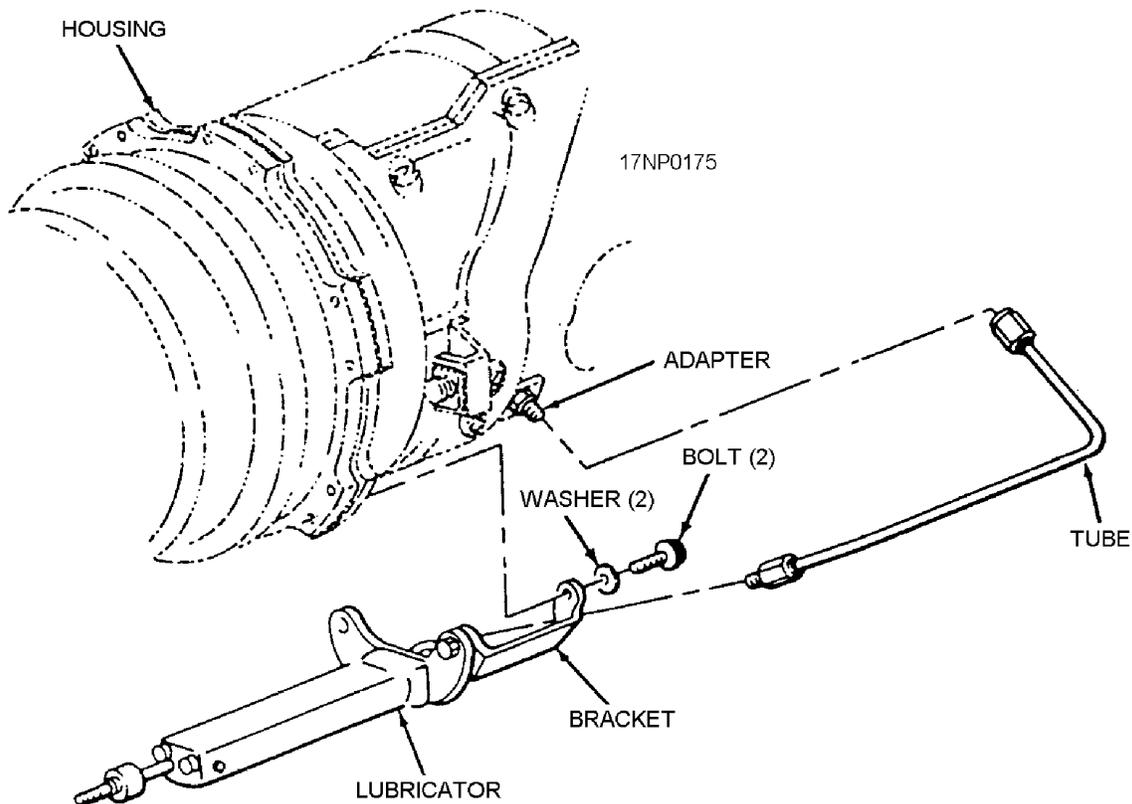


Figure 6-7.—Lubricator assembly installation (F-14).

- Q8. List the parts contained in the main body of the rotor assembly.
- Q9. What assembly provides the main cam path that controls the movement of the breech-bolt assemblies?
- Q10. What lubricant should you use for the M61A1 gun?

M61A1 GUN PRINCIPLES OF OPERATION

The operation of the M61A1 gun is divided into two distinct cycles—the firing cycle and the clearing cycle.

Firing Cycle

The firing cycle begins when power is applied to the firing contact assembly and the gun drive unit simultaneously.

If you look at the rotor from the rear, you see that it revolves in a counterclockwise direction. The ammunition is received from an external source. It is guided into the extractor lip on a breech-bolt assembly by the guide bar fingers (fig. 6-8). The bolt roller shaft follows the main cam path and moves the bolt assembly forward along the rotor tracks, chambering the round.

As the breech-bolt assembly enters the front dwell area of the main cam path, the locking cam forces the bolt shaft down, locking the bolt in the front locking

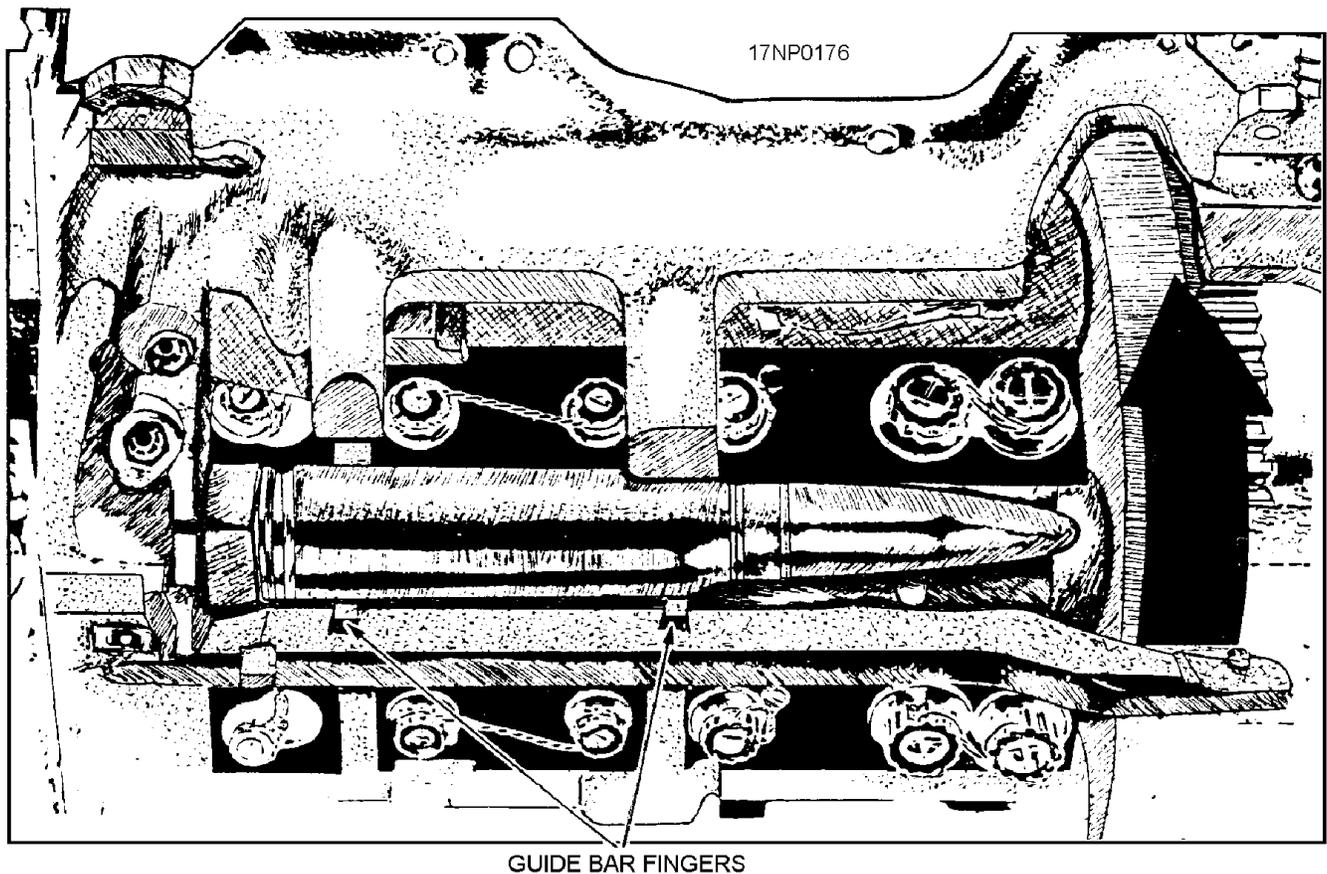


Figure 6-8.—Round guided into breech-bolt assembly.

well of the rotor (fig. 6-9). The insulated portion of the contact cam in the firing contact assembly depresses the firing pin cam in the breech-bolt assembly. This moves the firing pin forward against the primer of the round. The conductor portion of the contact cam makes contact with the firing pin cam, which allows a firing voltage to pass through the firing pin to fire the round.

The breech-bolt assembly remains locked throughout the locking cam period until the projectile leaves the barrel. After the projectile leaves the barrel, the barrel pressure is reduced. The unlocking cam lifts the bolt shaft, retracts the bolt-locking block, and unlocks the bolt.

The main cam path guides the breech-bolt assembly rearward. The empty case is removed from the chamber by the extractor lip of the bolt assembly. Then, the bolt assembly travels back along the rotor tracks until the guide bar removes the empty case from the bolt extractor lip and ejects it from the gun (fig. 6-10). To complete the cycle, the bolt assembly travels along the rear cam dwell area and into position to receive the next round.

REVIEW NUMBER 1 ANSWERS

A1. The naval aircraft that carry the M61A1 20-mm automatic gun are the F-14 and F/A-18.

- A2. When installed in naval aircraft, the M61A1 gun has a pilot selectable firing rate of 4,000 rounds per minute (GUN LOW) and 6,000 rounds per minute (GUN HIGH).
- A3. The primary parts of the M61A1 gun are the barrels, housing assembly, and rotor assembly.
- A4. The muzzle clamp assembly restrains individual barrel movement during firing.
- A5. The M61A1 gun has six rifled barrels that are secured to the rotor by three rows of interrupted locking lugs.
- A6. The recoil adapters have front mounting points so the gun can be mounted in the aircraft.
- A7. The rounds are guided into and out of the extractor lip of the breech-bolt assemblies by the guide bar.
- A8. The rotor tracks, rotor drive gear, and the locking lugs to lock the barrels in place are contained in the main body of the rotor assembly.
- A9. The rear housing assembly and associated parts provide the main cam path that controls the movement of the breech-bolt assemblies.

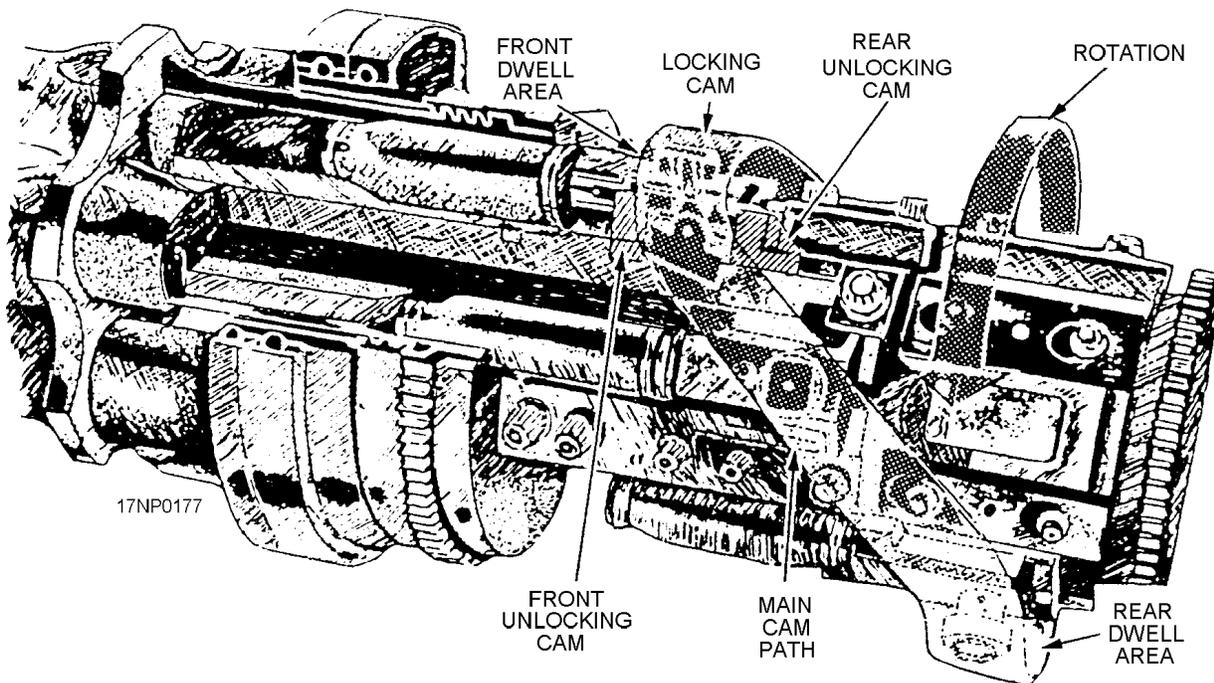


Figure 6-9.—Breech-bolt assembly in firing cycle.

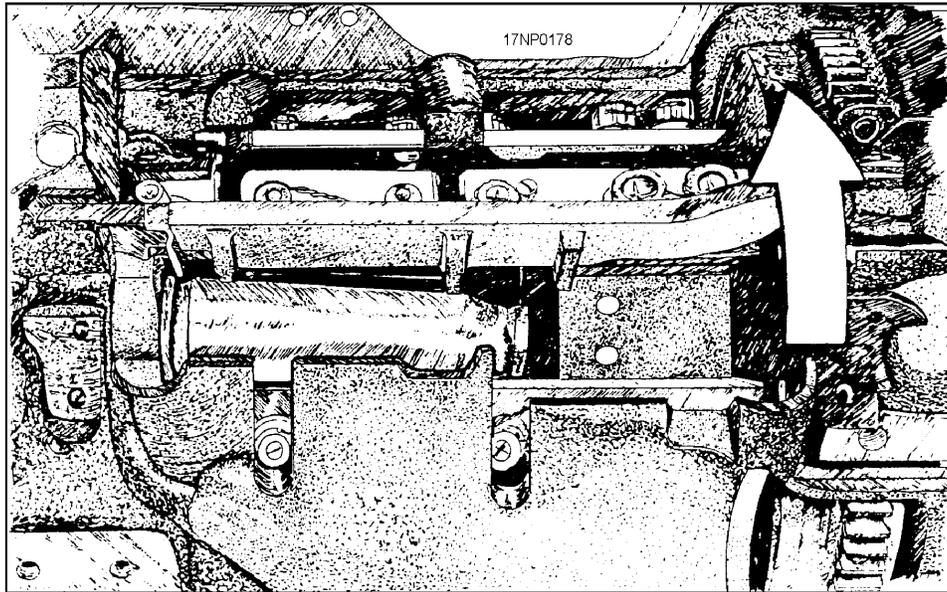


Figure 6-10.—Ejection of empty case.

A10. You should use DOD-L-85336 lubricant for the M61A1 gun.

The breech-bolt assembly has now completed a full firing cycle through the elliptical-shaped main cam path. It has performed seven actions or operations in the following sequence:

1. Feed
2. Chamber
3. Lock
4. Fire
5. Unlock
6. Extract

7. Eject

All six breech-bolt assemblies repeat this firing cycle until the clearing solenoid is actuated, and the gun starts the clearing cycle.

Clearing Cycle

The clearing cycle starts when the clearing solenoid is energized. The clearing solenoid depresses the clearing sector arm to the gun housing. This places the clearing sector arm in a ready position. The first bolt assembly that passes the sector arm triggers the actuating pin that lets the sector arm continue to the clearing mode position. This diverts the succeeding bolt assemblies into the clearing cam path (fig. 6-11).

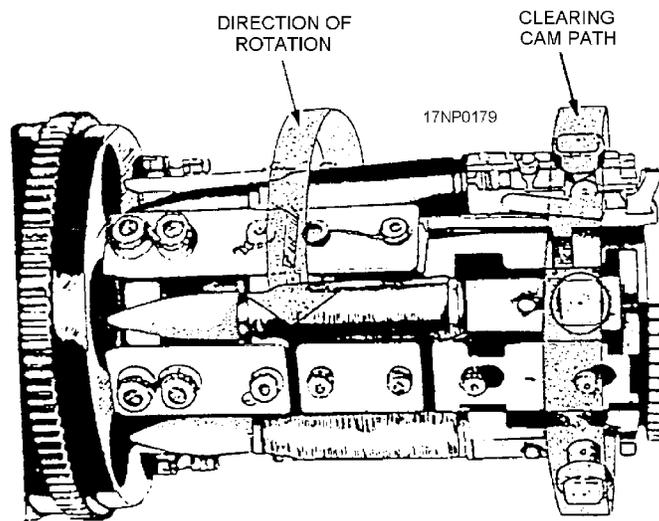


Figure 6-11.—Breech-bolt assembly in clearing cycle.

As the breech-bolt assembly picks up a round at the guide bar, the clearing sector arm depresses the bolt roller shaft. This locks the bolt assembly in the rear locking well of the rotor. While locked in this position, the bolt assembly cannot follow the main cam path, so it follows the clearing cam path. The clearing cam path isn't as deep as the main cam path, and it keeps the bolt roller shaft depressed. This firmly locks the bolt assembly in the rear of the rotor body.

The M61A1 gun continues to receive rounds during the clearing cycle. However, because each bolt assembly remains positioned at the back of the rotor during rotation, the guide bar cam fingers eject all unfired rounds. When the clearing solenoid is deactivated, the clearing sector arm pivots out of the main cam path. This allows the leaf springs in the rear locking well to force the bolt-locking block upward. The bolt roller shaft follows the main cam path that permits the gun to be fired.

If necessary, you may clear the gun manually. To do this, manually pivot the clearing sector cam into the main cam path while turning the rotor by hand.

For further information on the M61A1 automatic gun, you should refer to the *M61A1 Automatic Gun*, NAVAIR 11-95M61A1-1. NAVAIR 11-95M61A1-1 provides intermediate-level maintenance procedures and includes associated special support equipment.

REVIEW NUMBER 2

- Q1. *Name the two cycles of the M61A1 gun.*
- Q2. *When does the firing cycle begin in the M61A1 gun?*
- Q3. *After the projectile leaves the barrel, what component removes the empty case from the chamber?*
- Q4. *The main cam path is _____ shaped.*
- Q5. *List, in sequence, the six operations the breech-bolt assembly performs during a full firing cycle.*
- Q6. *At what point does the clearing cycle start?*
- Q7. *The M61A1 gun continues to receive rounds during the clearing cycle. What component ejects all unfired rounds?*

AMMUNITION HANDLING AND GUN DRIVE SYSTEMS

LEARNING OBJECTIVE: *Identify the ammunition handling and gun drive systems of the M61A1 automatic gun. Describe the principles of operation of each system and identify the interrelationship of the various systems.*

The ammunition and gun drive subsystems are discussed in the following paragraphs.

DRUM UNIT ASSEMBLY

Live ammunition and expended cases are stowed in the drum unit assembly. This assembly has four major parts—drum unit, entrance cover, exit cover, and scoop disk. Refer to figure 6-12 as you read about these parts.

Drum Unit. The drum unit is a cylindrical structure that consists of an outer drum and an inner drum helix. The live ammunition rounds and expended cases are stored radially around the longitudinal axis of the outer drum with their bases in an outward direction. Their bases in partitions suspend the rounds. These partitions are mounted lengthwise with respect to the inner surface of the outer drum. With the outer drum mounted stationary to the aircraft's structure, the rounds are moved along the length of the partitions by the rotation of the double-lead helix (inner drum). It's easy to understand this movement if you think of the inner drum helix as the threads on a screw. The projectile end of the casing protrudes into the threads. As the inner drum helix is rotated, it produces a screwing-type motion, causing the rounds to slide along the partitions from one end to the other end of the outer drum.

Entrance Cover. The entrance cover is stationary mounted to the entrance end of the outer drum. The entrance cover contains a retainer gear and 252 steel ball bearings that support the scoop disks and the inner drum helix. The retainer partitions are mounted to the retainer gear that controls the position of the rounds as they are passed from the entrance cover to the scoop disk. A spring-loaded timing pin on the entrance cover is used to index the drum for installation of the entrance unit.

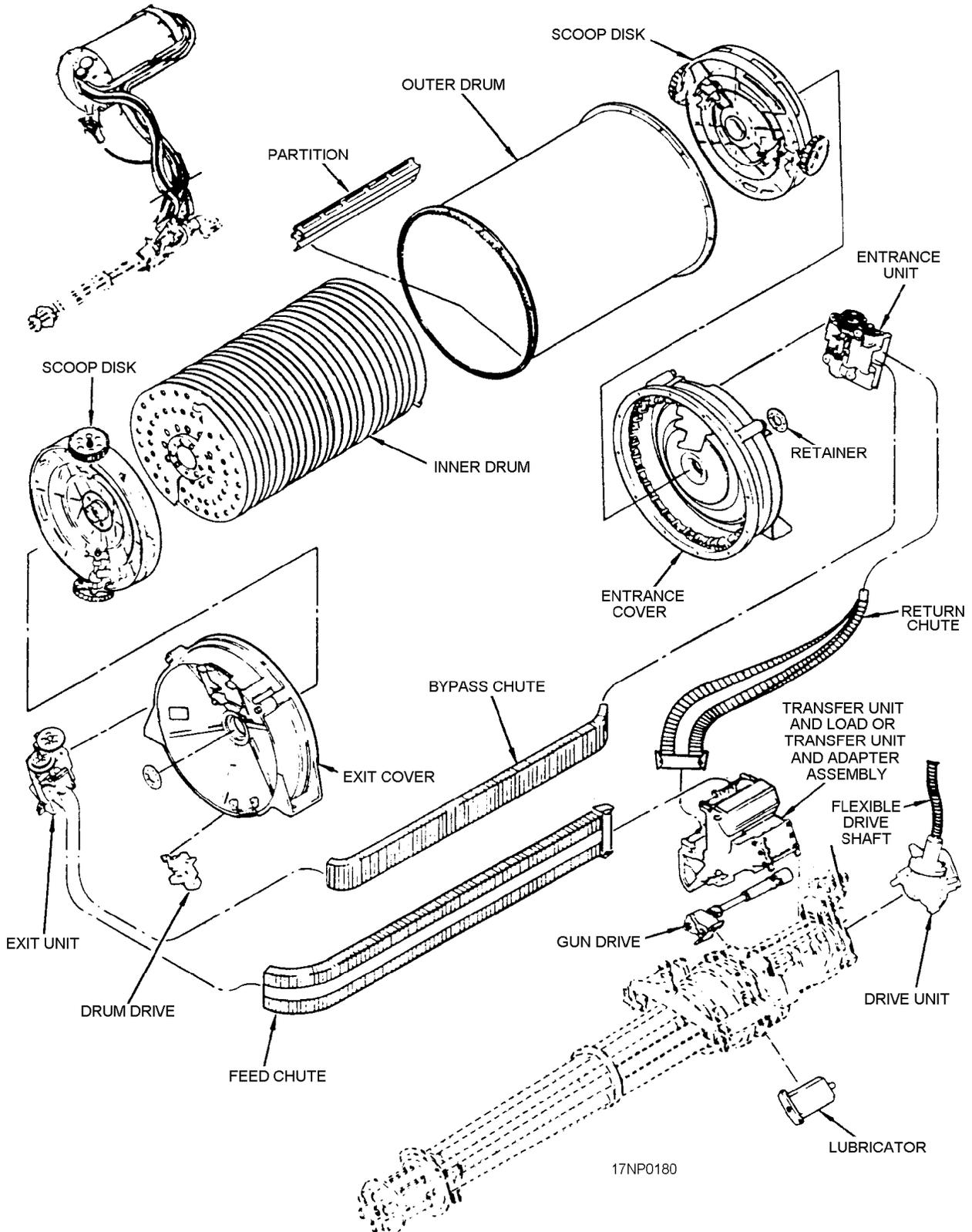


Figure 6-12.—Ammunition handling components (exploded view).

Exit Cover. The exit cover is stationary mounted to the exit end of the outer drum. The exit cover is constructed like the entrance cover. It controls the position of the rounds as they pass from the scoop disk to the exit cover. A spring-loaded timing pin on the exit cover is used to index the drum for installation of the exit unit.

Scoop Disk. A scoop disk is mounted on each end of the inner drum helix. Each scoop disk has two sets of sprocket spur gears located 180 degrees apart. These spur gears mesh with the retainer gear in the entrance/exit covers that provide rotating support for the inner drum helix. The sprockets attached to the spur gear transfer rounds from the entrance cover retainer partitions to the drum partitions, and from the drum partitions to the retainer partitions in the exit cover.

EXIT UNIT

The exit unit is attached over an opening in the exit cover and geared to the exit cover retainer gear. The exit unit contains two gear-driven sprocket assemblies. The sprocket assemblies remove live rounds or expended cases from the retainer partitions in the exit cover and place them in the conveyor elements. Before you install the exit unit to the exit cover, press and hold the exit unit timing pin and the exit cover timing pin to make sure there is proper gear alignment between the two components. Once the exit unit is properly attached to the exit cover, make sure that the spring-loaded timing pins release.

The exit unit also contains a last-round switch that is electrically connected to the gun control firing circuits. The projectiles of the 20-mm rounds actuate the switch. The switch prevents expended rounds (empty cases) from being fed into the gun and jamming it. Before the gun will fire, the ammunition must be cycled through the ammunition drum until the first round actuates the last-round switch. When there is no more ammunition present or when expended rounds are present, the last-round switch is released. This automatically initiates the gun clearing cycle and terminates gun firing. Before the gun can be fired again, the ground loading crew to actuate the last-round switch must manually position live ammunition.

ENTRANCE UNIT

The entrance unit is attached over the opening in the entrance cover and geared to the entrance cover retainer gear. The entrance unit contains three gear-driven sprocket assemblies. The sprocket

assemblies remove live rounds or expended cases from the conveyor elements and place them in the entrance cover retainer partitions. Before installation, press the spring-loaded timing pin and align the scoop sprocket stud pin with the entrance unit timing mark. With the entrance unit properly timed and aligned, you must press the entrance cover-timing pin and align the timing mark on the scoop disk with the timing mark on the entrance cover. You need to properly time and align both the entrance unit and the entrance cover to ensure proper gear alignment between the two components. Once the entrance unit is attached to the entrance cover, you should make sure that the spring-loaded timing pins release.

REVIEW NUMBER 2 ANSWERS

- A1. *The two cycles of the M61A1 gun are the firing cycle and the clearing cycle.*
- A2. *The firing cycle begins in the M61A1 gun when power is applied to the firing contact assembly.*
- A3. *After the projectile leaves the barrel, the extractor lip of the breech-bolt assembly removes the empty case from the chamber.*
- A4. *The main cam path is elliptical shaped.*
- A5. *The six operations the breech-bolt assembly performs during a full firing cycle are feed, chamber, lock and fire, unlock, extract, and eject.*
- A6. *The clearing cycle starts when the clearing solenoid is energized.*
- A7. *The M61A1 gun continues to receive rounds during the clearing cycle. The guide bar cam fingers eject all unfired rounds.*

TRANSFER UNIT AND ADAPTER ASSEMBLY

The transfer unit and adapter assembly are actually two separate components bolted together to form one unit. They are **never** separated at the organizational maintenance level. The function of each component is discussed in the following paragraphs.

Transfer Unit

The transfer unit is gear-driven by the gun and attached to the M61A1 gun housing by quick-release pins to make maintenance easier. The gear-driven sprocket assemblies and guides maintain positive

control of the rounds and conveyor elements passing through the transfer unit. The transfer unit removes the rounds from the conveyor and places them into the extractor lip of the gun breech bolts. The transfer unit also receives expended cases and unfired rounds from the gun breech bolts and places them in the conveyor elements. When you install the transfer unit and the adapter assembly as a single unit, press and hold the timing pin on the transfer unit and the gun housing. Once the transfer unit/adapter assembly is properly attached, you must make sure that the spring-loaded timing pins release.

Adapter Assembly

The adapter assembly bolts directly to the transfer unit. During downloading and loading operations, the adapter assembly interfaces with the linkless ammunition loading system (LALS).

REVIEW NUMBER 3

- Q1. List the major parts of the drum unit assembly.
- Q2. What component of the drum assembly looks like the threads of a screw?
- Q3. What is the purpose of the retainer gear and steel ball bearings contained in the entrance cover?
- Q4. What component should you use to index the drum for installation of the exit unit?
- Q5. What is the purpose of the two sets of sprocket spur gears located on the scoop disk?
- Q6. What switch in the exit unit prevents expended rounds from being fed into the gun and jamming it?
- Q7. What is the purpose of the sprocket assemblies in the entrance unit?
- Q8. What part of the transfer unit and adapter assembly interfaces with the linkless ammunition loading system (LALS)?

CHUTE ASSEMBLIES

The chute assemblies are interlocking segments. They provide a flexible path through which the conveyor elements transport live rounds and expended cases around an aircraft structure. The bypass chute provides a path from the entrance unit to the exit unit, through which the conveyor elements pass. The feed

chute provides a path from the exit unit to the adapter assembly, through which the conveyor transports live rounds or unexpended cases. The return chute provides a path from the transfer unit to the entrance unit, through which the conveyor transports expended cases or unfired rounds.

The construction of the chute assemblies lets the conveyor elements pass through in only one direction. If the system is rotated in the wrong direction, the element tabs will jam in the chute segments and damage the system. The chute ends are color-coded red and green to key the right connection to other components. Additionally, each end is clearly marked with a metal labeling plate. This identifies the component to which a particular chute end **must** be connected. The ends of the chutes are equipped with quick-release latches for ease of removal and installation.

CONVEYOR ASSEMBLY

The conveyor assembly consists of individual conveyor elements shaped to cradle a 20-mm case. The elements are joined together by removable hinge pins to form an endless conveyor assembly. (See figure 6-13.)

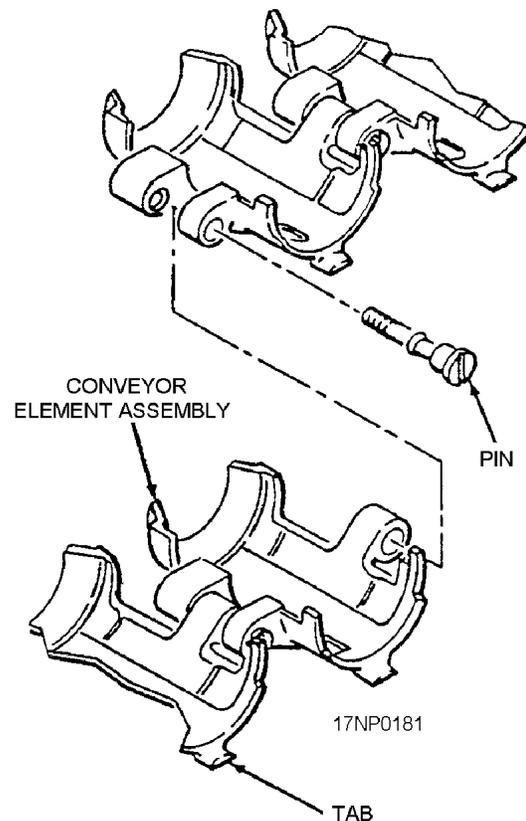


Figure 6-13.—Typical conveyor element assembly.

During system operation, the conveyor receives rounds of ammunition from the exit unit and delivers them through the feed chute to the transfer unit. The conveyor also receives expended cases and unfired rounds from the transfer unit and transports them through the return chute to the entrance unit. After receipt by the entrance unit, the expended cases and unfired rounds are removed from the conveyor elements and stored in the ammunition drum. The empty conveyor passes from the entrance unit to the exit unit through the bypass chute. Tabs on the conveyor elements, which engage guides in the chutes, exit unit, entrance unit, adapter assembly, and transfer unit, maintain positive control of the conveyor elements. The total number of elements required for a system varies according to aircraft application.

GUN DRIVE AND DRUM DRIVE SYSTEMS

A hydraulic drive unit run by the aircraft's hydraulic system simultaneously drives the M61A1 gun and the ammunition handling system. The hydraulic pressure is supplied through a hydraulic fluid manifold electrically controlled by a dual-rate solenoid valve. This solenoid valve is controlled from the cockpit through the gun control unit (GCU), which results in the gun firing at 6,000 (GUN HIGH) or 4,000 (GUN LOW) rounds per minute. Attached to the hydraulic drive unit is a mechanical drive unit that consists of a gear train with one input shaft (from the hydraulic drive unit) and, depending upon the type of aircraft, one or two output shafts.

F-14 aircraft. The F-14 aircraft uses a mechanical drive unit with two output shafts. The mechanical drive unit causes a telescoping shaft to drive the gun and the drum unit assembly.

F/A-18 aircraft. The F/A-18 aircraft uses a mechanical drive unit with one output shaft. Because the ammunition drum is near the mechanical drive unit, a gear on the output shaft of the mechanical drive unit meshes directly with the drum drive. A two-piece telescoping shaft transmits power from the same output shaft of the mechanical drive unit to the gun drive. This, in turn, drives the gun rotor.

Both aircraft have provisions to manually rotate the gun system by using a manual hand crank. During ground maintenance, the gun system may be rotated hydraulically. Actuating a manual control on the hydraulic drive unit when the aircraft's hydraulic system is operating does this.

REVIEW NUMBER 3 ANSWERS

- A1. *The major parts of the drum unit assembly are the drum unit, entrance cover, exit cover, and scoop disk.*
- A2. *The inner drum helix of the drum assembly looks like the threads of a screw and produces a screwing-type motion, causing rounds to slide along partitions from one end to the other end of the outer drum.*
- A3. *The purpose of the retainer gear and steel ball bearings contained in the entrance cover is to support the scoop disks and the inner drum helix.*
- A4. *A spring-loaded timing pin on the entrance cover is used to index the drum for installation of the exit unit.*
- A5. *The two sets of sprocket spur gears located on the scoop disk mesh with the retainer gear in the entrance and exit covers that provide rotating support for the inner drum helix.*
- A6. *The last round switch in the exit unit prevents expended rounds from being fed into the gun and jamming it.*
- A7. *The sprocket assemblies in the entrance unit remove live rounds or expended cases from the conveyor elements and place them in the entrance cover retainer partitions.*
- A8. *The adapter assembly of the transfer unit and adapter assembly interfaces with the linkless ammunition loading system (LALS).*

GUN GAS PURGE SYSTEM

The M61A1 gun is internally mounted in the aircraft's fuselage. When the gun is fired, the temperature of the gun barrels increases rapidly, and the gun compartment is filled with gun gas from the fired rounds. If the barrels are not properly cooled, the rounds may *cook-off* due to excessive barrel temperatures. Gun gas, when confined to an enclosed area such as a gun compartment, is highly explosive. The gun gas purge system cools the barrels and purges gas from the compartment during gun firing operations.

The gun gas purge system in the F-14 aircraft uses cold air from the refrigeration system to cool and purge residual gun gases from the ammunition drum and gun compartment. The subsystem, activated when gun firing is initiated, remains active for a 30-second period

after gun firing to ensure that all gases are cooled and purged.

The F/A-18 gun gas purge system uses engine bleed air and has an additional gas control provided by a hydraulically actuated ram-air scavenge door that opens automatically during gun-firing operations. The gun gasses are vented through louvers in the lower mold line of the aircraft fuselage.

REVIEW NUMBER 4

- Q1. What chute provides a path from the exit unit to the adapter assembly?
- Q2. What chute provides a path from the transfer unit to the entrance unit of the drum?
- Q3. What is the purpose of the gun gas purge system?
- Q4. Describe the difference between the gun gas purge systems of the F-14 aircraft and the F/A-18 aircraft.

M61A1 GUN SYSTEM INSTALLATIONS

LEARNING OBJECTIVE: *Identify M61A1 gun system installations to include those used on the F/A-18 and F-14 aircraft.*

M61A1 gun and ammunition handling system installations have the same basic components. However, some components are peculiar to specific aircraft. These differences are discussed in the following paragraphs.

F/A-18 GUN SYSTEM INSTALLATION

The F/A-18 M61A1 gun system (fig. 6-14) is internally mounted in the nose of the aircraft on the centerline. The fired projectiles exit the aircraft through the gun blast diffuser assembly, located just forward of the cockpit windscreen. Depending upon the mission objective, the gun can be operated in the air-to-ground (A/G) or air-to-air (A/A) computer mode. There are two A/G modes—continuously computed impact point (CCIP) and manual (MAN). There are three A/A

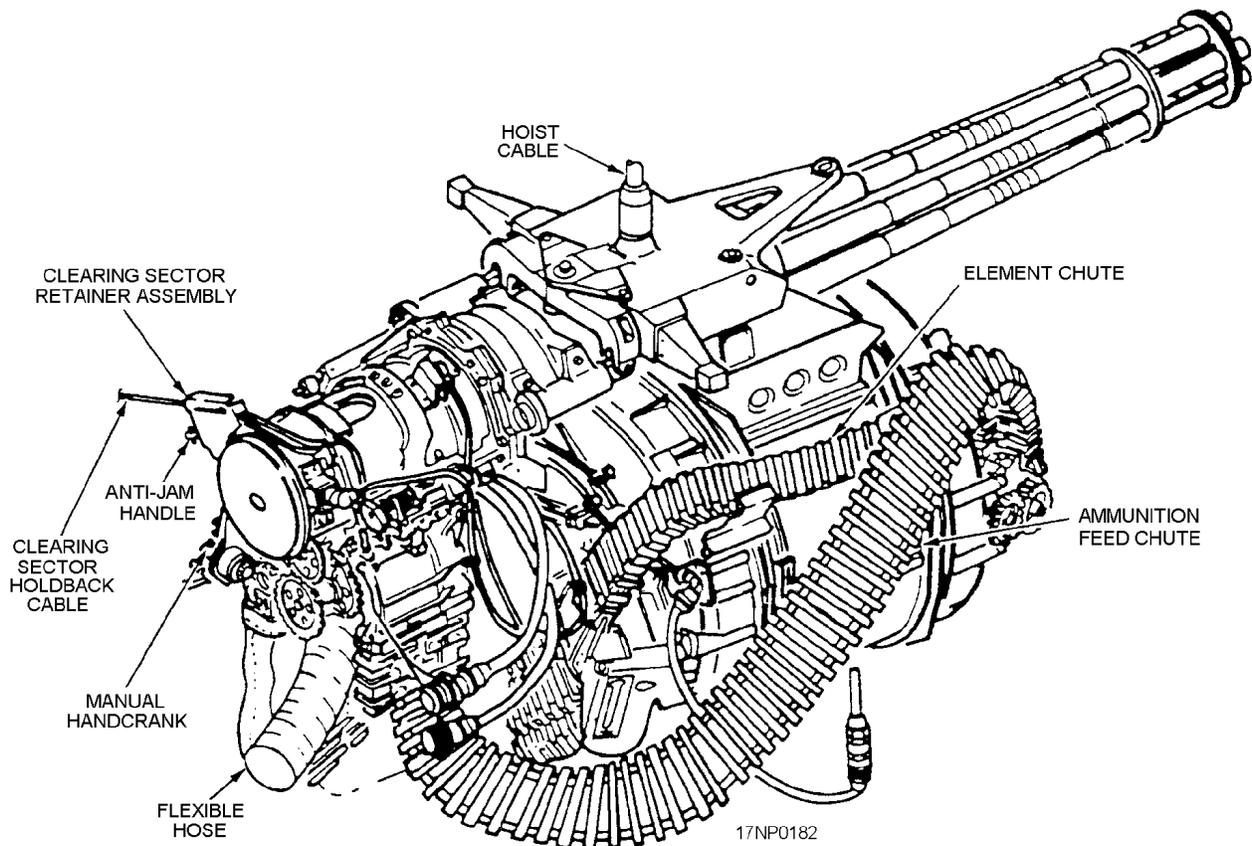


Figure 6-14.—F/A-18 M61A1 gun installation.

modes—director, disturbed, and cage. The pilot can select any one of the A/G or A/A modes while in flight.

The ammunition handling system holds a maximum of 578 rounds of ammunition. A round limiter, located in the gun compartment, can be preset to limit the total number of rounds the pilot can fire. The round limiter is used during training missions, and permits two or three gunnery missions from one gun load-out.

For example, ground maintenance personnel set the round limiter at 200 rounds. When the pilot has fired 200 rounds, the gun's electrical system automatically initiates the gun clearing cycle. This prevents further firing until ground maintenance personnel manually reset the round limiter.

While in flight, the pilot has the option of selecting unrestricted firing or presetting the number of rounds per burst. If the pilot selects unrestricted firing, the gunfire's continuously as long as the trigger is depressed and ammunition is available.

For example, if the pilot presets 50 rounds, the gunfire's bursts of 50 rounds each time the trigger is pulled and released. A display panel in the cockpit continuously indicates the number of rounds remaining.

The clearing sector retainer assembly (fig. 6-14) is used to manually clear the gun. When the manual clearing handle is in the cleared position, a wire rope assembly depresses the gun clearing sector assembly against the gun housing. This directs the breech-bolt assemblies into the clearing cam path when the gun is manually rotated. The manual clearing handle is held in the clearing position by a locking tab. **For safety reasons, the manual clearing handle should remain in the cleared position until you are actually performing gun-arming procedures.** When the gun access door is closed, you can determine the position of the manual clearing handle by the position of the indicator located on the door. If the indicator is flush with the door surface, the manual clearing handle is in the firing position. If the indicator protrudes from the door surface, the manual clearing handle is in the cleared position.

The entire gun system is handled as a single palletized unit. This includes the M61A1 gun, drum unit assembly, ammunition chutes, element chutes, and hydraulic motor. The system bolts directly to the aircraft structure with four bolts, and does not require any other boresighting or alignment. Other than minor

adjustments in the aircraft, all maintenance is performed at the intermediate-maintenance level. The system is removed from the aircraft as a unit by using gun-handling adapters, a weapon skid or trailer, and an Aero 14C bomb-hoisting unit. The bomb-hoisting unit is used to raise or lower the gun system as it is being removed or installed. A gun system hoist adapter, designed to support the hoist boom, is attached to the aircraft during the raising or lowering operation. A gun-handling adapter attached to a weapons skid or trailer, supports the gun system after it is removed from the aircraft.

For further information concerning the F/A-18 M61A1 gun installation, you should refer to *Description and Principles of Operation*, A1-F18AA-750-100; *Testing and Troubleshooting*, A1-F18AA-750-200; *Maintenance*, A1-F18AA-750-300; and *System Schematics*, A1-F18AA-750-500.

REVIEW NUMBER 4 ANSWERS

- A1. *The feed chute provides a path from the exit unit to the adapter assembly.*
- A2. *The return chute provides a path from the transfer unit to the entrance unit of the drum.*
- A3. *The gun gas purge system cools the barrels and purges gas from the gun compartment during gun-firing operations.*
- A4. *The gun gas purge systems of F/A-18 aircraft use engine bleed air and have additional gas control provided by a hydraulically actuated, ram-air scavenge door that opens automatically during gun-firing operation.*

F-14 GUN SYSTEM INSTALLATION

The F-14 M61A1 gun system (fig. 6-15) is mounted in the forward fuselage on the left side of the aircraft. Depending upon the mission objective, this gun system can be operated in an A/G mode, A/A mode, or an air combat maneuver (ACM) encounter mode. The computer pilot attack mode (ACM encounter mode) operates in conjunction with the weapon control system, computer signal data converter (CSDC), and the vertical display indicator system to display target data. The manual attack mode is normally used in the A/G mode. It is also used as the primary backup for the ACM encounter mode in case of system malfunction.

The M61A1 gun system accommodates a maximum of 676 rounds of 20-mm ammunition. There

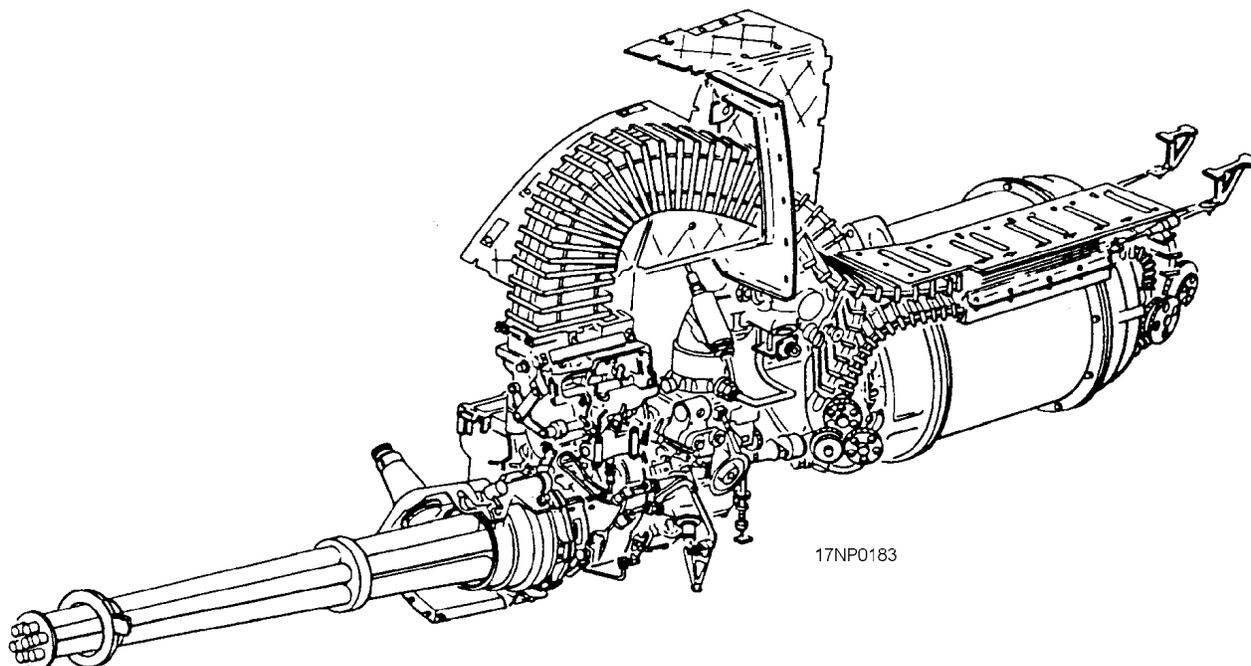


Figure 6-15.—F-14 M61A1 gun installation.

are 576 rounds in the drum and a total of 100 rounds in the chutes, transfer adapter assembly, and gun. The system can be set by ground maintenance personnel for unrestricted firing, or for rounds limit of 50, 100, or 200 rounds per burst. The HOOK/GUN panel contains a gun-rounds counter that gives a digital readout countdown of the rounds remaining in the gun system.

The clearing sector holdback assembly and safety pin (fig. 6-16) is used to clear the gun manually. With the clearing sector holdback assembly installed, the breech-bolt assemblies are diverted to the clearing cam path. Keep the clearing sector holdback assembly and safety pin installed until just before aircraft flight.

REVIEW NUMBER 5

- Q1. In F/A-18 aircraft, fired projectiles exit the aircraft through the gun blast diffuser assembly that is located _____.
- Q2. What maximum number of rounds does the M61A1 gun system hold when used on the F/A-18 aircraft?
- Q3. What component, located in the gun compartment, can be preset to limit the total number of rounds the pilot can fire?

- Q4. When used on F-14 aircraft, where is the M61A1 gun system mounted?
- Q5. What is the maximum capacity of the gun system when used on the F-14 aircraft?

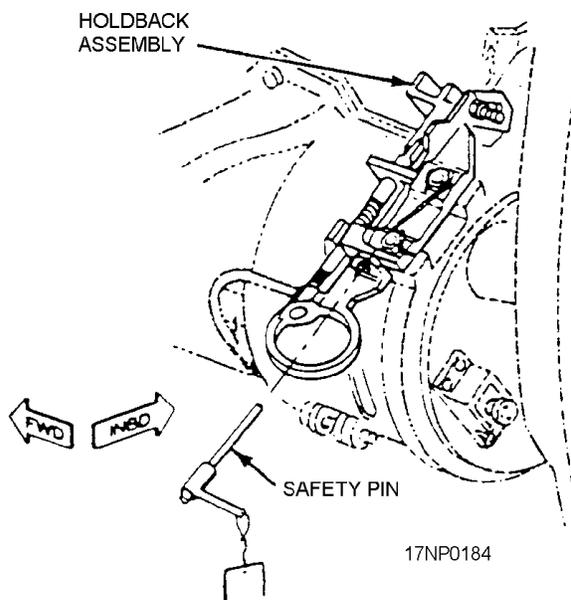


Figure 6-16.—F-14 clearing sector holdback assembly and safety pin.

MAINTENANCE AND TESTING

LEARNING OBJECTIVE: *Identify maintenance and testing procedures at the organizational and intermediate levels.*

The maintenance and testing responsibilities of an M61A1 gun installation are distributed evenly between the organizational and intermediate levels of maintenance. The basic responsibilities of these two levels of maintenance are discussed in the following paragraphs.

ORGANIZATIONAL MAINTENANCE

Organizational maintenance includes servicing (loading and unloading), preflight, postflight, minor periodic maintenance, malfunction troubleshooting, and removal and installation of components on the aircraft. Also, maintenance of the aircraft system and controls must be included in the AO's organizational responsibilities.

The gun firing record or log is kept at this level. The cumulative total of rounds fired is the basis for most of the maintenance. The number of rounds fired per firing flight is obtained from a counter located within the aircraft. For record accuracy, each time the gun installation is loaded, the counter must be reset (usually to zero) according to the instructions applicable to the aircraft. The two primary tasks that depend upon the round interval (rounds fired) are (1) torquing the two forward front track bolts (30,000 rounds), and (2) changing the breech-bolt assemblies (15,000 rounds).

Organizational responsibilities are **not** included in NAVAIR 11-95M61A1-1 or the NAVAIR 11-95M61A1-2. Organizational responsibilities are outlined in MRCs, aircraft MIMs, and aircraft loading manuals.

If a component is being removed for sudden stoppage (jam) maintenance, be careful and take extra precautions. Loose propellant powder from ruptured cartridge cases may be scattered about the gun compartment. This creates an extremely hazardous situation. The loose powder must be removed in a RADHAZ-free environment before you begin to remove a component.

INTERMEDIATE MAINTENANCE

Intermediate maintenance responsibilities are tasks associated with repair or replacement of unserviceable or damaged assemblies, components, or parts of the gun installation that do not require the special

maintenance facilities of an overhaul depot. When a gun reaches a round interval of 120,000 rounds fired or require major repair or alteration, it is sent to a depot-level maintenance activity. The ammunition handling and gun drive system maintenance procedures are identical at both the intermediate- and depot-maintenance levels (with one exception, the depot level removes bearings); therefore, such maintenance is generally performed at the intermediate level. Intermediate maintenance may be divided into two categories—scheduled and unscheduled.

Scheduled maintenance includes inspecting, disassembling, replacing parts, lubricating, assembling, and functionally checking components based on the round interval specified in technical manuals. Scheduled gun maintenance begins at 15,000 rounds and proceeds through various interval states for different parts replacement up to the 120,000-round overhaul interval. Scheduled maintenance for the handling and drive system is set at an interval of 30,000 rounds.

REVIEW NUMBER 6

- Q1. *The breech bolts are changed out when what number of rounds have been fired from the M61A1 gun system?*
- Q2. *What is the overhaul interval for the M61A1 gun?*
- Q3. *At what interval should scheduled maintenance for the handling and drive system be done?*

SAFETY PRECAUTIONS

LEARNING OBJECTIVE: *Identify safety precautions to follow when working with the M61A1 gun.*

The weapons systems described in this chapter are safe systems. Live rounds are isolated from the firing circuits except when the gun system is deliberately being fired. The gun system is RADHAZ safe and completely shielded from radiation fields. The gun is charged and cleared in flight, so the aircraft can take off and land without live rounds in the firing position. Although the sole purpose of all ordnance is to destroy an enemy, the equipment cannot identify friend from foe. Therefore, all safety precautions must be followed at all times.

The following general safety precautions are not related to any specific equipment or procedure. These

precautions are recommended safety precautions that all personnel should follow when operating and maintaining equipment.

- All persons who supervise or perform work in connection with ammunition handling should be familiar with the *United States Ordnance Safety Precautions*, NAVSEA OP 3347.
- When test firing is conducted using live ammunition, observe all existing range regulations.
- Before undertaking any operation for which a check off list exists, the check off list is read so all personnel know what to do.
- When provided, always use safety devices to prevent accidents. Keep safety devices in good operating order at all times.
- Do not make changes, modifications, or additions to a weapons system without prior approval and authorization from the appropriate authority.
- A hazardous condition exists if a gun malfunction occurs and there is anything in line with the gun muzzle. Observe area clearance requirements during maintenance periods.
- Percussion can fire electrically primed ammunition. NEVER cycle live ammunition through a gun for testing purposes.
- The explosive elements in electric primers are highly sensitive to static electricity. Make sure the primer button does not come into contact with the human body.
- Observe fire regulations and maintain good ventilation when using cleaning solvents and other volatile maintenance materials.
- Before performing maintenance actions involving pneumatic or hydraulic pressurized components, ensure that all pressure is removed and the component is in the safest possible condition.

REVIEW NUMBER 7

Q1. If a check off list is to be used during an operation, what action must take place first?

Q2. To prevent explosive primers on gun ammunition from being exposed to static electricity, what action should be taken?

Q3. When does a hazardous condition exist?

REVIEW NUMBER 5 ANSWERS

A1. In F/A-18 aircraft, fired projectiles exit the aircraft through the gun blast diffuser assembly that is located just forward of the cockpit windscreen.

A2. When used on the F/A-18 aircraft, the gun system holds a maximum of 578 rounds.

A3. A round limiter, located in the gun compartment, can be preset to limit the total number of rounds the pilot can fire.

A4. When used on F-14 aircraft, the M61A1 gun system is mounted in the forward fuselage on the left side of the aircraft.

A5. The maximum capacity of the gun system used on the F-14 aircraft is 676 rounds; 576 rounds in the drum and 100 rounds in the chute.

REVIEW NUMBER 6 ANSWERS

A1. The breech bolts are changed out when 15,000 rounds have been fired from the M61A1 gun system.

A2. The overhaul interval for the M61A1 gun is 120,000 rounds.

A3. Scheduled maintenance for the handling and drive system of the LALS should be done when the gun has fired 30,000 rounds.

REVIEW NUMBER 7 ANSWERS

A1. If a check off list is to be used during an operation, it must be read to all personnel who will take part in the operation.

A2. To prevent explosive primers on gun ammunition from being exposed to static electricity, make sure that the primer button of the ammunition doesn't come into contact with the human body.

A3. A hazardous condition exists if a gun malfunctions and there is anything in line with the gun muzzle.

