AIRCRAFT ARMAMENT

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PREFACE

This book is written for the enlisted men of Naval Aviation. It is one of a series of books designed to give them the background information necessary to perform their aviation duties.

A knowledge of aircraft armament is of primary importance to Aviation Ordnancemen responsible for general maintenance work. But the subdivisions of Aviation Ordnancemen—that is Aviation Bombsight Mechanics and Aviation Turret Mechanics—also need an understanding of aircraft armament. They need to know the relationship of their specialties to the broad subject of ordnance.

Starting with a general discussion of what to do with armament, this book follows with a discussion of how guns operate, and types of guns—Browning Machine gun and 20 mm automatics. Then come racks and shackles and bomb release systems. In conclusion, there is a section on bomb-handling equipment.

As one of the NAVY TRAINING COURSES, this book represents the joint endeavor of the Naval Air Technical Training Command and the Training Courses Section of the Bureau of Naval Personnel.

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ism is installed and is controlled by a valve in the pilot's cockpit.

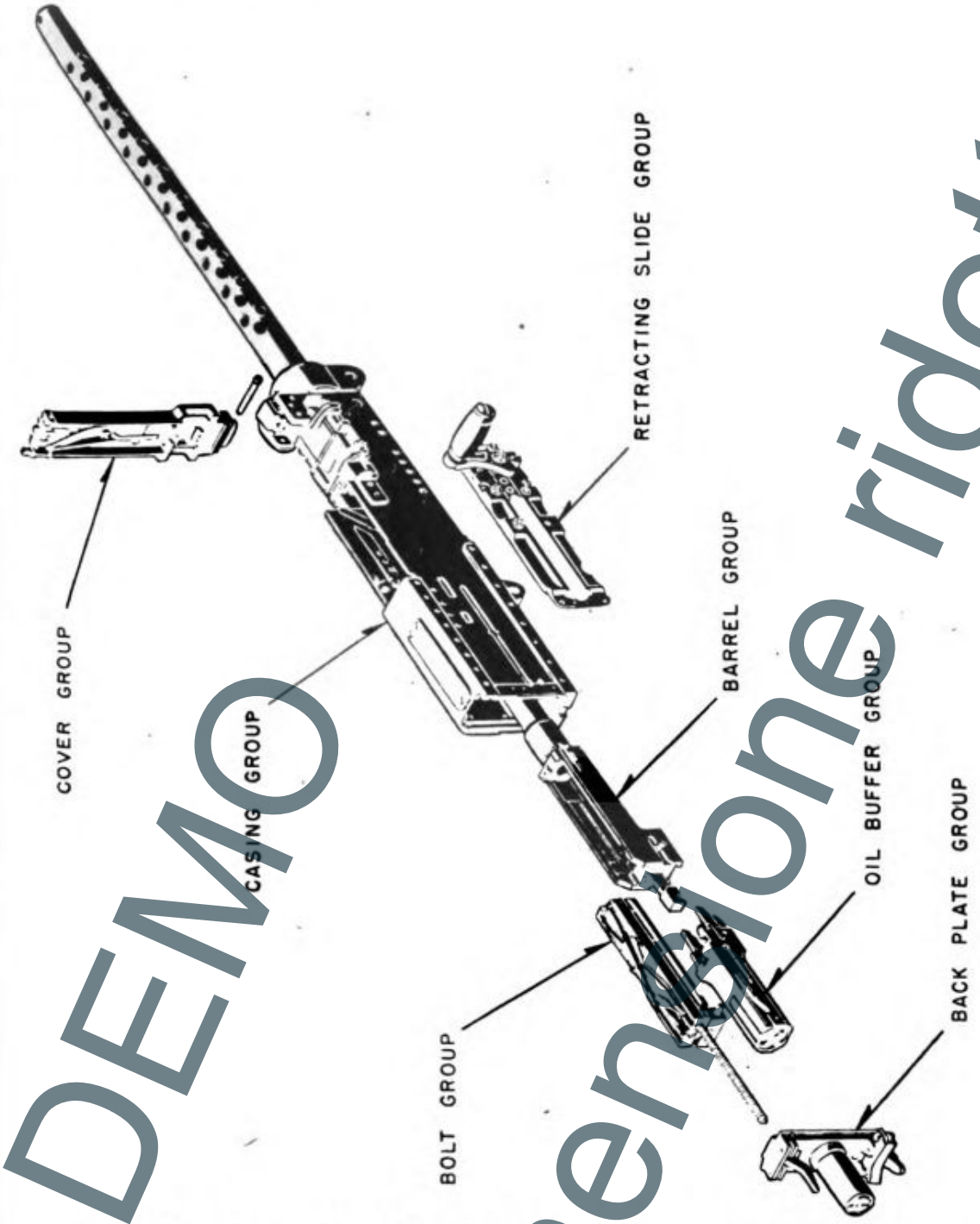


Figure 23.—Disassembly of the .50 caliber BAM gun according to groups.

THE RECEIVER GROUP

For convenience in assembly and disassembly, the parts of the gun are divided into groups which can be removed or installed as a unit (fig. 23).

On the following pages you will find pictures of the parts of a BAM gun broken down into groups.

The RECEIVER GROUP (fig. 24) makes up the main frame or chassis of the gun and contains most of the non-moving parts. The moving parts of the gun work inside the receiver. The mounting holes by which the gun is fastened to the airplane

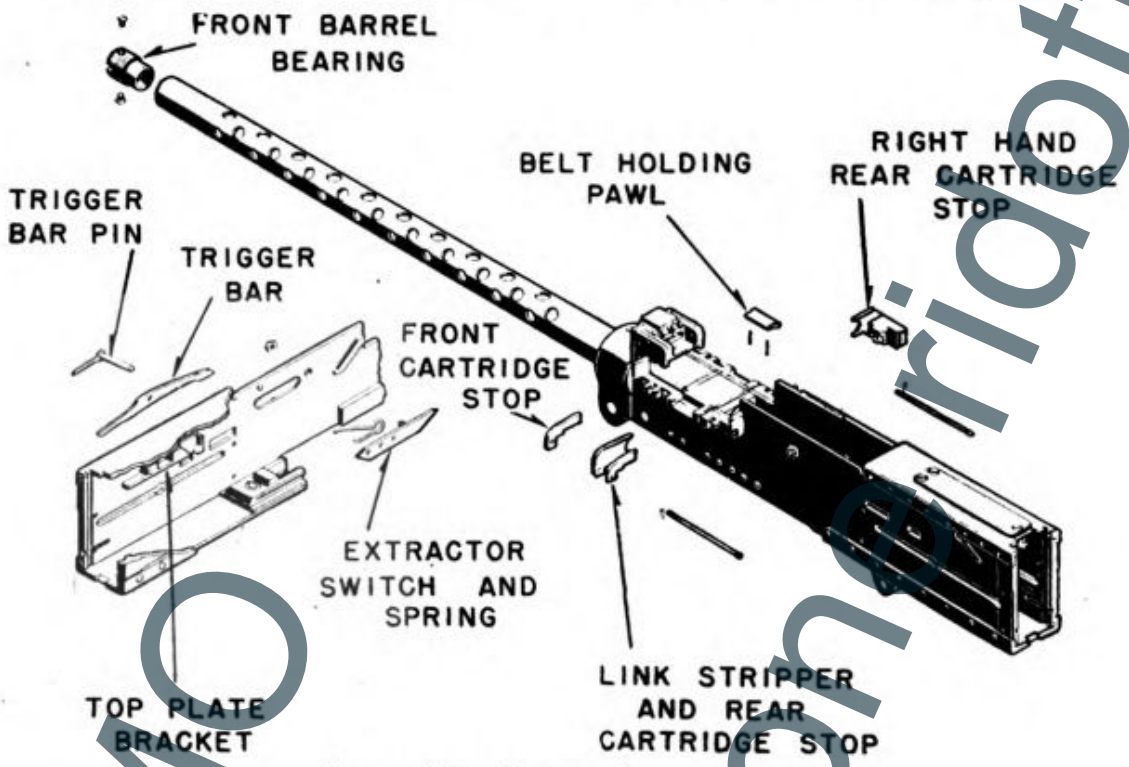


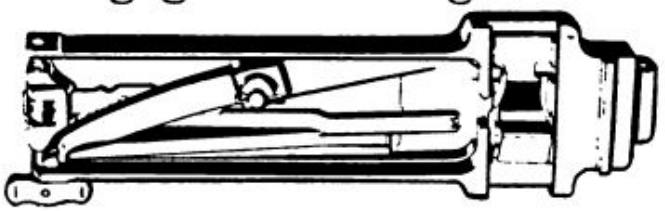
Figure 24.—The receiver group.

are in the receiver. There are two sets of these holes—a pair aft on projecting lugs and a pair in a TRUNNION ADAPTER which is fastened to the forward edge of the receiver around the barrel.

The receiver itself is made of two steel sideplates, riveted at the forward end to a TRUNNION BLOCK. Top and bottom plates are riveted to the after end of the side plates. The front portion of the receiver is open at the bottom to permit ejection of empty cartridge cases, while the top of the receiver, at the front, is closed by a hinged COVER which is considered as a separate group.

Besides serving as the frame of the gun, the receiver carries the trigger bar.

A bracket fastened to the top plate has a cam slot to engage the cocking lever of the bolt.



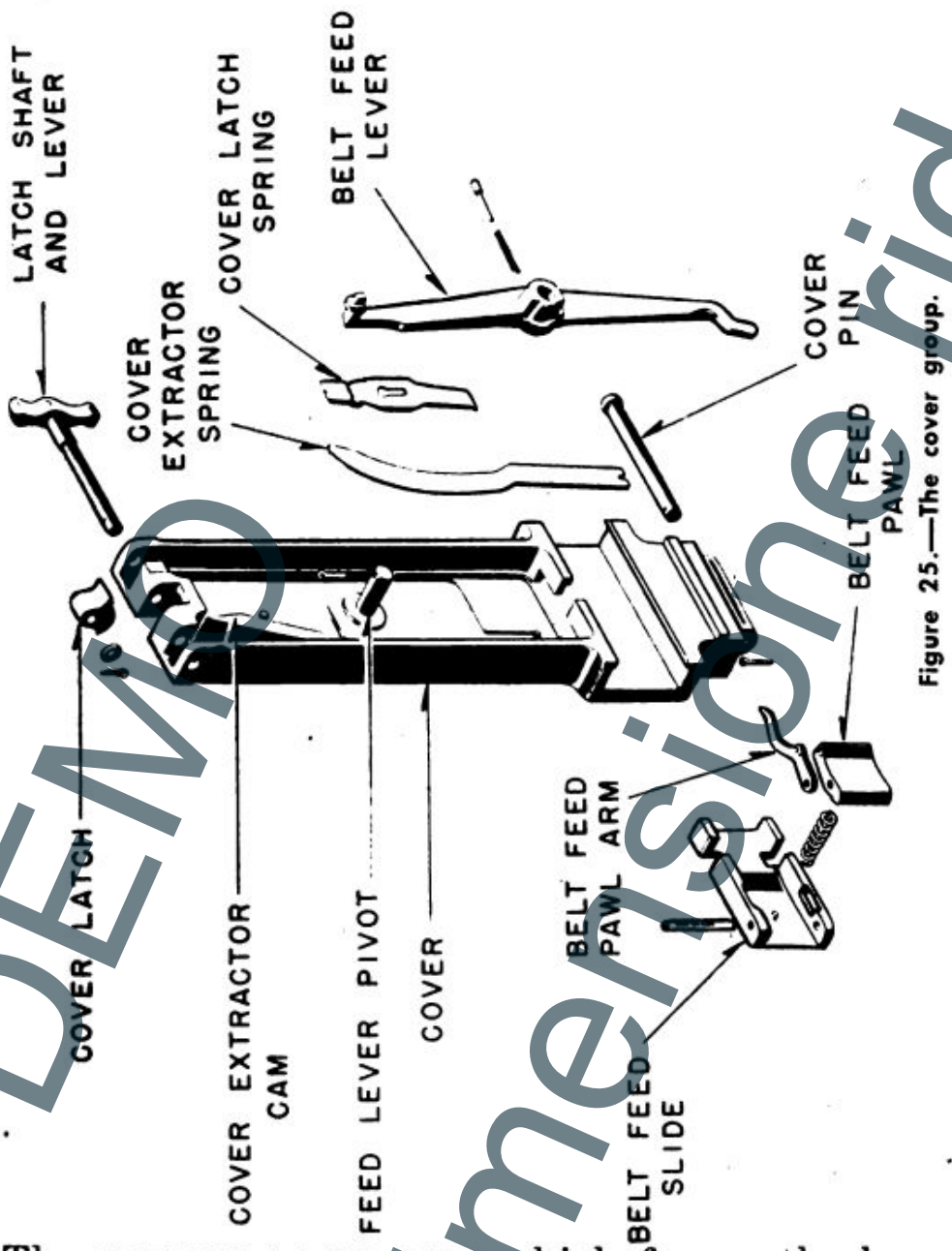


Figure 25.—The cover group.

The BREECH-LOCK CAM which forces the breech lock up into the locked position when the gun is in battery is fastened to the bottom plate of the receiver.

Part of the camming surfaces which control the movement of the extractor are attached to the side plate of the receiver.

The BARREL JACKET which admits cooling air around the barrel and supports it is screwed to the front of the receiver, and the rear of the receiver is slotted to receive the BACK PLATE GROUP, which will be discussed later.

THE COVER GROUP

The COVER or BELT FEED GROUP (fig. 25) is hinged to the top of the receiver. It serves as a cover for the receiver and can be lifted up to provide access to the interior of the gun. It also contains the belt feed mechanism. The BELT FEED LEVER is pivoted to the cover, and the BELT FEED SLIDE moves in tracks on it, carrying the belt feed pawl. Also attached to the cover are some of the cams controlling the movement of the extractor.

THE OIL BUFFER GROUP

Principal part of the OIL BUFFER GROUP is the buffer assembly which cushions the impact of the

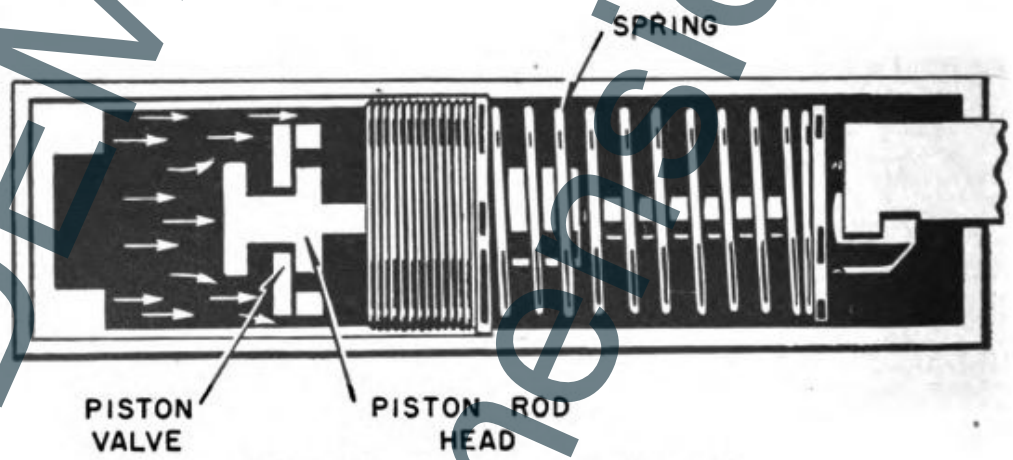


Figure 26.—How the oil buffer works.

recoiling barrel and barrel extension. This consists of a spring and an oil cylinder. In figure 26 you can see how this works. Before the barrel extension strikes, the spring is extended and the

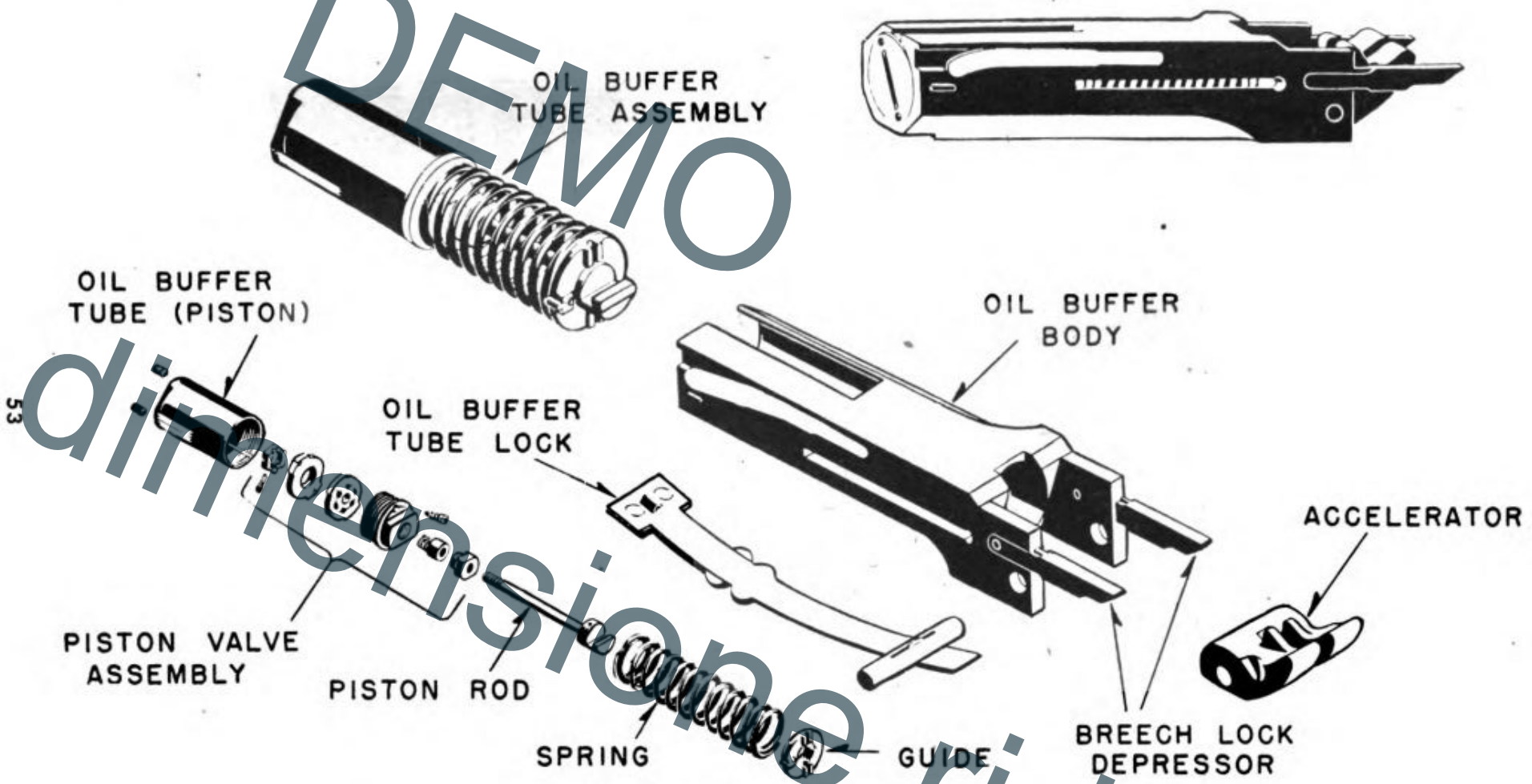


Figure 27.—Oil buffer group.

piston is in the forward part of the cyinder with the piston valve resting against it. When the barrel extension strikes, the spring is compressed. At the same time the piston is driven to the rear.

In order for the piston to move, the oil which is behind it must get in front of it. The only route is through the small holes in the piston valve. As the oil is slowly forced through these holes, the movement of the barrel extension is smoothly slowed down and stopped.

On the counter recoil stroke, the spring pushes the barrel extension back into battery, dragging the piston with it as it does so. On this stroke, however, the piston valve slips back to the far end of the piston stem, and the oil is able to flow freely through six good-sized holes in the piston. Thus no resistance is imposed to counter-recoil.

The oil buffer body has the ACCELERATOR pivoted to it. The function of the accelerator, you remember, is to flip the bolt backward during the recoil stroke and also to lock around the barrel extension shank and thus lock the barrel and extension into the recoil position. Sticking out in front of the barrel buffer body are two shafts known as the BREECH LOCK DEPRESSORS. These have cam surfaces which engage lugs on the sides of the BREECH LOCK. They force the lock downward during recoil when it rides off the BREECH LOCK CAM. These depressors provide a positive unlocking action during the recoil stroke.

THE BARREL GROUP

The BARREL AND BARREL EXTENSION are screwed together securely and are considered as one group (fig. 28). The only moving part within this group is the breech lock, which slides up and down in a slot in the barrel extension. And the bolt rides in grooves machined in the barrel extension.

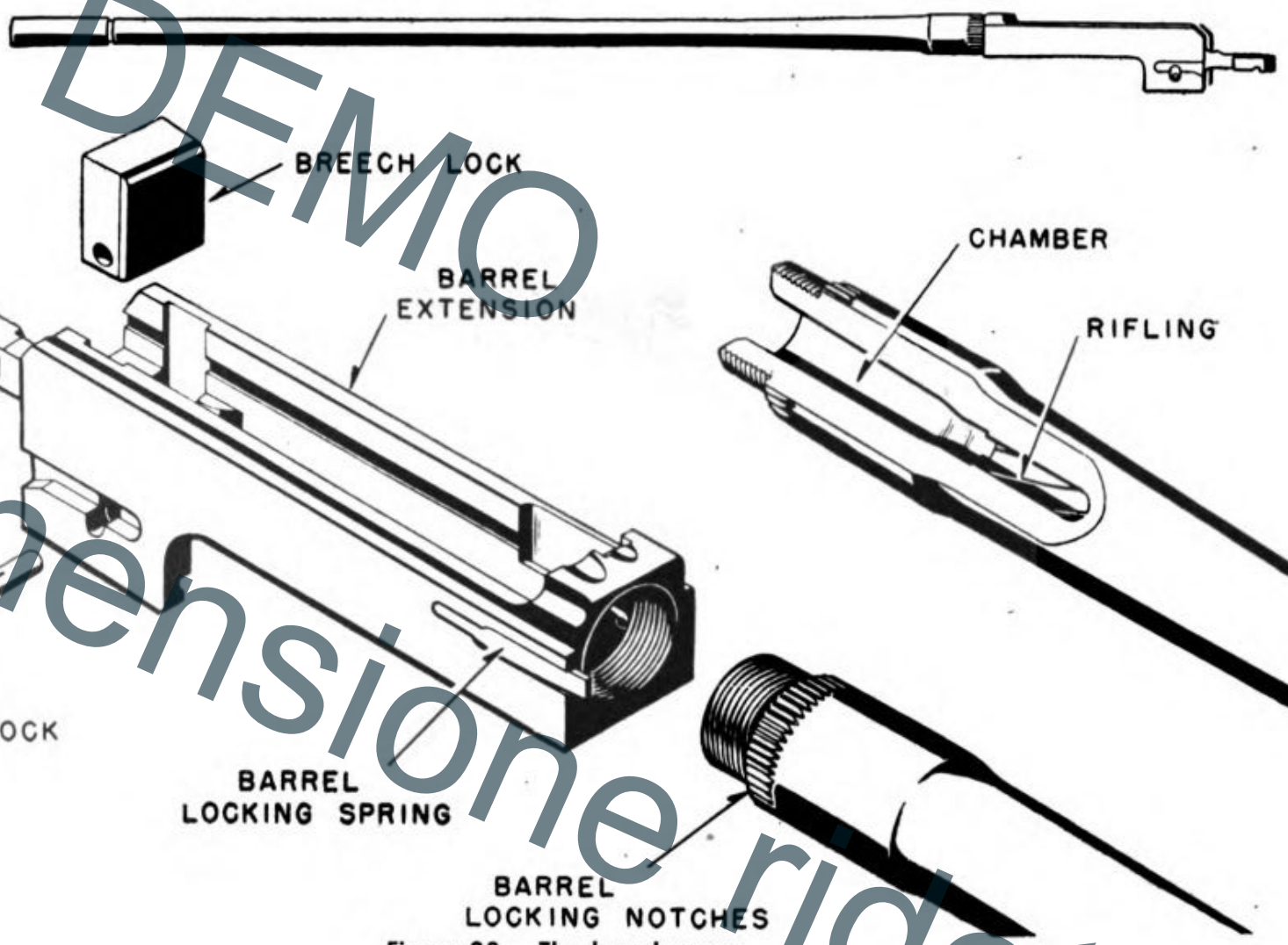


Figure 28.—The barrel group.

THE BACK PLATE GROUP

Two types of BACK PLATE GROUP are used. Both of them slide on to the after end of the receiver and close up the end. Both of them contain the buffer assembly with its disks. On guns set up for fixed mounting with remote control firing, that is all there is to the back plate. Flexible guns, which are aimed and fired by gunners standing behind them, sometimes contain hand grips and a trigger. The caliber .30 gun in figure 16 has a back plate of the flexible type while the caliber .50 is set up as a fixed gun. Figure 29 shows the basic back plate which can be used in a fixed mount or gun adaptor.

THE BOLT GROUP

The BOLT itself (fig. 30) does most of the work of operating the gun. It closes the breech. The firing pin and sear are mounted in the bolt, as well as the cocking lever which cocks the firing pin. The extractor, which draws the cartridges from the belt, is pivoted to its side. A T-slot on its forward face carries fresh cartridges into the action and extracts the spent cartridge from the chamber. The camming tracks on the top of the bolt operate the belt feed mechanism.

The driving spring fits into a recess in the after end of the bolt. It is compressed when the bolt moves backward and then, expanding, drives the bolt forward on counter-recoil.

The description given so far of the BAM will apply to both the caliber .30 and caliber .50 gun—with one exception. The caliber .30 does not have the oil buffer. Since the recoiling parts are lighter, it relies entirely on the spring to cushion the shock. In the caliber .30, therefore the buffer group is not known as the oil buffer group as it is in the caliber .50, but instead is called the LOCK FRAME GROUP.

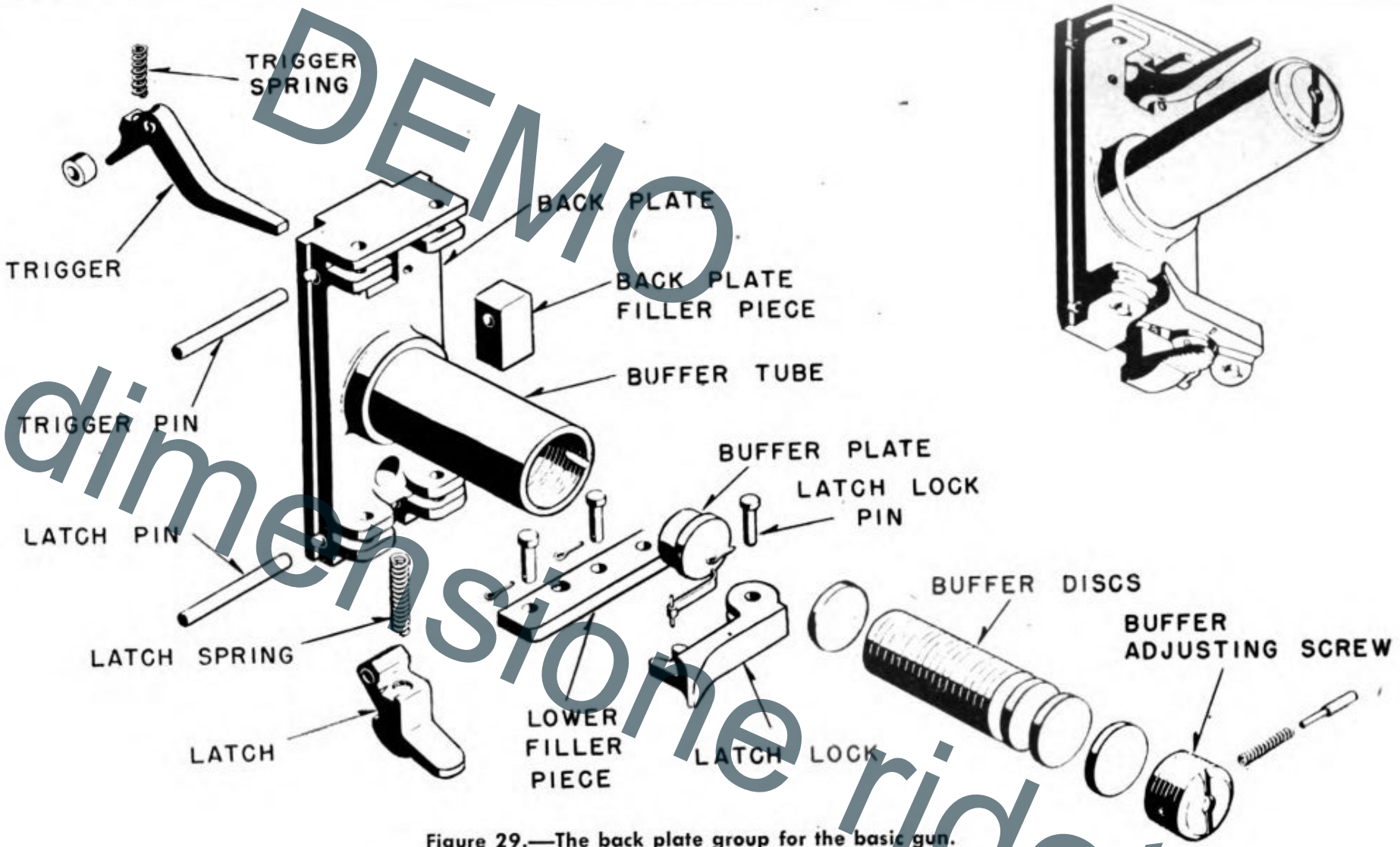


Figure 29.—The back plate group for the basic gun.

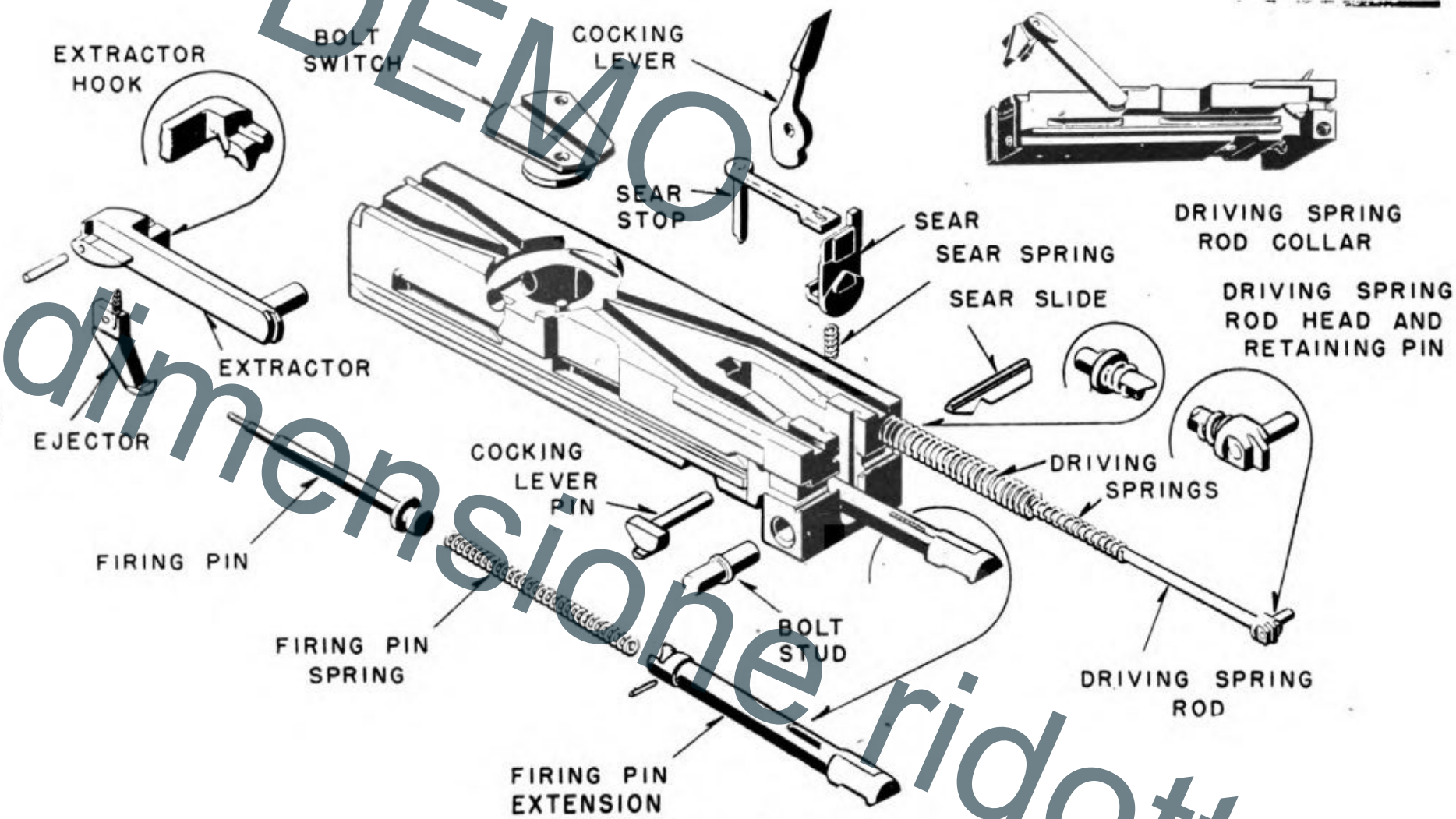


Figure 30.—The bolt group.

lock rides up the cam, fitting into the slot on the breech bolt, and the barrel extension continues to move forward into battery. In this case, however, the lock cannot rise—it cannot ride over the cam—and the mechanism jams. The barrel extension can't get forward into battery.

The gun will not fire, because the bolt is not far enough forward to bring the sear in contact with the trigger bar.

Even if the gun did fire, it would not feed, because the extractor has not been brought up to where it can grab a fresh cartridge from the feed belt.

There must be sufficient clearance in the headspace to permit the bolt to come forward and lock.

Then why not provide a good loose fit and be sure that the bolt can always get forward?

That won't work because too loose a fit will cause almost as much trouble as too tight a fit. If the fit is loose, you can't be sure that the cartridge will be rammed all the way home in the chamber. Sometimes it will seat all the way, sometimes it won't. This destroys the accuracy of the gun, because the bullet behaves differently when it is fully seated and when it isn't.

If the cartridge does seat all the way in the chamber, in spite of the loose headspace, a small space will be left between the back of the cartridge and the face of the bolt. If this space is too great, the firing pin may not be able to reach the cartridge, and the gun will not fire. If the gun does fire, the gas pressure against the unsupported base of the cartridge may blow it out, rupturing the cartridge. Then the ruptured cartridge cannot be extracted, and the gun will jam when it tries to ram home a fresh cartridge.

You can see that letting the headspace get too small or too large will ruin the performance of the gun.

HOW TO ADJUST HEADSPACE

Headspace is adjusted by screwing the barrel in and out of the barrel extension. A ring of notches is machined on the outside of the barrel, and a spring clip on the barrel extension snaps into one of the notches when you have adjusted the headspace. This spring clip locks the barrel and prevents it from creeping in and out of adjustment.

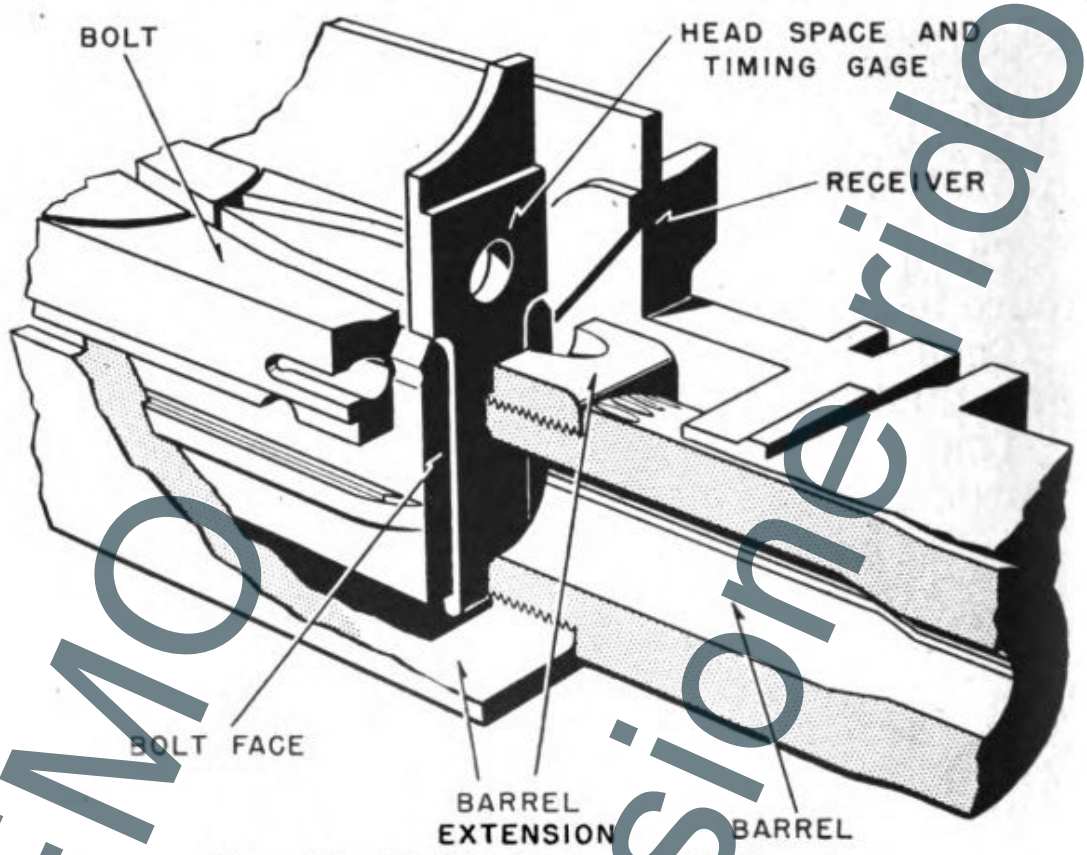


Figure 31.—Checking headspace with the gage.

Special gages are provided for head spacing. One comes with a timing gage attached to it. It is a combination headspace and timing gage. The end of the gage used for headspace is so marked. The other uses both ends for head spacing.

To check headspace, close the breech and try to slide the GO end of the gage down into the T-slot in the face of the bolt (fig. 31.). Be sure to pull back the bolt slightly—using the charging HANDLE or extractor to relieve the pressure of the driving spring. If the gage will not go in, the headspace

is too tight, and the barrel must be screwed out of the barrel extension. Now try the NO-GO end. If it WILL go in, the headspace is too loose.

The combination gage is a GO gage only. If it fits sloppily, the headspace is too loose. Screw the barrel into the extension until the gage will just slide in.

Fundamentally, the adjustment of headspace on the caliber .30 and caliber .50 gun is the same job. However, you have to use a slightly different method. On the caliber .50, the entire operation can be performed with the gun assembled. On the caliber .30, however, the spring lock is designed so that you have to disassemble the gun to screw the barrel in and out of the barrel extension. In this case, you assemble the breech bolt to the barrel extension in the closed breech position. Lock the bolt by pushing the breech block up with your fingers. Screw the barrel into the extension as far as it will go. Then back off the barrel one notch. Assemble the gun, and check the headspace with the gage.

In an emergency it is possible to adjust the headspace on the BAM without any special tools at all. To do this, screw the barrel into the receiver as far as it will go. You have to raise the cover and pull the bolt with the charging handle in order to change the adjustment of the barrel. Now let the bolt go forward and see whether the gun comes fully into battery.

You can tell whether the gun is fully in battery by lifting the cover. If the gun is in battery, the forward edge of the barrel extension should butt against the trunnion block which forms the front of the receiver.

If the action will not go all the way forward, you know that the headspace is too tight. Screw the barrel out of the receiver just enough to move the spring lock from one notch to the next notch.

Pull the bolt back again, let it go forward, and see whether the action moves into battery. Continue the process until you find the setting at which the action will just move all the way forward.

TIMING THE BAM

Headspace is the most important adjustment on the BAM. Second only in importance, however, is the adjustment of timing.

To understand the timing adjustment, recall what happens during the counter-recoil stroke of the action. The bolt moves forward, closes the breech, and locks. Then the bolt, barrel extension, and barrel move forward together into battery. As the action approaches battery, the sear mounted on the bolt hits against the trigger bar and is cammed downward, releasing the firing pin. On a fixed-mounted gun the sear slide hits against the solenoid shaft, is cammed to one side, and cams the sear downward.

To get the best performance out of a gun, you want the explosion of the fresh cartridge to occur at just the time which will make the action start to recoil the instant it comes into battery. However, it takes a certain amount of time, after the sear has been depressed, for the firing pin to move forward and for the explosion to occur. Therefore, the BAM is designed so that the sear will strike the trigger bar—or the sear slide will strike the solenoid shaft — a short distance before the action gets into battery.

But this distance — the timing adjustment — must not be too great. If the gun fires too soon, the action will start to recoil before the gun has come fully into battery. In extreme cases, the bolt will not get far enough forward for the extractor to grab a fresh cartridge out of the feed belt. And even if it's not that bad, the ability of the gun to

pull a heavy ammunition belt will be cut down because the recoil force will be less.

You use the timing end of the timing-headspace gage to check the timing of the BAM.

This is how you do it—

With the chamber empty, pull the charging handle all the way back and let it go forward again. This is to cock the firing pin. Now pull the bolt back about a quarter of an inch. Since the breech is locked, the barrel and barrel extension will be drawn back with the bolt. With the cover of the gun raised, slip the NO-FIRE end of the TIMING GAGE in front of the TRUNNION BLOCK on the receiver and allow the action to move forward until the front end of the BARREL EXTENSION comes to rest against the gage.

Now pull the trigger. Nothing should happen.

If the firing pin snaps, the timing distance is too great and must be reduced.

Now repeat, using the FIRE end. If the pin does NOT snap, the timing distance is too small.

Timing on the fixed-mounted gun can be adjusted by screwing the solenoid shaft in and out. No adjustment is provided on the flexible mounted gun, which fires by means of a trigger bar. To change the timing on such a gun, remove the trigger bar and measure it against a group of spares. Find a spare which is a little bit longer or shorter than the one you removed from the gun and use that one as a replacement. Now check the timing again.

RULES TO REMEMBER

Here are some SAFETY RULES that you should follow whenever you are working on a machine gun.

Be sure that the gun is securely ANCHORED in its mounting. Never lay a gun down where it may fall.

Be sure that the chamber and the bolt have NO CARTRIDGES in them.

Never COCK the gun against the pressure of a driving spring when the back plate is removed from the gun.

Never leave TWISTED ENDS of locking wires or cotter pins exposed.

Never ALTER or FORCE any part in such a manner as to prevent its being interchangeable with other guns.

Always be sure that the gun has been adjusted for proper HEADSPACE before you finish working on it.

On assembling a gun, be sure that the COCKING LEVER points FORWARD when the bolt is placed in the receiver.

Keep your tools and bench neat and clean.

After you have finished working on the gun and have test-fired it, pull the bolt back TWICE by hand and raise the cover. Check the T-slot in the bolt and the chamber to be sure no cartridges are still in the gun. Then release the FIRING PIN SPRING.

HOW THE GUNS ARE MOUNTED

The guns you read about in the previous chapter were all small arms which were held in the hand

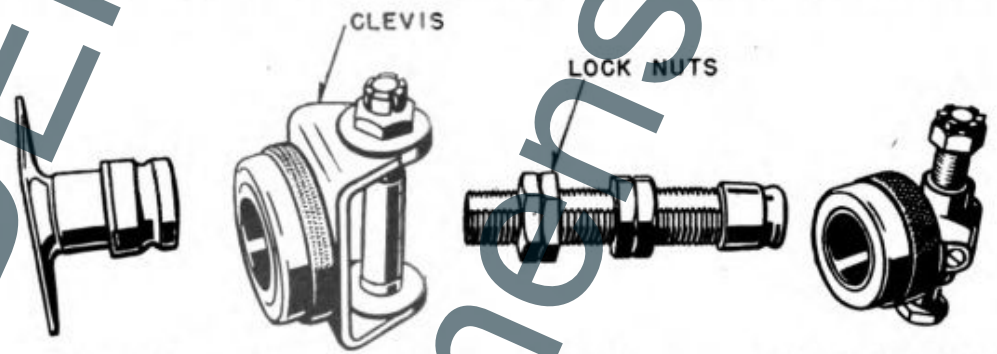


Figure 32.—Equipment for mounting fixed guns.

to be fired or—as in the case of the BAR, provided with a muzzle rest. The caliber .30 and caliber .50 BAM guns, however, are substantial weapons

backward until it strikes the REAR BUFFER—a powerful spring attached to the back plate of the receiver. You see the parts in figure 41.

The rear buffer stops the bolt, then starts it forward again. If the sear is still held down, the bolt will drive forward, picking up a fresh round, and repeating the whole process.

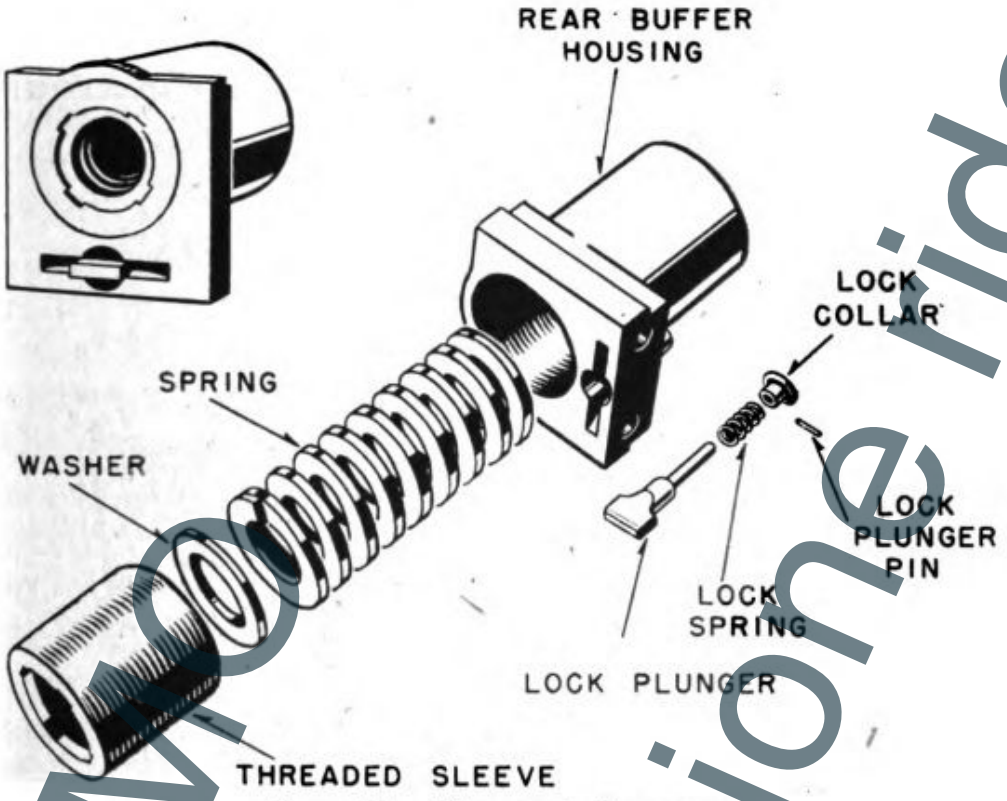


Figure 41.—The rear buffer group.

If the trigger has been released, it will snap into the slot under the bolt as the bolt starts forward. The bolt will be held in the retracted position, stopping the gun.

There is quite a shock as the sear catches the bolt. To cushion this shock the sear is hinged to a separate piece called the SEAR BLOCK instead of being hinged directly to the receiver. The sear block can slide in grooves in the receiver and is held in position by two powerful springs. These springs take up the shock when the sear catches the bolt.

FEEDING THE AMMUNITION

The only thing that remains now is to see how ammunition is fed into the gun. The 20 mm is ordinarily fed—like a BAM gun—from belts of cartridges fastened together by metal links. This belt is pushed into a feed mechanism mounted on top of the receiver. The first cartridge is engaged by the sprocket wheels which you can see in figure 42. A powerful coil spring at one end of the feed mechanism is trying to drive these wheels around.

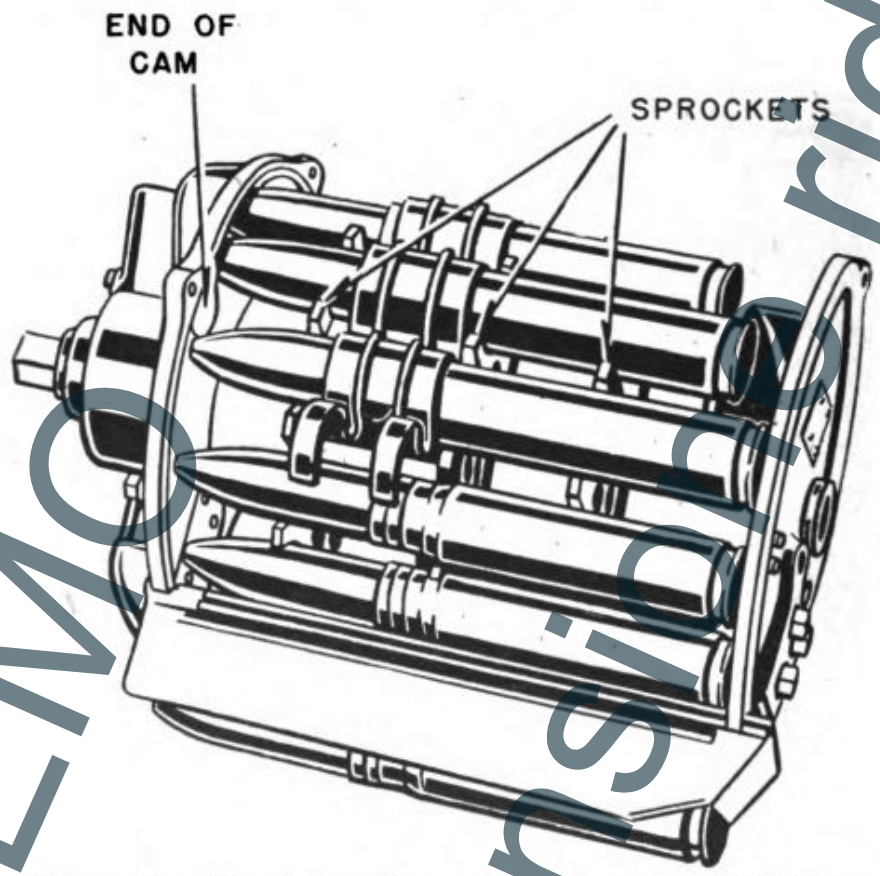


Figure 42.—How the cartridges are cammed out of the belt.

They pull the belt into the feed mechanism and around to the mouth leading into the action. As the belt is pulled in, the end of each shell presses against a slanting track on the forward edge of the feed mechanism. As the cartridge moves around, this track forces the cartridge backward out of the link of the belt. When the cartridge gets to the bottom of the mechanism, it is completely

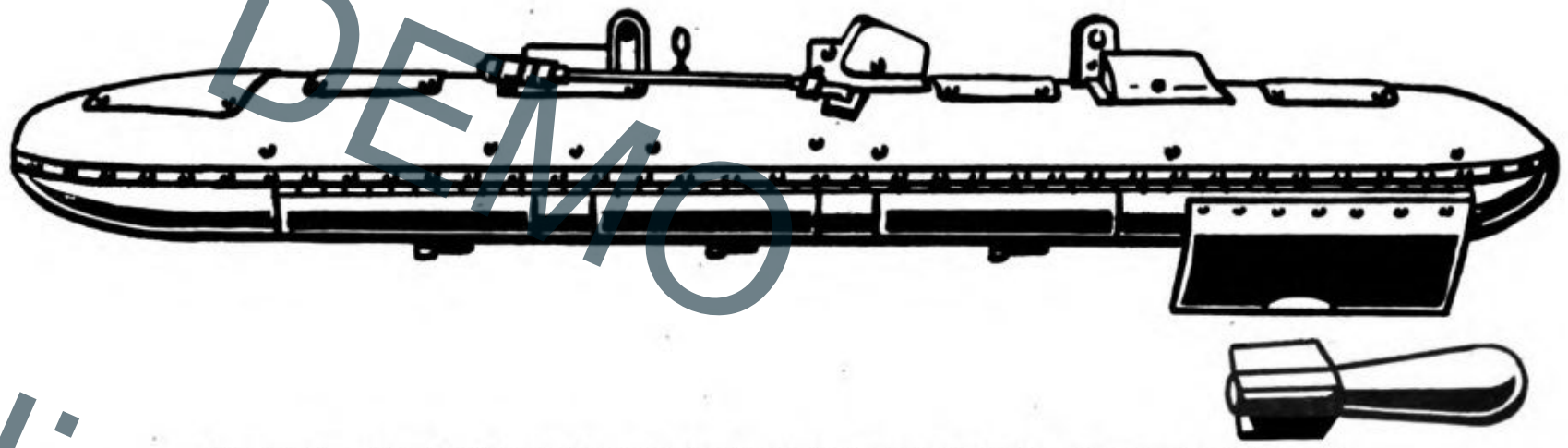


Figure 48.—The Mk 47 practice rack holds eight miniature bombs. One is being dropped.

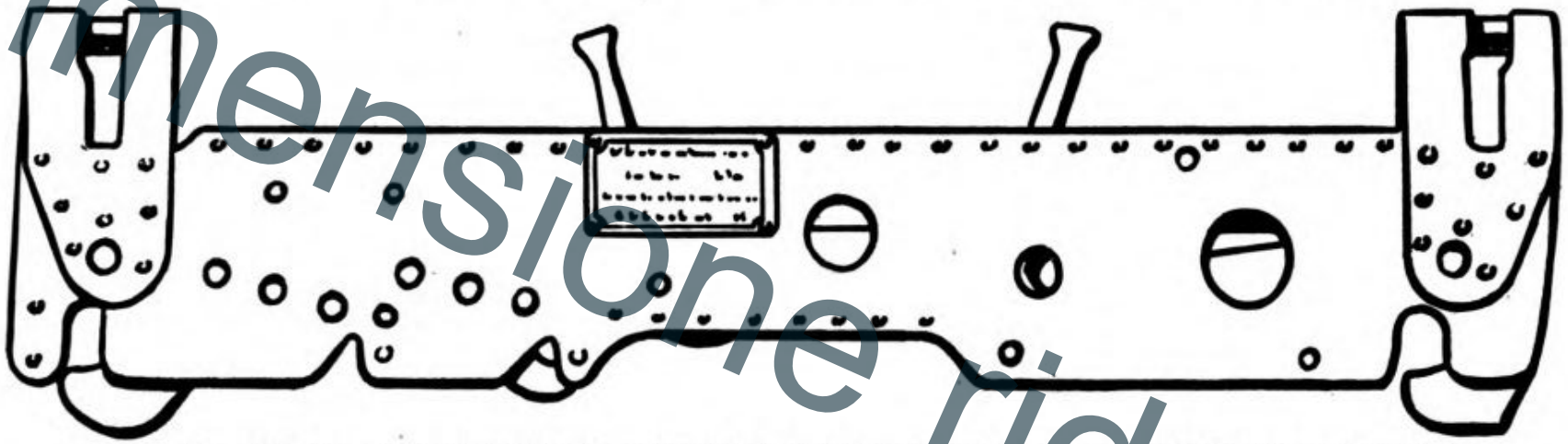


Figure 49.—The two levers protruding from this Mk 5 shackle mate with levers on a bomb release mechanism.

used which are much more like racks in their construction. That is, the arming and releasing mechanism is BUILT INTO the shackle instead of being in a separate release mechanism.

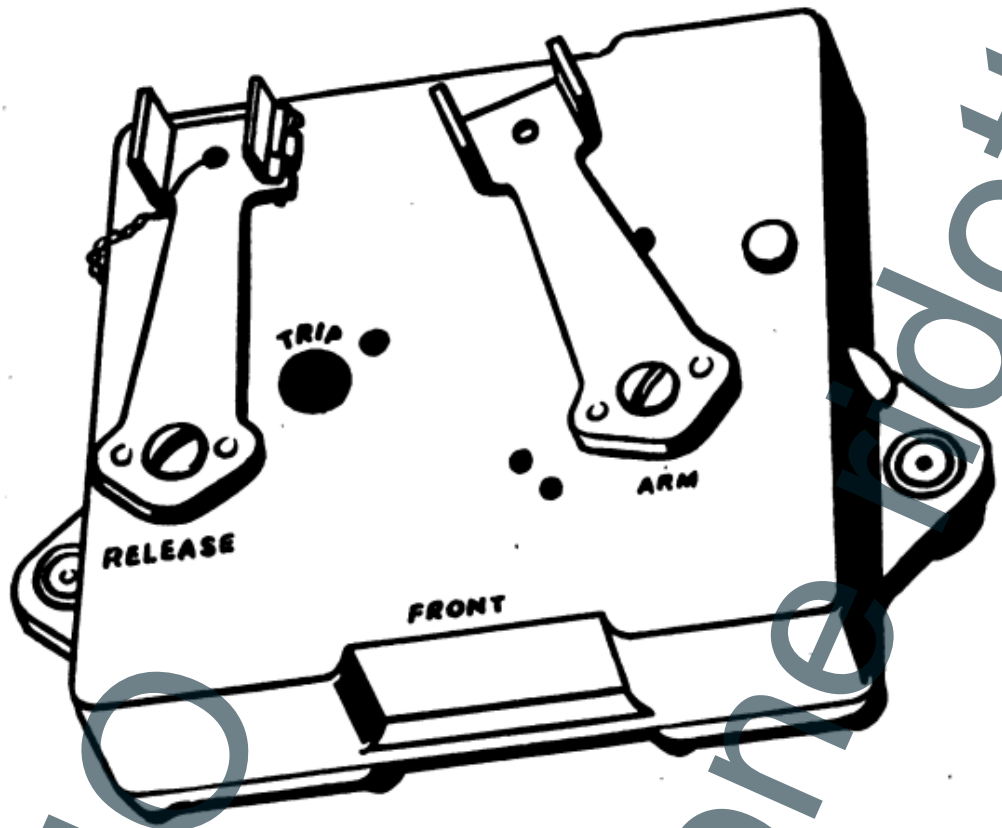


Figure 50.—This Bomb Release Mechanism is the N-2 type with two electric circuits.

These two shackles are the Mk 3 and the Mk 4. The chief difference between them is that the Mk 3 is ARMED electrically, while the Mk 4 is ARMED manually. The Mk 3 shackle has completely selective arming while the Mk 4 is semi-selective. Both provide for electrical or manual release. A peculiarity of these shackles is that before bombs are released electrically, the shackles must be UNLOCKED manually. On the Mk 3 this is done by a partial movement of the bomb release handle, and on the Mk 4 by manually arming the bombs.

The Mk 3 shackle is used in PATROL BOMBERS such as the PB2Y Coronado and PV-1 Ventura where the construction of the plane makes provi-

sion for manual arming difficult. The Mk 4 is used in TORPEDO BOMBERS.

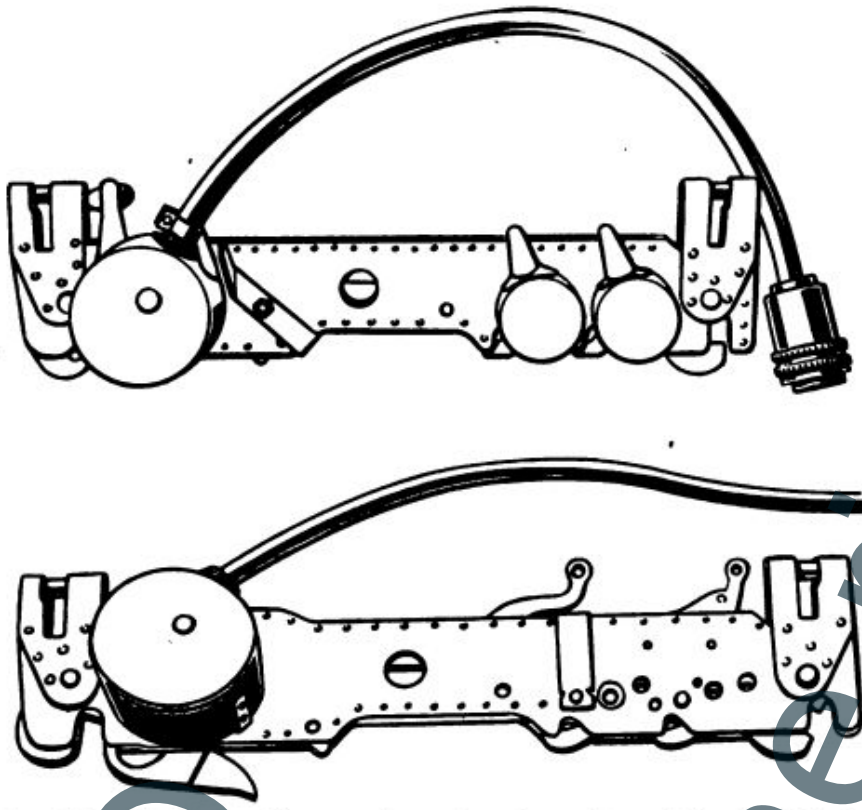


Figure 51.—The Mk 3 shackle, top, has electric arming while the Mk 4, bottom, arms manually.

HOW TO LOAD A BOMB

Loading bombs into a rack is not very difficult but it must be done right. The procedure is similar for each type of rack. For the purpose of explanation, however, here's how it's done on the Mk 51, the most common type of rack.

First, test the BOMB RELEASE HANDLE in the cockpit and the connecting cables to see that they move freely.

Test the ARMING mechanism. Try the arming handle at its three positions—"arm," "tail arm," and "safe." In the armed position, you should NOT be able to pull the arming wire retainers. Set the arming handle of the manual BOMB RELEASE at "safe" and test the ELECTRIC ARMING SWITCH at its four stages—"both arm," "nose arm," "tail arm," and "safe."

To test the RELEASE MECHANISM, close the bomb suspension hooks by rotating them by hand into the closed position. Then operate the release handle in the cockpit to see whether the lever and connecting cables operate freely and the suspension hooks spring open. Then close the bomb suspension hooks again and operate the rack by means of the ELECTRICAL system.

Now you are ready to HOIST the bomb into the rack. First hang the little brass plates on the end of the arming wire on the retainers. You have to do this BEFORE you hoist the bomb, because of the small clearance between the bomb and the rack, once the bomb is loaded.

Next open the bomb suspension hooks, hoist the bomb into place and close the hooks. You are now ready to thread the ARMING WIRES through the fuzes, secure them, and remove the safety pins from the fuzes.

Bombs weighing 100 pounds or less are usually hoisted into place by hand, but larger bombs must be lifted with a PORTABLE BOMB HOIST, a type of winch, and a cable. For some types of mounting, the bomb hoist is fastened to the side of the rack. There are special fittings on the rack to attach the hoist. When bombs are mounted UNDER THE WING of an airplane the hoist is usually put on top of the wing. Then the cable is run through a hole in the wing and down through the center of the rack to the bomb.

CHAPTER 6

BOMB RELEASE SYSTEMS

WHAT THEY ARE—WHAT THEY DO

Now that you know how bombs are dropped and armed, you are ready to study the entire bomb release system of the airplane.

What is a bomb release system? What does it have to do?

Remember that the bomber has just ONE bomb release switch. He may have as many as TWENTY bombs mounted in a bomb bay, or under the wings or both. He must have some way he can PICK THE PARTICULAR BOMB to be dropped or another way in which he can drop the bombs rapidly ONE AFTER ANOTHER. Moreover, he often wants to drop a string of bombs across the target, SPACED 10 feet, 50 feet, 100 feet apart. This gives him a much better chance of hitting the target and is called dropping the bombs "in train."

Also, the bombs must be dropped in an order

which will not UNBALANCE the plane. The bomber mustn't drop all the bombs on one side and then all on the other side—he must ALTERNATE, first on one side, then on the other.

The bomb release SYSTEM has to be set up so that the bomber can have a complete and easy choice of how he will drop his bombs.

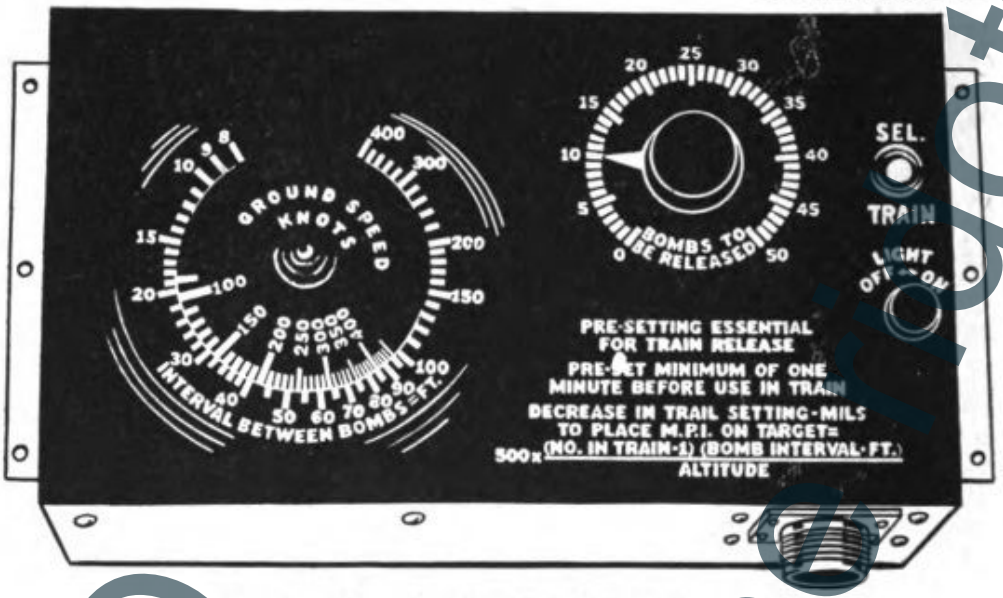


Figure 52.—Single-wire intervalometer.

Several important pieces of equipment are required to accomplish this. One of the most important and delicate is the INTERVALOMETER. This instrument (fig. 52) is a TIMING device designed to send out a series of electric impulses to operate the bomb racks. The impulses are SPACED just the right fraction of a second apart to drop the bombs IN TRAIN so that they will land the right DISTANCE apart. Also it is a COMPUTING device to figure out what that time interval should be.

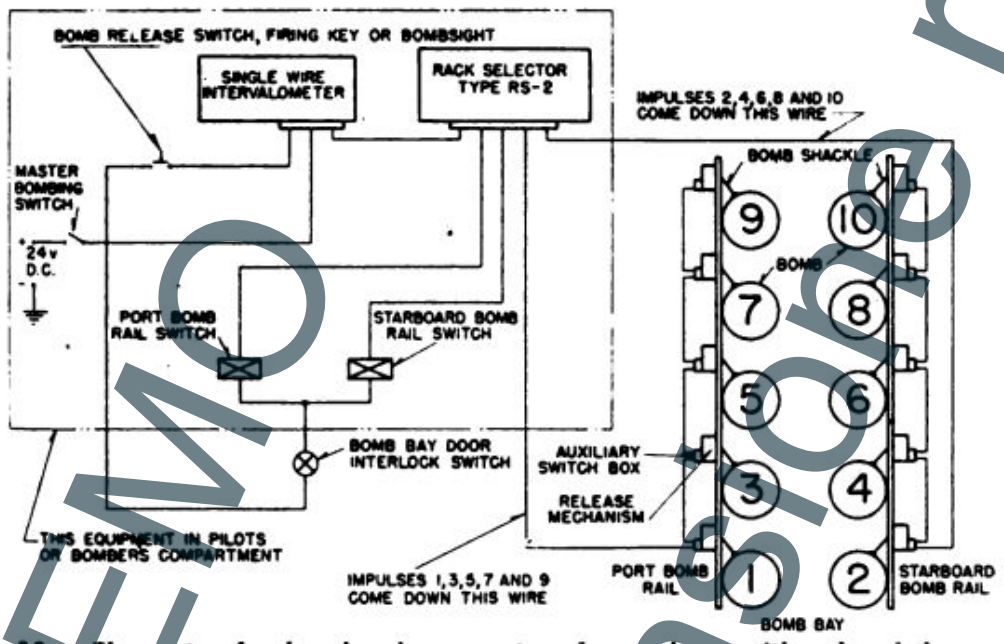
Suppose for instance, the bomber wants to drop 10 bombs 60 feet apart. The plane is flying at a ground speed of 285 knots. Then the bomber sets the upper right-hand SWITCH at "train." He sets the COUNTER knob to "10." And then he turns the INNER ground speed dial to bring 285 knots opposite 60 feet on the OUTER dial. These are the settings which have been made in figure 52. When

the bomb release switch is pressed, the intervalometer will send 10 impulses spaced so that the bombs will land 60 feet apart.

There are two types of intervalometers—the MULTI-WIRE and the SINGLE-WIRE. The multi-wire intervalometer has 13 outlet wires. These are connected to the different bomb stations, and when the intervalometer is operating it sends out a series of electrical impulses, one on each wire.

The single-wire intervalometer is the more common type. Here there is only one outlet wire and all the impulses are sent out along this wire.

With a single wire in the intervalometer you need some device to unscramble the impulses com-



53.—Elements of a bomb release system for a plane with a bomb bay.

ing along the single wire and distribute them to the different bomb stations. There are two such devices used. One is the BOMB RACK SELECTOR and the other is the BOMB STATION DISTRIBUTOR.

The bomb rack selector is usually used with planes which carry their bombs in a BOMB BAY. It is connected to the single-wire intervalometer and has TWO outlets. It distributes the impulses coming from the intervalometer so that they go out alternately along one outlet wire and then along

the other—one impulse to the first circuit, then one to the second circuit, again to the first circuit, and again to the second circuit, etc. This serves to insure that the bombs will be dropped evenly from BOTH SIDES of the plane and keep it on an even keel.

Mounted on each rack, shackle, or bomb release mechanism, in a circuit using the rack selector, is a TRANSFER SWITCH. This is a switch which closes when the release mechanism of the rack or shackle operates. Once the switch is closed, it passes on the next impulse to the NEXT bomb station.

BEGINNING AN ATTACK

Figure 53 shows a drawing of a typical bomb release system employing a bomb rack selector. Here is what happens when a bomber decides to make an attack.

First, he opens the BOMB BAY DOORS, and this automatically closes the bomb bay door INTERLOCK SWITCH. (This switch is there to make sure that the bombs are not dropped while the door is closed.) Then the bomber closes the two RAIL SWITCHES on his panel. He sets up the controls on the INTERVALOMETER by selecting the spacing of the bombs and the number of bombs to be dropped and puts the "trainsel" switch into the "train" position. Finally, he closes the MASTER BOMBING SWITCH.

At the proper instant, the bomber—or the bombsight—operates the BOMB RELEASE SWITCH. The intervalometer sends out its first impulse, which is shunted to the right hand side by the RACK SELECTOR. The signal goes to the lowermost bomb station on the right-hand side of the bay, and the bomb is DROPPED. At the same time the TRANSFER SWITCH is closed.

The next signal from the intervalometer goes to the lowermost left-hand station. A second bomb is dropped, and that transfer switch is closed.

The third signal from the intervalometer is shunted back to the right side, passes THROUGH the transfer switch of the lowermost bomb station and goes to the next station up, dropping that bomb and closing the corresponding transfer switch. And so on, until the number of bombs set on the intervalometer has been dropped.

WING-MOUNTED BOMBS

Planes in which the bombs are carried under the wings or are racked in a bomb bay side by side instead of one on top of the other may use a BOMB

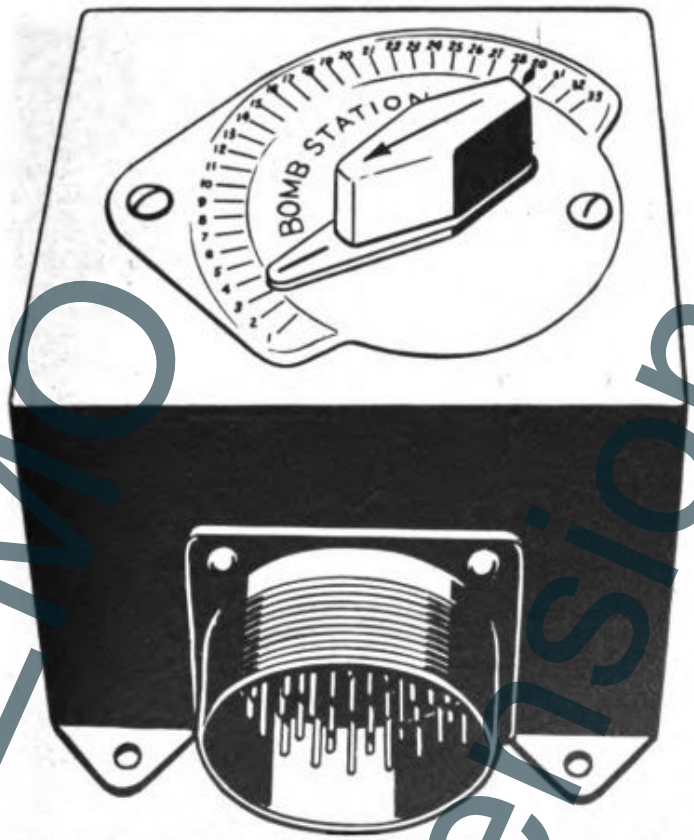


Figure 54.—A bomb station distributor, type SD-1.

STATION DISTRIBUTOR (fig. 54) with a single-wire intervalometer, in place of the rack selector. The station distributor receives electrical impulses through the single-wire from the intervalometer and distributes them to the different bomb stations through as many as 32 different outlet wires.

The station distributor can be used with both

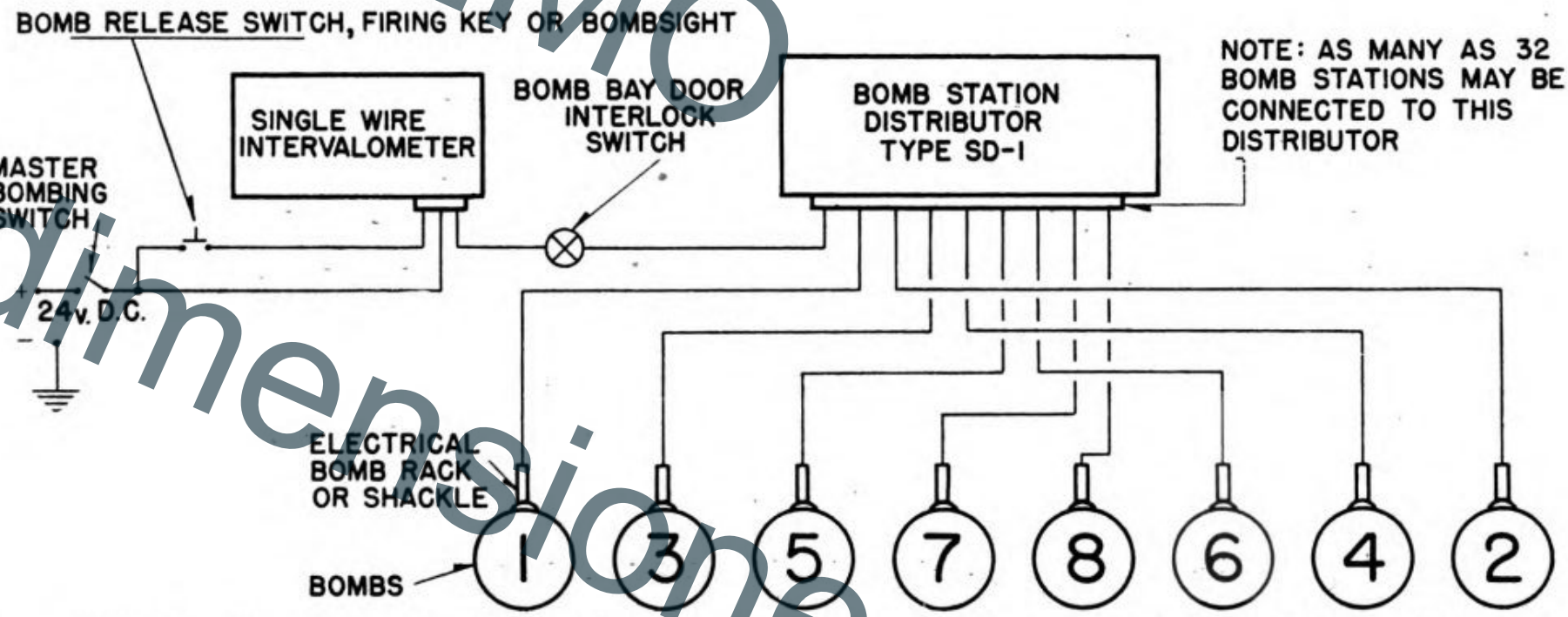


Figure 55.—This release system can be used when bombs are hung under the wings or side by side in a bomb bay.

selective and train bomb release. For SELECTIVE release, the pointer of the distributor is set by hand to the number on the dial corresponding to the bomb station desired. For train release, the pointer is set to the number of the FIRST bomb to be released, and succeeding bombs will be dropped in numerical order.

Figure 55 shows a typical hookup for a bomb release system using a station distributor. Here is what happens when bombs are to be dropped.

The bomber opens the BOMB BAY DOORS, and the bomb bay door INTERLOCK SWITCH closes automatically.

Then the controls on the INTERVALOMETER are set up as before.

The bomber sets the indicator on the BOMB STATION DISTRIBUTOR to the number of the FIRST bomb desired to be released—say No. 4.

Then the MASTER BOMBING SWITCH is closed, and everything is ready.

Over the target, the bomber operates the BOMB RELEASE SWITCH. The intervalometer sends out an impulse which is shunted by the bomb station distributor to station 4. That bomb is dropped. Another impulse comes from the intervalometer and is shunted to station 5. The next impulse goes to station 6, the next to station 7, and so on.

HANDLE WITH CARE

Always remember that intervalometers, station distributors, and rack selectors are comparatively delicate instruments. They are rugged enough to withstand normal handling and vibration but should not be subjected to unnecessary roughness and abuse.

NEVER clean, repair, or adjust these pieces of equipment in any way. Work on intervalometers, selectors and distributors should only be done by men specially trained for this purpose.

CHAPTER 7

BOMB HANDLING EQUIPMENT

A BIG JOB FOR YOU

Cannon balls were not originally intended for the decoration of military monuments. The same goes for modern aerial bombs.

As they leave the factories, you may see several addresses chalked up for special delivery—"HELLO, HITLER!" or, "DESTINATION, TOKYO!"

Presently these bombs are at an advanced base, or aboard a carrier, en route. In preparation for final delivery, YOU must take them out of storage, make them ready, and load them into airplanes for the final leg of their journey. BOMB HANDLING EQUIPMENT is the name which covers all of the various and sundry pieces of apparatus with which you transport your bombs, torpedoes, and mines from the magazine INTO the airplane.

This equipment varies a good deal, for different items are designed to meet different conditions. As an example, you might think that one bomb truck would serve all purposes—but bombs vary in weight from say 5 to 2,000 pounds, and they may be loaded from a concrete ramp in California, a

1,000 pounds to a height of almost 15 feet. This hoist is mounted on top of a wing, and the cable is run through holes in the wing and through the center of the rack.

Another type of manual hoist has an extension tube and is used from the side. The pulley at the end of the tube is hooked over the bracket at the side of the rack. Figure 63 shows such a hoist.

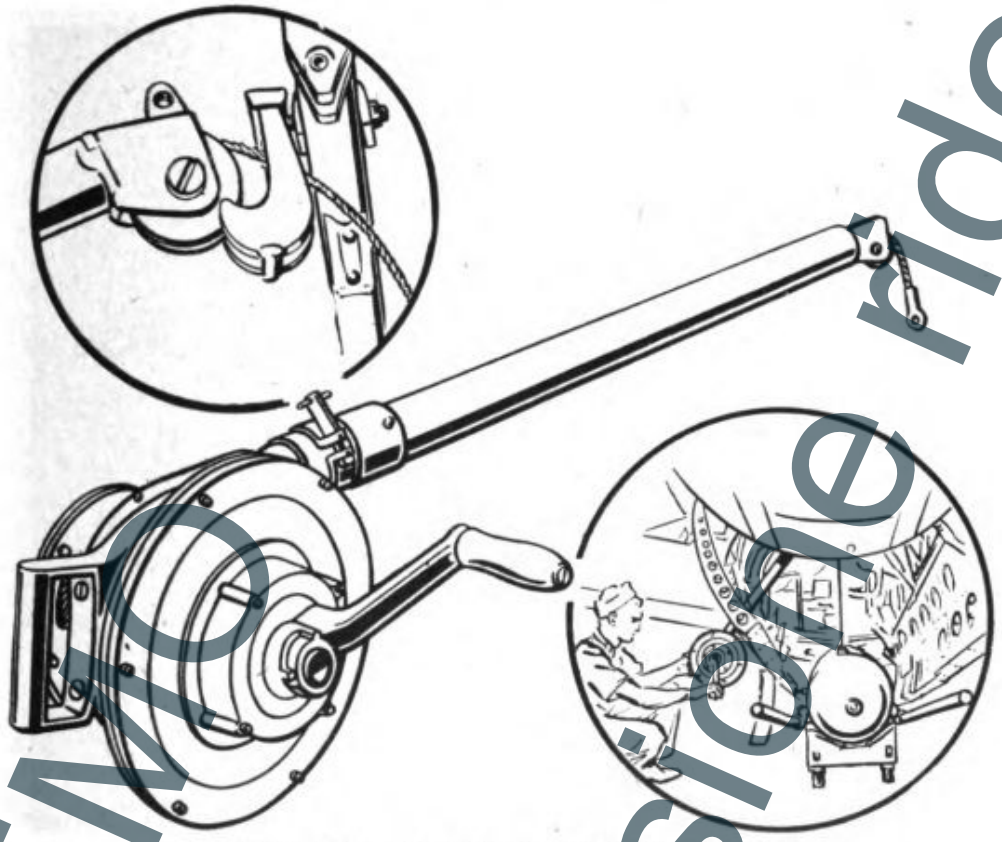


Figure 63.—Portable bomb hoist, Mk. 7.

The maintenance of any bomb handling equipment that has mechanical, moving parts is mainly a matter of LUBRICATION. A grease gun and an oil can are all that you will need, and the lubricating points are easy to find.

How Well Do You Know

AIRCRAFT ARMAMENT

QUIZ

CHAPTER 1

KNOWLEDGE PAYS DIVIDENDS

1. What is the difference between the designations "Mk" and "Mod"?
2. What is the Army equivalent for the Navy designation "Mk"?
3. In writing reports on equipment, how much of the designation for the various items must you use?
4. What does "AN" stand for?

CHAPTER 2

HOW GUNS OPERATE

1. What makes a gun kick?
2. In any gun, what is the function of the—
   (*a*) Chamber?
   (*b*) Firing pin?
   (*c*) Hammer?
   (*d*) Sear?
3. (*a*) What name is given to the gun group which contains most of the gun's moving parts?
   (*b*) What gun group holds this group?
4. (*a*) By what part of a gun are "caliber" and "gage" measured?
   (*b*) To what type of gun does each of these measurements apply?
5. (*a*) As bore size increases, how will caliber numbers change?
   (*b*) As bore size increases, how will gage numbers change?
   (*c*) Explain your answers to *a* and *b*.
6. In the Springfield rifle, what is the function of the—
   (*a*) Magazine cutoff?

(*b*) Safety?

7. Where on the Springfield will you find each of the parts mentioned in question 6?
8. In the Springfield rifle, —
   (*a*) How is the cartridge extracted?
   (*b*) What happens when the trigger is pulled?
9. A semi-automatic gun relieves the gunner of all the firing operations except one. What is that one?
10. (*a*) What is the basic force used to operate automatic guns?
    (*b*) Explain briefly how this force is used to operate gas-operated and blowback guns.
    (*c*) What is the third main type of automatic gun?
11. (*a*) Which of the types of operation mentioned in question 10 applies to the Winchester carbine?
    (*b*) How do the actions in Winchester carbines and Springfield rifles differ?
    (*c*) What part is added, in this carbine, to accomplish automatic operation of the action?
12. In the Winchester carbine,
    (*a*) What is the function of the operating spring?
    (*b*) How is the bolt rotated and retracted?
13. (*a*) What type of operation does the automatic pistol use?
    (*b*) Why is the pistol mis-named?
14. (*a*) What part accomplishes the locking of the slide in the automatic pistol?
    (*b*) What part accomplishes the unlocking?
15. (*a*) What kind of gun described in this chapter operates on the simplest principle upon which an automatic gun can work?
    (*b*) What is that principle?
    (*c*) What types of fire is this gun capable of?
16. In the Thompson sub-machine gun—
    (*a*) How is the firing pin cocked?
    (*b*) How is the bolt locked?
17. For each of the following weapons, give the caliber, type of fire and type of operation.
    (*a*) Enfield rifle.
    (*b*) Colt automatic pistol.
    (*c*) Smith & Wesson revolver.
    (*d*) Colt Ace pistol.
18. For each of the following weapons, give the caliber and accurate range.
    (*a*) Springfield rifle.
    (*b*) Winchester carbine.
    (*c*) Browning automatic rifle.

CHAPTER 3

BROWNING MACHINE GUNS

1. For caliber .50 and .30 Browning Aircraft Machine Guns, give the—
   (*a*) Type of operation.
   (*b*) Type of fire.
   (*c*) Type of feed.
   (*d*) Rate of fire.
2. (*a*) Is the BAM breech locked during recoil? How?
   (*b*) How does it unlock?
   (*c*) Is the breech locked before or after the gun returns to battery?
3. What does the accelerator accelerate?
4. (*a*) What part cocks the firing pin? Where is it located?
   (*b*) Does this happen during recoil or counter recoil?
   (*c*) How is the firing pin released in a free BAM? A fixed BAM?
5. (*a*) What is the purpose of the grooves in the top of the bolt?
   (*b*) Why are there two of them?
6. What are the 6 groups into which the BAM parts are divided for convenience in assembly and disassembly?
7. (*a*) How is routine cleaning of a BAM performed?
   (*b*) What special precaution is necessary before lubrication?
   (*c*) What special handling does a gun just received from storage require?
8. Describe the lubrication procedure for—
   (*a*) Normal temperatures.
   (*b*) Temperatures lower than 30° below zero.
9. (*a*) What does a gun do when headspace is too tight?
   (*b*) What is the best way to tell whether the headspace is too tight?
10. (*a*) What will happen to a gun with loose headspace?
    (*b*) What part do you move to change the headspace?
11. (*a*) What adjustment is almost as important as headspace?
    (*b*) How do you tell whether or not this adjustment is correct?

(*c*) If it is not correct, how do you change it?

12. When you assemble a gun, which way should the cocking lever point when you place the bolt in the receiver?
13. What is the basic difference between flexible and fixed guns?
14. What are some of the things you should check before the takeoff of an airplane whose armament is in your charge? When it returns?

CHAPTER 4

20 MM AUTOMATIC

1. (*a*) What type of operation does the 20 mm automatic use?
   (*b*) What type of feed does it use?
   (*c*) What is its rate of fire?
2. Why is the 20 mm automatic sometimes called a cannon?
3. How and when is the bolt locked? How is it unlocked?
4. What is the function of the inertia blocks?
5. What holds the bolt cocked? How?
6. Explain how the electric trigger fires the gun.
7. What stops the bolt's backward movement on the recoil stroke? What else does it do to the bolt?
8. What device moves the belt feed? Where does its energy come from?
9. What is a hang fire?
10. What is a cooked-off round?

CHAPTER 5

RACKS AND SHACKLES

1. What is meant by "arming" a bomb?
2. (*a*) What is the difference between racks and shackles?
   (*b*) Where would you expect to find a rack used?
3. Would you expect to find both manual and electrical release on the same rack?
4. What is the difference between selective and semi-selective arming?

5. (*a*) What is the Mk number of the most modern 2-hook rack? Single-hook rack?
   (*b*) What weight bomb can be carried on each of these racks?
6. Is electrical arming of the Mk 51 rack selective or semi-selective?
7. What rack would you use for dive bombing practice with miniature bombs?
8. What is a release mechanism?
9. How far apart are the suspension lugs on a Mk 51 rack? On a Mk 3 shackle?
10. (*a*) What is the chief difference between the Mk 3 and Mk 4 shackle?
    (*b*) How do they differ from the Mk 5?
11. How do you test the arming mechanism on a bomb rack?
12. Do you remove the safety pins from a fuze before or after attaching the arming wire to the rack? Before or after threading the wire through the fuze?

CHAPTER 6

BOMB RELEASE SYSTEMS

1. What is the purpose of an intervalometer?
2. (*a*) What determines whether you would use a bomb rack selector or a station distributor in an airplane?
   (*b*) What is the function of each?
3. What is a transfer switch?
4. How do you lubricate an intervalometer?

CHAPTER 7

BOMB HANDLING EQUIPMENT

1. What are hoisting bands used for?
2. What are bomb skids used for?
3. (*a*) What is the difference between a skid and a truck?
   (*b*) Would you ever use a bomb skid and a bomb truck together?
4. What is the purpose of the extension tube on a Mk 7 bomb hoist?

ANSWERS TO QUIZ

CHAPTER 1

KNOWLEDGE PAYS DIVIDENDS

1. "Mk" identifies a new design or pattern of a particular type of equipment, whereas "Mod" denotes a change so slight that it does not affect the basic design.
2. "M."
3. The complete designation for each new item mentioned.
4. Standardized for use by Army and Navy.

CHAPTER 2

HOW GUNS OPERATE

1. The pressure against the breech plug (bolt) as the gas formed by the burning gunpowder expands within the cartridge chamber.
2. (*a*) To hold the cartridge.
   (*b*) To explode the primer.
   (*c*) To drive the firing pin against the primer.
   (*d*) To cock the gun.
3. (*a*) Action.
   (*b*) Receiver.
4. (*a*) Bore (before rifling).
   (*b*) Caliber—rifle.
   Gage—shotgun.
5. (*a*) Caliber numbers will increase (be higher).
   (*b*) Gage numbers will decrease (be lower).
   (*c*) Caliber is a direct measure of bore size (before rifling), whereas gage represents not the size of the bore but the number of lead balls of bore diameter which would be required to weigh one pound. Therefore the larger the rifle the HIGHER THE CALIBER, but the larger the shotgun the

fewer balls per pound and the LOWER THE GAGE.

6. (*a*) To adjust the rifle for repeating or single-shot operation.
   (*b*) To prevent accidental firing while the rifle is cocked.
7. Magazine cutoff—left side of receiver.
   Safety—rear end of bolt.
8. See pages 12 and 13.
9. Pulling the trigger.
10. (*a*) The waste power of the cartridge.
    (*b*) Gas-operated guns are activated by the force of a piston driven by the expanding gas; whereas blowback guns are activated by backward movement of the bolt driven by the gas.
    (*c*) Recoil.
11. (*a*) Gas.
    (*b*) The carbine firing pin is moved by a hammer rather than by a spring as in the rifle.
    (*c*) Slide.
12. (*a*) To drive the slide (and bolt) forward so that a fresh cartridge is rammed into the chamber.
    (*b*) See pages 17-19.
13. (*a*) Recoil.
    (*b*) Because it is actually a semi-automatic pistol (the trigger must be pulled each time the gun is fired).
14. (*a*) Ribs.
    (*b*) Link.
15. (*a*) Thompson sub-machine gun. (Or: Sub-machine gun caliber .45 M3.)
    (*b*) Blowback.
    (*c*) Automatic and semi-automatic. (Or: Automatic only.)
16. (*a*) It is not cocked.
    (*b*) It is not locked.
17.

	CALIBER	FIRE	OPERATION
(*a*)	.30	Repeating	Manual
(*b*)	.45	Semi-auto.	Recoil
(*c*)	.38	Repeating	Manual
(*d*)	.22	Semi-auto.	Recoil

18.

	CALIBER	ACCURATE RANGE
(*a*)	.30	600 yards
(*b*)	.30	300 yards
(*c*)	.30	600 yards

CHAPTER 3

BROWNING MACHINE GUNS

1. (*a*) Recoil.
   (*b*) Full automatic.
   (*c*) Belt.
   (*d*) 400 to 500 rounds per minute (.50 caliber). 1,350 rounds per minute (.30 caliber).
2. (*a*) During the first part of the recoil stroke. By the breech lock, a metal plate which, when lifted, fits into a notch in the underside of the breech bolt.
   (*b*) The breech lock moves off the cam ramp on the floor of the receiver and is pushed downward by the lock depressors.
   (*c*) Before.
3. The backward movement of the bolt during recoil.
4. (*a*) Cocking lever. It protrudes from the top of the bolt.
   (*b*) Recoil.
   (*c*) See pages 41 and 42.
5. (*a*) To drive the belt feed lever.
   (*b*) So that the gun can be set up to feed from either right or left.
6. Receiver group.
   Cover group.
   Back plate group.
   Oil buffer (or Lock frame) group.
   Barrel group.
   Bolt group.
7. (*a*) All movable parts are disassembled and thoroughly wiped with dry-cleaning solvent; bore is swabbed with rifle bore cleaner until a clean flannel patch picks up no foreign matter.
   (*b*) Cloth gloves should be worn, so that perspiration from the hands cannot corrode the unprotected metal.
   (*c*) A special cleaning job to remove the heavy grease in which guns are stored and shipped. (See page 60.)
8. (*a*) Disassemble gun; wipe all parts with an oily cloth saturated with special preservative lubricating oil.
   (*b*) Disassemble gun; wipe all parts with a clean lintless cloth which has been saturated in oil

and then wrung dry; remove as much of the oil as possible with a dry clean lintless cloth.

9. (*a*) The gun will not fire, or if it fires it will not feed. (See pages 62-63.)
   (*b*) Check it with a No-Go gage.
10. (*a*) Accuracy will be impaired. (The cartridge may or may not seat all the way.)
    (*b*) Barrel.
11. (*a*) Timing.
    (*b*) Check it with the timing end of the timing-headspace gage. (See pages 64-65.)
    (*c*) By screwing the solenoid shaft in or out, on a fixed gun; or by replacing the trigger bar with a longer or shorter bar, on a flexible gun.
12. Forward.
13. Flexible guns are swivel-mounted in the fuselage and are aimed by an individual gunner; fixed guns are rigidly fastened to the frame of the airplane and are carefully lined up with the airplane so that the pilot can aim them by aiming the plane.
14. See pages 64 and 71.

CHAPTER 4

20 MM AUTOMATIC

1. (*a*) Blowback, gas pressure and recoil.
   (*b*) Belt.
   (*c*) 500 to 800 rounds per minute.
2. Because it shoots shells.
3. See page 76.
4. To prevent the receiver slides from bouncing back, as the gun fires, and unlocking the breech.
5. The sear. By snapping into a notch on the underside of the bolt.
6. See page 83.
7. Rear buffer. Starts it forward again.
8. Sprocket wheels. A coil spring kept wound by the gun's recoil movement.
9. A delay in cartridge explosion for some seconds or minutes after the firing pin strikes the cartridge.
10. A cartridge explosion caused by the heat of the barrel.

CHAPTER 5

RACKS AND SHACKLES

1. Adjusting its fuzes so that they will explode when the bomb hits.
2. (*a*) Racks are solidly and more or less permanently attached to the main structure of the airplane, whereas shackles can be easily detached from the plane.
   (*b*) When bombs are suspended from the underside of a wing or from the top of a bomb bay.
3. Yes. (Racks may be armed and safetied either manually or electrically or both.)
4. Selective arming permits arming of either one or both of the fuzes, whereas semi-selective arming permits arming of the tail fuze only, or both fuzes.
5. (*a*) Mk 51. Mk 50.
   (*b*) Mk 51—25 lbs. to 1600 lbs.
   Mk 50—25 lbs. to 500 lbs.
6. Selective.
7. Mk 47. (Mk 43.)
8. Mechanism, attached to the airplane, for controlling the operation of releasing and arming mechanisms on bomb shackles.
9. 14 inches. Same.
10. (*a*) The Mk 3 is armed electrically (selective arming), whereas the Mk 4 is armed manually (semi-selective arming).
    (*b*) They do not require a separate release mechanism.
11. Try the arming handle in its three positions. In the armed position you should not be able to pull open the arming wire retainers.
12. After. After.

CHAPTER 6

BOMB RELEASE SYSTEMS

1. To control the timing of bomb release so that the bombs will land the correct distance apart.
2. (*a*) The way in which the bombs are carried. (Bomb rack selectors are usually used with planes which carry their bombs in a bomb bay; whereas bomb station distributors are usually

used when the bombs are carried under the wings, or in a bomb bay side by side instead of one on top of another.)

(*b*) Both function to distribute impulses from the intervalometer to the different bomb stations: The bomb rack selector distributes the impulses to alternate racks, whereas the bomb station distributor distributes them direct to the individual bomb stations.

3. A mechanism used with bomb rack selectors, to pass the intervalometer impulses from each individual bomb station to the next station.
4. Intervalometers should be serviced only by men specially trained for this purpose.

CHAPTER 7

BOMB HANDLING EQUIPMENT

1. Securing hoisting cables to bomb bodies while leaving suspension lugs free to be secured to the suspension hooks of the bomb rack.
2. Carrying bombs and torpedoes.
3. (*a*) Most trucks have hydraulic lift mechanisms.
   (*b*) Yes. Trucks can raise loaded skids.
4. To carry a pulley which can be hooked over a bracket at the side of the rack, enabling the hoist to be used from the side.

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