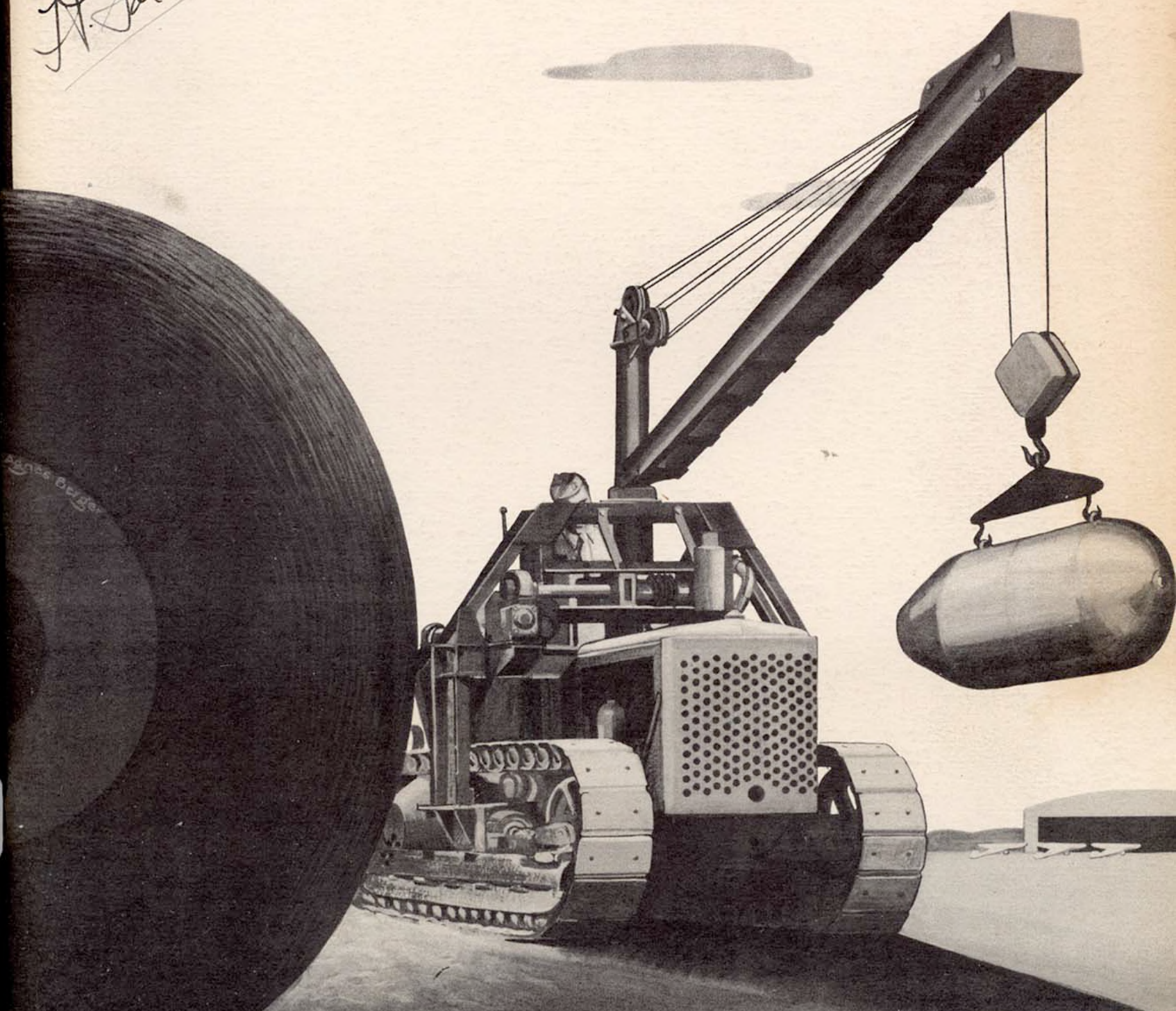


THE ORDNANCE SERGEANT

H. Solomon



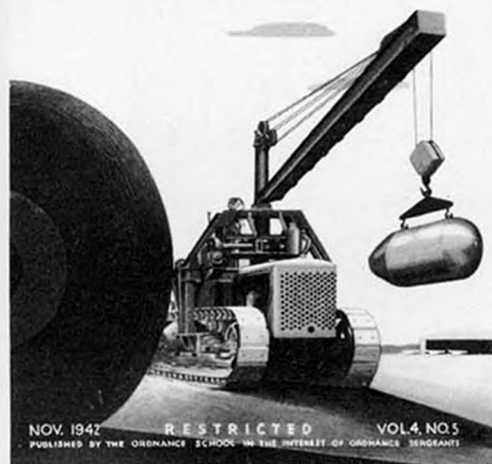
NOV. 1942

R E S T R I C T E D

VOL.4, NO.5

PUBLISHED BY THE ORDNANCE SCHOOL IN THE INTEREST OF ORDNANCE SERGEANTS

THE ORDNANCE SERGEANT



The cover this month is by Miss Agnes Berger, a member of the Art Section of The Ordnance School, and shows the Tractor Crane, M1, in use at an air base.

HIGHLIGHTS

This is the second of two issues intended to acquaint Ordnance personnel more generally with the special service vehicles.

Included in this second group of vehicle articles are the Aviation Ordnance vehicles which become of increasing importance as the Army Air Forces continue to expand. The Spare Parts Truck; the Tool and Bench Truck, M6; the Artillery Repair Truck, M2; and the Welding Trucks, complete the series.

Have you an inventive mind? Have you noticed how some tool or piece of equipment might be improved? Have you found a new way to make an old job easier? Several such ideas form the basis of an article which begins on page 445, and there must be many others which are in use throughout the Ordnance Department. Send them along, so that THE ORDNANCE SERGEANT can pass them on to other readers.

Several months ago THE ORDNANCE SERGEANT mentioned "Fire Power". It's a subject which has many interesting and important ramifications. Some of them are discussed on page 450.

Another article pertaining to the Aircraft Torpedo appears on page 454, with a discussion of the War Head and Exploder Mechanism. If other parts of this materiel puzzle you, tell us about it, and your puzzle will be solved.

Among the regular monthly pages may be found a number of interesting and useful articles.

For example, "Stop that Knock" under the Automotive heading on page 468, tells us a lot of things which we may not have understood clearly before. Every individual who has any connection of any kind with a vehicle should read this article.

The organization and functions of the Ordnance Section, Army Air Forces is explained on page 494. Among the other important articles are "Breach Mechanisms", on page 462; "Special Orders", on page 477; "I & I Report", on page 478; and the second installment of "Storage of Ammunition", on page 489. Every article in this issue is worthwhile. Read them all.

Address all communications to: THE ORDNANCE SERGEANT, The Ordnance School, Ordnance Training Center, Aberdeen Proving Ground, Maryland.

REPRODUCTION PLANT
THE ORDNANCE SCHOOL
ABERDEEN PROVING GROUND
MARYLAND

RESTRICTED

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"RESTRICTED"

Restricted military information will not be communicated to the public or to the press but may be given to any person known to be in the service of the United States and to persons of undoubted loyalty and discretion who are cooperating in Government work.

The coming of November, 1942, brought changes in the official family of The Ordnance School. Colonel George W. Outland, who had been Commandant of The Ordnance School since January, 1941, and who had been responsible for its physical design even prior to that time, became the Commanding Officer of the Ordnance Replacement Training Center, also at Aberdeen Proving Ground. Lieutenant Colonel John D. Billingsley, Assistant Commandant under Colonel Outland, became the new Commandant. Colonel Billingsley was succeeded by Major Oren E. Hurlbut, Executive Officer.

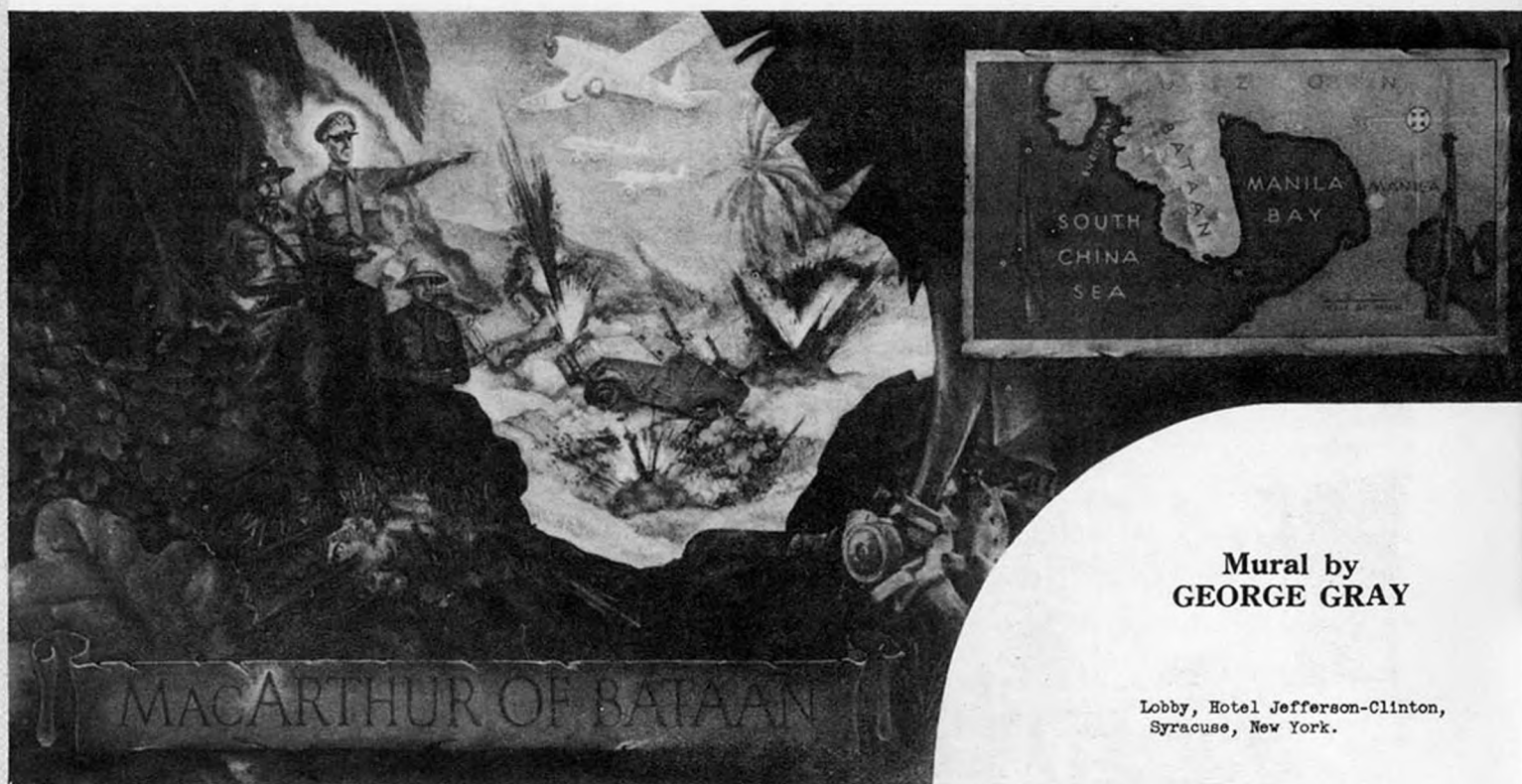


Col. George W. Outland

THE ORDNANCE SERGEANT is glad to see you go to your new assignment. Since before its very first issue you have offered it encouragement and advice. This encouragement and advice, we know, is still ours for the asking. The Ordnance School has accomplished much under your leadership. It could not expect to keep you always. You deserve to go on to new fields with even greater responsibilities. THE ORDNANCE SERGEANT wishes for you all the good fortune which will be experienced by those with whom you will now be associated. The Ordnance Replacement Training Center is fortunate indeed.

Lt. Col. John D. Billingsley

THE ORDNANCE SERGEANT has been under your direct control since its birth. Its constant growth is sufficient evidence of the manner in which you have exercised that control. Many decisions have been made, many problems have been solved, and a great deal of useful knowledge has been sent to our readers throughout the Ordnance Department under your careful guidance. The loss of an able Commandant is eased greatly by the knowledge that in his place he leaves an able assistant to carry on in his stead. THE ORDNANCE SERGEANT knows that it can look to you now, as before, for that supervision which will insure its future.



Mural by
GEORGE GRAY

Lobby, Hotel Jefferson-Clinton,
Syracuse, New York.

In tribute to the fighting forces of Democracy -- of MacArthur's heroes at Bataan -- Artist George Gray, of the American Military Institute, Washington, D. C., depicts the indelible imprint on the minds of all lovers of freedom by their gallant stand and sacrifices in the Philippines.

In the immediate foreground is featured Major General Jonathan Wainwright, ranking Field Commander, General Douglas MacArthur, Commander of American and Philippine Forces, Major General Richard K. Sutherland, Chief of Staff, directing operations. A shattered Jap plane occupies the immediate lower right of the canvas together with

an unexploded Jap bomb, a blood-stained Benquet Igorot spear and shield with other battle fragments scattered in the lush jungle vegetation. A map of the Theater of Operations in the Philippines -- flanked by two Cal. 30 M1 rifles, is placed in the upper right of the canvas, orienting the action or incident portrayed in the painting. In the middle distance Artist Gray has caught the indomitable spirit of the U. S. troops, hungry, fever ridden, exhausted, valiantly fighting off wave after wave of attacking fresh Jap troops -- the pick of the Mikado's armies -- to crumple after a blazing stand of many weeks -- without relief -- against overwhelming forces -- 10 to 1 odds. Overhead Jap planes rain down concentrated death and destruction.

Thirty miles from the Mexican Border, in southwestern New Mexico, a typical American town swelters in the sun. Clouds of dust and sand sweep through its streets on occasion. During some winters biting blizzards whistle down from the North, laying the town under a freezing blanket of snow. Not the most comfortable, but as true as any, are the homes of its residents.

These homes are occupied by men and women with varied blood in their veins. The town might be Spanish, or Mexican, or Indian, or something else -- actually it is American.

The official population of this cluster of American homes is thirty-six hundred -- minus one hundred and twenty. Or, let's say it differently. Let's say the population is thirty-four hundred and eighty persons, plus one hundred twenty spirits.

For many years this town carried on much as any town might. It's citizens lived normal American lives. Courtships, marriages, births, deaths -- these are the life of any American town. Work and play, happiness and sorrow, reverence for the Almighty, enthusiasm for Country -- these are typical of the American way of life. A baby is born, he passes through boyhood and becomes a man. He has received a decent education, he has learned to live the life of a free man, and he accepts the responsibilities that are to be his. He marries, raises a family, and passes into old age. He has given to his children the same opportunities which were given him, perhaps a little more. He has guided them with the advice which comes from experience. And when he reaches his death bed, and passes on to the great beyond, his town has profited by his living.

So have men and women lived and died for generations in this New Mexican town. Like many American towns, its young men formed a

National Guard Company. They drilled and studied and became good soldiers. Finally there came a national emergency, and these citizen soldiers became a part of a rapidly growing army. At a training camp they became seasoned and hardened, ready to fight and die for all their fathers had taught them was sacred. Then came Pearl Harbor!

While the world waited with growing fear and admiration for MacArthur's men on Bataan, a typical American town thirty miles from the Mexican border prayed and worked and hoped. The people of this town knew that one hundred and twenty of their best men were on Bataan. Their brothers, husbands, fathers, sons, and sweethearts. These were among the men who were writing history in human blood.

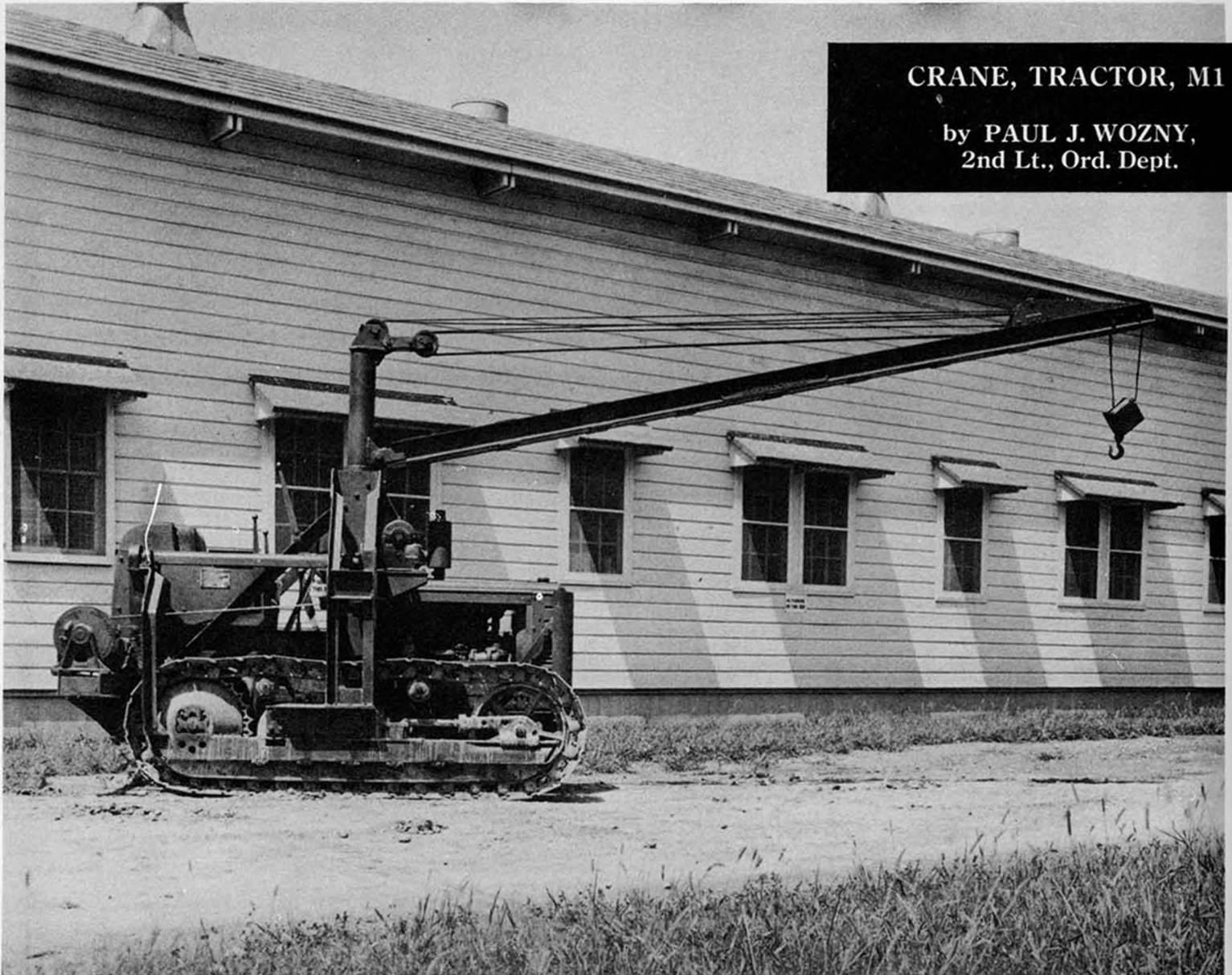
Then came the end. These people, like many others of course, were stunned. Not one man of their one hundred and twenty had escaped. Some were dead and, even worse, others were maimed or captured by creatures who were heathenish in their concept of living. Even yet there came letters, long delayed, telling of the spirit of true fighting Americans, carrying words of cheer from men destined to early death to loved ones filled with worry and heartache. This, too, is the typical American way of living -- and dying.

Deming, New Mexico, still swelters in the sun. It still has its courtships and marriages, its births and deaths. These things can not be taken from it. But it has changed. Its citizens play a little less and work a little harder. They do their best today, and tomorrow they will do a little more. They are determined to live the American way, and to die the American way.

Deming is guided by the spirits of one hundred and twenty men who went to Bataan -- and did not return.

CRANE, TRACTOR, M1

by PAUL J. WOZNY,
2nd Lt., Ord. Dept.



GENERAL DESCRIPTION:

The Tractor Crane, M1, is similar to any TracTractor Model T-6, with the addition of a hoist. The hoist gears are mounted on the rear of the driver's seat. The cables are tested for 2000 pounds capacity. The boom may be lowered to the ground and raised to a full 180 degrees. It can also make a full but not a continuous swing. It may be swung to either side, but should always be brought back to the front in reverse, not around through the rear.

The crane is mounted in front of the tractor operator and is mounted on the tractor by "L" beams. In the rear and under the crane mechanism will be found an adjustable horizontal drawbar, which can be used for pulling other vehicles or for any other work which an ordinary tractor of the same size is capable of doing. Specifications and capabilities (U. S. measurement) of the Tractor Crane, M1, are:

Fuel tank	-----	28 gals.
Water cooling system	-----	9-1/2 gals.
Transmission	-----	4 gals.
Crankcase pan	-----	9 qts.
Sprocket drive cases (each side)	-----	2 pints

The engine is a four cylinder, International Harvester. The tractor has five forward and one reverse speeds.

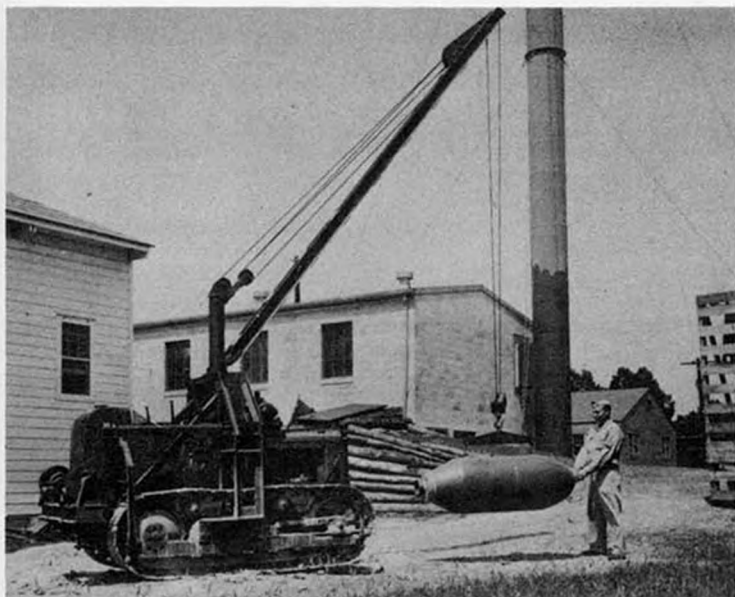
The general overall dimensions of the Tractor Crane, M1, are

Length (overall)	-----	116-7/8 inches
Width (overall)	-----	69 inches
Height (to top of mast)	-----	109-1/2 inches
Drawbar Height	-----	12-1/4 inches
Drawbar horizontal adjustment	-----	19-1/2 inches

EQUIPMENT:

The equipment generally found with the Tractor Crane, M1 is located under the seat, and consists of the following items:

- 1 ea. Fire extinguisher, hand
- 1 ea. Water pump wrench
- 1 ea. Hexagon socket wrench (9/16", 5/8", 3/4")
- 1 ea. Socket Wrench handle (Combination offset and "T")
- 1 ea. Hexagon socket wrench (7/8", 13/16", 1", 1-1/8")
- 1 ea. Socket wrench set carrying case
- 1 ea. Socket wrench set, complete, in carrying case
- 1 ea. Square drain plug socket wrench (1/2" and 11/16")
- 1 ea. Magneto gauge
- 1 ea. Spark plug wrench (7/8")
- 1 ea. Steering clutch compressor bolt
- 1 ea. Bucket lubricator. (Lincoln 25 pound capacity)
- 1 ea. Sprocket drive oil filler extension
- 1 ea. End wrench (3/4" - 7/8")

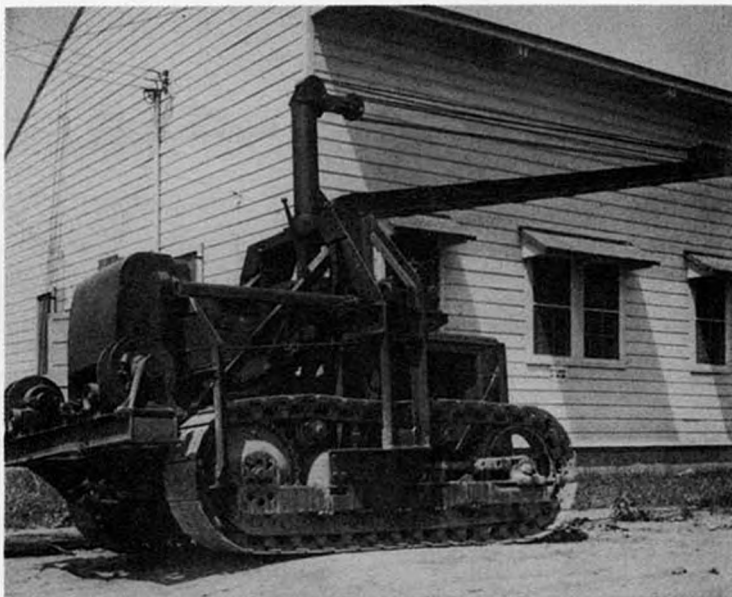


- 1 ea. Oil can
- 1 ea. Grease gun (Hand lubricator, 9 oz.) (Lincoln)
- 1 ea. Ball peen hammer (1-1/2 lb.)
- 1 ea. Monkey wrench (21")
- 1 ea. Combination slip joint pliers (8")
- 1 ea. Screwdriver (5" - Wooden handle)
- 1 ea. Tow chain

USES:

The primary use of the Tractor Crane, M1, is to ease the handling of 500 pound bombs and heavier, in loading and unloading from flat cars and box cars, and in storage. It is also used for loading and unloading bomb trailers. For bombs weighing 1100 pounds and less, the 14-inch spreader bar is inserted into the suspension lugs and for the 2000 pound bombs, the 30 inch spreader bar is used. This will necessitate the removal of the shipping bands, which can be done very easily.

The tractor can be used for pulling vehicles when they can't be pulled by the truck on very soft roads. It can also move the trailers to



any storage stack where it may be difficult to maneuver the bomb service truck due to the conditions of the road.

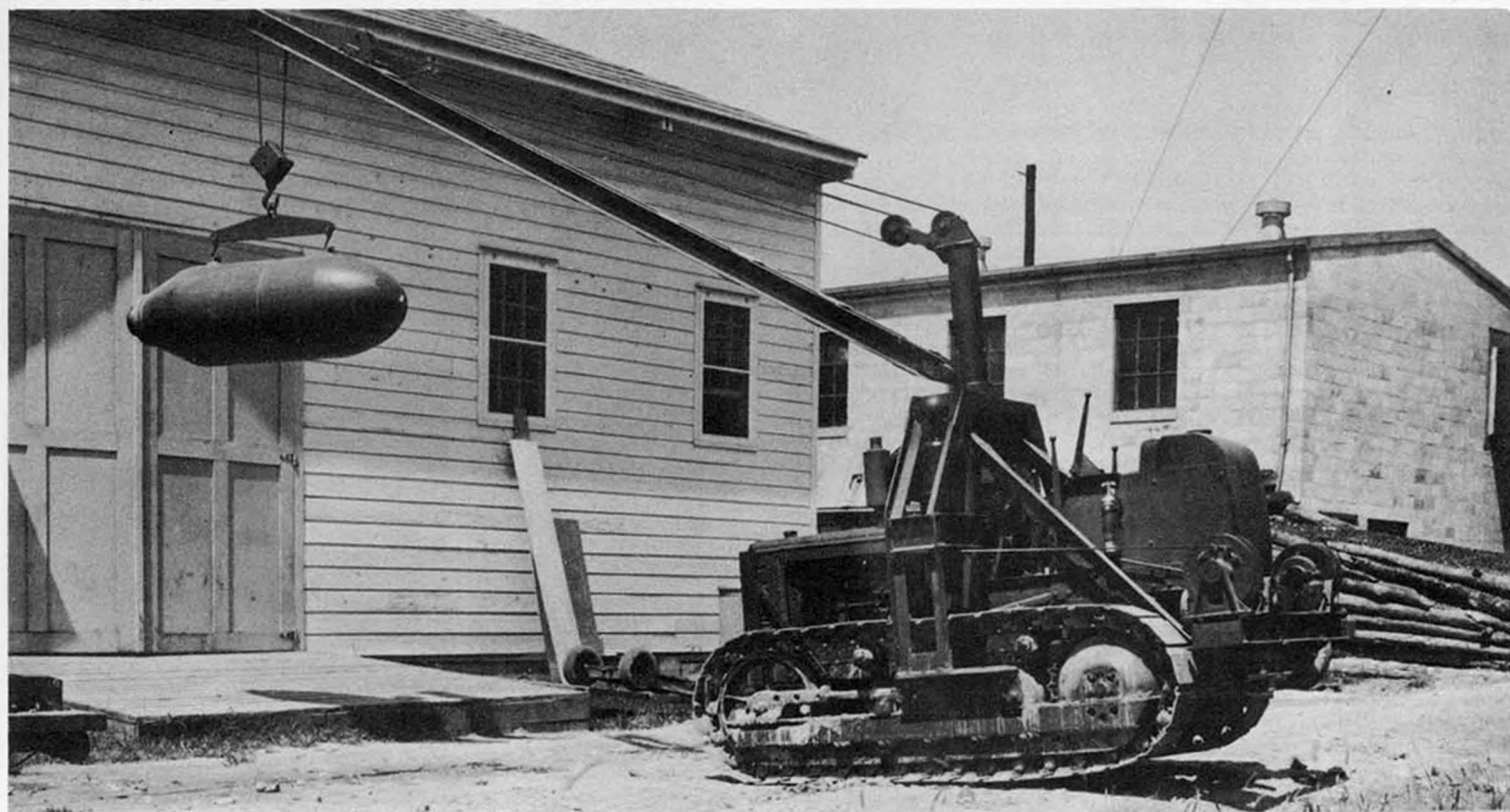
The Tractor Crane, M1, can be used for any other work that an ordinary tractor of the same size is capable of doing. There will be occasion when the Air Corps may have a use for it to help pull engines out of airplanes and put them back in.

It must be remembered that the Tractor Crane, M1, may be called upon to perform many duties, and after use it should be lubricated thoroughly, especially when used in sandy terrain. Care should be taken to house the tractor whenever possible. If in the field with no housing facilities, a tarp should be thrown over it.

GENERAL PRECAUTIONS AND INSTRUCTIONS:

1. Do not let a careless person operate the crane.
2. The machine is new when you get it, though it has been completely tested. Do not race the engine.

(Continued on page 425)



THE SPARE PARTS TRUCK

by JOSEPH TAMPICO, 1st Lt., Ord. Dept.

In order to avoid the possibility of deadlining ordnance materiel while replacement parts are being obtained, it is necessary for the Ordnance Maintenance Company to carry with it a supply of spare parts. The variety of materiel which the average company maintains is so large that it is practically impossible for any section to carry an adequate supply of spare parts in its usual shop trucks. For this reason the Ordnance Department has found it necessary to provide trucks for the sole purpose of carrying supplies of spare parts.

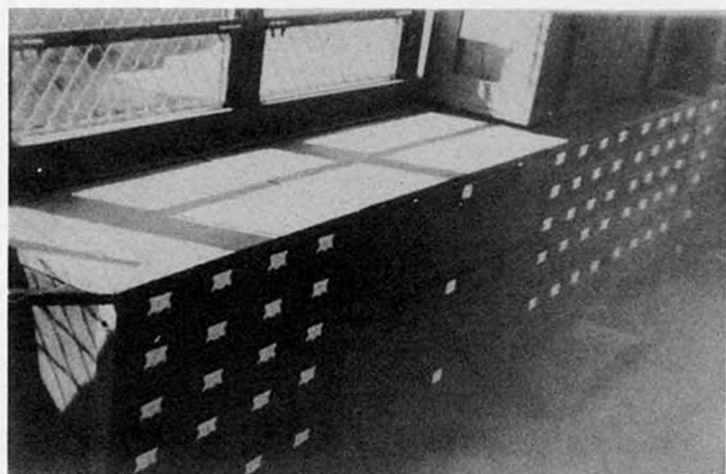


Fig. 1

View of interior of Spare Parts Truck, M2. Photograph taken from front of truck, showing arrangement of bins and cabinets on right side of truck. From left to right are the Cabinet, type 1, Class B; Bin, type 1, class A; and two Cabinets, type 1, class B. The Cabinet, type 1, class A, is barely visible at the extreme right. The box seen at the right of the photograph is an improvisation for carrying records and is not part of the standard truck equipment.

Originally, these trucks were 1-1/2 ton, 4 x 4 (2 DT) cargo trucks supplied with cabinets and bins. However, the new bus type shop trucks 2-1/2 Ton 4 x 4, (2 DT) chassis with bus type body, (now being furnished as 6 x 6 (4 DT)) have proven themselves so well adapted for use in the field under all types of weather conditions that the same type of truck body and chassis has been adopted for the spare parts trucks.

This bus type spare parts truck, equipped with cabinets and bins, is not only useful for the storage of parts but also is convenient for keeping section records and for use as additional, sheltered, work space. The truck carries the usual control box, switch, extension cords, and plugs, with which the bus type shop trucks are supplied. In addition, its load consists of the following:

ITEM	QUANTITY
Cabinet, type I, Class A, (Sheet Metal)	3
Cabinet, type I, Class B, (Sheet Metal)	5
Bins, type I, Class A, (Sheet Metal)	2
Cage, expanded metal	2
Cabinet, card book, complete with ten books, 19" x 12-3/4" x 17-1/2"	1

The Cabinet, Class A, contains twelve partitioned drawers arranged in two vertical rows. The upper three of each row are 11" wide and 2-1/2 inches deep, while the lower three drawers of each row are 4-1/2 inches deep. The Cabinet, class B contains twenty partitioned drawers in 4 vertical rows. The upper three drawers of each row are 5-1/2 inches wide by 2-1/2 inches deep while the lower two are 4-1/2 inches deep.

Both cabinets are 17-1/4 inches long. Spring latches prevent the drawers from opening while the truck is moving. Each bin, class A, consists of three compartments 33-1/2 inches wide, 9 inches high and 17-1/2 inches

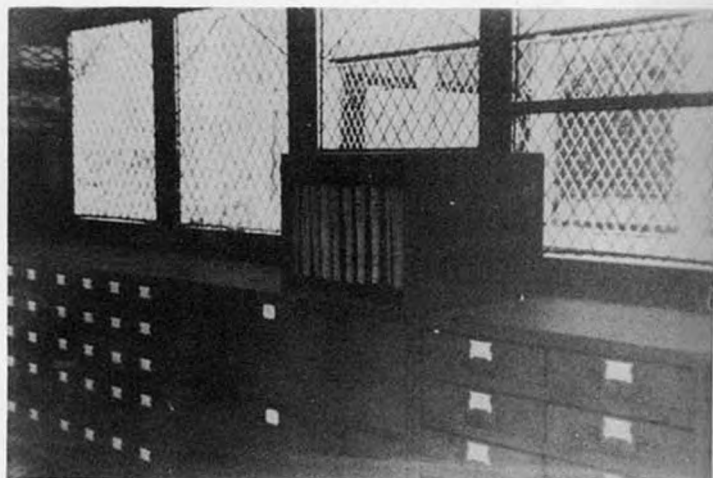


Fig. 2

View of interior of Spare Parts Truck, M2. Photograph taken from front of truck, showing arrangement of bins and cabinets on the left side of the truck. From right to left (front to rear of truck) are seen one Cabinet, Type 1, Class A; one Bin, Type 1, Class A; two Cabinets, Type 1, Class B. The Cabinet, Card book, may be seen mounted on the Bin.

deep, mounted one above the other. The doors of these compartments are hinged at the lower end and latch at the top. Chains at each end of the bin support the doors in a horizontal position when they are dropped.

The Cages, Expanded Metal, are large, open, wire cages, 31-3/4 inches high, 24 inches wide and 16 inches deep. Four horizontal wire shelves partition each cage.

The Cabinet, card book, with ten books, is provided for maintaining the records of the stock of spare parts on hand. The card books are sheet metal binders containing stock record cards, each of which at all times shows the balance of a particular item, on hand as well as the

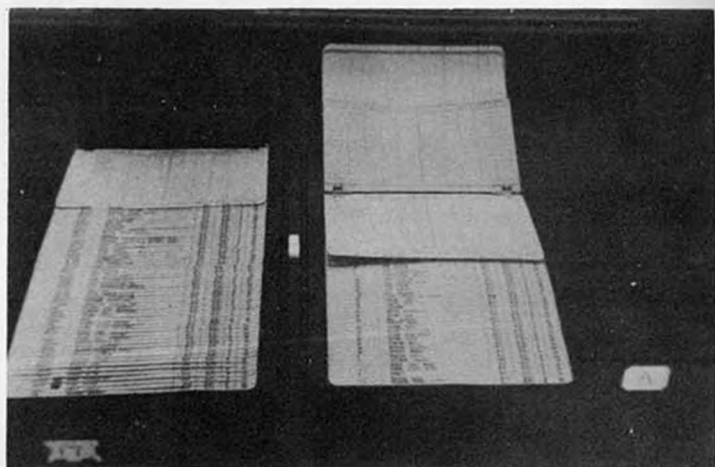


Fig. 3

View of open card book from card book cabinet, showing Stock Record Cards.

number of the drawer or bin in which that part is to be found. Also shown by the cards are the minimum and maximum quantities of each item which should be maintained on hand. If the stock of any part falls below the minimum indicated on the card, or if the stock falls to zero, the corresponding card can be marked with a colored tab, the color of which indicates the status of the stock of that item. Thus the card books provide a rapid and efficient method of locating the parts in the truck and of maintaining the stock records.

The cabinets and bins are arranged along the walls of the truck, reaching to the bottoms of the truck windows. On the right side of the truck, front to rear, are located one cabinet, class B; one bin; two cabinets class B; and one cabinet, class A. An expanded metal cage is mounted on the class A cabinet at the rear of the truck. On the left side of the truck, again from front to rear, are located one cabinet, class A; one bin; two cabinets, class B; and one cabinet, class A, the last also having mounted upon it an expanded metal cage. The card book cabinet may be bolted to the top of one of the cabinets or bins, wherever convenient.

The accompanying photographs show the spare parts truck, M2, interior.

The Tables of Organization allot spare parts trucks to Ordnance units as follows:

Ordnance Medium Maintenance Company	4
Ordnance Heavy Maintenance Company	10
Ordnance Maintenance Co., Mountain Division	1

Because of the storage space provided by the spare parts trucks, it is possible for the Ordnance Maintenance Company to take with it into the field sufficient spare parts to carry on its normal work for thirty days, if a serious disruption of the normal flow of supplies should occur.



CRANE, TRACTOR, M1

(Continued from page 423)

3. A good crane operator saves time and assures safety by keeping the load near the ground.

4. The crane moves easily. Set the load down in such a position that the pull on the hook is vertical.

5. Pull the boom up high enough so that you can handle the load without teetering.

6. The crane boom can make a full but not continuous swing. Boom may be swung to either side but should be brought back to front in reverse, not around through rear.

7. The crane mechanism is driven by the power take-off located at the rear of the TracTractor. The control levers for operating power take-off and for hoisting, swinging and for topping the boom are located within easy reach from the seat.

8. Load and boom hoists are identical. These hoists, as well as the swinger, have individual reversing mechanisms built into full enclosed oil tight gear cases.



NUMBERING OF ARMY SUPPLY FACILITIES

The September issue of THE ORDNANCE SERGEANT (page 233) offered an interpretation in regard to the numbering of army supply installations. FM 9-5 states that "All army supply facilities, general supply depots, ammunition depots and ASP's are numbered serially in a single series".

The current interpretation of this statement at the time that article was prepared for publication indicated, as stated by THE ORDNANCE SERGEANT, that "all the general supply depots within an army will be numbered serially, as No. 1, No. 2, No. 3, etc., all ammunition depots within an army will be numbered serially, as No. 1, No. 2, No. 3, etc., and all ASP's within an army will be numbered serially in the same manner".

A subsequent interpretation changes this policy. ALL THE SUPPLY FACILITIES WITHIN AN ARMY, REGARDLESS OF TYPE OR ACTIVITY, WILL BE NUMBERED IN A SINGLE SERIES.

31st Ordnance Company (HM)
Ft. Benning, Ga.
August 11, 1942

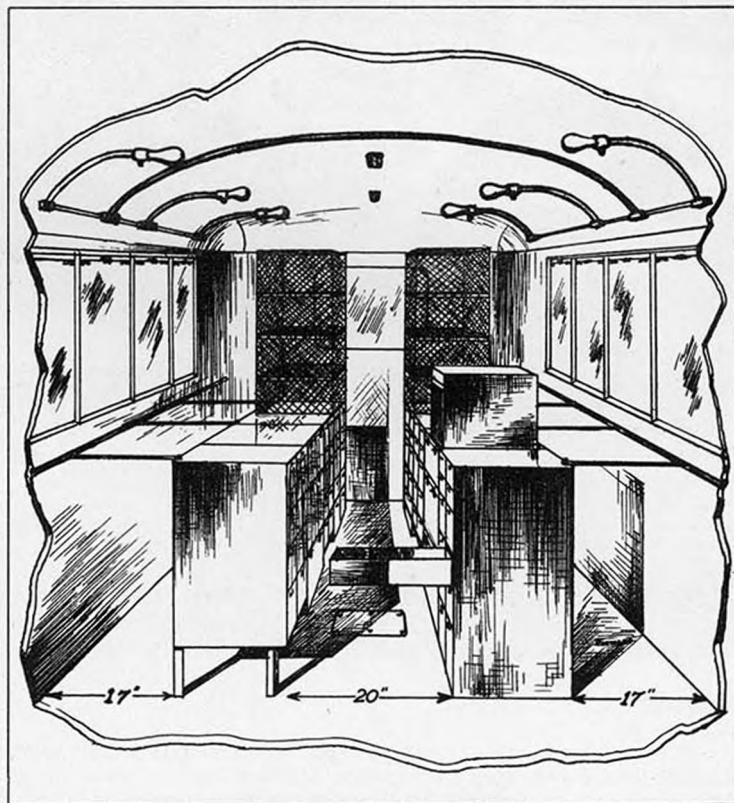
THE ORDNANCE SERGEANT,
The Ordnance School,
Aberdeen Proving Ground, Md.

Subject: Ordnance Supply Trucks

Dear Sir:

Because of a change in T/BA No. 9 dated April 30, 1942, this organization lost thirty-eight (38) vehicles, ten (10) of which were truck, spare parts, 1-1/2-ton, 4 x 4.

Steps had to be taken immediately to return to Ordnance depots parts that could no longer be carried. After consulting the section chiefs of this organization on the quantity and type of parts that we needed to operate efficiently it was learned that there were still too many parts to be carried on the spare-parts trucks allotted a heavy maintenance (Field Army) company.



So that more parts could be carried by the spare-parts trucks the bins were moved toward the center allowing enough space to open the drawers and to walk between the bins. Having accomplished this change in each spare-parts truck it was possible to store bulky parts such as generators, starters, magnetos, rifle stocks, etc. behind the bins.

Enclosed is a sketch showing how the change of bins appears from the rear doorway of the truck. One point must be kept in mind and that is not to overload the truck. Keeping in mind not to overload the trucks, this organization did retain a large quantity of spare-parts that would have to be given up and all personnel of Ordnance Supply Sections are acquainted with the fact that it is no easy job to stock a basic load of necessary spare parts.

Hoping this suggestion will be of some benefit to ordnance companies that had to give up some of their spare parts trucks, this organization remains

Very truly yours,

D. L. SMITH
1st Lt. 31st Ord. Co. (HM)
Supply Officer



by PAUL J. WOZNY, 2nd Lt., Ord. Dept.

PURPOSE:

The purpose of this vehicle is to pull two bomb trailers, M5, with complete load, and to carry all personnel to load and unload the trailers, namely; crew chief, chauffeur, and three munitions workers.

GENERAL DESCRIPTION:

The truck, bomb service, M6, 1-1/2-ton, (4x4) Chevrolet, has a front axle drive which should be used when it is operated on wet, soft surfaces and in sand. Unfortunately, the tires with which it comes equipped will not give a sufficient amount of traction on very wet roads. The truck has a canvas top that can be taken down in clear weather and seats that can be pushed forward when the vehicle is left standing for any period of time. This will preserve the good condition of the seats. There are three seats on one side of the truck bed for the members of the crew and a safety belt is provided for each seat. Safety belts for the driver and the crew chief's seat are provided also since this is an open body truck. Overhead, on the truck bed, is mounted the hand winch and an "I" beam for lifting the heavier bombs. The truck has two (2) gasoline tanks, the main tank and the auxiliary, which carry 35 gallons of gasoline each. Behind the front seat is located an equipment chest, and a tool chest is located to the left of the driver on the running board. It is possible to drop the windshield when the canvas top is off and when, of course, the weather permits. The bed of the truck is large enough to carry a bomb lift truck, which is part of the equipment needed for unloading the bombs from the trailer and delivering them to the plane. A pintle at the rear of the truck is used to couple the trailer to the truck. The truck is equipped with the WARNER ELECTRIC BRAKE SYSTEM with cable attachment to the trailer. The

trailer brake system is regulated on the dash, and when the trailer is being pulled, the knob should be set at No. 4 (Heavy) at all times. The trailer brake is operated together with the truck, thus eliminating any possibility of "jack-knife", or swaying of the trailer when the truck comes to a stop. Gross weight of the truck is 6990 pounds. Maximum payload and driver is 2000 pounds. Maximum trailed load is 14,000 pounds.

EQUIPMENT:

The following described tools and equipment will be found in each truck:

The tools carried in the Bomb Handling tool box:

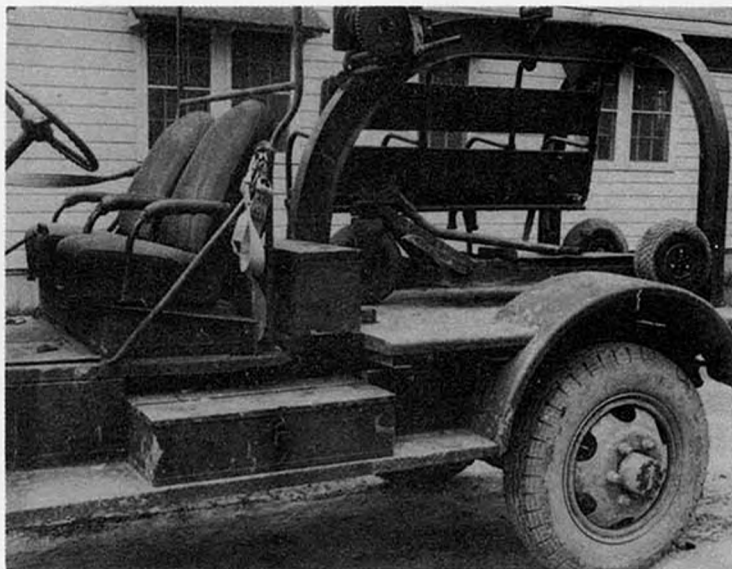
- 2 each Bar, bomb handling, 2 - man
- 2 each Bar, bomb handling, 4 - man
- 1 each Bar, spreader, 14"
- 1 each Bar, Spreader, 30"
- 4 each Hook, bomb, single hand
- 1 each Shovel, D-handle, round point
- 2 each 20' Prolong - 3/4" manila rope with steel hook
- 1 each Flag, Danger, red

The tools and equipment carried in the truck tool box:

- 1 each Extinguisher, fire CO₂
- 1 each Truck, bomb lift
- 1 each Wheel with tire
- 2 each Padlocks



- 1 each Bag, tool, assembly
- 1 each Screwdriver, 5/32, 1/4, 5/16 (clutch head)
- 1 each Wrench, (#723, 25, 27-C, 28-S, 731-A) (double open end)
- 1 each Wrench, nut wheel bearing
- 1 each Handle, Wheel wrench
- 1 each Wrench, spark plug



- 1 each Iron, tire changing
- 1 each Gun, lubrication, 9 oz., push type
- 1 each Wrench, wheel
- 1 each Can, oil
- 1 each Jack, auto assembly
- 1 each Crank, starting assembly

Ellington Field, Texas
July 14, 1942

The Editor
THE ORDNANCE SERGEANT
Aberdeen Proving Ground, Md.

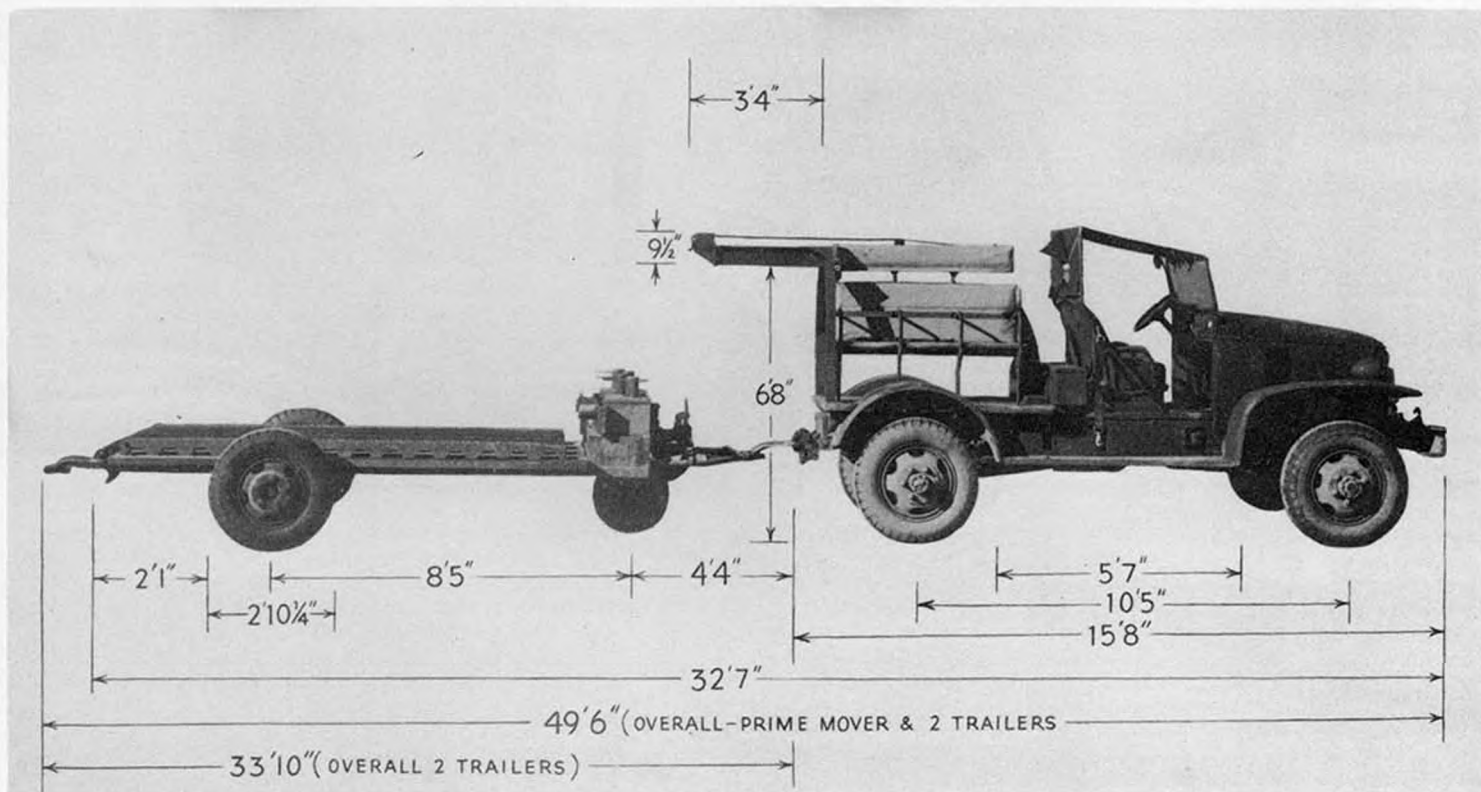
Gentlemen:

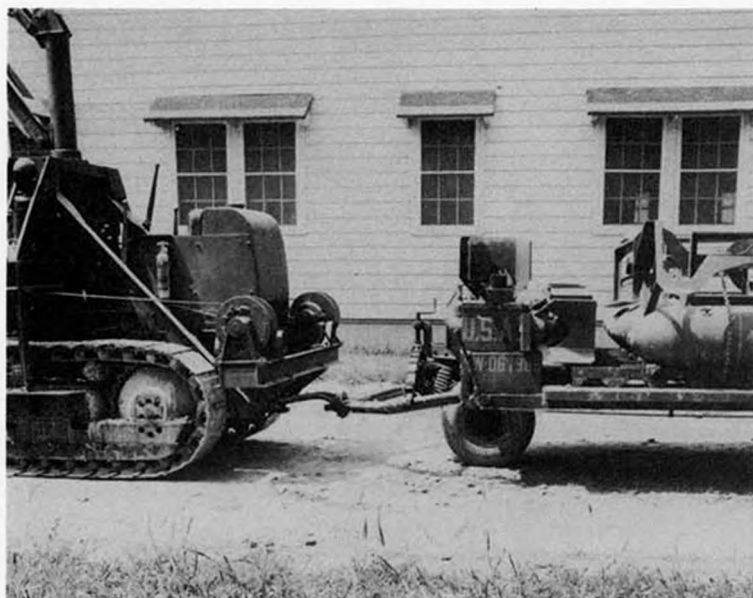
I inclose a picture of truck, bomb, service, M6, and trailer, bomb, M5, with an over-lay giving dimensions of various interesting distances.

The picture was taken for this purpose to give this measurement which has been found to be very useful and am passing it on for whatever it may be worth.

Best wishes,

LOUIS B. ARMBRECHT
Capt., Ordnance Department
Station Ordnance Officer

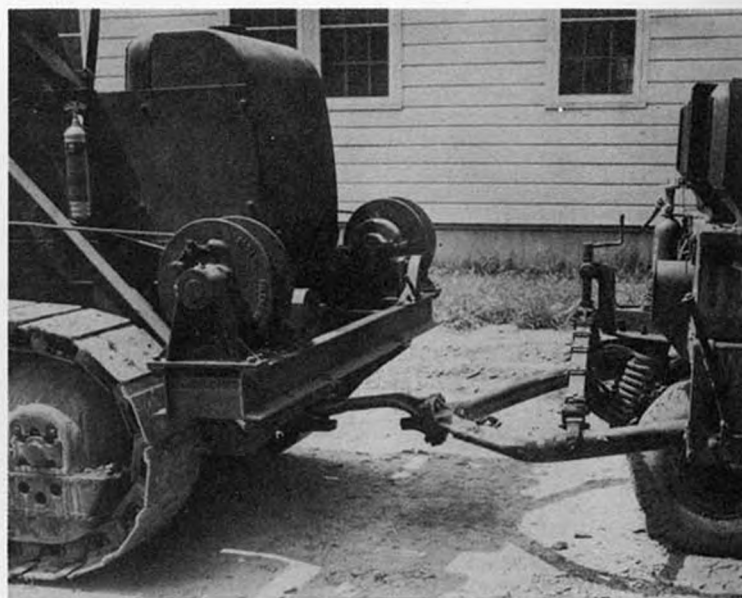




1 each Handle, auto jack
 1 each, Extension, gun, lubrication
 4 each, Chain, tire, assembly

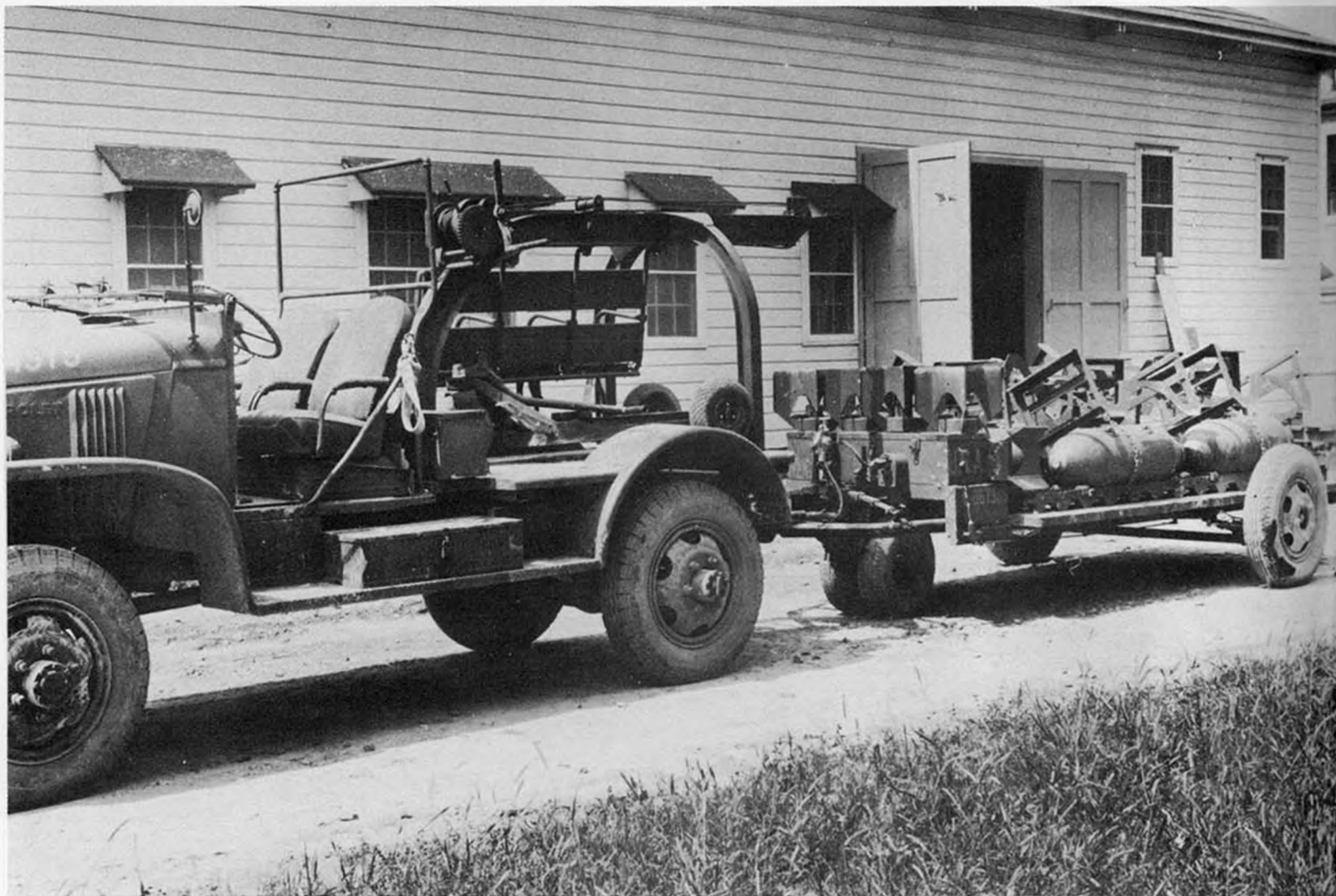
USES:

This truck is to be used for hauling trailer loads of bombs and for lifting some of the heavier bombs. It is not contemplated that the truck should be put to other and widely varied uses.



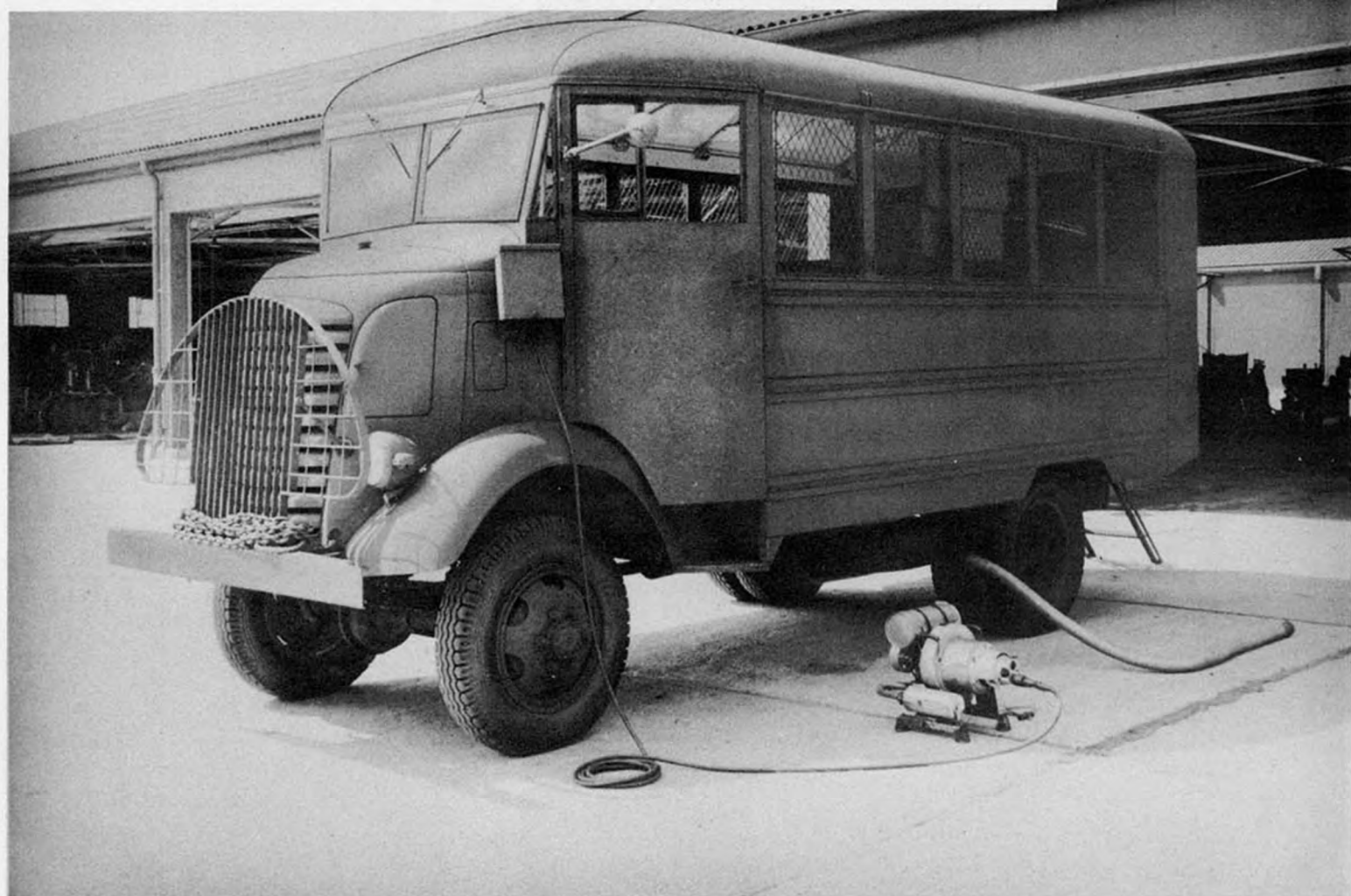
CAPABILITIES:

This truck is designed to haul two completely loaded trailers over normal roads. It is not at all unlikely that difficulty will be encountered in pulling such a load over swampy terrain or soft roads. The cable on the winch is tested to 2000 lb. capacity and should be adequate to handle the 1000 and 2000 lb. bombs very easily. Although the cable is only tested for 2000 lbs., it can be used for rolling the 4000 lb. light case, demolition bomb on to the trailer, as has been described in the July issue of THE ORDNANCE SERGEANT.



TOOL AND BENCH TRUCK, M2

by Lt. GEORGE F. PIE, Jr., Shop Officer, 1st Ord. Co.



The tool and Bench Truck, M2, which we will discuss in this article is a bus type, cab over engine model with all-steel body. It is a six wheel, 4x4, with a 131 inch wheel base. The engine is a G.M.C., six cylinder model rated 33.19 B.A.E. horse-power. Its thirty gallon gasoline tank capacity gives it a cruising range of 225 road miles.

This truck has an over-all length of 235-1/4 inches; and an over-all width of 95 inches; and an over-all height of 119 inches. Its turning radius is 27 feet 9 inches. The netweight is 9710 pounds and it can carry a payload of 3290 pounds which gives it a gross weight of 13000 pounds.

The height inside the bus is 6 feet 4 inches. Other dimensions inside are length 192 inches and width 90-5/8 inches.

On either side inside the bus are two wooden benches. These benches are 11 feet long and two feet wide. They are mounted above the floor level on an arrangement of cabinets and bins which in turn are securely bolted to the floor. One might think on first thought that the inside of this vehicle would be very crowded, but such is not the case as the distance between benches is approximately three feet, which allows plenty of room for at least four men to work in comfort.

One of the features of this vehicle is the heating and air-conditioning unit which is operated by an electrical motor which takes its power from the storage battery of the vehicle. All outside air coming into the vehicle passes through a filtering unit and is circulated throughout by the fan of the heating unit.

The electrical system of this portable workshop consists of six electric light sockets as well as six double outlets to provide current for drills, grinders, etc. These sockets and double outlets are evenly spaced, three on either side. When available, current may be taken from any outside source, provided that it is 110 volt. However, under field conditions where an outside source is not available the power is taken from a portable gasoline operated generator.

Blackout curtains are also part of the equipment of this truck. Should the organization be required to work in the field at night, where blackout conditions are not required, a provision is made to mount flood lights by means of brackets on either side of the truck.

Two vises, machinist, bench, swivel base, 4-1/2 inch jaw, are mounted on the benches, one on either side. A six inch, two wheel, grinder, complete with eye shields, is also mounted on the rear of one bench. Additional special equipment, such as, drill press, etc., may be mounted on the benches depending on the work the organization is called on to do and the space available.

As the name "tool and bench" implies, the jobs performed in this truck are for the most part disassembly, repair and reassembly, of component parts of larger units. This type work does not require any great use of the heavier machine tools. However, what is required and what is to be found on this truck is an adequate outlay of hand tools. These hand tools consist of hack saws and blades, blowtorches, chisels, clamps, soldering coppers and handles, drifts, files, hammers, mallets, (wood,



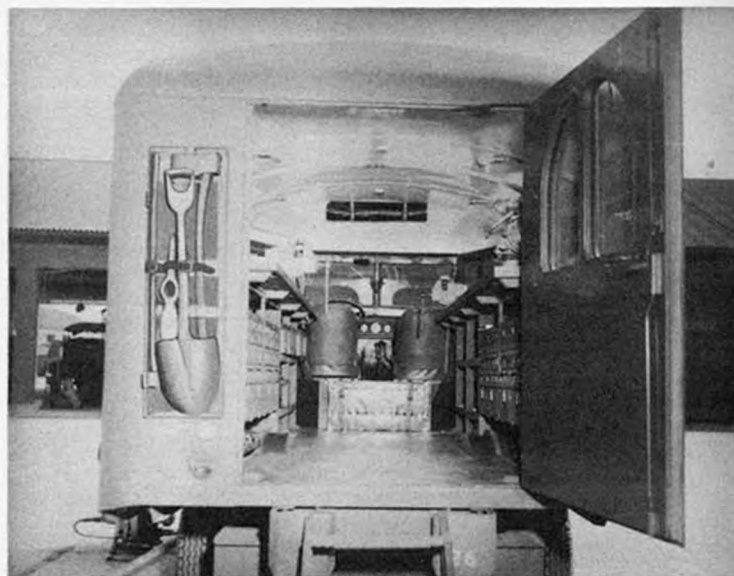
brass, rawhide) saws, pliers, screwdrivers, and tinner's shears. The above mentioned are available not only in different types but also in various sizes. The most elaborate outlay, however, is the selection of wrenches. In this group we have the master set of socket wrenches complete with adjustments, Bonney set of socket wrenches, engineer, tappet, Allen, and adjustable wrenches which include Crescent, Monkey and Stillson type. In addition to the above a complete set of Carpenter tools and a complete set of leather tools have been made available on each of this type vehicle.

Quite a bit of research has been performed on this truck to make the design and tool load standard so that this vehicle may be used as a component part of any section within a Maintenance Regiment, Company, or detachment. As noted in the preceding paragraphs the tools provided with this type truck are all bench type tools and are used solely for that purpose. With the right men using the tools, as much work can be accomplished as in a shop many times larger.

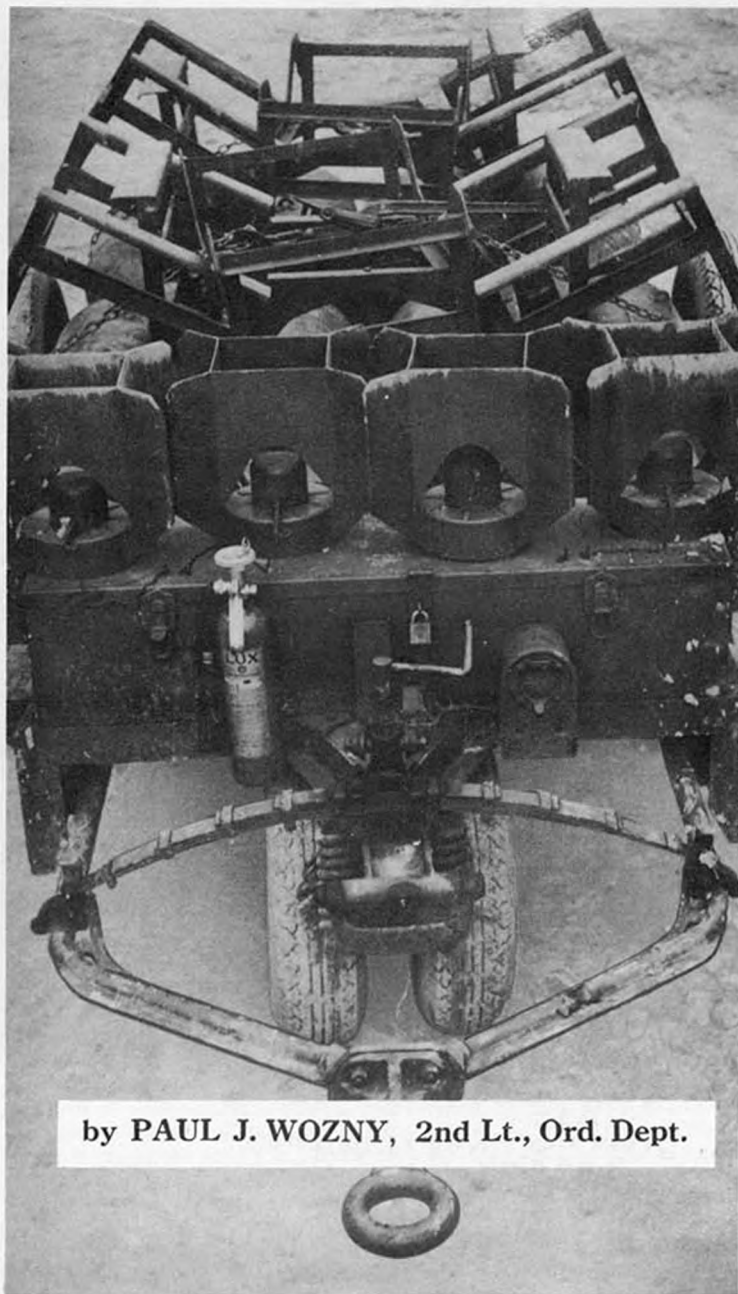
With reference to the photographs shown one can easily see the possibility of this vehicle in the field. The high road clearance together with the dual wheels and the all wheel drive, make it accessible to most any type of road or highway.

Of the many features embodied in this portable work shop those most outstanding in the writer's mind are its compactness, its adaptability for weather conditions, and the cleanliness it affords. Not much need be said of the advantage of being able to disassemble a unit such as an oil gear from a remote control system and reassembling it with the assurance that sand and grit from the storm that is blowing up outside will not be present in that unit later on to undo the good that has been

done by the overhaul. Of all special Ordnance vehicles present today in the Ordnance Department the Tool and Bench truck is adapted to a greater variety of maintenance of most, and is indispensable to the efficiency of any Ordnance Maintenance Unit.



TRAILER, BOMB SERVICE, M5



by PAUL J. WOZNY, 2nd Lt., Ord. Dept.

PURPOSE:

The purpose of the trailer, bomb service, M5, is but one, and that is to haul all types and sizes of bombs handled by the Aviation Ordnance units for the Air Corps.

GENERAL DESCRIPTION:

The bomb trailer, M5, is a low bodied, three-wheeled vehicle. At the front end there is a yoke which is regulated by the spring and screw to raise and lower it. This is to facilitate moving the lunette into position so as to fit into the pintle of a truck or another trailer. It has a low platform body with special equipment to carry bombs, known as channels or racks, of which there are four (4) assembled to the trailer bed. These channels can be inverted for smaller sized demolition bombs and for fragmentation bombs. They are bolted to the bed of the trailer at both ends of the trailer by two bolts. The front part of the trailer mounts a component and tool chest, on the top and side of which are mounted the eight (8) fin posts for carrying fins. Fin securing pins engage in slots in the fin posts and are used to secure the fins to the posts. The vehicle

is equipped with a WARNER ELECTRIC BRAKE and a hand-operated parking brake.

The WARNER ELECTRIC BRAKE is operated by the foot brake on the bomb service truck. Electrical current passes through the cable which is plugged into the rear of the truck socket, to the socket on the front of the trailer. Acting as a safety brake, when and if the truck and trailer become uncoupled, the WARNER ELECTRIC BRAKE cable pulls out of the sockets in the truck and trailer and operates the emergency lever, which gets current from the 6-volt, dry cell battery located in the component chest, and activates the brake, thus eliminating a runaway trailer.

The hand-operated parking brake is used when the trailer is parked to be loaded or unloaded, and should never be engaged when the trailer is in motion. Located at the front part of the trailer is a double casted wheel of small diameter, which helps to take part of the weight, and it also keeps the yoke of the trailer off the ground, thus taking the strain off the yoke. This vehicle has limited mobility in deep mud and sand, because of the casted wheel moving from side to side.

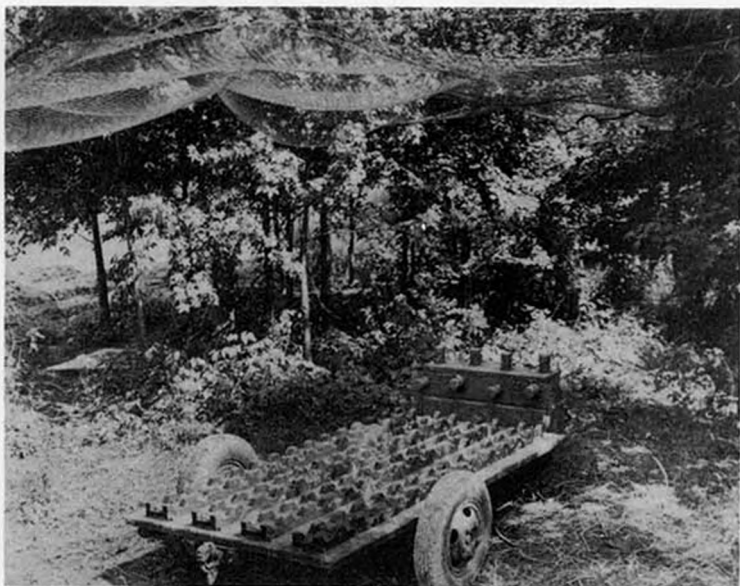
The vehicle is designed for a maximum pay load of 5000 pounds. The following maximum bomb loads can be carried on one (1) trailer:

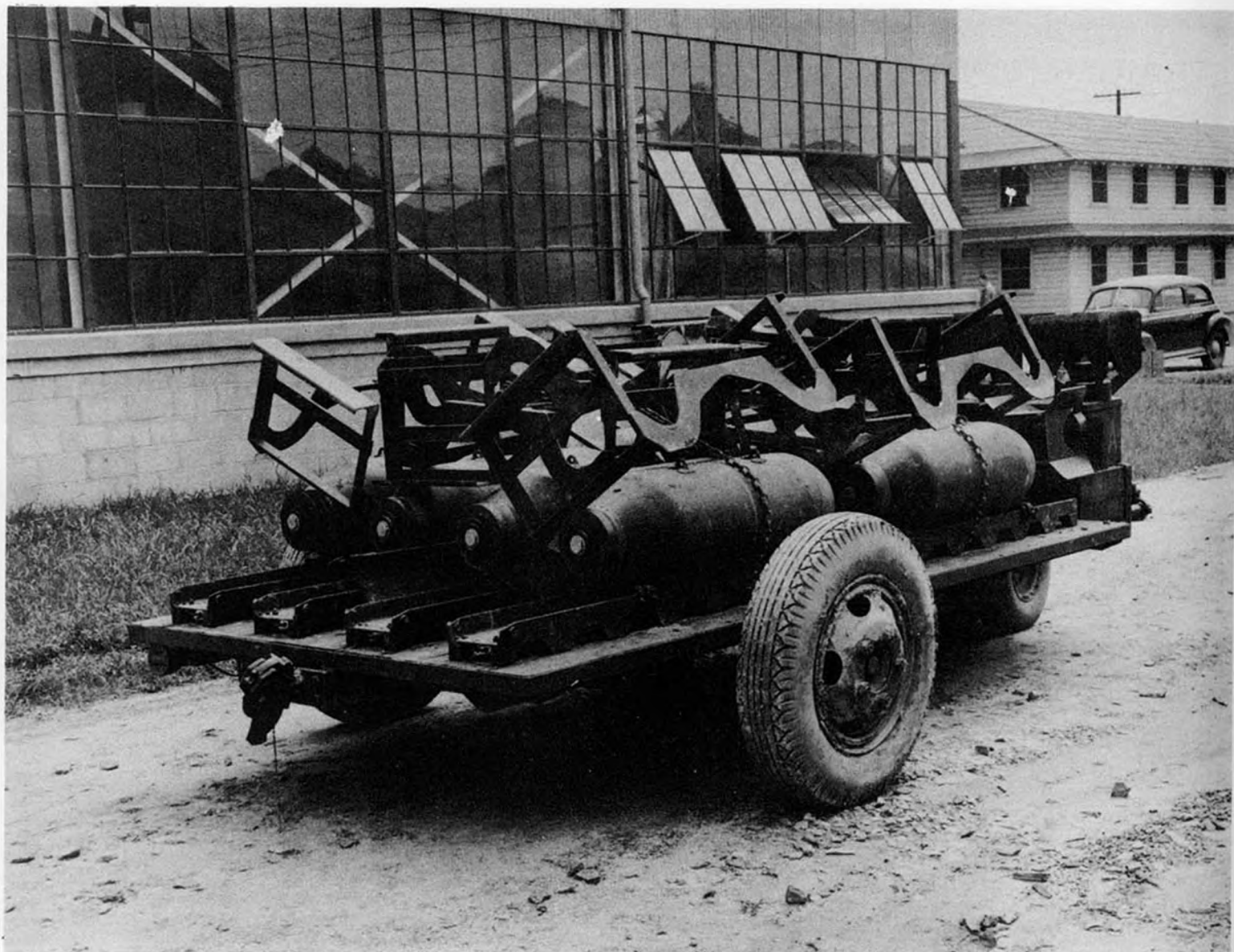
100 lb. bomb	-----	24
250- 300 lb. bomb	-----	16
500- 600 lb. bomb	-----	8
1000-1100 lb. bomb	-----	4
2000 lb. bomb	-----	2
4000 lb. bomb	-----	1

EQUIPMENT:

The equipment and accessories for the trailer, bomb service, M5, will be found in the tool and component chest at the front of the trailer where the following named items will be stored neatly:

- 1 each Battery, dry-cell, 6-volt
- 2 each Binder, load
- 16 each Bracket, with 32 each Screws, thumb
- 1 each Cable, braid, coupling, with chain
- 2 each Chain, 1/4" straight link, 10' with 2 hooks and 1 turnbuckle
- 1 each Channel, loading welded construction
- 1 each Extinguisher, fire, CO₂
- 1 each Gun, grease, Alemite, hydraulic
- 1 each Lantern, electric
- 6 each Platform, bomb handling, welded construction
- 4 each Rack, consisting of:
 - 2 each Block, wedge, (B175933A)
 - 2 each Block, wedge, (B175933B)
 - 26 each Block, wedge, (B146011)
 - 60 each Bolt, carr. and nut
 - 1 each Channel, 8" x 11-1/4"
 - 15 each Fasteners
 - 60 each Nut





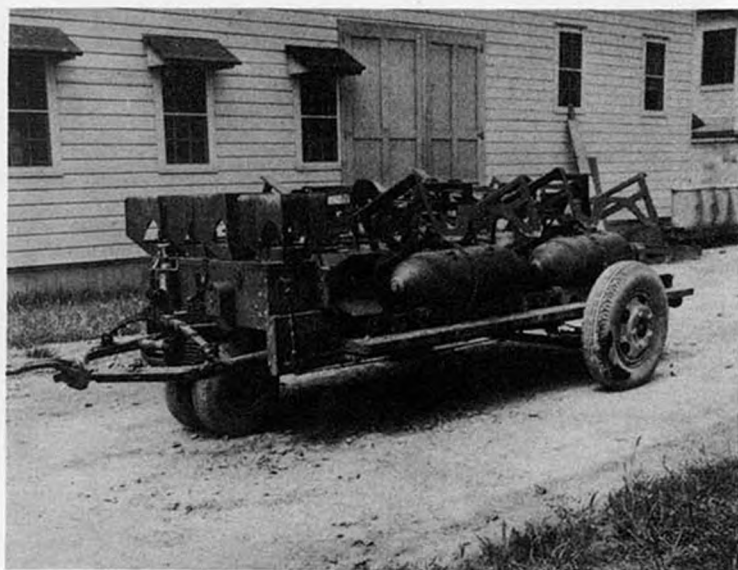
- 2 each Pin
- 60 each Washer, lock
- 2 each Spacer
- 1 each Stand, loading channel, welded construction with:
 - 6 each Rivet
 - 1 each Webbing

- 4 each Strap, web, 1/8" x 1-1/2" x 28' with:
 - 4 each Clip
- 4 each Strap, web, 1/8" x 1-1/2" x 6" with
 - 4 each Buckle
- 1 each Wrench, hub nut
- 1 each Wrench, wheel nut
- 1 each Flag, danger, red

USES:

When the trailer is used to haul 100, 250, or 300 pound bombs, the channels will be turned over so that the channel chocks on the channel are on top. Then one bomb should be placed between each chock (outside channels). The same side of the channel will be used for fragmentation bombs, but every chock will be used if possible.

For bombs of sizes 500, 600, 1000, 1100, and 2000 pounds, the channels will be used on the reverse side so that the bombs rest on the channel parallel to the length of the trailer. Two (2) 500 or 600 pounds bombs are placed on each of the four channels. When carrying the 1000 or 1100 pound bombs, two are placed on each of the two outside channels. One 200 pound bomb may be carried on each of the two outside channels. For the 4000 pound bomb, the channels should be filled in with heavy timber, so that the weight will be off the flanges of the channels. The bomb is rolled up the ramps so that the shipping bands are on the outside of the two inside channels and the long axis of the bomb lies across the width of the trailer. This trailer is designed to haul bombs and should not be used for any other purpose. The net weight of the trailer is 2000 pounds. Maximum pay load is 5000 pounds at 45 M.P.H. Gross weight is 7000 pounds. Tire pressure is 55 pounds.



"OBSERVE! REMEMBER! COMPARE!"

by

GEORGE W. OUTLAND
Colonel, Ordnance Department
Commandant, The Ordnance School

September 19, 1942

A short time ago I returned from a journey which took me across the continent. On every side was the visible evidence of an awakened America rebuilding her military forces. New camps are to be found in many communities, and recently built manufacturing plants are far more numerous than you would expect. One sees large groups of workers, like swarming bees, busily engaged in putting the finishing touches on hundreds of airplanes around the production plants. The shipyards are filled with growing ships, and the glare of lights throughout the night tells the story of continuous production lines.

The newscasters tell, and the papers repeat, stories from the fighting front — the news of sinking ships, of the loss of planes in combat, of the destruction of guns and tanks. They also relate tales of men in mortal battle, heroes making sacrifices beyond the call of duty — nations in total war.

During the past decade of peace, when our individual efforts were bent upon the search for happiness, the development of good fellowship, and the provision of luxuries to make our daily lives more worthwhile, we as a nation have developed our natural and industrial resources to a high degree of productive efficiency. The great majority of Americans who contributed toward this national progress are the descendants of liberty-loving people who came to this country and developed its great natural resources for the common good. We have always been slow to become involved in international disagreements.

For many years the dictator nations of Europe and Asia have been waging ruthless war against their neighbors. We remained aloof until the cynics of Japan stabbed us in the back at Pearl Harbor. We were woefully unprepared for this attack. We have had to suffer defeats and insults because of such unpreparedness. Fortunately we have again had allies who have been able to hold our enemies within certain limits while we are mobilizing our strength. These enemies have not been able to reach our mainland, and now, for them, it is too late if we continue to prosecute vigorously this war that has been thrust upon us.

We have great wealth in natural resources, in productive capacity, in manpower, and in the intelligence of our people. We need only proper management to enable us to reach our objective. Success in battle depends not only upon the quality of our soldiers but also upon the quality of the weapons provided for their use. Every man, woman, and child in this country, every soldier and every workman, must make personal sacrifices, must think in terms of national interest rather than personal gain, must carry his fair share of the load if ultimate victory is to be achieved.

Today, as in all past wars, the male youth of the nation are called upon to carry the heaviest burdens. They must leave behind their normal peacetime pursuits and go to the combat field. It is their responsibility, yes, their privilege, to fight for the preservation of their faiths and for the honor of their nation.

Only a small percentage of our military personnel are assigned to the Ordnance Department, and yet, here at Aberdeen, we have training capacity for about 17,000 men. We are developing at the present time numerous other schools and training centers. The military might of the nation is growing rapidly. We already have considerable forces stationed in many widely scattered areas on the earth. By the end of another year these may be more than tripled. Many, perhaps most, of you will by then have joined them. It is our primary concern here at The Ordnance School that you be adequately prepared to face these strenuous tasks ahead.

This class is the first to graduate since we started enrolling a class each week. Its size shows that we will add nearly 240 officers to our strength weekly. When one reflects that during the many years of peace following the first World War our department was permitted a total of only about 325 officers, the magnitude of our present expansion becomes more obvious. Today we have expanded sufficiently to train approximately 12,000 ordnance officers here each year.

During normal times it has been our yearly custom to bring into the department about 15 to 20 new officers, to train them in formal schools for 2 years, and then to send them out to our field forces and manufacturing plants for further training. Today the shortage of time has necessitated a curtailment of this training period to three months. We have speeded up our courses to the limit of your capacity to absorb knowledge. Like a fast moving drama we have presented brief glimpses of ordnance to your view. The ultimate value of this training to you and your nation depends not so much upon the details of what you have learned here, but rather upon how well you have developed the technique of assimilating and analyzing information so that you may eventually acquire that high degree of specialized knowledge so essential to your future success.

Leaders in our armed forces today must be physically and mentally young, with highly trained minds. The education of the mind does not merely consist of cataloguing facts for storage in one's memory. I have known people with photographic minds who could memorize page after page of the written book. This is not education. In your future activities you should conduct the education of your minds on a much broader plane. You must school your mind to think for itself. A mind that merely accepts facts without exercising the power of reasoning is of little value in the creative sense and must be given continual guidance.

Alexander Graham Bell, the famous scientist and inventor, devised a "Rule of Three" for application to self-education. The rule was simply "Observe! Remember! Compare!" How easy it is to observe the work of others, to see how the job can be done. To memorize details is sometimes advisable in specific instances. Usually, however, the memory should pick up and retain only the more important facts. Comparison is the key-stone of this rule. From it springs the most important guide to human behavior, which, for lack of a better term, is frequently called good common sense. The man who lets his actions depart too far from the normal expectancy will find difficulty in operating as a member of a team.

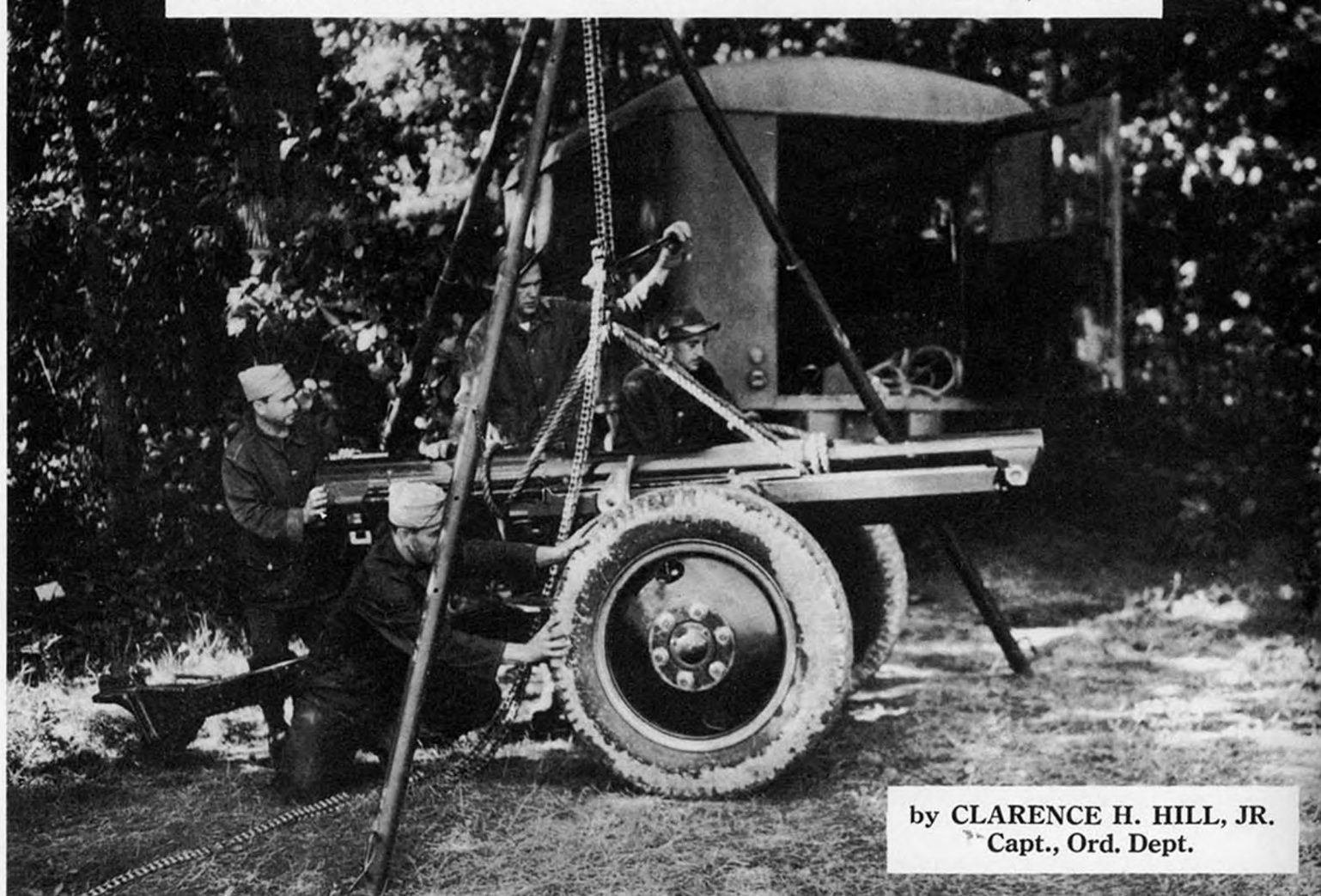
You who are graduating here today have met the standards established by the Chief of Ordnance for second lieutenants. Some of your classmates have not been so fortunate. A few failed because of physical disqualifications, others because of low academic grades, and many because they were inept as leaders of men. We have found here at the school that all too many candidates have not developed many of the attributes necessary for a leader, who must sway his men graciously and bend them to his will without apparent effort. Because of this I wish to leave a few thoughts with you this morning upon this subject.

As we review the pages of history and study the lives of great leaders, it immediately becomes apparent that what we term formal education has played no very important part. Many of the greatest men during early biblical times were illiterate. Would Grant or Lee have been more successful with degrees from Oxford? As we search the lives of the greatest of these leaders, we find no common denominator. We do find, however, many things all possessed which may be considered as standard attributes. These include initiative, thoroughness, and the powers of observation, concentration, and expression as well as adaptability, resourcefulness, organizing ability, personality, and color.

It might be well for each of you to make a personal survey of your own individuality. Look at yourselves through the eyes of "Joe Doakes", the common soldier. See how you stack up in his opinion. Will he call you a snob because you pretend to be superior, or, even worse, will he lose his respect for you because you call him Joe and borrow his money? Will he call you soft or lazy because you do not share his privations and hardships? Will he call you timid because you dodge responsibilities? Will he have contempt for you because you can't take it?

(Continued on page 499)

ARTILLERY REPAIR TRUCK, M2



by CLARENCE H. HILL, JR.
Capt., Ord. Dept.

The Artillery Repair Truck, M2, as supplied Medium and Heavy Maintenance Companies, is a standard Ordnance maintenance vehicle, with bus-type body, which has been equipped with a basic load described in SNL G-82. This load, consisting of the prescribed allowances of machine units, benches, and tools, when supplemented with appropriate Special Repair or Maintenance Tools, is all that is required to facilitate the inspection, maintenance, or repair of any field artillery weapon.

Some of the methods of employing the basic load, composed of TRUCK EQUIPMENT, MACHINE UNIT, TRUCK TOOLS, and ARTILLERY MECHANIC'S KITS advanced herein are depicted in the accompanying plates.

The vehicle provides not only means of storing and transporting necessary supplies of spare parts, standard hardware, and equipment, but a well-equipped shop suitable for use in any situation.

TRUCK EQUIPMENT

The Ordnance property listed below used to equip the vehicle are known as items of truck equipment. The stores, equipment, and bench carried in the body of the truck are rendered readily accessible upon use of the steel ladder. The electrical fittings facilitate the use of power driven tools, within or without the truck, and means of lighting the vehicle. Ample rope and blocks, supplemented with a chain hoist and collapsible tripod are furnished to accomplish lifting operations.

The truck equipment consists of:

- 1 BENCH, cabinet, type V, Class C
- 2 BLOCK, tackle, double-sheave, for 3-inch circumference rope

- 1 BLOCK, tackle, single-sheave, for 3-inch circumference rope
- 1 BOX, control, waterproof, type II
- 1 CHEK-CHART, lubrication, guide, No. 45
- 2 CORD, extension, heavy-duty, 25-feet
- 3 CORD, extension, heavy-duty, 50-feet
- 2 CORD, extension, light, 25-feet
- 1 HOIST, chain, ratchet lever, 4-1/2-ton capacity
- 1 LADDER, steel
- 4 PLUG, adapter
- 4 PLUG, double, outlet
- 300 ROPE, manila, 3-strand, 3-inch circumference, feet
- 100 ROPE, manila, 3-strand, 4-1/2-inch circumference, feet
- 1 SWITCH, 2-pole, multi-breaker, 25 amp.
- 1 TRIPOD, collapsible, with 3 plates for hoist

MACHINE UNIT

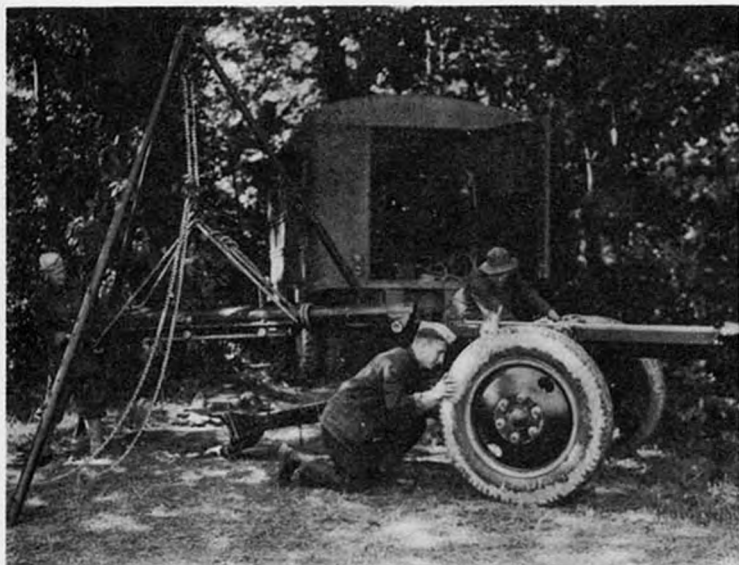
A single machine unit is employed with this vehicle, namely:

- 1 DRILL, electric, portable, 1/2-inch capacity, heavy-duty, 110 V.

TRUCK TOOLS

It shall suffice to list the truck tools, for the methods of utilizing these are well recognized.

- 12 BLADES, hacksaw, hand, flexible, 10-inch, 18 teeth
- 12 BLADES, hacksaw, hand, flexible, 10-inch, 24 teeth
- 1 BUSTER, rivet, 5/8 inch cut, 12 inches long
- 1 CHISEL-SET, machinists, hand cold. Composed of:
 - 5 CHISELS: 1/2, 5/8, 3/4, 7/8, & 1 inch

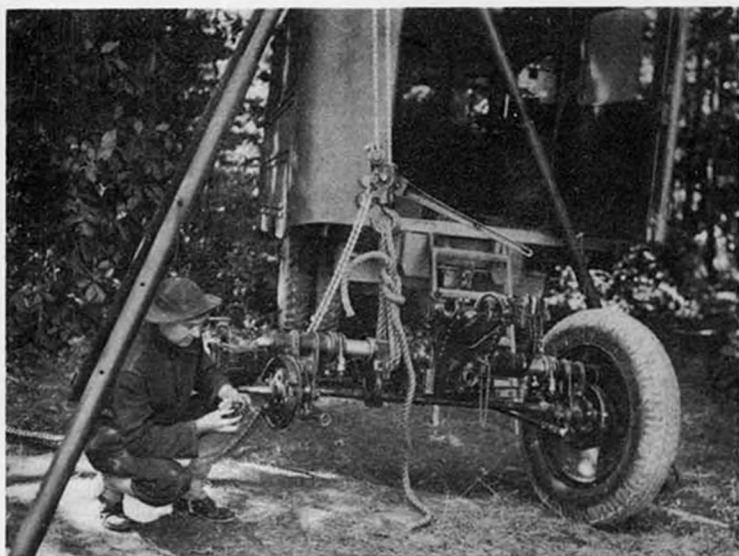


1 ROLL

1 DRILL-SET, twist, straight-shank, high-speed steel. Consisting of:

1 CASE, drill indexing, steel

29 DRILLS: 1/16 to 1/2 inch, inclusive, by 64ths.



1 EXTRACTOR-SET, screw. Composed of:

1 CASE, metal.

5 DRILL, screw extractor. Nos. 1 through 5, inclusive

5 EXTRACTOR, screw, Nos. 1 through 5, inclusive

10 GUIDE, drill, 9/32, 5/16, 11/32, & 3/8 O.D. x 1/8 I.D. x 1-3/16 long; 13/32, 7/16, 15/32, & 1/2 O.D. x 3/16 I.D. x 1-3/16 long; and 17/32 & 9/16 O.D. x 1/4 x 1-3/16 long.

1 WRENCH, extractor

1 FILE, A.S., three-square, smooth, 6 inch

1 FRAME, hacksaw, pistol-grip-handle, adjustable

1 GAGE, thickness, 26 leaves, .0015-.025 inch

1 JAW-FACE, for 4-1/2 inch machinist vise, pair

1 PLIERS, combination, slip-joint, 8-inch

1 PLIERS, diagonal-cutting, 6-inch

1 PLIERS, gripping, adjustable, 1/4 - 1-5/8 opening, 45° offset. 10 inch.

1 PLIERS, side-cutting, flat-nose, 8-inch

1 PLIERS, side-cutting, long-needle-nose, 7-inch

1 PUNCH, center, 5-inch

1 PUNCH-SET, drive pin, standard. Composed of:

1 ROLL

8 PUNCH: 3/32, 1/3, 5/32, 3/16, 7/32, 1/4, 5/16, and 3/8 in pt.

1 SCREWDRIVER, offset, 5/8 x 6

1 SCREWDRIVER, offset, 5/8 x 8

1 SCREWDRIVER-SET, machinists, heavy duty, pyralin handle. Composed of:

5 SCREWDRIVER: 4, 6, 8, 10, and 12 inch blades

1 VISE, machinists, bench, swivel-base, swivel-jaw, 6-inch opening

1 WRENCH, pipe, adjustable, 14-inch

1 WRENCH-SET, adjustable, single-end. Composed of:

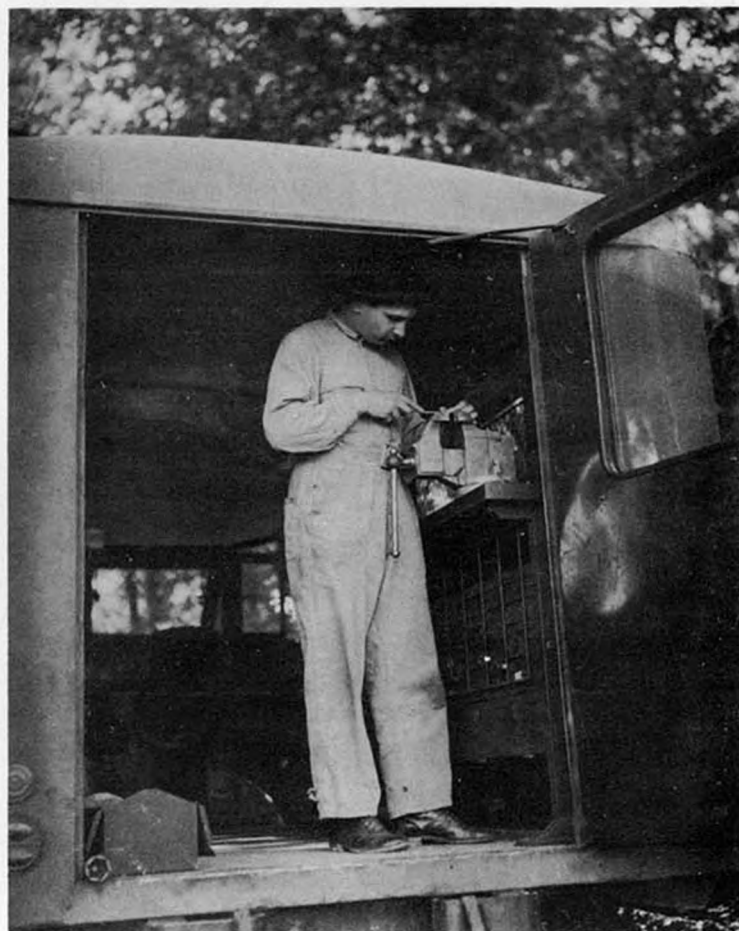
6 WRENCH: 4, 6, 8, 10, 12, and 15 inch

1 WRENCH-SET, engineers, double-head, alloy-steel. Composed of:

1 ROLL

13 WRENCH: 3/8 & 7/16, 7/16 & 1/2, 1/2 & 9/16, 9/16 & 5/8, 5/8 & 11/16, 11/16 & 3/4, 25/32 & 13/16, 3/4 & 7/8, 7/8 & 15/16, 15/16 & 1, & 1-1/16 & 1-1/8.

(Continued on page 500)



WELDING TRUCKS

by W. G. SYLVESTER, Capt., Ord. Dept.



Figure 1 -- Truck, Ordnance Maintenance (left rear view)

The repair and maintenance of Ordnance equipment by welding in the field is accomplished with the facilities transported in welding trucks. These constitute a part of the organizational equipment of service sections in medium and heavy ordnance maintenance companies.

Allocation of welding trucks to field units is summarized by the following:

No. of Trucks	Unit
1	Ordnance Company M. M.
2	Ordnance Company H. M.
1	Ordnance Section, Air Base Company
2	Ordnance Maintenance Battalion Armored Division
1	Ordnance Hq and Hq Company, Battalion, Armored Division

The equipment on these welding trucks is designed to enable trained welding specialists to perform oxy-acetylene, electric arc and forge welding operations. These comprehend the repair of broken metal parts or damaged material, the fabrication of certain replacement parts, the build-

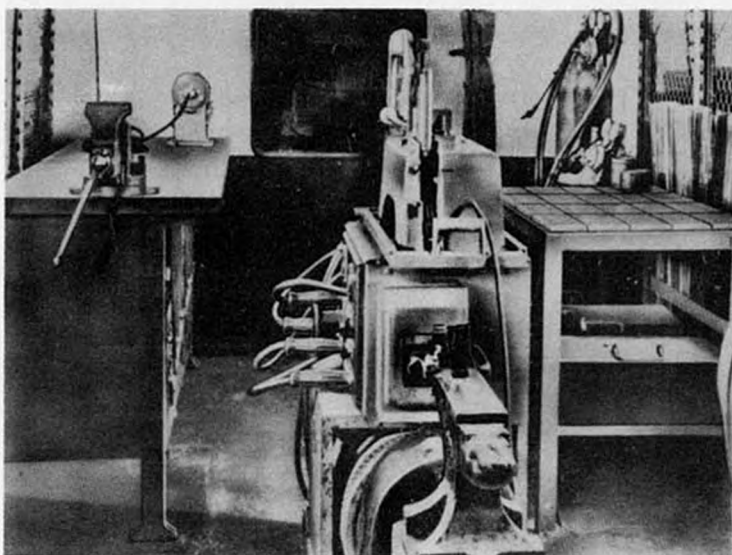


Figure 3 -- Truck, welding, M3 (interior view)

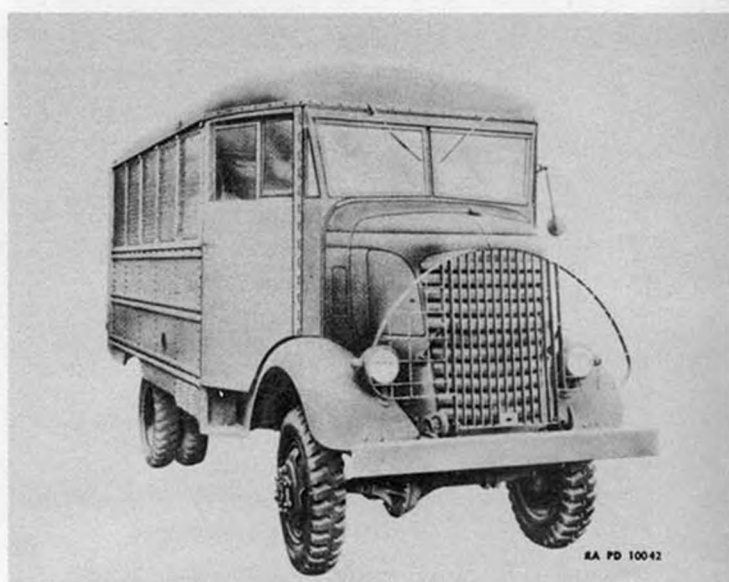


Figure 2 -- Truck, Ordnance Maintenance (right front view)

ing up of sections, hard surfacing worn parts and numerous other welding and cutting operations. Many of the welding operations may be performed by the personnel with little or no supervision. It is important that the welding operators understand the use of the welding equipment on the trucks and its application to all types of Ordnance metals.

There are three types of welding trucks operated by Ordnance personnel in the field, namely the M2, M3, and M12.

The pertinent Standard Nomenclature Lists covering parts, spare parts and equipment on these three types of welding trucks are as follows:

SNL G-59	Truck Welding M2
SNL G-59	Truck Welding M3
SNL G-142	Truck Welding M12

TRUCK, WELDING, M2

The M2 welding truck is known as 1-1/2 - 3 ton, 4 x 4 cab-over-engine type.

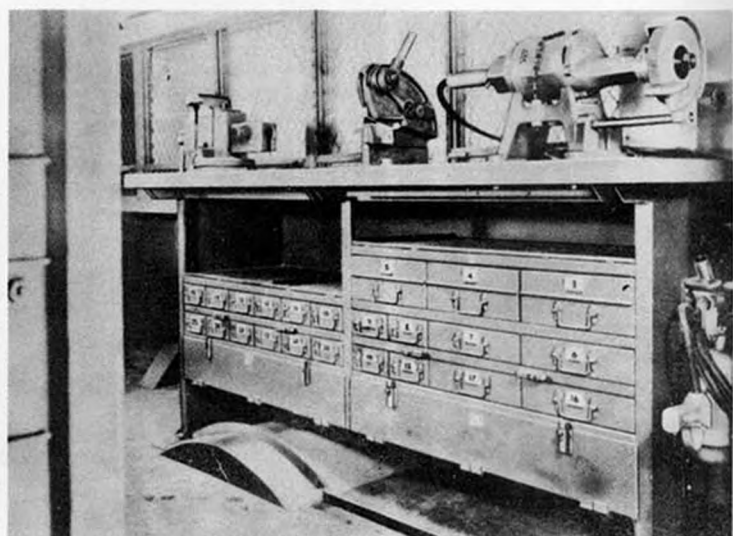


Figure 4 -- Bench cabinet Type V, Class C, showing numerical order of drawers

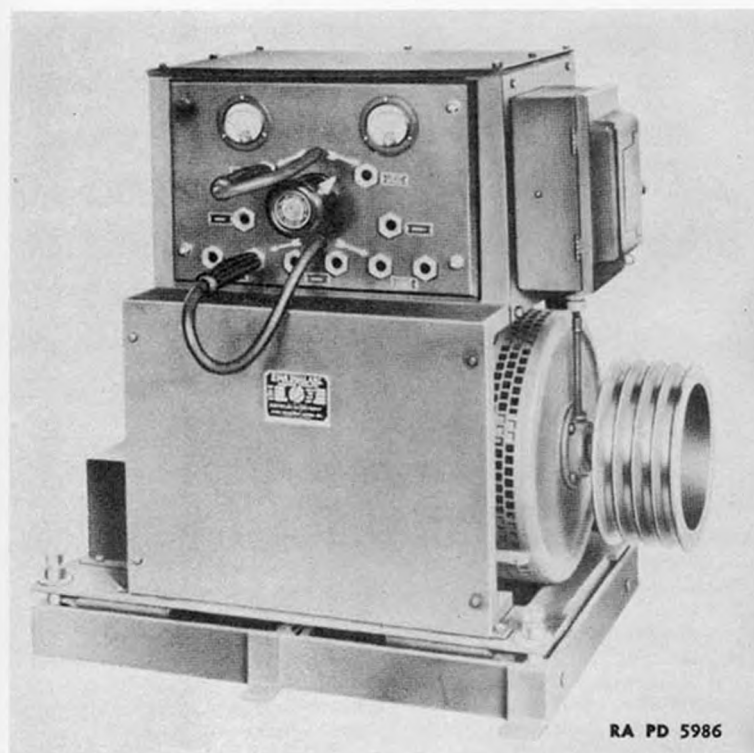


Figure 5 -- Generator, 200 amperes

It is equipped with a 200-ampere arc welding generator driven from a power take-off to develop direct current for arc welding. The truck body is designed with drop sides to permit a greater floor surface when operated in bivouac. The equipment carried by this truck is now essentially the same as that contained in the later type M3 welding truck. Although a number of the type M2 welding trucks are still in use in field maintenance companies, the design is now obsolete.

TRUCK, WELDING, M3

The M3 welding truck body is the 4x4 1939 Chevrolet cab-over-engine bus body type. It is equipped with a 200-ampere arc welding generator driven from a power take-off to develop direct current for arc welding. By means of a split ring commutator, 110-volt alternating current is also developed for the overhead lighting and to operate the portable grinder, portable drill press and power hack saw. When the welding generator is not operating, all of the 110-volt alternating current supply can be obtained from an outside source through a control box located on the outside left front of the truck.



Figure 7 -- Electric arc welding on M3 welding truck

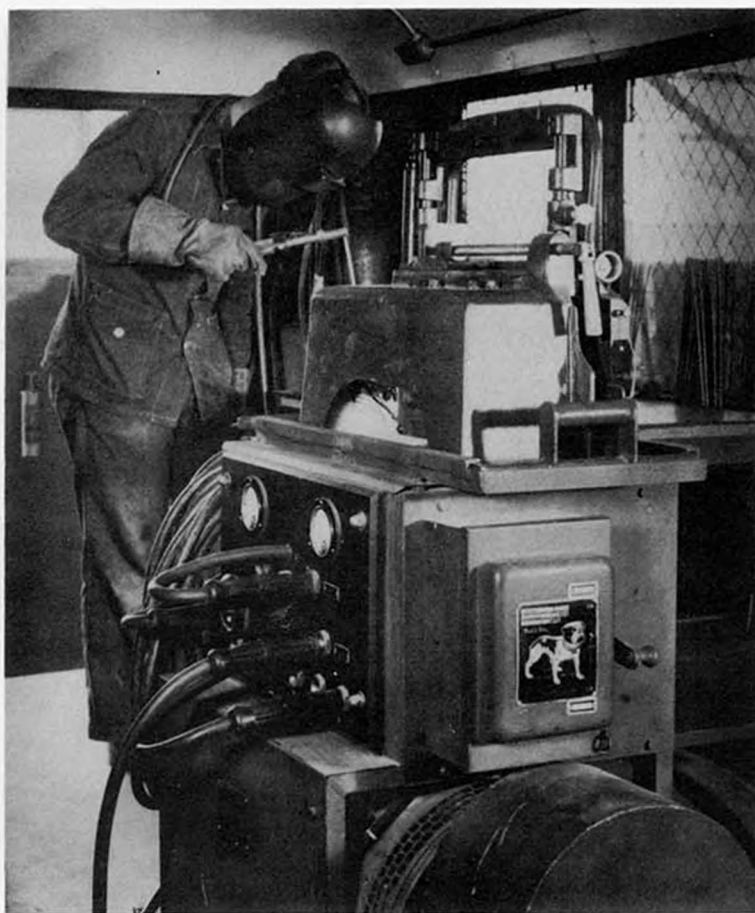


Figure 6 -- Arc welding generator in operation -- M3 welding truck

Exterior views of the truck body design are shown in Figure 1 and 2, while a general view showing the layout of the interior of the truck is shown in Figures 3 and 4.

The direct current supply for electric arc welding is generated by the plug-in type welding generator shown in Figures 5 and 6. A typical arc welding operation performed using the arc welding facilities of the M3 welding truck is shown in Figure 7.

The welding operation is performed on a hinged steel plate which constitutes the top of the welding table.

The equipment, comprising the combination oxy-acetylene welding and cutting outfits supplied with these trucks is shown in Figure 8. When oxy-acetylene welding, the hinged steel plate is raised to permit the use of the firebrick table top located immediately beneath it. When so used the oxy-acetylene welding operation is performed as shown in Figure 9.

The tools comprising the welders' kits and other miscellaneous welding accessories and supplies are shown in Figures 10 through 13.

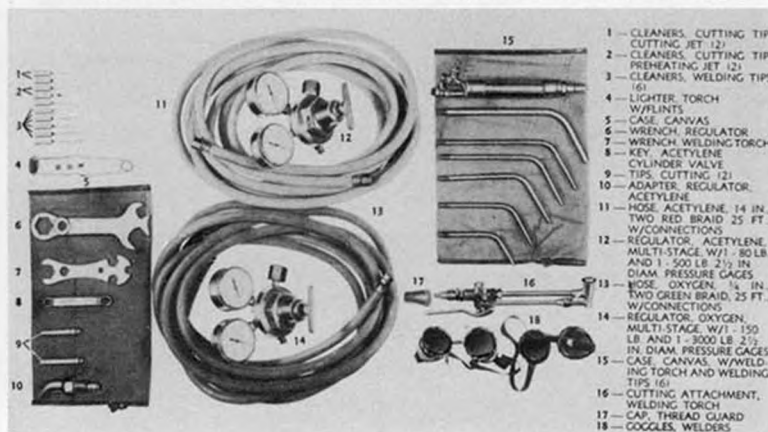


Figure 8 -- Combination oxyacetylene welding and cutting outfit



Figure 9 -- Oxyacetylene welding on M3 welding truck

A light-proof screen shown in Figure 14 is provided to shield work being arc welded to protect personnel in the vicinity from harmful light rays.

The preparation of metal sections for welding or finishing of welded structures which involve grinding, sawing or drilling operations requires the use of equipment shown in Figures 15 through 18. Typical applications of these items of equipment on the M3 welding truck are shown in Figures 19 through 22.

Welding operations which cannot be conveniently accomplished by bringing the units inside the truck can be performed by driving the truck to the job and extending the welding leads to the location where welding is desired. This expedient is illustrated in Figures 23 and 24.

The M3 welding truck is equipped with a portable electric driven updraft type forge and essential blacksmith tools for forging and forge welding operations. These are shown in Figures 25 through 27.

It should be noted that snap-on window curtains are provided to permit welding operations at night. This is important in order to screen off the intense light produced by welding operations which would otherwise be easily detected.

A more detailed list of welding equipment and supplies on the M3 welding truck are given in the itemized list below.

ITEM	Quantity per truck	Location on truck
EQUIPMENT, TRUCK:		
BENCH, cabinet, type V, class C -----	1	B-bench
BOX, control, weatherproof, type 11 -----	1	Left front outside

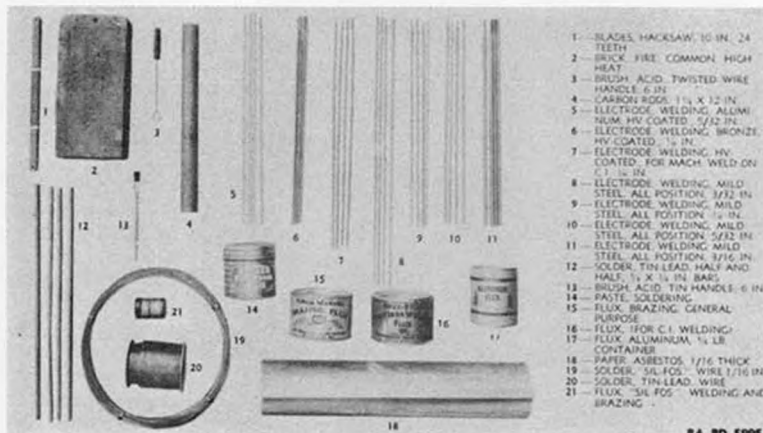


Figure 11 -- Welding electrodes and supplies

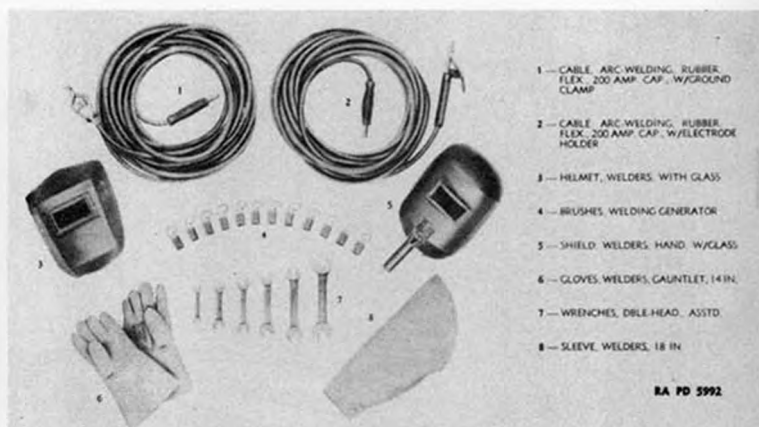


Figure 10 -- Welding accessories

CORD, extension, two conductor, #12 A.W.G., with male connector on one end, with female connector other end, 50 ft. -----	1	B-26
CORD, extension, two conductor, #12 A.W.G., with male connector on one end, with female connector other end, 25 ft. -----	2	B-26
CORD, extension light, two conductor, #18 A.W.G., with male connector on one end, with soft rubber medium base screw socket and lamp guard on other end, 25 ft. -----	2	B-26
FRAME, welding tank, type 11 -----	1	Left rear
LADDER -----	1	Compartment under truck
PLUG, adapter -----	4	B-6
PLUG, double outlet -----	4	B-6
SCREEN, welding, collapsible -----	1	Left rear
SHEAR, hand, bench type, 3/16 in. -----	1	B-top
TABLE, welding with welding plate -----	1	Left side

MACHINE TOOLS:

DRILL, electric, portable, 1/2 in., heavy duty, 110 volt, universal, 15 ft. extension cord ---	1	B-rear
FORGE, portable, with following tools: -----	1	On floor left
1 CHISEL, blacksmith, hot cut, 1-1/4 in. square at eye, with handle 18 in. long		
1 HAMMER, blacksmith, hand, size #2		
1 NIPPER, cutting, blacksmith, 14 in.		
1 PUNCH-SET, blacksmith, round eye, 1 each of 1/4, 1/2, 3/4, and 1 in., with one handle 18 in. long.		
1 PUNCH-SET, blacksmith, square eye, 1 each of 1/4, 1/2, 3/4, and 1 in., with one handle 18 in. long.		
1 TONG, blacksmith, bolt, 1/4 in. size, 18 in. long		
1 TONG, blacksmith, double pick up, 18 in. long		
1 TONG, blacksmith, gad. 18 in. long		
1 TONG, blacksmith, single pick up, 18 in. long		

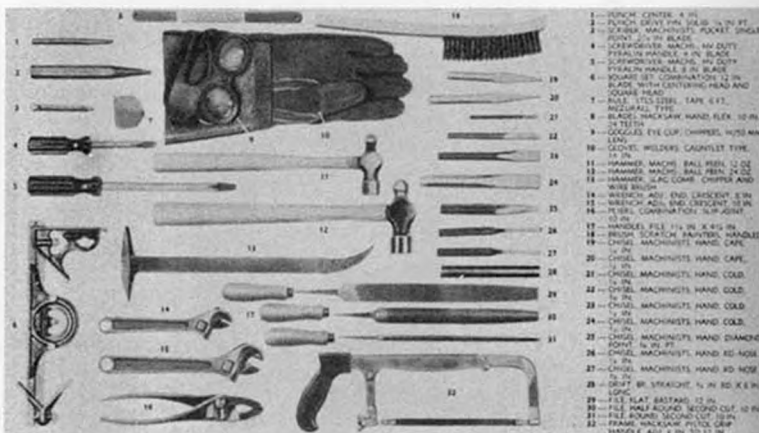
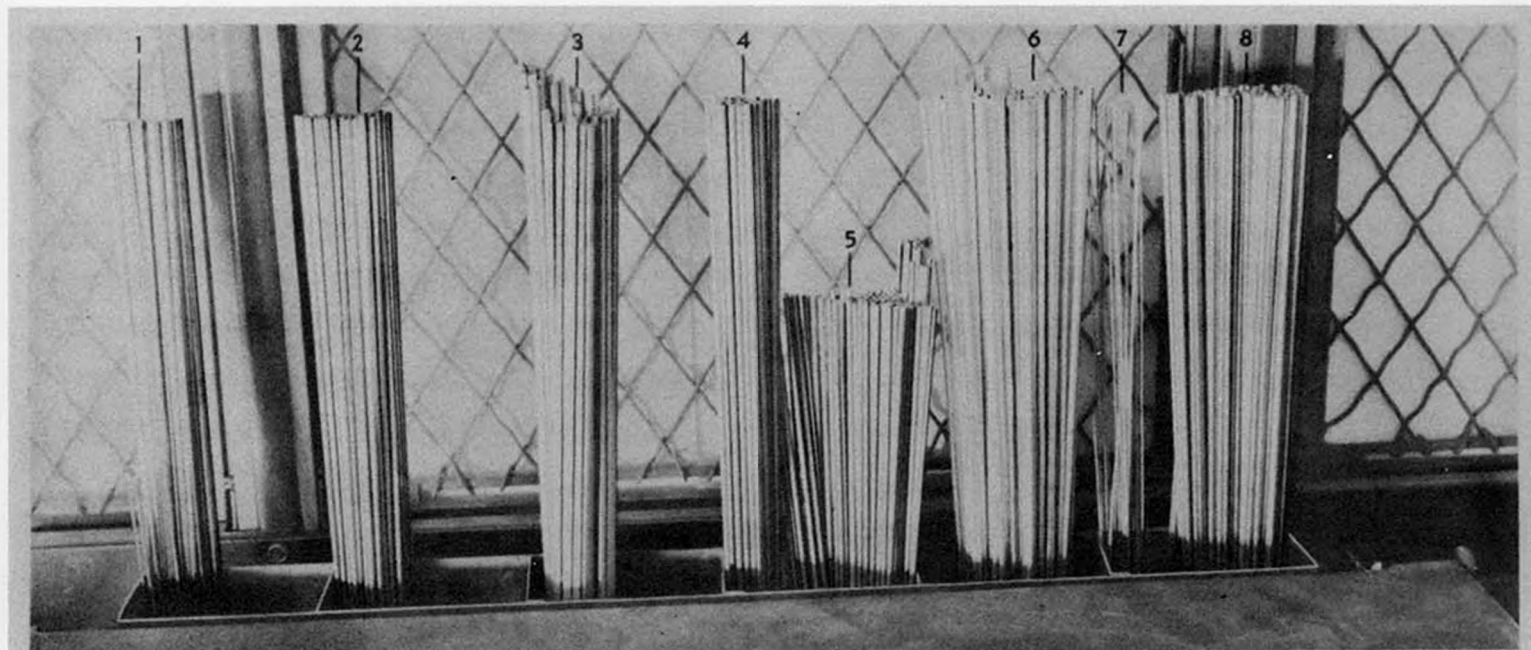


Figure 12 -- Welder's kit



- 1 - RODS, GAS-WELDING, LOW CARBON STEEL, COPPERIZED, STRAIGHT, 1/16 IN.
 2 - RODS, GAS-WELDING, LOW CARBON STEEL, COPPERIZED, STRAIGHT, 1/8 IN.
 3 - RODS, CAST-IRON WELDING, CAST, GRAY, 3/16 IN.
 4 - RODS, WELDING, 40% CHROMIUM, ALLOY STEEL, FOR HARD SURFACING, 5/32 IN.

- 5 - ELECTRODES, WELDING, MANGANESE, FOR HARD SURFACE, 1/8 IN.
 6 - RODS, WELDING, ALUMINUM, ALLOY, 5% SILICON, DRAWN, 1/8 IN.
 7 - RODS, WELDING, BRONZE, STRAIGHT, 1/16 IN.
 8 - RODS, WELDING, BRONZE, STRAIGHT, 1/8 IN.

RA PD 5996

Figure 13 -- Welding rods and electrodes in place in welding table

- 1 TONG, blacksmith, straight lipped with V slot in each lip, 18 in. long.
 GENERATOR, welding, 200 ampere, driven from power take-off, with the following accessories -----
 1 CABLE, electrode, flex., 50 ft., 200 ampere capacity
 1 CABLE, ground, flex., 50 ft., 200 ampere capacity, with ground clamp attached -----
 1 GLOVES, pair welders -----
 1 HELMET, welders, with No. 12 filter glass and cover glass -----
 1 HOLDER, electrode, 1/8 to 1/4 in. capacity
 1 PULLEY, 4 sheave, "C" section grooves pitch diameter, (9.6 in.) -----
 1 SHIELD, welders hand, with No. 12 filter glass and cover glass -----
 1 SLEEVE, welders -----

- 1 Floor center
 On generator
 On generator
 B-12
 B-2
 On cable
 On generator
 B-2
 B-12

- 1 SWITCH, two pole, double throw, mounted on generator
 GRINDER, electric, portable, 6 inch, 100 volt, universal, with wheel, 15 ft. extension cord, with grinder stand for conversion to bench grinder -----
 HACKSAW, power, with base -----

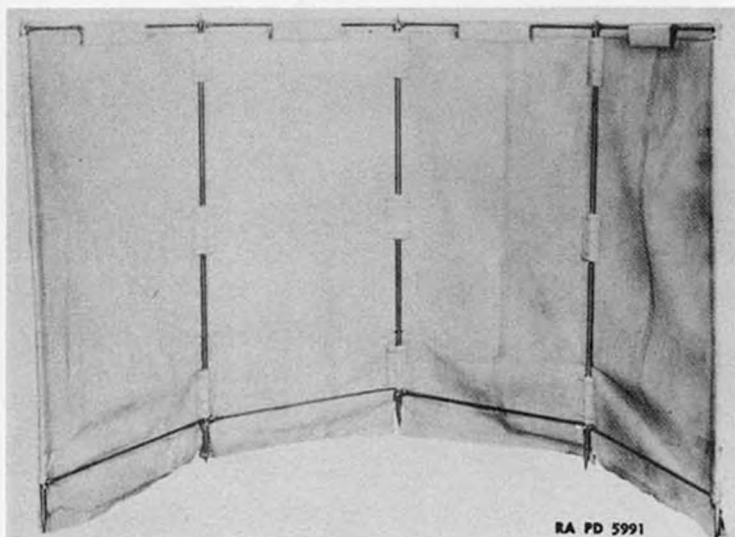
- 1 B-top
 1 On generator

EQUIPMENT, WELDERS:

- OUTFITS, comb., oxy-acetylene, welding and cutting complete, consisting of: -----

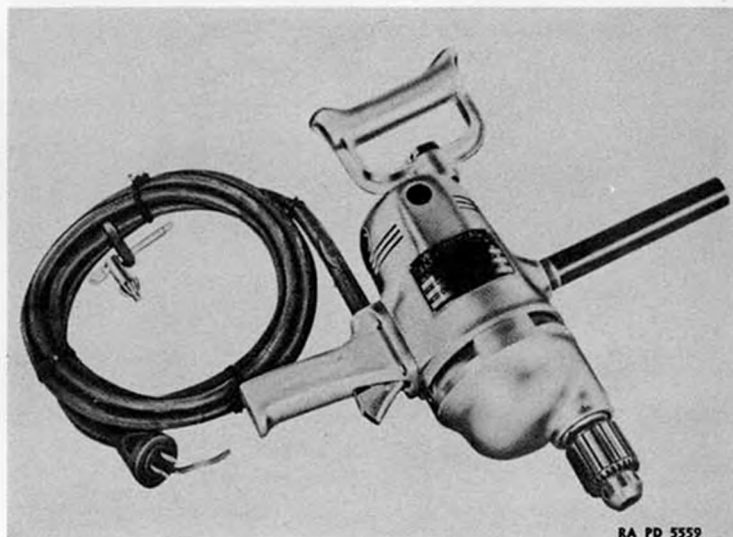
- 2 Under weld-
 ing table

- 1 ADAPTER, regulator, acetylene to commercial or "Airco" tank
 1 ATTACHMENT, cutting 80°-90° angle head, with head nut
 1 BOX, tool, steel, welding set
 1 CAP, thread guard



RA PD 5991

Figure 14 -- Welding screen



RA PD 5559

Figure 15 -- Portable electric drill (1/2 in.)

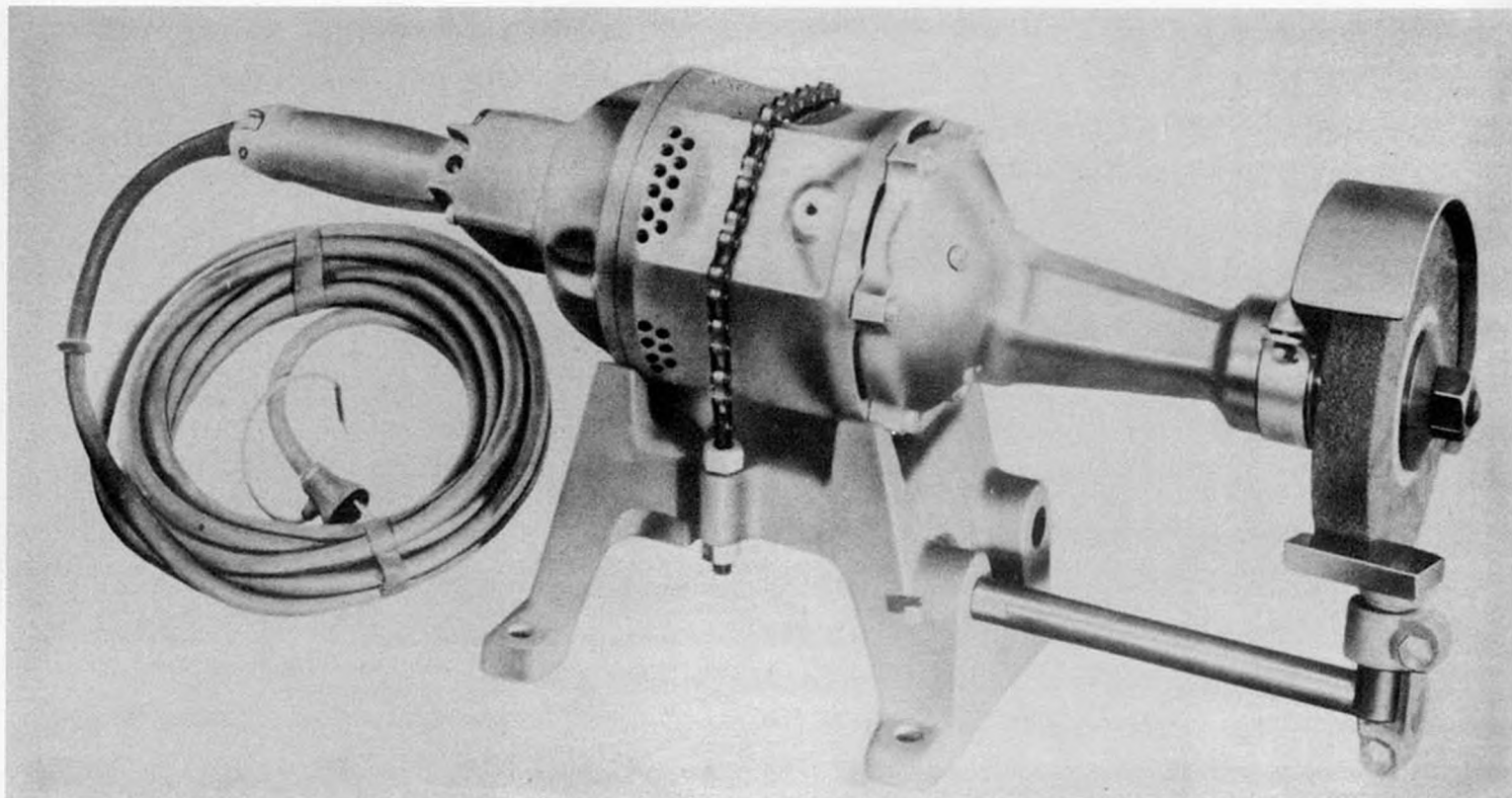


Figure 16 -- Portable grinder on stand

- 2 CASES, canvas (for tips, cutting attachment and mixing head)
- 2 CLEANERS, cutting tip, cutting jet
- 2 CLEANERS, cutting tip, preheating jet
- 6 CLEANERS, welding tip
- 1 CONTAINER, for tip cleaners
- 6 FLINT, torch lighter
- 2 GOGGLES, welders, eye cup, medium shade, 50mm lenses with clear cover lenses
- 1 HOSE, acetylene, 1/4 in., two red braid, 25 ft., with connections
- 1 HOSE, oxygen, 1/4 in., two green braid, 25 ft. with connections
- 1 KEY, acetylene tank, valve
- 1 LIGHTER; torch
- 1 REGULATOR, multi-stage, acetylene, with 1-80 lb. and 1-500 lb. 2-1/2 in. diameter pressure gages

- 1 REGULATOR, oxygen, multi-stage with 1-150 lb. and 1-3,000 lb. 2-1/2 in. diameter pressure gages
- 1 TIP, cutting, for metal 1/8 to 1 in. thick
- 1 TIP, cutting, for cutting metal 1 to 3 in. thick
- 1 TIP, for radiator repairing
- 1 TIP, welding (for welding metal 1/32 to 1/16 in. thick)
- 1 TIP, welding (for welding metal 1/8 to 3/16 in. thick)
- 1 TIP, welding (for welding metal 1/4 to 3/8 in. thick)
- 1 TIP, welding (for welding metal 1/2 to 5/8 in. thick)
- 1 TIP, welding, (for welding metal 1 in. and over)
- 1 TIP, welding (to be used for heating purposes)
- 1 TORCH, welding, with connections
- 1 WRENCH, regulator
- 1 WRENCH, welding torch

TOOLS, WELDERS, TRUCK SET:

- ANVIL, blacksmith 100 lb. with hardie and block 1
- Front center and B-16

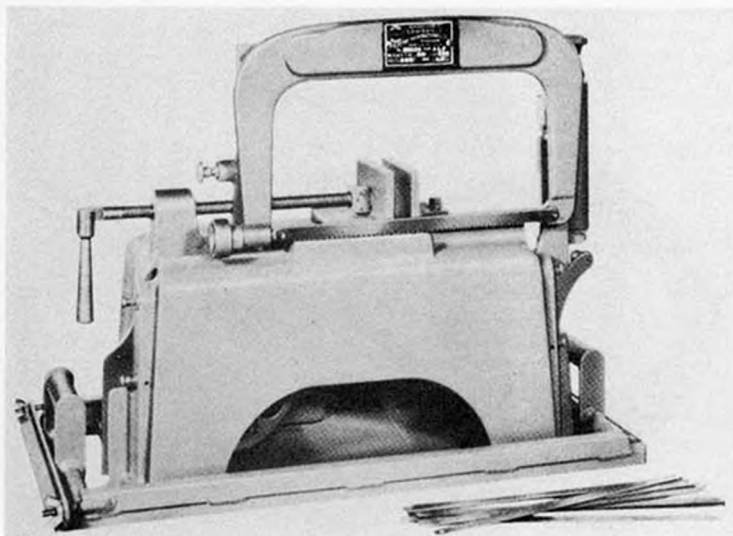


Figure 17 -- Power hacksaw with base

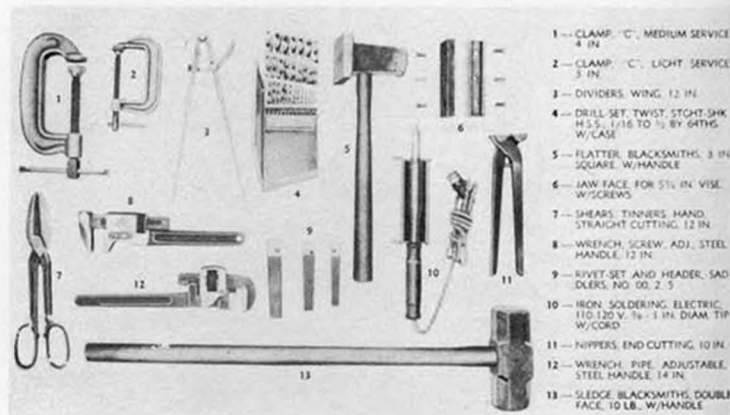


Figure 18 -- Tools and accessories



Figure 19 -- Sharpening chisel by grinding, using portable electric grinder mounted on bench stand, M3 welding truck

CLAMPS, "C" light service, 3 in. -----	4	B-10
CLAMPS, "C", medium service, 4 in. -----	4	B-10
DIVIDER, wing, 12 in. (Pexto #165 or equal) --	1	B-20
DRILL SET, twist, high speed, straight-shank, one each 1/16 to 1/2 in. by 64ths, in metal case -----	1	B-16
FLATTER, blacksmiths, square, 3 in. face, handled -----	1	Rear weld table
JAW-FACES, for 5-1/4 in. vise -----	1	B-16
IRON, soldering, electric, 150-220 W., 110-120 volt, 5/8 in. diameter tip -----	1	B-17
NIPPERS, end cutting, with adjustable screw-in handle, 10 in. pr. -----	1	B-7
SET AND HEADER, rivet, saddlers No. 00 ---	1	B-18
SET AND HEADER, rivet, saddlers No. 2 ---	1	B-18
SET AND HEADER, rivet, saddlers No. 5 ---	1	B-18
SHEARS, tinners, hand, straight, cutting, 12 in. pr. -----	1	B-7
SLEDGE, blacksmiths, double face, 10 lb. 30 in. handle -----	1	Rear weld table
TOOLS, WELDERS, TRUCK SET:		
VISE, machinists, bench, swivel, base, swivel jaw (5-14 in. widths of jaws) -----	1	B-top



Figure 21 -- Cutting metal section with power hacksaw on M3 welding truck



Figure 20 -- Drilling web section of welded section, using portable electric drill, M3 welding truck

WRENCH, pipe, adjustable, steel handle, 14 in.	1	B-18
WRENCH, screw, monkey, steel handle, 12 in.	1	B-18
KIT, WELDERS:		
BLADES, hacksaw, 10 in., 24 teeth, doz. -----	1	
BOX, tool, with tray, type 11 -----	1	
BRUSH, scratch, painters, handled, 7/8 x 14 in.	1	
CHISEL, machinists, hand, cape, 1/4 in. -----	1	
CHISEL, machinists, hand, cape, 1/2 in. -----	1	
CHISEL, machinists, hand, cold, 1/4 in. -----	1	
CHISEL, machinists, hand, cold, 3/8 in. -----	1	
CHISEL, machinists, hand, cold, 1/2 in. -----	1	
CHISEL, machinists, hand, cold, 3/4 in. -----	1	
CHISEL, machinists, hand, dia.-pt., 3/8 in. pt.	1	
CHISEL, machinists, hand, rd. nose, 1/4 in. -----	1	
CHISEL, machinists, hand, rd. nose, 3/8 in. -----	1	
DRIFT, brass, 3/4 in. rd., 6 in. long -----	1	
FILE, A. S., flat, bast., 12 in. -----	1	
FILE, half-rd., sec-cut., 10 in. -----	1	
FILE, rd., sec-cut., 10 in. -----	1	
FRAME, hacksaw, pistol grip, adj., 8 to 12 in. blade -----	1	
GLOVES, welders, 14 in. pr. -----	1	
GOGGLES, eye-cup, chippers, with 50mm lens	1	
HAMMER, machinists, ball peen, 12 oz., handled	1	

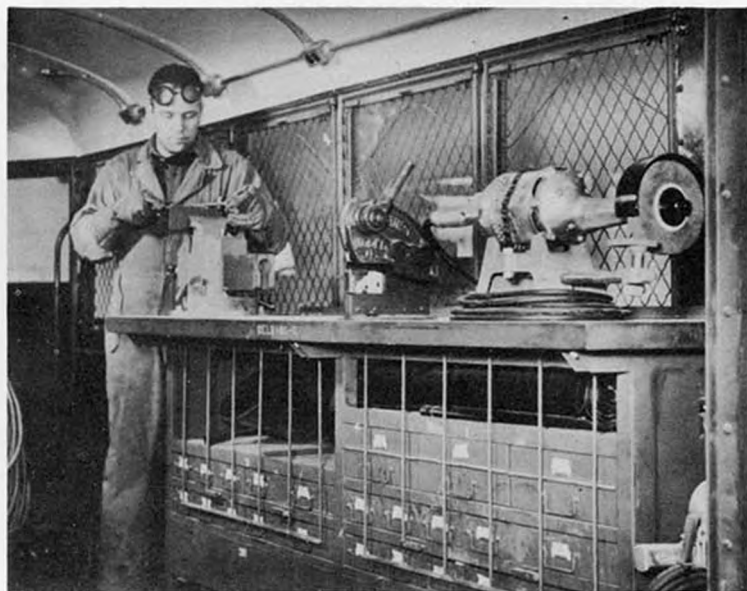


Figure 22 -- Preparing edge of metal section by filing, using the bench vise on the M3 welding truck



Figure 23 -- Field repair of boom on M1 wrecker by arc welding, using M3 welding truck

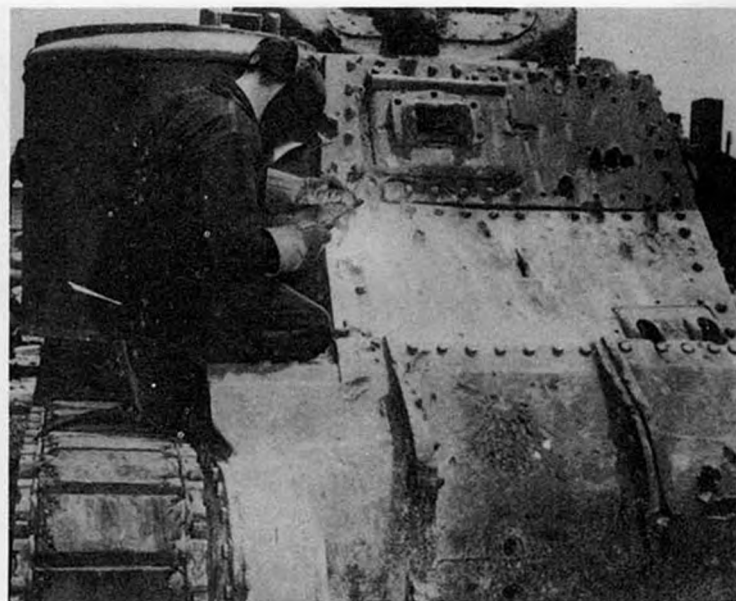


Figure 24 -- Field repair of medium tank hull by arc welding, using M3 welding truck

HAMMER, machinists, ball peen, 24 oz., handled	1
HAMMER, slag	1
HANDLE, file, wood, 1-1/4 to 4-1/4 in.	1
PLIERS, comb, slip-joint, 10 in.	1
PUNCH, center, 5 in.	1
PUNCH, steel hand, 1/4 in. pt., 7-1/2 in. long	1
RULE, steel, tape, 72 in. long, Mezurall type	1
SCREWDRIVER, pyralin, 4 in. blade	1
SCREWDRIVER, pyralin, 8 in. blade	1
SCRIBER, pocket, complete	1
SQUARE, combination, 12 in. w/centering head, square head and blade	1
WRENCH, adj., single end, 8 in. (Crescent type)	1
WRENCH, adj., single end, 12 in. (Crescent type)	1

SUPPLIES, TRUCK SET:

ACID, muriatic, oz.	8	B-top
ASBESTOS powder (for paste), 1 lb.	5	B-3
BLADE, hacksaw, 10 in., 24 teeth, doz.	4	B-9
BRICK, fire, common, high heat	20	Weld table
BRUSH, acid, tin handle, 6 in. doz.	1	B-9
BRUSH, acid, twisted wire handle, 6 in. doz.	1	B-9
CARBON rods, 1-1/4 rd. x 12 in.	5	B-3
ELECTRODE, hv.-coated, aluminum, 5/32 in., lb.	5	B-22
ELECTRODE, hv.-coated, for machine weld on C.I., 1/8 in.	10	B-21
ELECTRODE, hv.-coated, bronze, 1/8 in., lb.	5	B-13
ELECTRODE, hv.-coated, all position, mild steel, reverse polarity, 3/32 in. lb.	15	B-14
ELECTRODE, hv.-coated, all position, mild steel, reverse polarity, 1/8 in. lb.	25	B-15

ELECTRODE, hv.-coated, all position, mild steel, reverse polarity, 5/32 in. lb.	50	B-25
ELECTRODE, hv.-coated, all position, mild steel, reverse polarity, 3/16 in. lb.	25	B-23
FLUX, aluminum (in 1/4 lb. containers), lb.	1	B-4
FLUX, brazing, general purpose, lb.	1	B-4
FLUX, (for cast-iron welding), lb.	1	B-4
PASTE, soldering, lb.	1	B-4
PAPER, asbestos, 1/16 in. thick x 36 in. wide, lb.	50	Left rear
RODS, welding, copperized, 1/16 in. lb.	5	On Weld table
RODS, welding, copperized, 1/8 in. lb.	10	On Weld table
RODS, welding, cast iron, gray, 3/16 in. lb.	10	On Weld table
RODS, welding, alloy steel, for hard surfacing, 5/32 in. lb.	10	On Weld table
RODS, welding, manganese, 1/8 in. for hard surfacing lb.	10	On Weld table
RODS, welding, aluminum, 1/8 in. lb.	5	On Weld table
RODS, welding, bronze, 1/16 in. lb.	1	On Weld table
RODS, welding, bronze, 1/8 in. lb.	10	On Weld table
SOLDER, Sil-Fos or equivalent, 1/16 in. wire, w/necessary flux (suitable for welding ferrous and nonferrous metals) lb.	1	B-4
SOLDER, tin-lead, half and half, 1/4 x 1/4 in. bars, lb.	5	B-11
SOLDER, tin-lead, wire, lb.	5	B-4
ZINC (for cutting acid), lb.	1	B-27

TRUCK, WELDING, M12

The standard welding truck is 2-1/2-ton, 6 x 6 truck body type. It is equipped with a 300-ampere electric arc welding generator driven

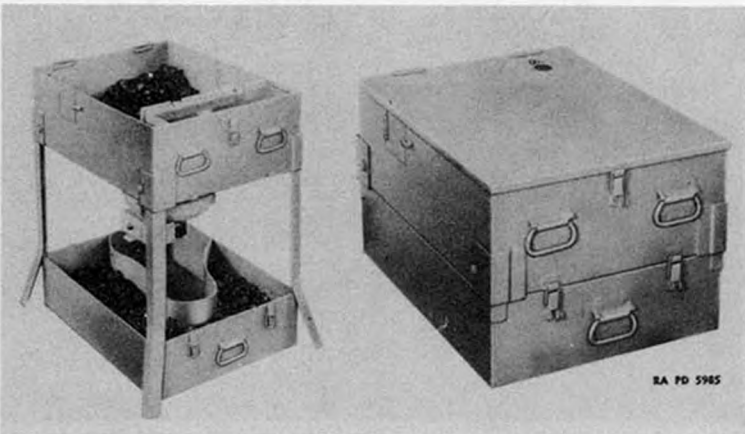


Figure 25 -- Portable forge

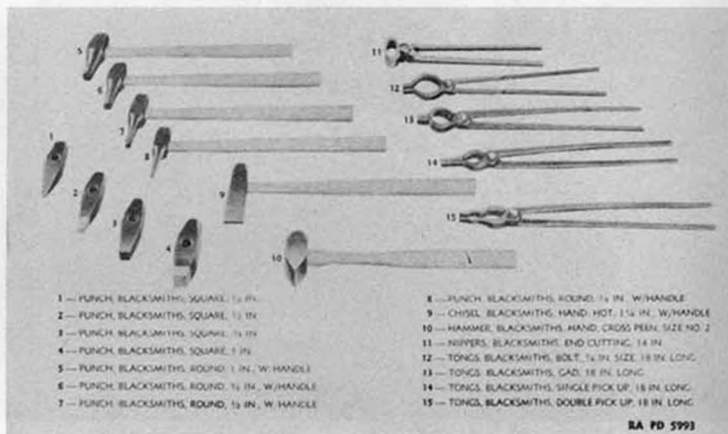


Figure 26 -- Blacksmith's tools

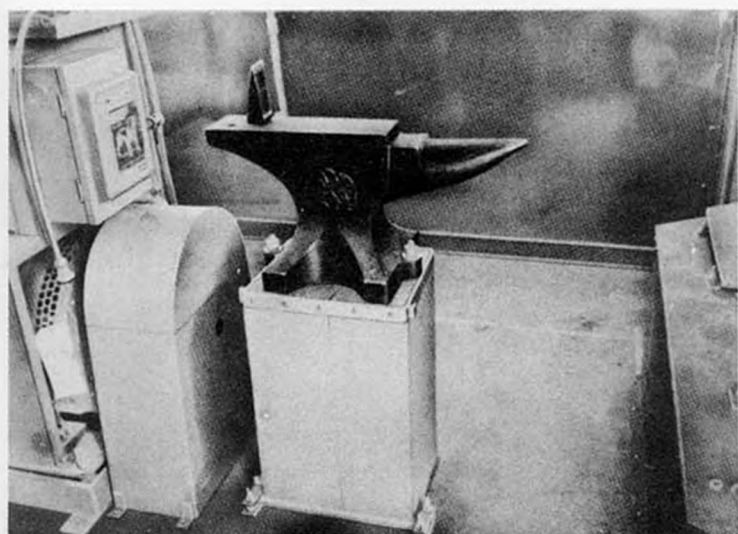


Figure 27 -- Anvil and block

by a separate V-8 gasoline engine. A 1-KW auxiliary generator driven by this engine develops 110 volts, 60-cycle, single phase current for lighting and for the machine units carried as part of the truck equipment.

Exterior views of the truck body design are shown in Figures 28 and 29. The interior of this truck, showing the location of the electric arc and oxy-acetylene welding equipment, supplies and auxiliaries, are shown in Figures 30 through 33.

The increased capacity of the separately driven arc welding generator permits arc welding and arc cutting of heavier work than that accomplished with either the M2 or M3 welding trucks. Other notable features are indirect lighting, pull curtains for night welding, the re-allocation of equipment for more efficient use of the large floor space and the collapsible roof feature to effect smaller crating space. The welding equipment and supplies on the M12 welding truck are itemized below.

ITEM	Quantity per truck
EQUIPMENT, TRUCK:	
BATTERY, 6 volt, 3 cell, 19 plates, per cell, 153 amps.	1
BENCH, cabinet, type V, class H	1
BENCH, type X, Class A	1
BOX, control, weatherproof, type II	1
CORD, extension, two conductor, #12 A.W.G., 25 ft.	2
CORD, extension, two conductor, #12 A.W.G., 50 ft.	3
CORD, extension, light, two conductor, #18 A.W.G., 25 ft.	2
COVER, bench, type X, Class A	1
COVER, front, and retainer for benches, Type IX and X	1



Figure 28 -- Truck, welding, M12 (right front view)

EXTINGUISHER, carbon dioxide, 2 lbs. capacity	1
FRAME, welding tank, type II	1
GENERATOR, welding, 300 amps with 1 kw aux. gen., 110 V., 60 c., single phase	1
GUIDE, lubrication, War Dept., No.	1
LADDER,	1
PLUG, adapter	4
PLUG, double outlet	4
SCREEN, welding, collapsible	1
SWITCH, overload, 2 pole, 25 amps, 3 wire, 115/230 volts, A.C.,	1
SWITCH, 2 pole, double throw, 30 amps, 230 volts, AC	1
TABLE, welding, type II, complete with bricks and top plate	1

MACHINE UNITS:

DRILL, electric, portable, 1/2 in., 1 speed	1
FORGE, electric, portable, 60 cycle, single phase w/bin	1
GRINDER, elec. portable, 6 in., 110 volt, univ. motor, w/stand	1
HACKSAW, power, 110 volt, univ. motor, w/mounting base	1

TOOLS, TRUCK:

ANVIL, blacksmiths, 100 lb., with hardie	1
BLOCK, anvil	1
CHISEL, blacksmiths, hot cut, 1-1/4 in. sq., 1-1/4 in. cut 16 in. handle	1
CLAMP, C, light service, 3 in.	4
CLAMP, C, medium service, 4 in.	4
DIVIDER, wing, 12 in.	1
DRILL-SET, twist, H.S.S., 1/16 in. to 1/2 in. by 64ths, in indexed metal case	1
FLATTER, blacksmiths, square, 3 in. face, handled	1
HAMMER, blacksmiths, hand, 2-1/2 lb., cross peen	1
HANDBOOK, "WELDING ENCYCLOPEDIA", latest edition	1
HONE, medium, handled	2
IRON, soldering, electric, 150/200 watts	1
JAW-FACE, for 5-1/4 in. vise (or 5 in.), pr.	1
NIPPER, end-cutting, adj. handle, 10 in.	1
NIPPER, end-cutting, blacksmith, 14 in.	1
PUNCH-SET, blacksmiths, round, eye, 4 per set	1
PUNCH-SET, blacksmiths, square eye, 4 per set	1
SET AND HEADER, rivet, saddlers, No. 00	1
SET AND HEADER, rivet, saddlers, No. 2	1
SET AND HEADER, rivet, saddlers, No. 5	1
SHEARS, hand, bench type, 3/16 in. thick	1
SHEARS, tinners, hand, straight-cutting, 12 in., 3 in. cut.	1
SLEDGE, blacksmiths, double-faced, 10 lb., 32 in. overall	1
TONGS, blacksmiths, bolt, 1/4 in. size, 16 in. long	1
TONGS, blacksmiths, double pick up, 16 in. long	1
TONGS, blacksmiths, gad, 16 in. long	1
TONGS, blacksmiths, single pick up, 16 in. long	1
TONGS, blacksmiths, straight lipped with V slot, 16 in. long	1
VISE, machinists, bench, swivel base, swivel jaws, 5-1/4 in. width of jaws, (or 5 in.)	1
WRENCH, pipe, adjustable, heavy duty, steel handle, 14 in.	1
WRENCH, screw, monkey, steel handle, 12 in. long	1

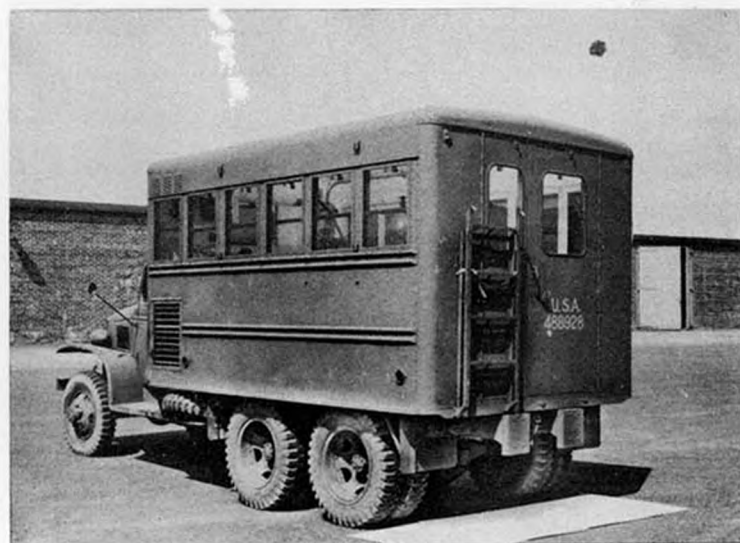


Figure 29 -- Truck, welding, M12 (left rear view)

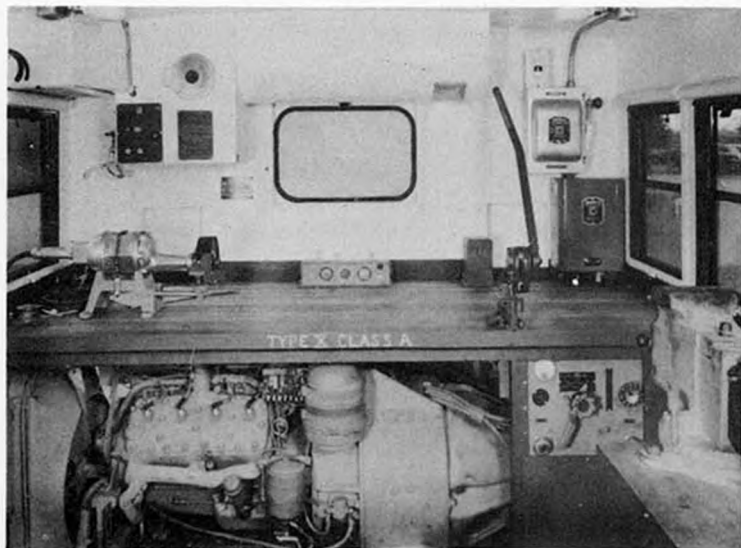


Figure 30 -- Welding generator, 300 amp., with controls and other equipment, Welding truck M12



Figure 31 -- Work bench and electrical controls, welding truck M12

KIT, WELDER'S, COMPLETE (Consisting of):

- 1 CHISEL, hand, cape, 1/4 in. width of bit, 1/2 in. stock, 6-1/4 in. long
- 1 CHISEL, hand, cape, 5/16 in. width of bit, 1/2 in. stock, 6-1/4 in. long

- 1 CHISEL, hand, cold, 5/16 in. width of bit, 1/4 in. stock, 5 in. long
- 1 CHISEL, hand, cold, 3/8 in. width of bit, 5/16 in. stock, 5-1/4 in. long

(Continued on page 500)



Figure 32 -- Interior view of welding truck M12, showing anvil and block in traveling position

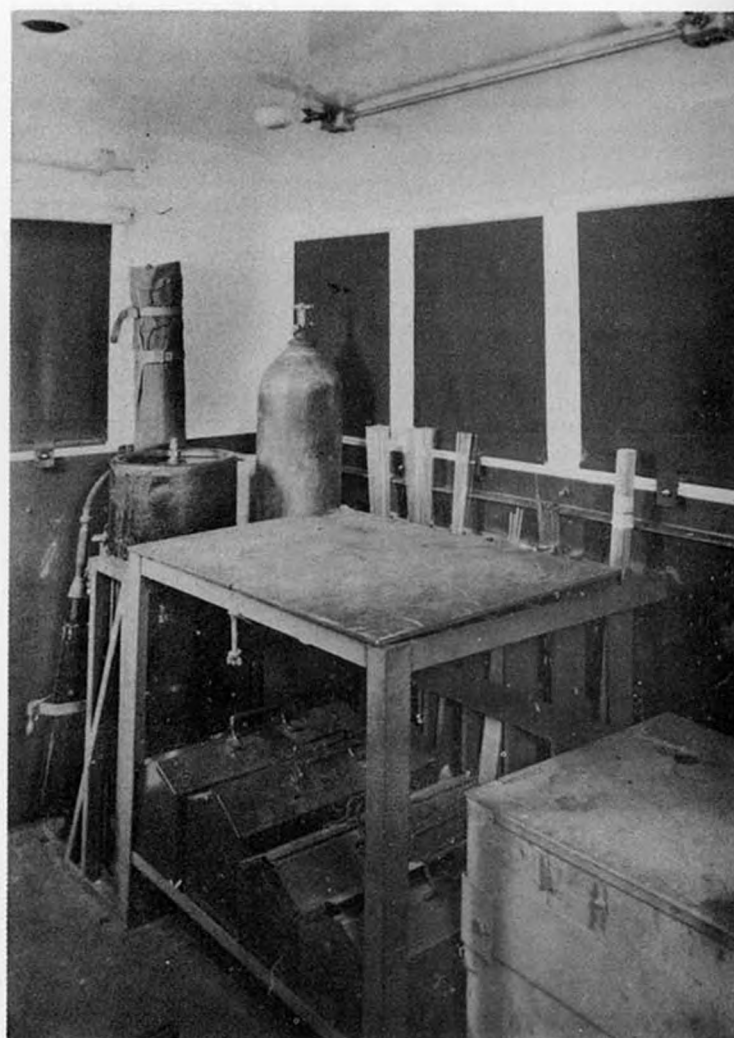


Figure 33 -- Welding table and equipment, welding truck M12

IT'S AN IDEA!

Sometimes the ideas which originate in the minds of Ordnance personnel in the field are astounding. Many of them come through the mail. Some are so very simple that it is hard to believe that they are new ideas, yet this is true. To perform an old task in a new and easier way, to make a tool which will save skinned knuckles and time and cuss words, to make a machine operate a little more efficiently — these things are being tossed back and forth through human minds every day. Some of them crystalize and become reality. Some, sad to say, are allowed to wither too soon and the world loses what might otherwise have been an excellent idea.

Be it known to all readers that every idea received is carefully considered. Some are printed, if they will help other personnel and violate no existing rules. Some are printed for the purpose of exciting comment from the personnel who may have use for them. Some are forwarded to proper authority for further consideration. Every idea has a chance.

A number of representative ideas are presented herewith. The first seems to be so simple that it's almost silly. On the other hand, maybe it is neither simple nor silly. Anyway, the suggestion is for the modification of the oil return line fitting on the Generating Unit, M5, used with the 40mm AA Gun, and is suggested by Tech. 4th Grade Fred A. Richardson and Tech. 5th Grade Merle S. Hagenbush, both of the 104th Ordnance Company (MM).

Being a proposed modification of materiel, the Editor does not suggest that you proceed to make the change immediately, but any com-

ments will be appreciated. In the meantime the idea is being forwarded to proper authority.

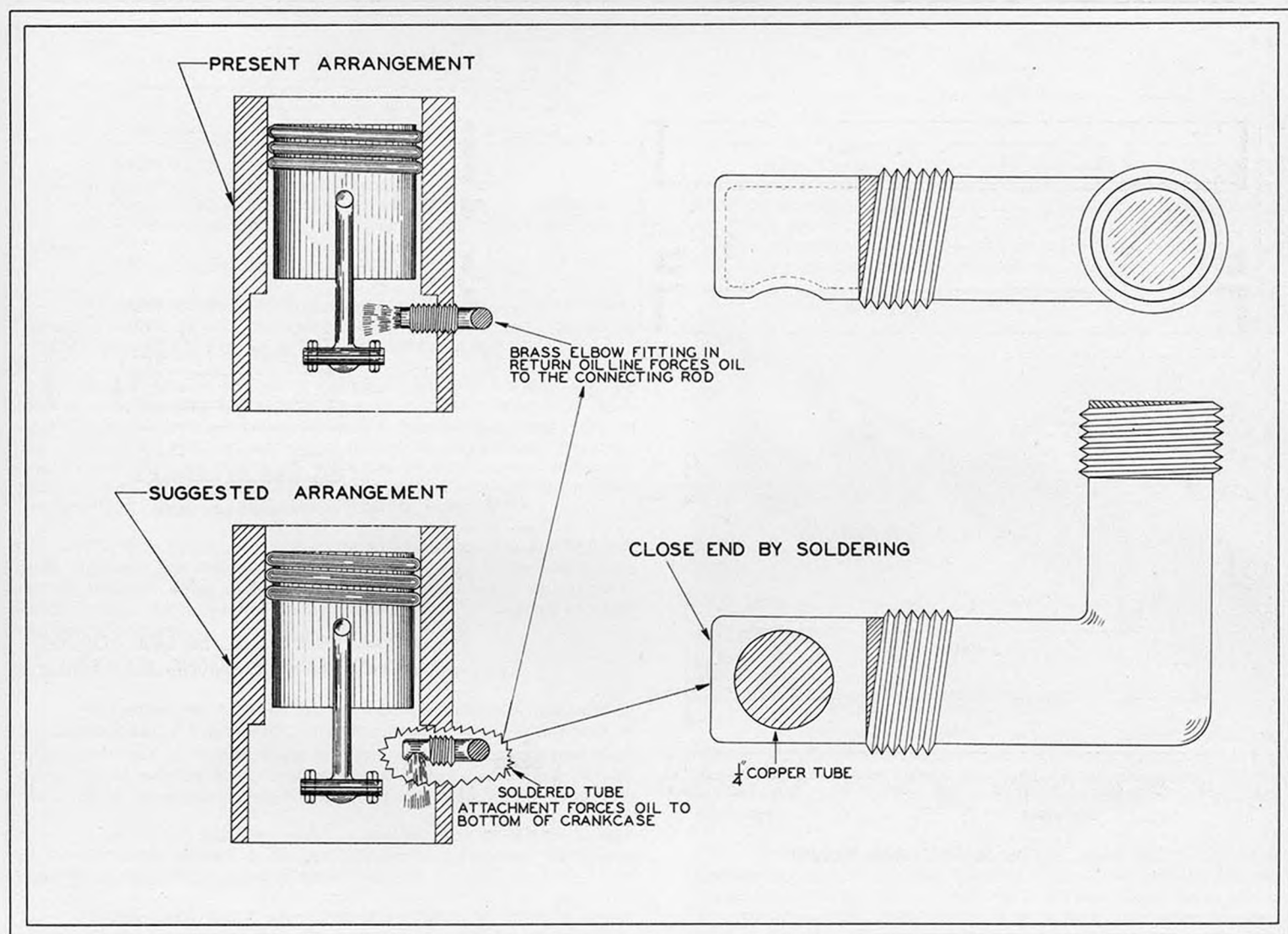
The purpose of the proposed modification is to reduce the oil consumption of the engine in question. It seems that the oil return line from the oil filter discharges a constant stream of oil into the crankcase (see drawing). This stream of oil happens to be directed into the throw of the crankshaft and #4 connecting rod. This sets up a "splash" system of lubrication on #3 and #4 cylinders in addition to the regular "force feed" lubrication system.

Although some oil is probably lost due to the excessive amount being splashed up into #3 and #4 cylinders, where the rings probably cannot control it due to its excessive amount, it is also thought by the above mentioned thinkers that a great amount of oil is being lost by passing through the intake valve guides of #3 and #4 cylinders and being subsequently sucked into the cylinders.

It is proposed, therefore, that by deflecting the oil stream down along the side of the crankcase it will be returned to the oil pan without coming in contact with the crankshaft and the connecting rod.

This modification is extremely simple and easily applied, provided that the carbon doesn't have to be cleaned from the cylinder head, a condition which may already have resulted from excessive oil consumption. The only part affected is a 1/4" elbow brass fitting.

Maybe you'll hear more about this idea later.



As you may or may not know, it is often necessary to delink, or unlink, cal. .50 ammunition in order that AP, incendiary and tracer ammunition may be relinked in a different ratio. Accomplishing this task with greater ease and speed seems to have taxed the minds of more than one Ordnance man. Two ideas on this subject which have been received by THE ORDNANCE SERGEANT are presented herewith.

Master Sergeant Chauncey Perry, of the Ordnance Office of the Fourth Air Force offers an attachment for this purpose which is used with the cal. .50 link loading machine. The principal parts and the material needed for each is as follows:

1. Link Stripper

- 1 angle iron 1" to 1-1/4" x 1", 10-9/16" long
- 1 strap iron 1/4" x 3/4", 10-9/16" long
- 2 strap iron 1/4" x 3/4", 3-7/8" long
- 2 strap iron 3/16" x 1/8", 3/4" long

Upright part of angle iron should be milled out to allow cartridges to rest on flat part. Bases of cartridges should then be perpendicular to the loading bar. The angle iron is cut as shown by the accompanying drawing and attached with centers .950 inch apart. These parts are then welded as shown. This attachment rests on the front end of the link loading machine, and is used as an adapter to hold the links forward when withdrawing the cartridges.

2. Cartridge delinker.

- 1 angle iron, 1" x 3/4", 9-9/16" long
- 2 pieces 3/8" x 1" x 1-1/2"

The two pieces are welded to the angle iron and the front side of the angle iron is rounded off and tapered to allow the delinker to rest in the cannellure of the cartridges.

3. Cartridge rest

- 1 piece 5/8" x 1/8", 11-1/4" long
- 2 pieces round bar 2-5/8" long

Cartridge rest is tapered toward the front and is placed in front of the pusher bar, and is used to support the bottom of the cartridge head while it is being extracted.

4. Pin

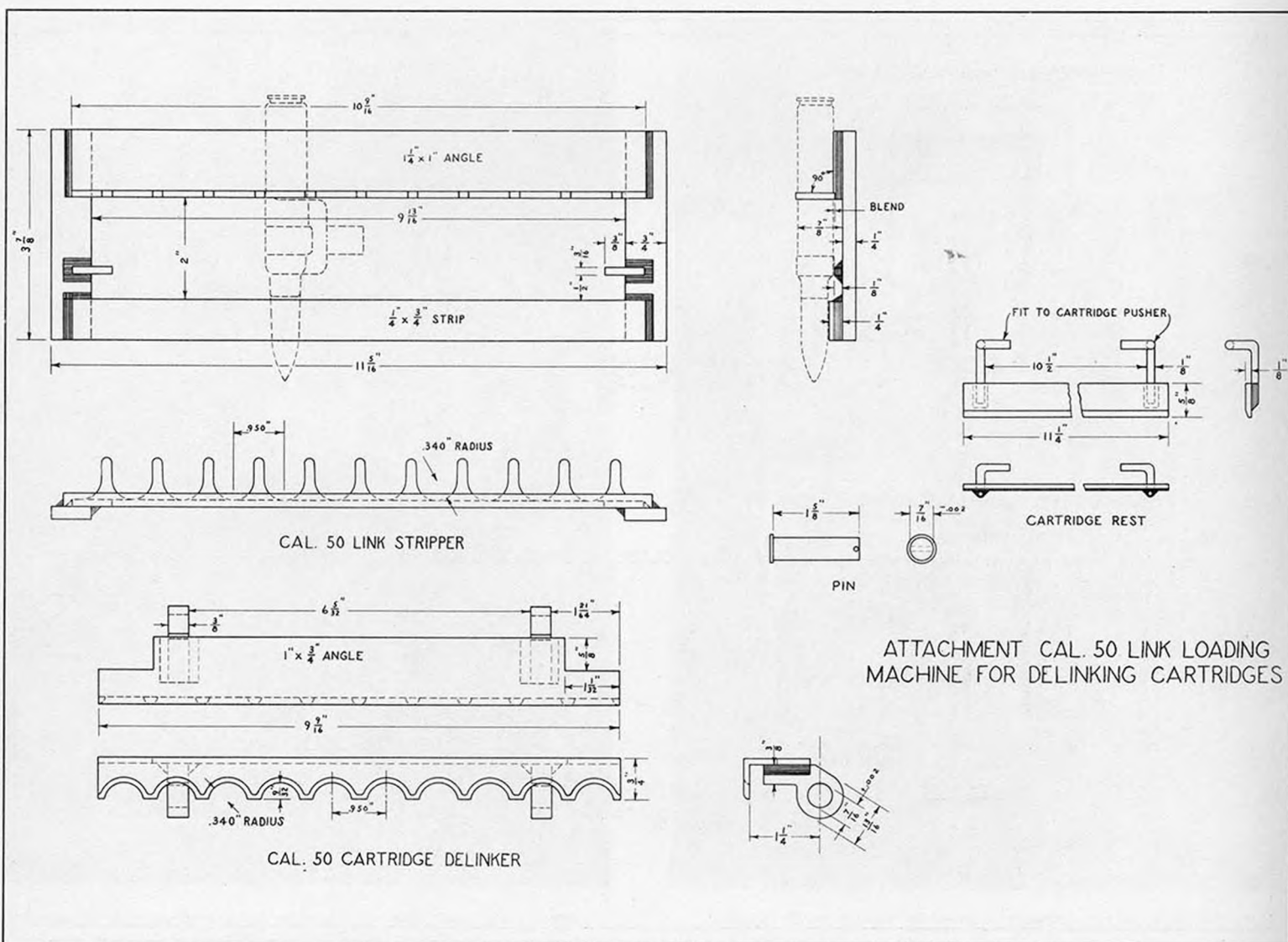
- 2 pieces 5/8" round, 1-3/4" long

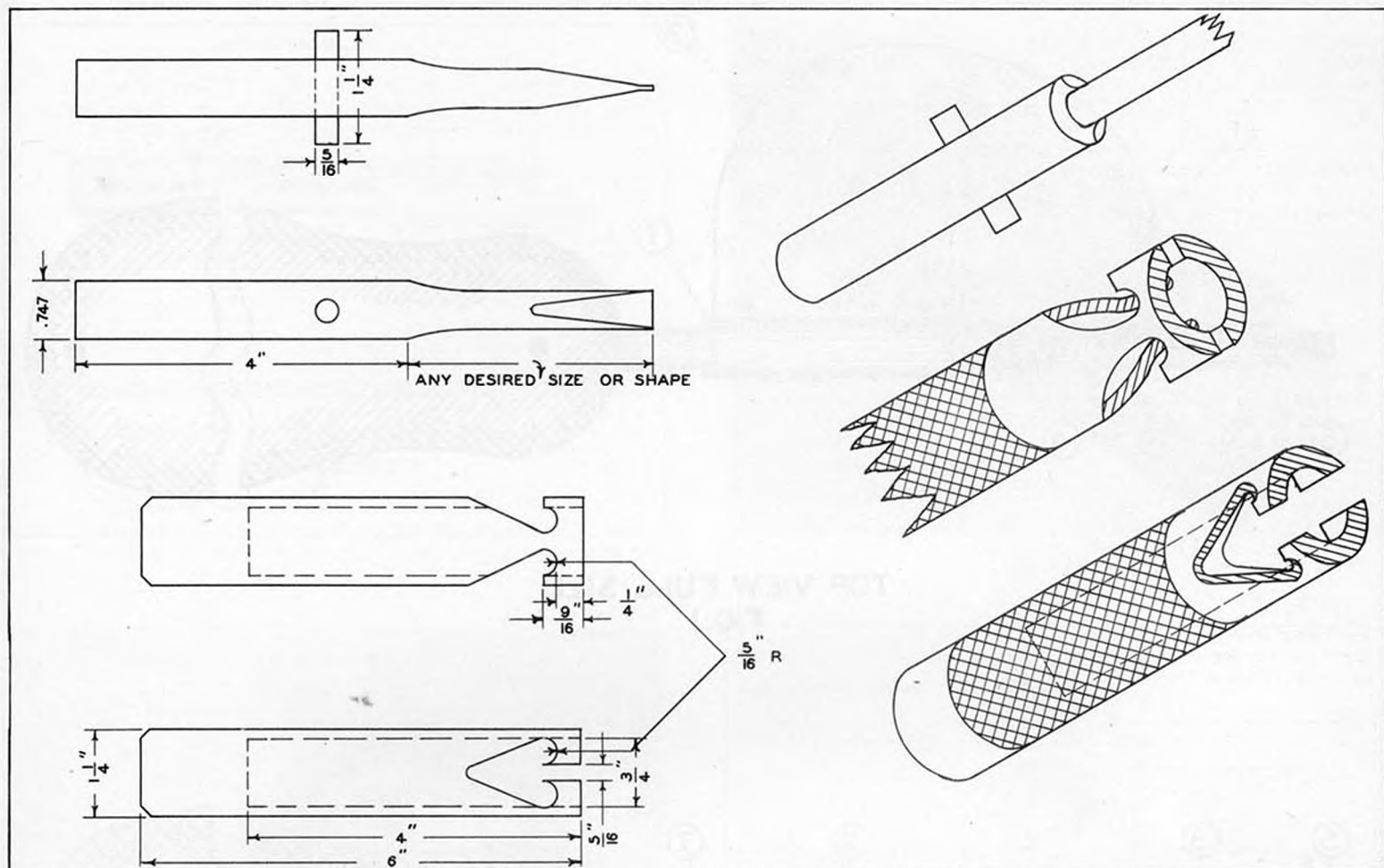
These pins replace the pins used for connecting the pusher bar to the handle group of the link loading machine. The cartridge delinker is connected by the longer pins.

To operate the attachment the belt of cartridges is placed in the link stripper with the double thickness of links down. The handle of the link loading machine is moved forward, and the delinker will ride up over the cartridge head. The delinker is then pushed down by one hand and the handle raised to withdraw the cartridges from the links.

Another idea for accomplishing the same purpose has been submitted by 1st Lt. Irwin M. Sarlat, Air Base Officer, who gives his mailing address as A. P. O. No. 948, Seattle, Washington. No drawing is provided because no fabrication of parts is required. It appears that this idea was developed at a station where a shortage of material may have existed, or at least that it is adaptable to such a station.

At this "remote outpost" a cal. .50 M2 aircraft fixed gun was temporarily changed as follows:





- Remove firing pin and cocking lever
- Remove oil buffer body and spring.
- Remove barrel from barrel extension, replacing extension.
- Remove inner spring from driving rod assembly, leaving outer spring.
- Build up retracting slide handle for easy pulling.

The belts are now passed through the gun by pulling on the retracting slide handle. In this way it is possible, according to Lt. Sarlat, to "unlink fast enough to keep up with the demand for ammunition".

A considerable number of civilians employed for duty with the Ordnance Department are regular readers of THE ORDNANCE SERGEANT. One of these gentlemen, Mr. John E. Jorgensen, Senior Armament Machinist, of the Post Ordnance Shop, Indiantown Gap Military Reservation, Pennsylvania, submits a tool which may be manufactured with comparative ease. Mr. Jorgensen calls it a percussion screw driver, and its construction is shown by the accompanying sketches.

The tool is made of a good grade of carbon tool steel and is hardened. The angle of the cut in the handle is cut on a Brown and Sharpe milling machine, using an index head gearing of 44 to 100 with an idler which is taken out to reverse the direction of angle. This gives an angle of about 40 degrees.

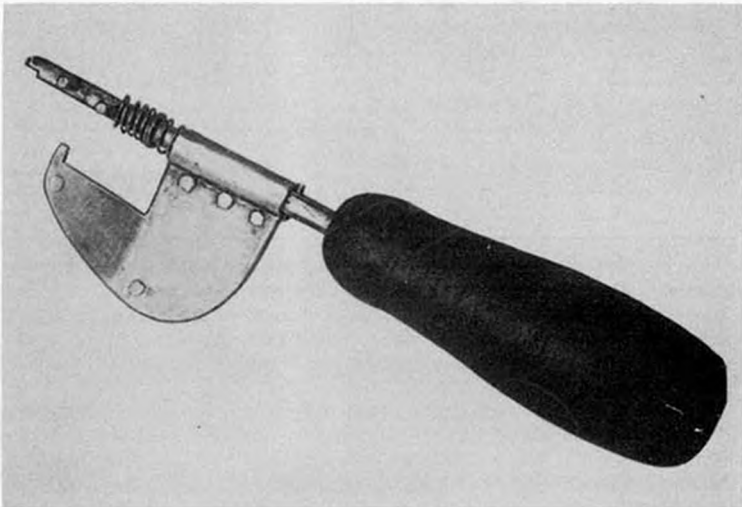
Mr. Jorgensen tells of the use of the tool as follows:

"By putting the blade of the screwdriver in the slot and twisting the handle either to right or left, depending on whether the screw is to be taken out or put in, then striking the head with a hammer, tremendous force can be exerted on the screw without injury to the head. Blades can be made any size or shape for wherever a twisting motion is needed.

"I have found this very useful in removing the floor plate screws on the 1903 rifle, as well as the gas cylinder lock screw on the M1 and many other things from small arms to tanks.

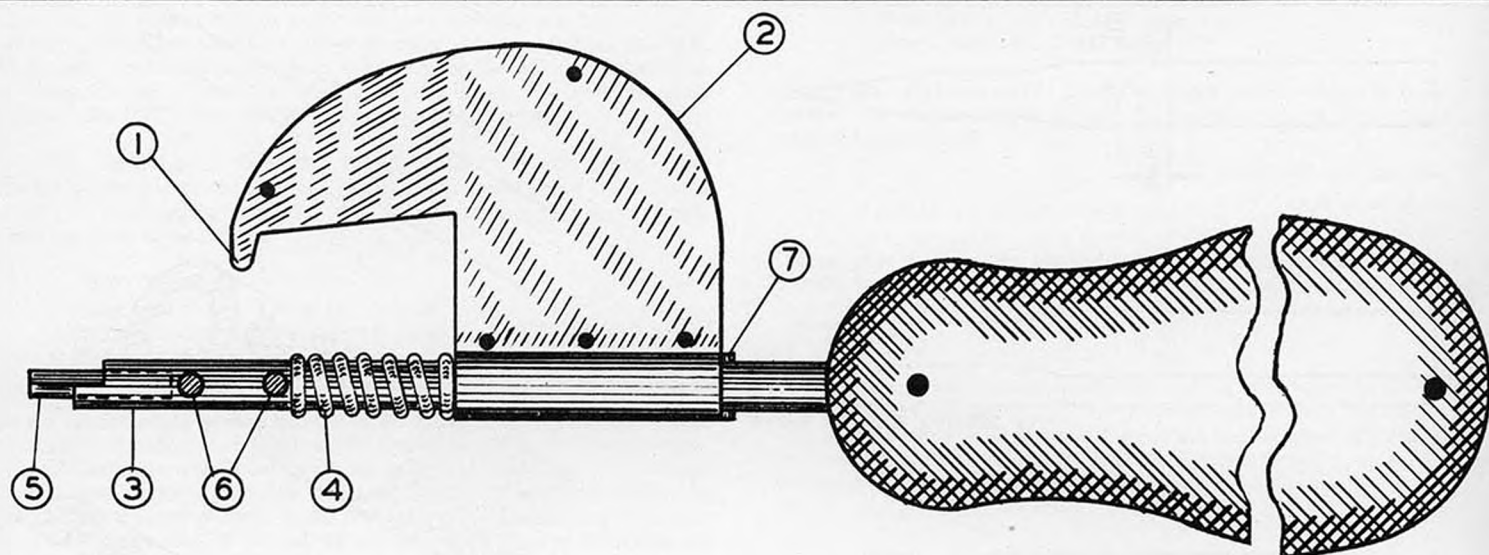
"I have found that a screw put in as tightly as possible by any other method is easily removed with but a few blows of the hammer."

Some time ago 1st Lt. Leonard A. Kratzer, Base Ordnance Officer at Fort Kobbe, Canal Zone, sent in information regarding two inventions which may prove useful. Credit for the inventions is given to Technician 5th Grade James L. Kane. The inventor was an inventor in civil life before his enlistment in the army, and has to his credit inventions covering automatic feeds for trimming presses, etc.

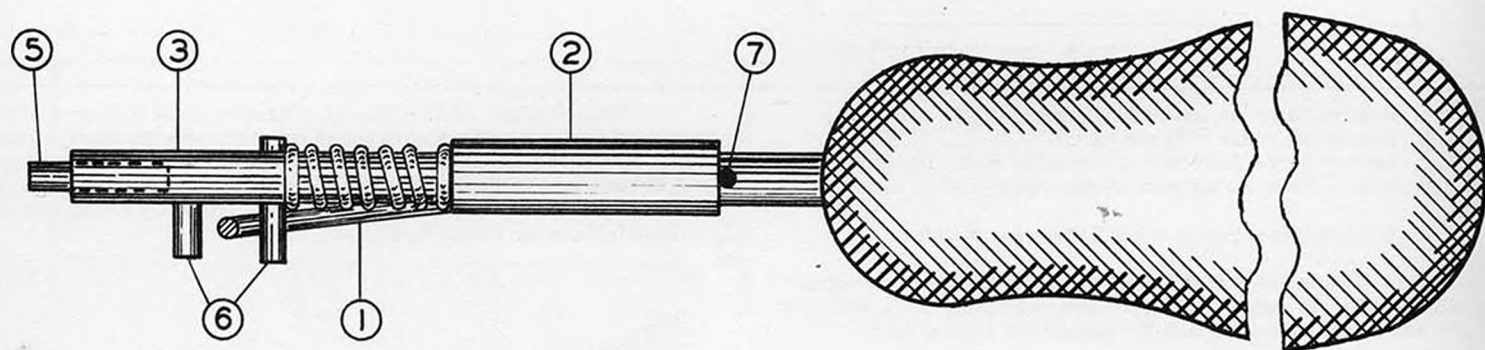


One of these inventions is a "lock frame remover", a handy device for all cal. .30 M2 machine guns, and the inventor points out that a practiced twist of the wrist will remove a lock frame very rapidly. It is pointed out, however, that this tool will not work with certain other machine gun models.

To remove driving spring and rod, place end of tool on end of driving spring rod and push forward. Then push left and pressure of spring will back rod out. To remove lock frame, place the tool on top of the spacer so a pin on the tool will be on each side of the spacer, then push tool to the left, which will push in retainer in side of lock frame.



TOP VIEW FULL SIZE
FIG. 1



SIDE VIEW FULL SIZE
FIG. 2

At the same time pull back. When the lockframe is pulled back a quarter of an inch, slide the tool to the right so as to release the point on the tool from the hole in the receiver, and the lockframe will come out. With a little practice this can be done in less than three seconds. This tool is also used to push the lockframe spring and rod back in place.

Figure 1 (see drawings) shows a top view of the tool. Figure 2 is a side view. Number 1 is the point which pushes in retainer on lockframe; Number 2 slides on Number 3 when lockframe is pulled back. If Number 2 did not slide on Number 3, you could not pull out the lockframe when Number 1 is holding in the retainer. The reason for spring Number 4 is to have point Number 1 line up with the retainer when the tool is first placed on the spacer on the lockframe. Number 5 fits into driving rod. Number 6 pins fit on each side of spacer. Number 7 is stop for Number 2. Number 3 is made out of square rod. Number 2 is a piece of sheet metal bent around the square rod, the two being riveted together. The hole is made square. The sheet metal doubled is about $3/32$ " thick.

Technician Kane calls his second invention presented here a "Recoil Spring Compressor". It is used to hold the recuperator spring of a 37mm automatic gun, M4, in the compressed position when it is removed from the recuperator. This is necessary to replace the packing in the

stuffing box. The tool fills the needs of an improvised device called for in paragraph 18i (7) TM 9-1240.

The device is made from 2-1/2" common pipe, and various small pieces of scrap iron, and all the work necessary in making this tool was performed on the machine shop and welding trucks assigned to Kane's organization.

The use of the tool, in general, is as follows:

Remove the two compressors ("A") from the tube by removing the four holding pins ("B"). Insert the recuperator spring and rod in the tube, and replace the compressors and pins. Then tighten the two nuts ("C") until the compressors have each moved toward each other about 1-1/2". The compression of the spring is then held by the tube and the piston rod may be removed safely.

Bear in mind that THE ORDNANCE SERGEANT cannot guarantee these ideas. However, it is perfectly apparent that the originators have made them work successfully, and it seems reasonable that they will be useful to others. If you do use them, both the inventors and THE ORDNANCE SERGEANT will be pleased to receive your comments.

FIRE POWER

I

It hasn't been unusual in recent years to use in our daily language words or phrases, or terms, which have a purely military application. The same thing is true of all occupations or professions. Language grows and develops, just as do people and their knowledge and their accomplishments.

Although as a usual thing each word or phrase has a certain definite meaning, this is not always the case. In the May (1942) issue THE ORDNANCE SERGEANT used a common military term and made

a promise in connection with it. Reference was, and is here, made to the term "FIRE POWER"

"Fire Power", as a term, remains in common use. Finding a suitable definition for it has been quite an uncommon task — and an unsuccessful one. When you speak of "Fire Power" in your conversation, we can't be sure just what you mean, and when we refer to "Fire Power" we can't expect you to know just what we mean. True, we have found definitions which are accepted as satisfactory by certain military institutions



This illustration and its caption, which have been yanked from YANK, The Army Newspaper, are typical of common usage of the term, "Fire Power".

BUSHMASTERS. American troops in Panama here ford tropical stream in phase of jungle warfare training. Nicknamed for a poisonous snake of the region, they represent crack U. S. elements stationed in Canal Zone area. Note amazing fire power of this small unit alone.

of learning. Being acceptable, however, does not necessarily mean that the definition is definite and incapable of being misunderstood.

Colonel W. L. Wharton, of the Infantry School at Fort Benning, Georgia, provides us with an exclusive and enlightening discussion of a definition of "Fire Power" (see Part III of this article), and at the same time gives us a useful definition of a definition.

According to Col. Wharton, "A true definition should be definitive, i.e., it should define and limit a term; it should be inclusive, including all factors necessary for a proper understanding; and also exclusive, eliminating all non-essentials of the meaning."

II

Several military schools were asked to define "Fire Power". Some did not comply, which wasn't surprising. One replied that no single individual present was capable of providing a definite explanation or definition of the term. That wasn't surprising either. Neither circumstance is any more surprising than the fact that the term is used every day by people who really don't know what it means, except in a more or less vague sort of a way.

But some replies were received. For example, the Command and General Staff School states that "A definition of 'Fire Power' at this school follows:

"Fire Power: The potential capacity of a unit for delivering fire: this capacity being calculated by considering the factors of volume, accuracy, distribution and control."

Upon being asked to give a definition or to give their conception of the meaning of "Fire Power", many officers of the Coast Artillery School hesitated to express an opinion. However, an interesting test was made by writing out a definition, the idea of one officer, and then circulating it to the different Departments of the School for comment. The definition follows: "Fire Power is the mass of ammunition expressed as a function of the number of projectiles and their destructive effect which can be concentrated in a main effort and applied in a decisive direction."

With this as a starter, each officer approached added his own idea, and these definitions were accumulated:

"The rate at which destructive effort can be concentrated on a given enemy target."

"The volume of fire, considering number of projectiles and destructive effect which can be concentrated at a point under control of the commander."

"The total volume of effective fire, expressed in terms of relative damage, which can be concentrated on a target or a series of targets at any one time."

"The potential destructive effect of ammunition components, in a given period, when directed against suitable targets. It is a function of mass velocity and accuracy."

"The density or volume of effective fire which can be brought to bear on a designated target per unit of time."

Finally, a search was made by the Librarian of the Coast Artillery School, and from all available military dictionaries and encyclopedias only one definition was found. This was the same definition quoted in the May issue of THE ORDNANCE SERGEANT, that by Colonel Garber in his "Modern Military Dictionary."

So, we have found definitions, but what do they mean, or rather do they mean anything so definite that we can use it to explain the term when we hear it or see it in print?

Only one thing is definitely proven — a large number of considerations are involved in the determination of "Fire Power". Let's look at them, extracted from this collection of definitions, so that each can be considered separately.

- Volume of fire
- Accuracy of fire
- Distribution of fire
- Control of fire
- Number of projectiles

- Destructive effect
- Decisive direction
- Rate of concentration of destructive effort
- Potential destructive effect of ammunition components
- A given period (of time)
- Density of effective fire
- Volume of effective fire
- Unit of time

Notice that several of these terms mean the same things, although expressed in different words. They leave plenty of room for argument. But when we speak of the "Fire Power" of an organization, we must mean some definite thing. Let's examine some of the terms listed above to see just how they affect the thing we try to say.

We must recognize immediately that in actual practice anything which is potential or merely possible must be discarded. It is the concrete factor which must be considered. The fire which is potential within an organization must be used to advantage if it actually becomes "Fire Power." This idea involves some of the factors listed, such as accuracy of fire, distribution of fire, and control of fire.

In actual combat it is certainly impossible to determine the effective fire power being brought into actual use. Too many things influence battle, and action is too rapid. Such influences and actions, though, are considered carefully in maneuvers, although much of the consideration has been done beforehand. FM 105-5, "Umpire Manual", tells us some interesting things.

We assume, of course, that an infantry element, or any element acting as infantry, will advance against an enemy only when it has decisive superiority of fire as compared with the elements immediately opposing it. What this superiority of fire must be in order to be decisive is another one of those indefinite things. Terrain and other conditions being equal, a superiority of 2 to 1 might prove satisfactory for the attacker, although in most cases a superiority of 3 or 4 to 1 might be required for success. If the defender has good cover and field of fire, or if the attacker has little cover, a superiority of fire of 5 to 1, or even more, might be necessary for success. It should be borne in mind that war experience has proven that a determined defender, well placed, can delay or even stop a greatly superior force.

This comparison of attacker and defender injects itself into the question in still another way. For instance, the machine gun is especially effective in defense, yet in attack its effectiveness is a questionable quantity. The potential "Fire Power" of an infantry company remains a constant factor only so long as a definite number of firing weapons, and no other factor, is considered. Yet its effective "Fire Power" in defense would be greater than in attack, simply because of the effectiveness of certain weapons in differing situations.

Mentioning differing situations calls attention to another of the factors listed, "distribution of fire". One company may attack another company frontally, and if the "Fire Power" of the two companies is equal the result may be a stalemate. But if the attacking company employs one platoon to attack frontally, and two platoons to envelop the flank of the defender, the situation is quite different. The frontal attack is almost certainly stopped, because of the concentration of the fire of the defending company upon the attacking platoon. At the same time, however, the envelopment has a good chance of success, because of the concentration of the "Fire Power" of two platoons of the attacker against the defending company which is not in a position to use its potential "Fire Power".

Associated closely with "distribution of fire" is "volume of fire" and "accuracy of fire". The effectiveness of a company of entrenched infantry firing in the general direction of an enemy known to be advancing but remaining invisible because of darkness or hiding cover is extremely low. It is merely a matter of guess and of chance. But consider the case of the lone sniper, firing at a plainly visible enemy. Every shot is a hit. The company has volume but not accuracy. The sniper has no volume, but his accuracy is deadly. The company may have high potential "Fire Power", yet its effectiveness is low. Figured on the same basis the sniper has practically no potential "Fire Power", yet he has great effectiveness.

The discussion follows logically to still others of the factors listed "Fire Power" applied in a "decisive direction" is quite apt to be effective. This is an obvious fact, of course, yet it accounts for the difference between the effectiveness of the company firing in the dark and the sniper. The sniper is sure that each shot is in a "decisive direction",

the company is not so sure. Of interest at the same time is the "number of projectiles" fired, and the result of comparison is plainly evident.

Certain of the other factors listed are interesting, too, such as the "unit of time" involved. Some definite period of time must of course be used as a basis for computations. Obviously this period of time must exceed that required for the firing of one round from each weapon. If all weapons fired simultaneously, and the enemy was under cover, there would be no effectiveness of fire. If, in the next instant, the enemy broke from cover and attacked, they would meet no resistance. The defenders would find themselves in a position like that of a duelist who over-anxiously fired at his opponent too quickly and erratically, only to find himself forced to pose as a target while his opponent took careful and deliberate aim. Effective "Fire Power", then, must involve continuous effectiveness, as well as the other factors considered.

Thus far only one reference has been made to any specific weapon, the machine gun. The difference in weapons is another important factor to be considered. According to FM 105-5, "The relative effect of the several weapons cannot be evaluated precisely, but is indicated sufficiently accurately by the following factors:"

	0-100 yards	100-200 yards	0-300 yards	0-500 yards	500- 1000 yards	1000- 1500 yards	1500- 2000 yards
Rifle, caliber .30, all models			1	1	0.5		
Carbine							
Automatic Rifle				3	1.5		
Submachine gun	3	1.5					
Light machine gun				6	6	3	
Heavy machine gun				10	10	5	
60mm Mortar				6	6		
81mm Mortar				15	15	15	15

Bear in mind that these figures are intended for the use of umpires in maneuvers. In actual combat they will be found inaccurate to some extent. Add to this uncertainty that equally uncertain human element, consisting of such factors as training, morale, fatigue, leadership, etc., and it becomes evident that no answer will fit more than a very few situations.

III

Col. Wharton, previously mentioned, furnishes the following discussion of "Fire Power".

Fire Power is: "The volume, accuracy, distribution and control of fire, considered together". (Page 127, Modern Military Dictionary, by Garber).

Volume of fire — "the number of rounds that can be fired or delivered in a given time." (Page 322, Garber.)

Accuracy — "the mechanical ability of a fire arm, when clamped in position, to place a group of shots in a small area on a target; it is the accuracy of the weapon, as distinct from the man firing it." (Page 3, Garber.)

Distribution — "an intentional dispersion of fire for the purpose of covering a desired frontage, or depth (area)." (Page 101, Garber.)

Control — The selection of targets and regulation by fire unit (squad, section and platoon in the infantry) commander, so as to bring the most effective fire, of the proper kinds, and amounts, to bear on the designated targets at the proper time.

We are compelled to arrive at the logical conclusion that we have fire power if, and only if, all the elements noted are present. The untrained, or worse yet, the partially trained officer or non-commissioned officer is apt to be ensnared into a "bobby trap" of phraseology, i.e., the use of "canned language", and to believe that one of these factors is all-important.

Volume is only one of the factors in fire power, and although it is important, its efficacy is influenced by whether it is frontal, flanking, grazing, or plunging. (See par. 136, FM 23-5.)

Accuracy is affected by dispersion, by the mechanical condition of the gun (and mount), by the psychological, physical, mental and moral attitude of the firer (par. 133, FM 23-5), and by his degree of marksmanship (par. 48, FM 23-5).

Danger space and beaten zone, which are determined largely by topographical features of the terrain, affect accuracy. Only the shots that hit the target — enemy — produce casualties.

Distribution might better include concentration and distribution. The application of this factor, like most of the vital factors in Fire Power, is greatly influenced by the physical and psychological qualifications of the rifleman and/or gunner. Its efficient application depends primarily on the nature and size of the targets (par. 140, FM 23-5).

Fire Control. — There is no doubt that the most important characteristic in Fire Control, as in all lines of human endeavor, is the energy training and skill of the commanders of the fire units. That over-worked phrase — "We learn to do by doing" — so often spoken, but so seldom used, applies with great force here.

IV

It isn't very likely that Ordnance personnel will add very greatly to the "Fire Power" of any combat unit. But never let it be said that Ordnance personnel were responsible for the diminishing of the effectiveness of any combat unit. We may speak or think of "Fire Power" in different terms, but we always use it as a certain something which does exist — never as something which is absent.

In preliminary correspondence with service schools on this subject the Editor, without giving the subject a sufficiently careful consideration, asked for "discussions of "Fire Power", or its absence".

No one made mention of this in later correspondence except Col. Wharton. He, after a fashion, objected to mention of such a subject, but, with no desire to engage in verbal or written combat with the Colonel, the Editor does desire to discuss the subject briefly. This discussion is best begun by using Col. Wharton's remarks.

"Reference par. 3 of the basic communication — wherein reference is made to absence of Fire Power, it is my considered judgement that the total absence of Fire Power in a tactical situation would be very rare, so seldom encountered that the less said the better on such a subject.

"If in the opinion of the Editor of THE ORDNANCE SERGEANT, it is deemed advisable or necessary to comment on such an unfortunate condition (i.e., total absence of Fire Power), then it should be emphasized that this condition could exist only if all of the following circumstances exist:

"a. No weapons of any kind, permitted by the Rules of Land Warfare (FM 27-10), are present:

"(1) Don't forget the case of the Confederate Veteran from Georgia, who said he could lick any two damn Yankees with cornstalks (weapons were present, but no ammunition, since Sherman had completed his march to the Sea.)

"(2) Don't forget the use of Trench Mortar shells in defense of defiles by dropping the shell over the cliffs and letting gravity act as the propellant charge.

"b. No ammunition.

"If the Editor of THE ORDNANCE SERGEANT desires to extend the scope of his article to include a diminution of Fire Power, then it is suggested that he include the following essential factors:

"a. Conditions resultant from failure of the mechanical operation of the weapon.

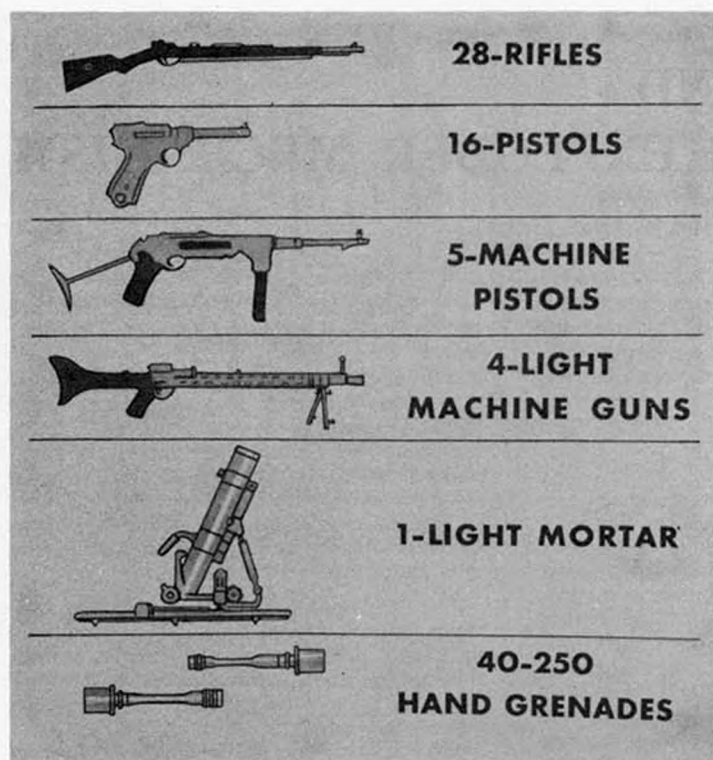
"b. Deterioration, destruction, and the expenditure of ammunition.

"c. Psychological, physical, mental and moral attitude of the soldier ("Man behind the gun").

Again we say, "Never let it be said that Ordnance personnel has been responsible for the diminution of the "Fire Power" of a combat unit."

Note two of the conditions mentioned above which are applicable to Ordnance problems:

Conditions resultant from failure of the mechanical operation of the weapon. Mechanical failures are certain to occur. We could list many reasons for such failures, reasons which would be the inevitable results



These illustrations were used in a poster showing the characteristics of German military units, insignia, etc. The illustration below was intended to show the "fire power" of a unit comparable to our squad organization. Above is an illustration of the weapons carried by an organization which compares in size with our platoon. These are typical of illustrations commonly used in discussions of "fire power".



of combat conditions and therefore unavoidable. Nothing can be done to completely eliminate such failures so long as men employ mechanical devices in combat. They can be reduced by improvements in manufacture, by proper instruction in the use of weapons, by proper efforts by all individuals to adequately care for and preserve weapons, and by eliminating or reducing those combat conditions which lessen the effectiveness of weapons whenever possible. These methods, however, are not within the control of Ordnance personnel.

But what Ordnance man would want to know that his carelessness or lack of interest had resulted in the failure of any piece of Ordnance materiel, with consequent loss of life, maiming of heroic comrades, or possibly the loss of an engagement? It doesn't require much imagination to understand the responsibility of every Ordnance man in this connection. You can't make a gun operate better than it should, but you can exert every effort to keep it operating as well as it should.

Deterioration, destruction, and the expenditure of ammunition. Over the latter we have no control, but we should take more than a passing glance at the first two words of this heading. Proper handling, adequate storage precautions, careful planning of all ammunition installations, efficient methods and systems of supply — these are the things which insure adequate ammunition for the fighting troops — things which we can successfully accomplish or carelessly neglect.

This article has discussed a term which was born of warfare. War has a most pronounced effect upon many things, including our language.

(Continued on page 501)

THE MARK 13 WAR HEAD AND MARK 4-1 EXPLODER MECHANISM

by K. E. TURNER, 1st Lt., Ord. Dept.

Description, Tests, and Assembly

The war head of the torpedo carries the main explosive charge and the exploder mechanism. It is the prime function of the torpedo to deliver the war head at the target; it is the function of the exploder mechanism to explode the main explosive charge upon impact with the target.

This war head is designated as the Mark 13. The shell is made of sheet steel, slightly conical in form at its after portion and hemispherical in form at its forward end. A steel joint ring is riveted and soldered to its after end, this ring being tapped to receive the joint screws for connecting the head to the air flask. The joint ring is also flanged to receive a steel bulkhead, dished in form, which is bolted to it and by means of a rubber gasket forms a water tight closure for the after end. A fitting for attaching an air pressure testing line is secured to the bulkhead. At the forward end of the war head is secured a bronze nose piece. The after end of the head is reinforced with three strengthening rings, riveted and soldered to the shell.

The interior surface of the war head is covered with a special lacquer or paint such as is used in the interior of projectiles. This coating not only protects the interior of the war head; it also prevents the TNT from coming in contact with the lead used for ballast or the lead-tin used in the many soldering operations on the shell. While there have been no indications of the formation of explosive substances in containers car-

rying TNT, the use of this special paint guards against such a possibility. Both the inside and the outside of the shell are also protected from corrosion by a thin cadmium coating. However, the inside of the shell still requires the protection of the paint.

The shell contains 400 pounds of cast TNT, which is poured in the molten state with the head nosed down at an angle of 30 degrees. In this way when the TNT solidifies the center of gravity of the cast charge is below the fore and aft axis of the torpedo. A lead ballast weight (12 lbs.) is soldered on the bottom center line four inches forward of the joint ring for the purpose of increasing the stability of the torpedo. A casing extends into the bottom of the forward portion of the head for the fitting of the standard U.S. Navy Exploder Mechanism, Mk. 4-1, and the Mk. 2 Booster.

For transportation and storage a cast iron ring is furnished with each war head in service; this ring is bolted on the joint for head to flask with six joint screws; the purpose being to protect the war head joint ring. The war head should always be stored nose up.

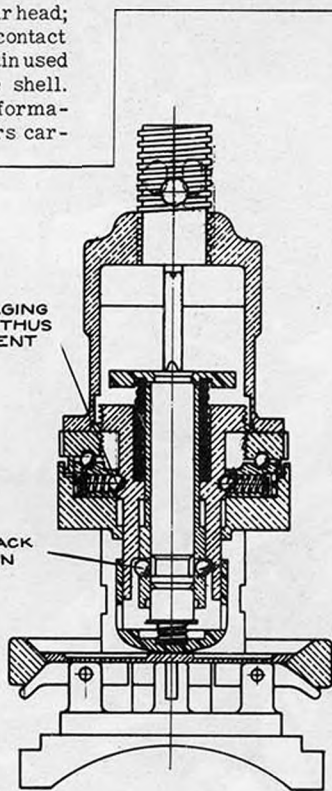
It is also necessary when assembling the head to the air flask or the head to the joint ring to note carefully the joint screws used. These joint screws are of the same size but of different threads than those used in the assembly of the air flask to the afterbody or the tail to the afterbody. They are of course, not interchangeable. It is possible to identify these different joint screws by the fact that those used to join the head to the air flask are slotted on the square head while those used elsewhere have plain heads.

The Mk. 4-1 exploder mechanism, after being assembled to the base plate, fits easily in the cavity of the war head. However, it must first be assembled. When shipped, the war head with base plate of the exploder mechanism installed, the exploder mechanism, the detonator, and the booster are shipped in four separate packages. To assemble the exploder mechanism remove the base plate from the war head and the exploder mechanism, the anti-countermining push rod, and the vertical shaft from the package. Check the serial numbers on all these parts. These numbers should be the same and should check with the serial number of the war head.

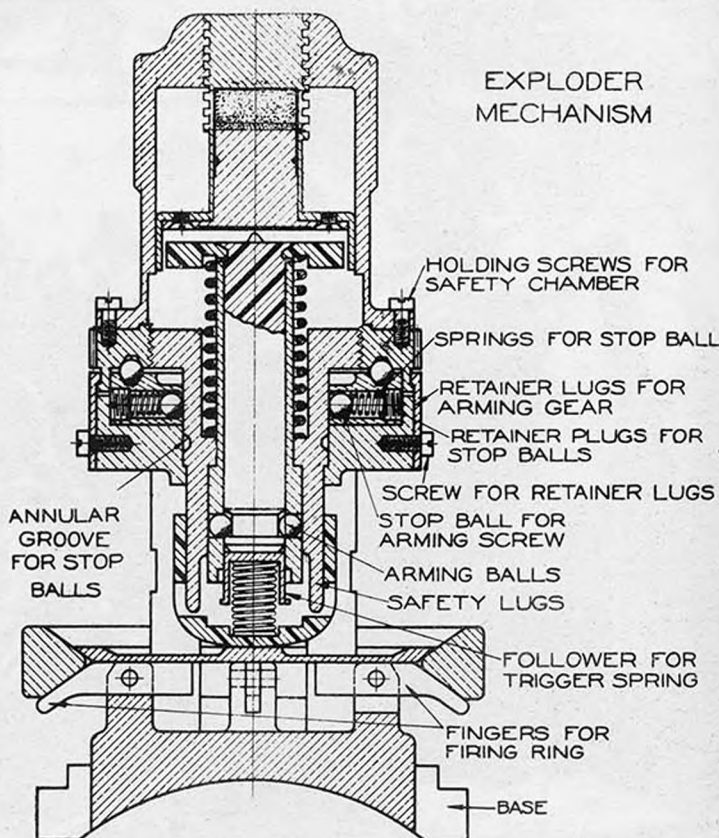
Before assembling the exploder to the base plate, the impeller should be greased

NOTE THAT STOP BALLS ARE ENGAGING ANNULAR GROOVE IN ARMING SCREW THUS PREVENTING FURTHER UPWARD MOVEMENT WHEN ARMED.

NOTE THAT ARMING BALLS ARE BACK CLEAR OF GROOVE AROUND FIRING PIN GUIDE STEM.

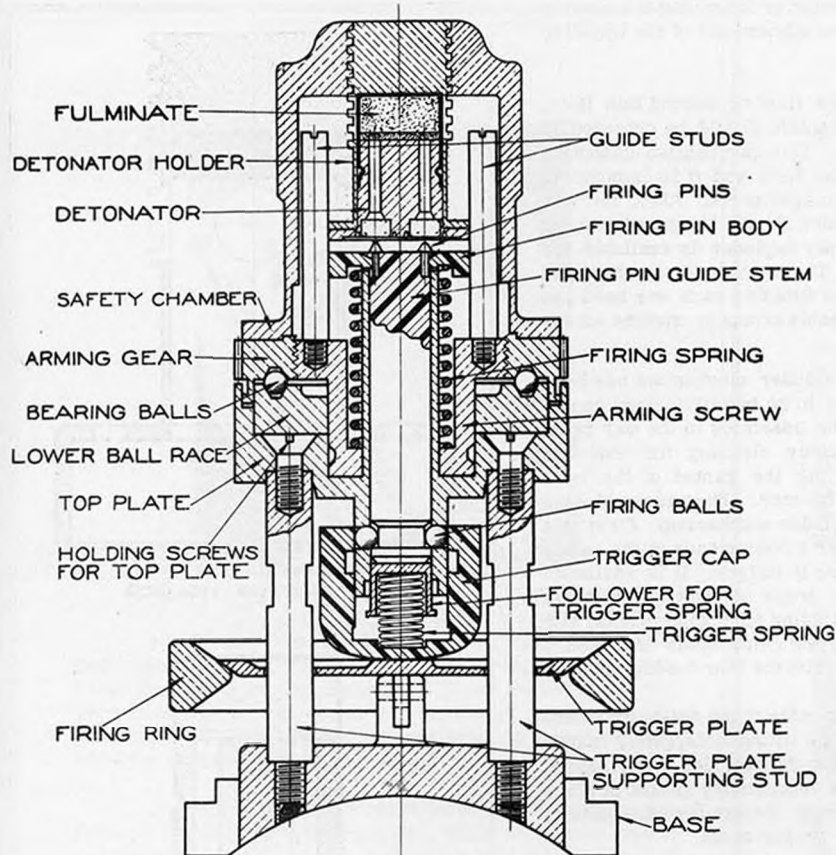


ARMED POSITION



Initial position showing arming balls

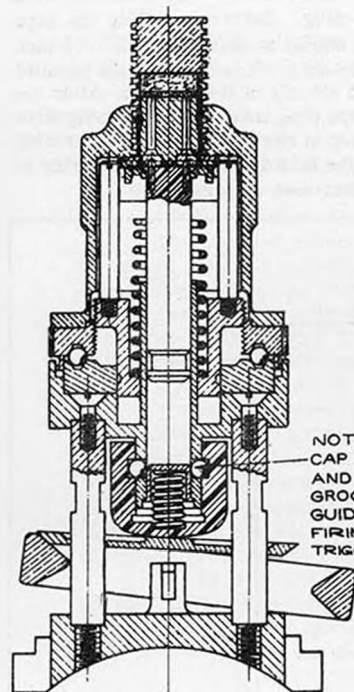
EXPLODER
MECHANISM



EXPLODER MECHANISM

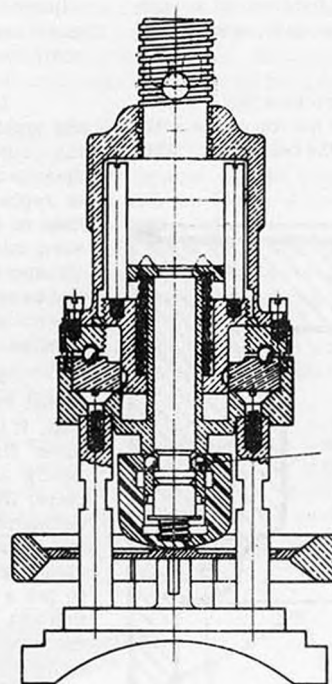
Initial position showing arming balls

through the grease fitting on the side of the base plate. A small grease gun with the proper fitting is provided in the box of exploder tools, usually available at all bases using torpedoes. After greasing the impeller, proceed to assemble the exploder mechanism. Remove the idler gear, and after compressing the spring



FIRED POSITION

NOTE THAT GROOVE IN TRIGGER CAP IS IN LINE WITH FIRING BALLS AND THAT BALLS ARE BACKED INTO GROOVE THUS RELEASING FIRING PIN GUIDE PIN. DISPLACEMENT OF THE FIRING RING DUE TO IMPACT TILTS THE TRIGGER PLATE AND RAISES THE TRIGGER CAP.

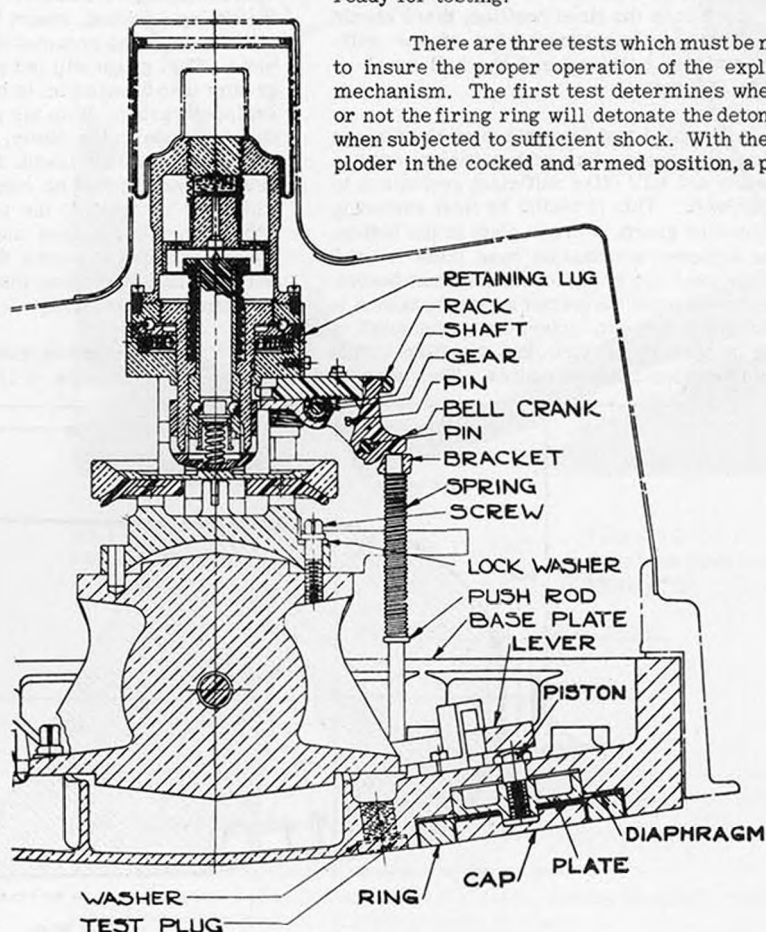


ARMED POSITION

NOTE THAT FIRING BALLS ARE BEING HELD IN ANNULAR GROOVE OF FIRING PIN GUIDE STEM BY THE TRIGGER CAP.

on the anti-countermining push rod with the proper tool provided, install this push rod and spring. At the same time, mesh the arrow-marked gear on the bottom of the vertical shaft with the middle tooth of the worm gear attached to the impeller shaft. Then engage each shaft in its proper place and secure the exploder mechanism to the base plate by means of the four securing studs. The exploder mechanism is then ready for testing.

There are three tests which must be made to insure the proper operation of the exploder mechanism. The first test determines whether or not the firing ring will detonate the detonator when subjected to sufficient shock. With the exploder in the cocked and armed position, a push,

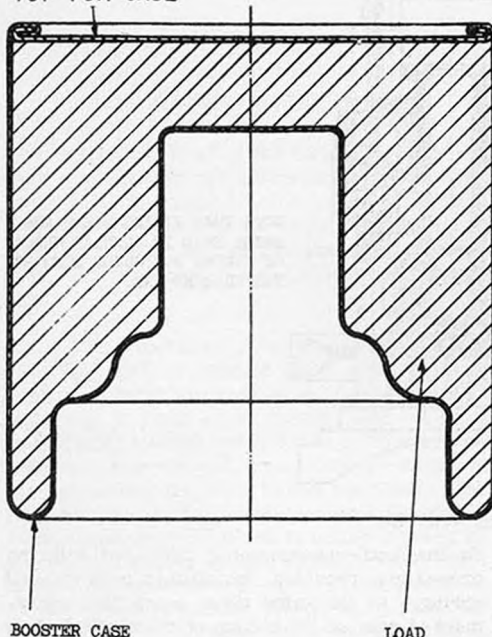


Anti-countermining mechanism

applied horizontally and registered on a push balance, of 3-1/2 to 5-1/2 pounds, should fire the mechanism.

The second test determines that there is sufficient clearance between the top of the anti-countermining push rod and the bell crank. With

TOP FOR CASE



MARK II BOOSTER

the rack and fork pushed in against the trigger cap, which is in the fired position, there should be a clearance between the top of the anti-countermining push rod and the bell crank of .003 to .009 inch.

The third test determines whether or not the impeller blades turn with sufficient ease in the water and still offer sufficient resistance to air currents. This is tested by first removing the impeller guard, a brass plate in the bottom of the exploder mechanism base plate located directly over the impeller channel and blades. Then, by means of the feather gauge, furnished in the exploder tool kit, determine the amount of force necessary to turn the impeller. This should be from 18 to 20 ounces. This may be

adjusted by tightening or loosening the packing gland located on the inboard end of the impeller shaft housing.

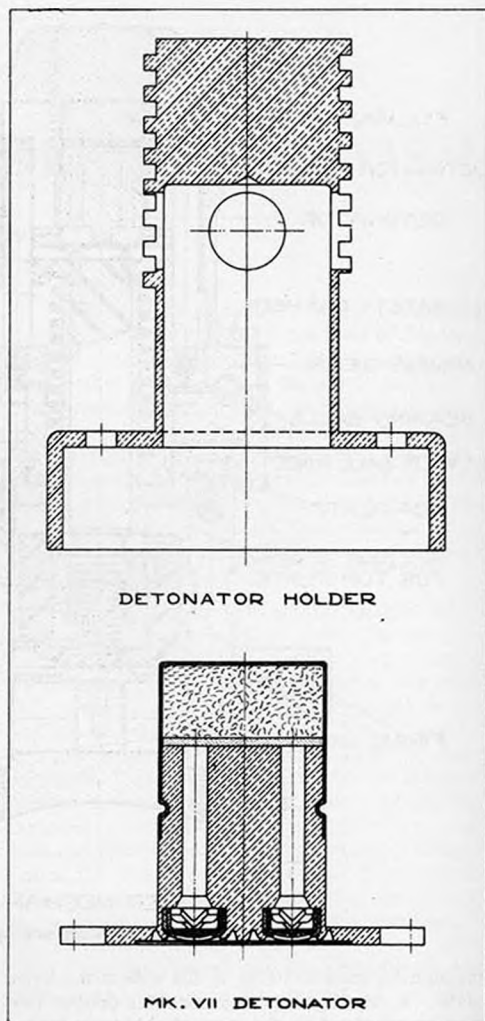
If either the first or second test fails, the exploder mechanism should be returned to the point of issue. This mechanism cannot be disassembled in the field and it is impossible to replace any damaged parts. Also, the war head of this exploder should be stored and not used until the proper exploder is available for its specific use. These exploder mechanisms and base plates are fitted to each war head and are not interchangeable except in extreme emergencies.

When the exploder mechanism has been tested and appears to be in satisfactory condition, it is ready for assembly in the war head. After first thoroughly cleaning the exploder cavity and inspecting the gasket of the base plate, install the booster. Then assemble the detonator to the exploder mechanism. First turn the detonator holder a few threads in the safety chamber to be sure it is free. It is advisable to put a very few drops of light oil on these threads. Then, aligning all scribe marks, slip the detonator over the guide studs and secure to the arming gear with the four holding screws.

With the assembly of the detonator to the exploder, by using the lifting tools, gently install the entire assembly in the exploder cavity, having seen that there is a satisfactory gasket in place on the exploder flange. Fasten the base plate to the flange with the proper studs.

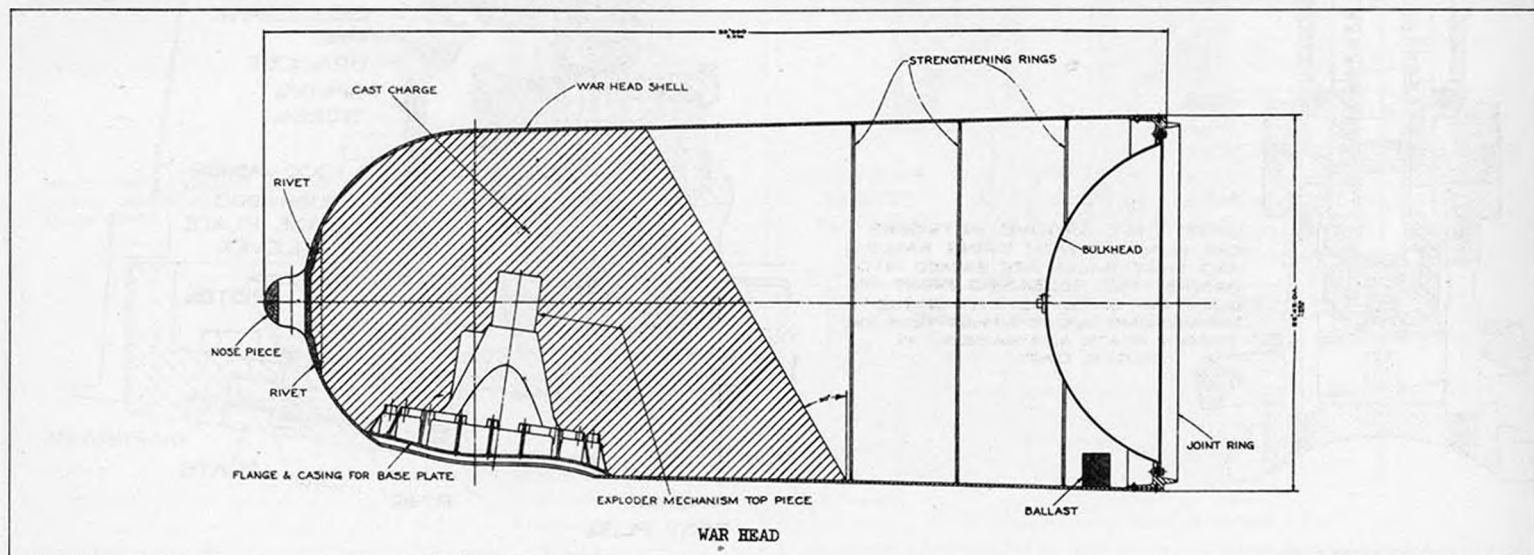
When the exploder mechanism is secured in place, it is necessary to make sure that the gasket has formed a water tight seal. To provide for this, there is a slotted head fitting located in approximately the middle of the base plate. With the fitting removed, insert the gauge and attach the bicycle pump provided in the kit of exploder tools. This gauge will not permit any pressure greater than 5 lbs/sq. in. to be built up inside the exploder casing. With air pressure pumped to the maximum in the cavity, test around the edge of the base plate for leaks. If any leaks are discovered they should be remedied immediately. This test completed, the test on the impeller should be checked once more with the feather gauge, in order to insure that the impeller has not been damaged when inserting the exploder mechanism in its cavity.

It is now time to install the arming wire. At any time available, a 1/16 inch hole should



be drilled vertically through the nose ring. It is advisable to bevel the edges of this hole to make sure that the arming wire will not catch on any burrs or be cut by the sharp edges. Also, the securing stud hole located directly aft of the impeller channel should be tapped to receive a 1/4 inch pipe plug. Before inserting the pipe plug, its head should be drilled with a 1/16 inch drill so that the axis of the hole will lie parallel to the fore and aft axis of the torpedo. After inserting this pipe plug, take .64 inch arming wire and make a loop at one end. Insert this arming wire through the hole drilled in the nose ring in

(Continued on page 501)





Under this heading THE ORDNANCE SERGEANT reproduces advance information pertaining to Ordnance Field Service Technical Bulletins. These Bulletins are not yet published in most cases, and in almost every instance this information will reach readers prior to complete distribution of the Bulletins in the field.

For some items the exact form of the forthcoming Bulletin is given (less its number), while for others only a preliminary version of the text which will be used in the Bulletin is available in time for publication.

In either case these items are OFFICIAL, being published by direction of The Chief of Ordnance.

Ordnance Field ()
Service Bulletin No.)

Office, Chief of Ordnance
War Department
Washington, D. C.
September 18, 1942

INSPECTION, REVERSAL, REPLACEMENT, AND RECLAMATION OF TANK TRACKS; HALF TRACK TRACKS, AND BOGIE WHEELS

1. The following definitions will govern the inspection, reversal, replacement, and reclamation of tank tracks, half track tracks, and bogie wheels:

a. Tank Tracks:

(1) Reversible - to be turned:

The standard reversible type rubber block tank track will be turned when the rubber on the first side has either worn to the extent that wear on the steel end links is imminent, or when the rubber has cracked over the cross tubes to such an extent that separation of the rubber from, and exposure of, the cross tubes is imminent, whichever condition shall first occur.

(2) Reversible - to be removed:

The standard reversible type rubber block tank track will be removed when the rubber on the second side has worn to the extent that wear in the steel end links is imminent.

(3) Non-reversible - to be removed:

The non-reversible type rubber block tank track will be removed when the rubber on the ground side has worn to the extent that wear on the steel end links is imminent.

(4) The rubber block tank track with steel Burgess Norton adapter will be removed when the steel shoe has worn to the extent that it no longer provides traction or when wear on the end links is imminent.

b. Half-Track Tracks:

(1) Half-Track Tracks will be removed when the rubber on the ground side has worn to the extent that wear on the steel

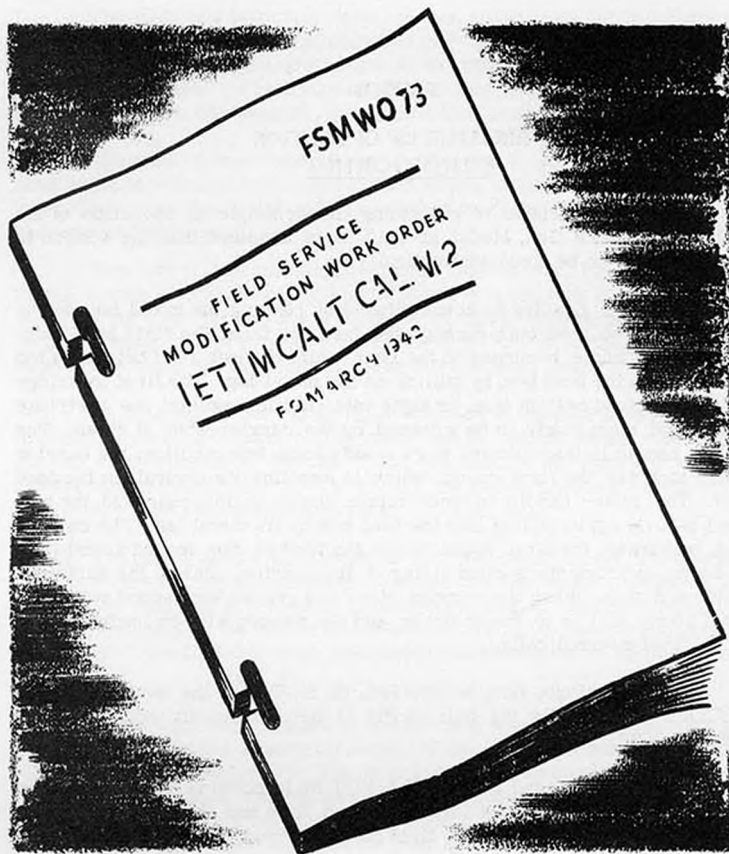
cross bars and exposure of the cables is imminent. Quite often the rubber will separate from and expose the cross bars before the track is worn out. When this condition occurs the track may be run until wear on the cross bars is imminent.

c. Bogie Wheels:

(1) Bogie wheels will be removed when the rubber has worn down even with the height of the rim flanges. Bogie wheel tires which have rubber along one or both sides scooped out, due to cutting action of the track and connectors or track guides, need not be changed unless there is not a continuous band of rubber all the way around the center portion of the wheel.

2. In replacing single blocks which have worn out or become damaged, replacement should be made with a block that has about the same amount of wear as the track.

3. Half-track and tank tracks which are operated on roads have a tendency to wear faster on the right hand side of the vehicle. Left hand tracks should either be combined with other tracks of equal wear or tracks should be switched from one side of the vehicle to the other in order to obtain maximum wear from all tracks.



RA PD NO. 107)
FSMWO G104-B)

SEPTEMBER, 12, 1942

FSMWO G104-B
Ordnance Department
Washington

FIELD SERVICE MODIFICATION WORK ORDER

1. Major Item Affected:

Name	SNL	TM
Medium Tank, M3	G104	9-750

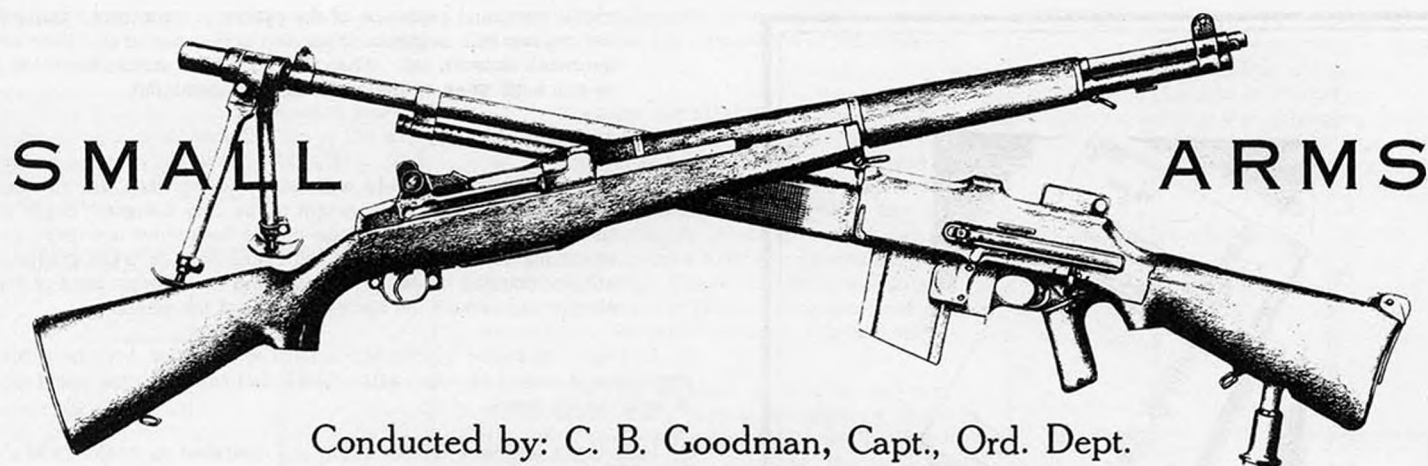
2. Parts Modified:

Name	Drg. (current)
Five Cylinder Priming Systems	

3. Purpose of Modification:

To convert Continental R975-EC2 engine having the single cylinder priming systems to five cylinder priming systems.

(Continued on page 502)



VICKERS MACHINE GUN, MODEL OF 1915

PART II

PRINCIPLE OF OPERATION FUNCTIONING

For the purpose of explaining the principle of operation of the Vickers Machine Gun, Model of 1915, it is assumed that the weapon is loaded, ready to be fired automatically.

NOTE: Loading is accomplished by passing the metal tag, on the end of the web feed belt, through the feed box from the right hand side. The roller handle is turned to the rear while the web feed belt is pulled further into the feed box, by pulling on the metal tag. The first cartridge in the web feed belt is thus brought into position against the cartridge guide and stop, ready to be grasped by the carrier when it rises. The roller handle is then allowed to go slowly back into position, the carrier rises to grasp the first round, which is awaiting its arrival, in the feed box. The roller handle is, once more, turned to the rear and the web feed belt is, again, pulled into the feed box by its metal tag. The carrier has withdrawn the first round to be chambered, the second round is in position, awaiting the second rising of the carrier, against the cartridge guide and stop. When the carrier rises and grasps the second round the first round will be in the chamber and the weapon will be loaded, ready to be fired automatically.

Should single fire be desired, do NOT pull the belt FOR THE SECOND TIME while the bolt handle is being manually operated FOR THE SECOND TIME.

Then the second round WILL NOT be in position to be grasped by the carrier when it rises for the second time and WILL NOT be automatically chambered when the first round is fired.

For each single shot desired, thereafter, it will be necessary to operate the roller handle manually in order to load the weapon.

As the explanation of functioning progresses, the mechanical operations which take place during the operation of loading the weapon will be explained.

The weapon is, therefore, assumed to be loaded and ready to be fired automatically. The action is as follows:

The right and left handles are grasped by the right and left hands respectively, the thumbs are uppermost and extended to rest on the rearward surface of the trigger thumbpiece which is located in a central position between the handles, on the upper end of the trigger. The index finger, of each hand, is extended to rest on the forward surface of the safety catch which is located just forward of the trigger thumb piece.

Forward pressure, exerted by the thumbs on the trigger thumb piece and rearward pressure exerted by the index fingers on the safety

catch presses those two pieces together. The trigger pivots forward on the trigger pin which passes through its lower end. The safety catch pivots upward on the safety catch pin which passes through its upper forward portion. In pivoting upward it removes its obstruction to the forward movement of the trigger to which, in its normal position, it provides a safety factor by preventing the unintentional discharge of the weapon.

From that function it derives its name, as most of the other parts derive their names from one or another of their functions.

As the trigger pivots forward it carries forward the trigger pawl which is mounted in a recess in the lower forward surface of the trigger where it is secured by the trigger pawl pin.

As the trigger pawl moves forward it causes the lower tip of the trigger lever to pivot forward on the trigger lever pin. The upper tip of the trigger lever is thus brought to the rear, against the tension of the trigger lever spring, which it compresses. The release of thumb pressure, on the trigger thumb piece, will allow the trigger lever spring to expand to force the upper tip of the trigger lever forward and its lower tip to the rear to cause the cessation of fire.

The rearward movement of the upper tip of the trigger lever causes the trigger bar, in the rear cover, the rear end of which is engaged by the upper tip of the trigger lever, to be drawn rearward against the tension of the trigger bar spring located in the rear right hand corner of the rear cover.

The forward end of the trigger bar is engaged by the hand sear. When the trigger bar is drawn rearward it draws the upper tip of the hand sear to the rear, against the tension of the main spring, in the lock, causing its lower tip to rotate forward on the hand sear pin.

As the upper tip of the hand sear rotates to the rear, on the hand sear pin, and its lower tip rotates forward, the latter disengages itself from the hand sear notch in the tumbler, permitting the tail, the upper tip, of the tumbler to drop down to the rear, pivoting downward on the tumbler pin. This disengagement and pivoting movement removes the restraining influence of the lower tip of the tumbler which, fitted into its groove in the firing pin, holds the firing pin to the rear against the pressure of the main spring, the long end of which is pressing against the lug on the upper surface of the firing pin, striving to force it forward. The removal of the restraint of the lower tip of the tumbler, allows the main spring to propel the firing pin forward. The point, or striker, on the forward end of the firing pin passes through the firing pin hole in the face of the carrier and strikes the primer in the base of the chambered cartridge detonating it.

The weapon is fired.

The force of the blow struck by the striker of the firing pin explodes the charge of fulminate of mercury contained in the primer. The explosion ignites the propelling charge of smokeless powder contained in the cartridge case. As the propelling charge burns, the gases formed expand to attain a chamber pressure of approximately fifty thousand pounds to the square inch.

The sidewise pressure of the expanding gas, acting on the circumference of the cartridge case along its entire length, expands the malleable metal of which it is constructed and presses it firmly against the walls of the chamber, embossing it into machine markings and any pits which may have resulted from use or lack of proper care, tending to lock the spent cartridge case in the chamber.

The forward pressure of the expanding gas forces the projectile from the bottle neck portion of the cartridge case in which it is crimped and forces it out, forward, through the bore of the barrel. As the projectile leaves the chamber and enters the bore of the barrel it contacts the four grooves and the four lands which constitute the uniform right hand rifling of the barrel.

Portions of the projectile are forced into the grooves and four lug like protuberances are formed on the circumference of the projectile for its entire length. These lugs follow the grooves during its passage through the barrel, as in tracks, while the balance of the projectile rides out on the lands.

The riding forward of the lugs, in the grooves, effects a rotary movement, to the right, on the projectile, over its long axis, causing it to make one complete revolution every ten inches and two and four-fifth revolutions during its passage through the twenty-eight inch barrel.

The projectile leaves the muzzle of the barrel, passes through space for a distance of approximately one and one-half inches and then passes through the opening provided in the muzzle attachment front disc with a velocity of approximately two thousand seven hundred feet per second, with a potential range of three miles and an effective range of in the neighborhood of one thousand yards.

The expanded gas, which propels and follows the projectile forward, is expelled from the barrel when the projectile leaves it. The expelled gas strikes the convex rearward surface of the muzzle attachment front disc and is deflected against the concave forward surface of the muzzle attachment barrel disc which, just behind it, is screwed on the threaded muzzle end of the barrel, both of which are recoiling parts of the weapon, where it assists in the recoiling action.

When the expelled gas has assisted in the recoiling action in the manner described, it escapes through a port provided in the side of the muzzle attachment barrel disc.

The rearward pressure of the expanding gas actuates the recoil parts of the weapon while the projectile is being propelled forward through the barrel. The rearward force thus generated is afforded a final kick by the gas expelled from the muzzle end of the barrel.

The weapon is in its fired condition.

The firing pin is in its extreme forward position with its striker protruding through the firing pin hole in the carrier which is in its uppermost position. The main spring is relieved of tension to the maximum degree, the hand sear is forward resting against the main spring and is disengaged from the tumbler. The tail of the tumbler is depressed and is resting on the shank of the side levers. The projection, on the base of the tumbler, is forward, but still in its notch in the firing pin which it has released of restraint. The notches in the upper forward arms of the side levers are engaged with the lifting levers locking them in horizontal position. The forward tips of the lifting levers are under the wide upper end of the carrier, which it has lifted into position, locking it in its extreme upward position. The side levers are pressed firmly, downward, against the safety sear which, in turn, is pressed downward against the safety sear spring, depressing it. The safety sear, in its downward movement, freed the raised portion of its upper surface from the recess in the lower surface of the firing pin, leaving the latter free to fly forward under the pressure exerted by the main spring.

The spent cartridge case is in the chamber. Its base is held in the lower section of the "T" slot of the carrier, just below the gib. The next new round is in the web feed belt, its base grasped by the upper

section of the "T" slot in the carrier and is held in its proper position by the notch, in which it is seated, in the gib.

The recoil spring is without tension and the fuze is in perpendicular position. The fuze links are extended forward to their full extreme. The barrel, with the muzzle attachment barrel disc, and the right and left hand recoil plates are in their extreme forward position. The feed box slide and upper slide lever are in their extreme left position while the bottom lever is forward.

The side levers, cross head and crank are in elongated horizontal position and the roller handle is forward, resting on the dead stop.

Recoil action begins.

The rearward pressure of the expanding gas in the chamber, augmented by the rearward pressure of the gas deflected to the rear after its expulsion from the muzzle end of the barrel, forces the recoiling parts of the weapon rearward.

As the barrel, with the muzzle attachment barrel disc, is forced to the rear it rides back on the parallel cylindrical surfaces, the front one of which takes bearing in the stuffing box while the rear one takes bearing in the trunnion block.

The right and left hand recoil plates, fitted over the trunnions on either side of the block at the chamber end of the barrel, are forced to the rear by the rearward movement of the barrel. The journals of the crank are fitted into the openings on the rear end of the right and left hand recoil plates and, consequently, the crank also is moved to the rear.

Attached to the crank, between the recoil plates, is the cross head which is attached to the side levers which, in turn, is attached to the lock. The cross head, the side levers and the lock, therefore, move to the rear with the crank.

The barrel, the muzzle attachment barrel disc, the right and left recoil plates, the cross head, the side levers and the lock move, horizontally, to the rear as one for a distance of about three-sixteenths of an inch. In that position the lower surfaces of the horns on the carrier will rest on the upper surfaces of the right and left hand cams.

At that point, the roller handle comes in contact with the roller mounted on the right hand filling piece and is rotated to the rear when its tail end is cammed downward and the handle, its forward end, is rotated upward from the dead stop. As the roller handle rotates to the rear, the roller revolves to the front.

The roller handle is fastened to the right hand journal of the crank and its rearward rotary movement causes the rearward rotation of the crank. The journals of the crank form its axis and, as they are located at its rear extremity, the crank describes an arc in its rearward rotation causing its forward end to rise, upward and backward, out of its horizontal position.

The cross head, hinged to the forward end of the crank, has its rear end raised by the upward movement of the crank and they unite in the formation of an inverted "V". The side levers is fastened to the forward end of the cross head and its forward end is pivoted, by the side levers pin and side levers pin bushing which pass through it, to the lock frame. As the cross head rises it draws the rear end of the side levers upward and backward with it and they combine to form the front arm of the inverted "V", which is longer than the rear arm formed by the crank alone.

As the side levers, with its rear or shank end elevated, is drawn to the rear its forward end, fastened to the lock, draws the lock to the rear.

As the rear end of the side levers is raised, the tumbler, the tail of which is resting on the shank of the side levers, is elevated. As its tail is pivoted upward, on the tumbler pin, its lower end, engaged in its notch in the firing pin, is drawn to the rear and forces the firing pin to the rear. When the firing pin moves to the rear it compresses the main spring by drawing its long, or forward, leg which is engaged with the lug on the forward upper surface of the firing pin to the rear. The short, or rear, leg of the main spring is resting against the forward surface of the hand sear and is pressed forward, to meet the rearward moving long leg, by the rearward rotation of the hand sear over the hand sear pin. The rotation of the hand sear is, for the portion above the hand sear pin, to the rear and, for the portion below the hand sear pin, to the front. Its movement is actuated by the upward movement and forward rotation of the tumbler.

This movement of the tumbler continues until the movement of the hand sear is reversed, i.e., until the portion above the hand sear pin changes its rearward motion for forward movement and the portion below the hand sear pin changes its forward motion to rearward movement. This change is effected by the shape of the tumbler and the movement is actuated by the pressure, or resistance, of the short leg of the main spring on the lower portion of the hand sear.

The hand sear at this point, enters its notch in the tumbler and holds the tumbler in its present position with its tail end elevated and its lower tip, engaged in its notch in the firing pin, drawn to the rear and holding the firing pin in its rearmost position in spite of the effort of the main spring, engaged with the lug on its upper surface, to force it forward.

To insure against the accidental discharge of the weapon the safety sear is provided. At this stage of the operation of the weapon, the rear end of the safety sear, actuated by the safety sear spring, rises and an elevation on its upper surface engages a recess in the lower surface of the firing pin and helps the tumbler to hold it in position. The tumbler and the safety sear each guarantee the firing pin remaining in position in the event the other fails. The safety sear is hinged at its forward end where it engages the safety sear pin.

The weapon is cocked.

As the upward, rearward, movement of the side levers continues it becomes disengaged from the lifting levers which pivot forward and downward out of horizontal position, and their forward tips drop to their extreme lower position leaving the carrier free to drop down along the face of the lock to which it is engaged by means of grooves in its rear surface.

The carrier does not drop, at this point, because as the force of the recoil is experienced and the recoiling portions of the weapon recoil and move to the rear as one, the "horns" on the carrier are positioned over the same on the right and left outside plates, inside the breech casing. As the lock moves to the rear the "horns" ride along the upper surfaces of the cams, keeping the carrier in its highest position. When they reach the rear end of the cams they drop off and take position on the right and left hand recoil plates. To guarantee their dropping to this position, cover guides, right and left hand, are provided to cam them downward thus making this action positive.

At the rear end of the cams, notches, called "steps", are provided to hold the lock in rearward position should it be desired to do so. Utilizing these steps is referred to as "hanging the lock". These steps also serve to prevent the return, forward, of the carrier, along the top surfaces of the cams, if as the result of a round having a weak charge the lock has not been drawn sufficiently far to the rear to permit the carrier to drop into position to chamber the new round.

As the lock moves to the rear the spent cartridge case held in the lower section of the "T" slot in the carrier, below the gib, is extracted from the chamber. At the same time the next new round, held in the upper section of the "T" slot and in the notch in the gib is withdrawn from the web feed belt. Both are, of course, drawn to the rear with the lock. When the rear ends of the cams are reached and the carrier drops until its "horns" rest on the recoil plates, the next new round is in line with the chamber. The lower section of the carrier, then, drops through the opening in the bottom plate, provided by the drawing of the bottom plate slide to the rear, and outside of the weapon. The spent cartridge case may be ejected, by the force of gravity, at this point.

When the end of the rearward movement of the recoil parts as one is reached and their elongated horizontal alignment is broken at the pivot point of the crank and the cross head and at the pivot point of the side levers and the lock, there is an imperceptible slackening of speed in the rearward movement.

The forces of recoil and of inertia are still in effect in the barrel, the source of the momentum, after deriving its own impetus from the expanding gas, which drives the other recoiling parts to the rear. It is still moving to the rear.

The rearward movement of the barrel is still effecting the rearward movement of the right and left hand recoil plates which are fastened to it. They, in turn, are still effecting the rearward movement of the crank, the journals of which pass through them.

The roller handle has contacted the roller, which revolves forward as the roller handle begins its rearward rotation, breaking the horizontal alignment of the crank, the cross head and the side levers from that of the barrel, the lock and the right and left hand recoil plates. As the crank, the cross head and the side levers rise, at the pivot point of the crank and the cross head, to form the inverted "V" the forward arm of the inverted "V", formed by the cross head and the side levers move rearward more rapidly than do the other parts. They transmit additional impetus to the lock which moves rearward at the same speed. The impulse is checked, momentarily, by the resistance of the firmly chambered cartridge as the lock begins to separate from the chamber end of the barrel. It is here that slow initial extraction is performed. Effectual slow initial extraction is comparable to the proper and successful use of a tow rope.

In slow initial extraction the "stretch" in the soft metal from which the spent cartridge case is made is drawn out to its limit and the case is withdrawn from the chamber with a final, strong, pull when all the slack has been taken up.

The stretch in a tow rope is slowly drawn out to its limit before the drag, or resistance, of the standing object to be towed is added to the natural, frictional, resistance of the object furnishing the power of locomotion.

Failure to effectually take up the slack in a tow rope results in its separation and failure to move the object to be towed.

Failure to effectually perform slow initial extraction results in ruptured cartridge cases and the removal of the weapon from action while the malfunction is being reduced.

Therein lies the weakness of this weapon. The rupturing of cartridge cases is the most frequent malfunction of this gun, a malfunction not always attributable to faulty ammunition. The resistance of the firmly chambered cartridge, which effected the slackening of the speed of the rearward movement of the lock, the side levers and the cross head, is overcome by the continued rearward rotation of the crank as it reaches and passes it perpendicular position and effects the distorted, buckling action of the crank, on one side, and the cross head and the side levers, on the other side, in their formation of the inverted "V" to which there has been reference.

At the time the lock, the side levers and the cross head are beginning to experience the resistance of the chambered cartridge, the assistance of the gas expelled from the muzzle end of the barrel and deflected against the muzzle attachment barrel disc is felt and the right and left recoil plates and the crank continue their rearward movement, unaffected by the resistance set up by the chambered cartridge case.

As that resistance is overcome, by the cross head, the side levers and the lock in the manner described, the lock continues to draw away from the chamber end of the barrel, extracting the spent cartridge case from the chamber.

As the spent cartridge case is extracted from the chamber, the next new round is withdrawn from the web feed belt and both are moved to the rear, in the carrier, with the lock.

While the recoil force is in effect, the rearward movement of the recoiling parts stretch the recoil spring beyond the limits of its normal condition and as the crank rotates to the rear, the fusee inserted in the left hand journal of the crank is rotated to the rear and downward. It describes a complete half circle, from its normal perpendicular position, coming to rest in reversed position. The front and rear fusee links, which are stretched forward in horizontal position when the recoiling parts are forward, are wound around the fusee and within a recess provided in its outer surface. It is this action of the fusee and fusee links which extends the recoil spring.

As the recoiling parts move rearward the bottom lever of the feed box, which is engaged in a notch, or hook, in the upper forward surface of the left hand recoil plate, is drawn to the rear.

The rearward movement of the bottom lever causes the upper slide lever, which is fastened to it, to pivot from left to right.

The movement, to the right, of the upper slide lever imparts a transverse movement to the slide to which it is engaged and the slide also moves from left to right.

When the slide moves to the right, it carries with it the upper pawls which are fastened to its right hand lower surface. As they are carried to the right they ride up the left hand side, over the top and down the right hand side of the next new round in the web feed belt. The upward movement is accomplished against the resistance of the upper pawl spring which forces them downward again when they have passed the center of the upper circumference of the next new round. During this operation the bottom pawls, by reason of the tension of the bottom pawls spring, hold the web feed belt in position, preventing its being pushed out of the feed box by the pressure exerted by the upper pawls on the left side of the round as they change position. The bottom pawls engage the web feed belt between the next new round and the one to follow, from the bottom.

The barrel with the muzzle attachment front disc and the right and left hand recoil plates have recoiled approximately one inch. The crank has rotated about two and one-quarter inches beyond its upward, perpendicular, center and its forward end has traveled upward and backward, about four and five-eighths lineal inches from its horizontal, normal, position. The carrier, on the front surface of the lock, has traveled the length of the cams, a distance of approximately three inches.

Recoiling action has been completed.

Forward movement, of the recoiling parts, begins.

The recoil spring now comes into self-energized action. Its rearward extension was accomplished by the driving power of the recoiling parts which exceeded its resistance to such extension. It now utilizes the strength thus imparted, in resuming its normal condition, to force the recoiling parts to return to their forward position.

As its recoil action begins, it draws the fuzee, by means of the fuzee links through which their connection is made, from its upside down position to its normal upright position. The fuzee is inserted in the left hand journal of the crank and its upward and forward rotation causes the crank to rotate upward and forward. The roller handle is actuated, in the same movement, by the crank because of its being fastened to the right hand journal of the crank.

As the crank rotates forward it drives the cross head which is pivoted to its forward end and the side levers, fastened to the forward end of the cross head, to the front. The side levers is pivoted on the lock frame and, as it moves forward, it drives the lock before it.

As they complete their forward movement and the lock reaches its extreme forward position, the crank, the cross head and the side levers assume their normal position, in elongated horizontal alignment and parallel with the right and left recoil plates and the barrel. During the forward travel of the lock, the "horns" of the carrier were carried forward as they rested on the upper surface of the right and left hand recoil plates.

The carrier was in its extremelower position with the new round held in the upper section of its "T" slot and in the notch of the gib and in line with the chamber. The new round entered the chamber as it approached it and was completely seated when the lock reached its extreme forward position. During the forward movement of the lock, the lower portion of the carrier, with the spent cartridge case held in the lower section of the "T" slot below the gib, was extended below the bottom plate through the opening made available by drawing the bottom plate slide to the rear. The spent cartridge case was carried forward outside of the weapon unless it had been already ejected, by gravity, when the carrier dropped from the cams to rest on the recoil plates, at the end of the rearward movement of the lock.

As the lock approached its extreme forward position, the carrier reached the rear end of the right and left hand carrier supporting springs, on the forward end of the right and left hand recoil plates. It passed between the carrier supporting springs which support it in its uppermost position, to prevent the carrier falling below the level of the cams if the mechanism is hand operated without a cartridge being held in the grooves.

When the side levers attains its extreme forward position, it presses down on the safety sear, pressing it down against the resistance of the safety sear spring, thus disengaging the elevated section of its upper surface from the recess in the under surface of the firing pin, leaving the latter free to fly forward when trigger action is applied.

As the side levers pivots downward the arms at its forward end rotate to the rear, engaging the camming surfaces of the lifting levers

and cams them back into horizontal position. As the front ends of the lifting levers are raised upward, by the camming movement of their rear end, their forward tips engage the lower surface of the widest portion of the carrier and elevate the carrier to its extreme upward position. As the carrier rises it disengages the new round from the notch in the gib and passes over it as it continues its upward movement. As it rises it grasps the next new round in its "T" slot, and seats it in the notch in the gib just vacated by the round just chambered, in preparation to withdrawal from the web feed belt on the next rearward journey of the lock.

The round just chambered now occupies the place in the "T" slot of the carrier recently occupied by the round last fired, the spent cartridge case of which, if it was not ejected by gravity, was carried forward to the extreme forward position of the lock, but outside the weapon, where it extended forward beyond the breech casing and below the bottom plate under the feed box. When the carrier was raised the spent cartridge was ejected by the upward pull of the rising carrier and the downward pull of the obstructing bottom plate.

As the recoiling parts moved forward the bottom lever of the feed box was moved forward by the forward thrust of the returning left hand recoil plate. Its forward movement caused the right to left pivoting movement of the upper slide lever which actuated the right to left movement of the slide. The upper pawls, fastened to the slide, were also moved to the left and pushed the next new round ahead of them to rest against the cartridge guide and stop, in position to be grasped by the carrier when it rises again during the next operation of the mechanism.

As the next new round in the web feed belt is positioned, the empty loop in the belt, just vacated by the round just chambered, is moved to the left and out of the weapon. The movement of the web feed belt, accomplished against the resistance of the bottom pawl spring, caused the depression of the bottom pawls which, actuated by the bottom pawl spring, rise again to take position behind, to the right, of the round to follow the next new round. That round was allowed to move to the left by the depression of the bottom pawls.

As the crank took its forward position the roller handle, which is fastened to its right journal, reached its extreme forward position against the dead stop.

The dead stop positively locks the roller handle momentarily when the breech is closed and the cartridge is fired.

It pivots on the stud of the dead stop bracket which is riveted to the outside right hand side of the gun casing. The action is made positive by means of the dead stop plunger. A small groove is cut in the stud to receive the dead stop pin, which secures the dead stop while allowing it to have limited rotary movement.

The forward movement of the recoiling parts has been completed.

COMMENTARY

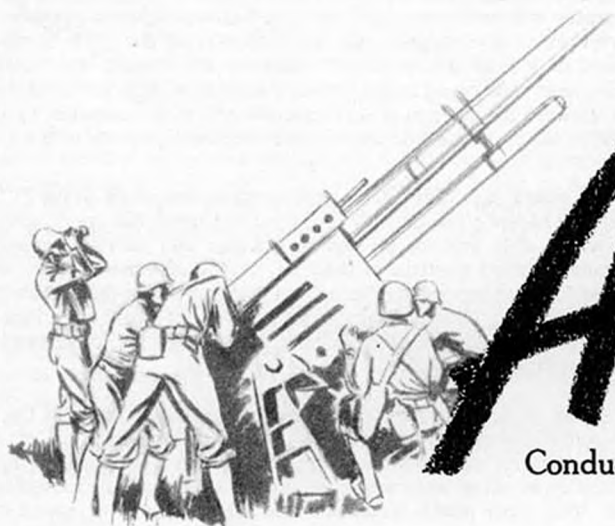
By maintaining forward pressure on the trigger thumb piece and rearward pressure against the safety catch, thus preventing the hand sear from engaging the notch in the forward surface of the tumbler, the weapon will continue to fire as long as there is ammunition in the belt.

The discontinuance of such pressure will permit the trigger to pivot to the rear, over the trigger pin in its base, drawing the trigger pawl, mounted in the recess in the forward surface of the trigger, from contact with the trigger lever, the lower tip of which will pivot to the rear as the expanding trigger lever spring actuates the forward movement of the upper tip of the trigger lever.

The forward movement of the upper tip of the trigger lever permits the trigger bar, actuated by the expansion of the compressed trigger bar spring in the rear right hand corner of the rear cover, to move forward to engage the upper tip of the hand sear which will effect the engagement of the lower tip of the hand sear in the notch in the forward surface of the tumbler, restraining the forward impulse of the firing pin, causing the cessation of fire with the weapon in loaded and cocked position.

If it is assumed that sufficient rounds have been fired to bring the water in the water jacket to its boiling point, it may also be assumed that the water has absorbed most of the heat from the barrel, resulting from the round just fired. And that the vapor rising from the steam generated

(Continued on page 502)



Artillery

Conducted by: W. C. Minshaw, Major, Ord. Dept.

FUNDAMENTALS OF ARTILLERY WEAPONS

by D. A. WERBLIN
2nd Lt., Ord. Dept.

BREECH MECHANISMS

A breech mechanism is a mechanical device for opening and closing the breech, or rear end, of a cannon before and after loading and for firing the round of ammunition which has been inserted. The components are:

- Breechblock.
- Operating mechanism.
- Firing mechanism.
- Safety devices.
- Obturator included only in the breech mechanisms of cannon firing separate-loading ammunition.

TYPES OF BREECH MECHANISMS

There are three general types of breech mechanisms, classified according to their breechblocks as follows:

- Interrupted-screw type.
- Eccentric-screw (Nordenfeld) type.
- Sliding-wedge type.

INTERRUPTED-SCREW BREECHBLOCK. - a. Schematic illustration. (Fig. 7.) - To illustrate the basic operation of an interrupted-screw breechblock, consider a threaded bolt engaged in a nut. If the threads of the bolt are cut away on one half of the circumference, and the threads of the nut are cut away on the opposite half, then the bolt can be pushed straight through the nut. If the screw is given half a turn, the remaining threads of the bolt will engage the remaining threads of the nut, thereby holding the bolt in place. The convenient feature of this arrangement is that it allows the bolt to slide all the way into the nut and then requires only a half-turn to lock the bolt in place. If the threads were not cut away as outlined above, several turns of the bolt would be necessary to attain the same result.

Actual application. - The aforementioned nut and bolt represent respectively the breech recess and the breechblock in an interrupted-

screw breech mechanism. The arrangement shown in figure 7 is unsymmetrical. In actual practice, the threaded surface of the breechblock is divided into an even number of sectors, and the threads of alternate sectors are cut away (see Figure 8). Thus, half the surface of the breechblock is threaded, and half is plain, or slotted. Similarly, the threads of the breech are cut away opposite the threaded sectors of the block. Here again, the breechblock can be rapidly slid nearly to its seated position, with the threaded sectors of the block sliding in the blank sectors of the breech. Then, with a comparatively small turn, the threads of the breech and block are fully engaged, and the block is locked.

WELIN BREECHBLOCK. - The Welin, or stepped-thread, breechblock is a modification of the interrupted-screw type of block just described. Consider again a threaded nut and bolt (see Figure 9). Let the threads of the bolt be cut away as follows: on one-quarter of the circumference for one-third of the height of the threads; on the adjoining quarter for two-thirds of the height; on the next quarter of the circumference for the full height (threads completely cut away). This leaves the remaining quarter of the circumference with a full thread. The result is a stepped thread covering three-quarters of the circumference of the bolt. Let the nut be cut away correspondingly, so that the bolt can be slid freely into it. In order to engage the stepped threads of the bolt fully with those of the nut, it now requires only a quarter turn of the bolt, whereas it required one-half of a turn in the interrupted screw shown in Figure 7. Hence, it is seen that by stepping a thread, the rotation necessary to lock the bolt, or breechblock, is decreased. By this means, also, the threaded area may cover a larger portion of the block surface, e.g.,

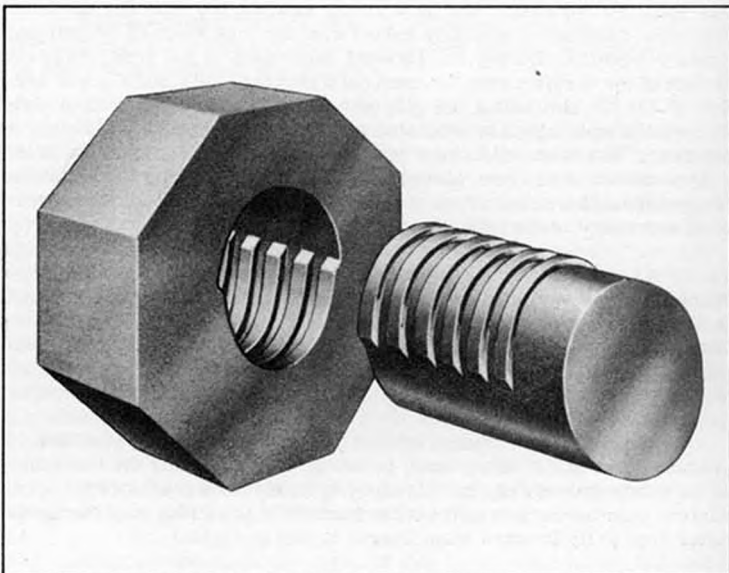


Figure 7 -- Interrupted-screw breechblock (schematic)

two-thirds, three-fourths, or even more. In the interrupted-screw breechblock, only one-half the block area is threaded. This large increase in threaded area attained by the Welin type permits the use of a smaller block. In actual practice, the Welin block has several stepped-thread sectors, alternated with plain sectors, as shown in Figure 10.

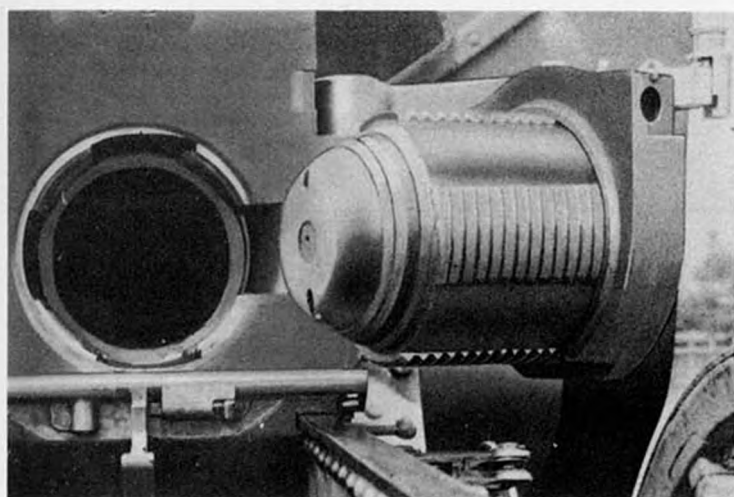


Figure 8 -- Interrupted-screw breechblock

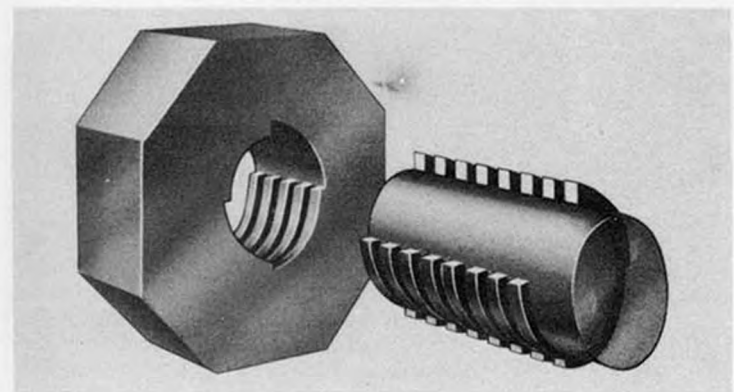


Figure 9 -- Stepped-thread breechblock (schematic)

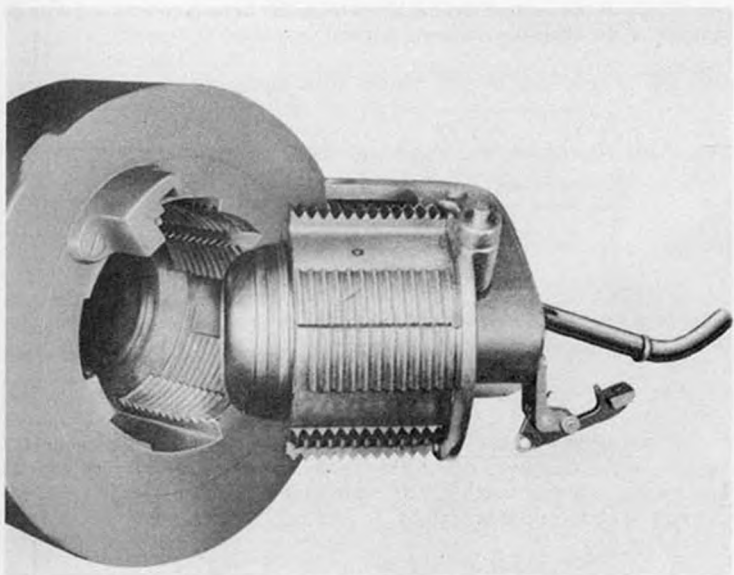


Figure 10 -- Welin breechblock

ECCENTRIC-SCREW BREECHBLOCK. (Figure 11.) - The eccentric-screw, or Nordenfeld, type of breechblock is cylindrical and is threaded on its exterior surface to screw into the breech recess, which is correspondingly threaded. The breechblock is much larger than the bore, and the axis about which it rotates does not coincide with axis of

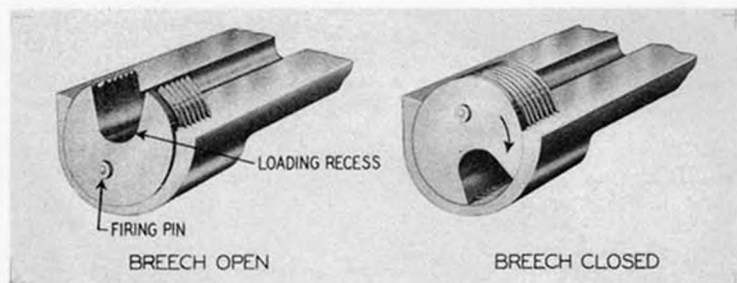


Figure 11 -- Eccentric-screw breechblock

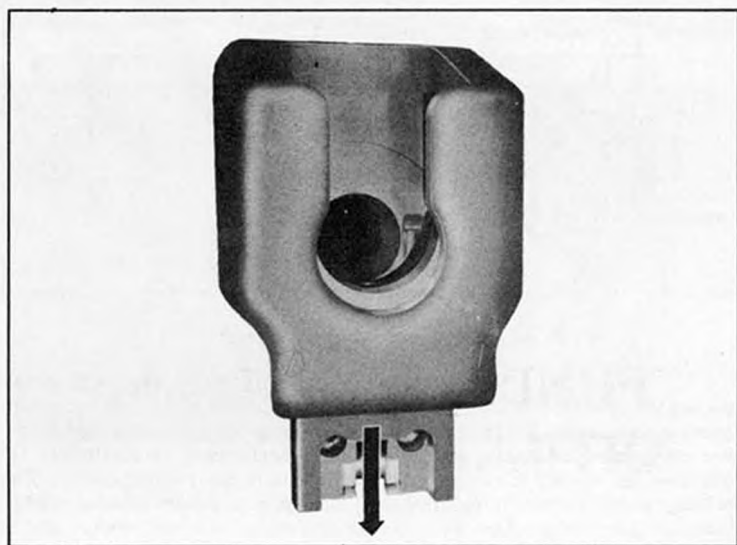


Figure 12 -- Drop-block breechblock

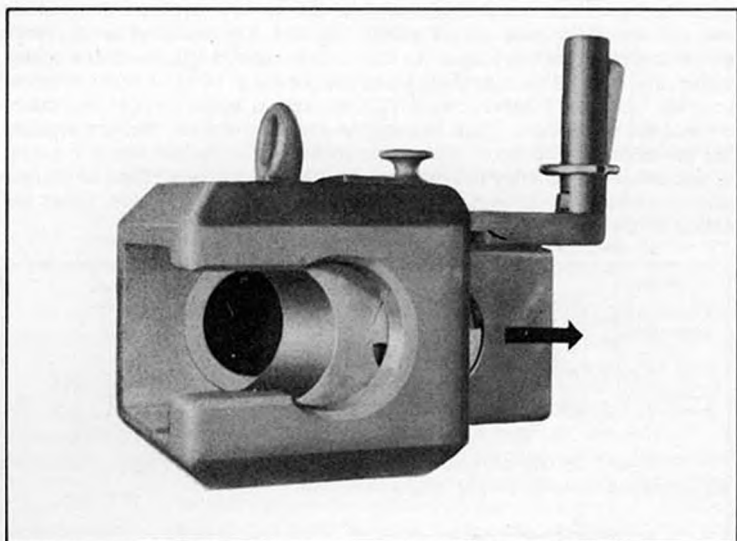


Figure 13 -- Horizontal sliding-wedge breechblock

the bore. There is a U-shaped off-center opening in the block called the loading recess, which coincides with the bore when the block is in its open position. The ammunition is inserted into the bore through the loading recess. With ammunition inserted as far as it will go, the breechblock is rotated about its axis approximately a half-revolution to its closed position. This rotation locates the loading recess away from the bore and causes the solid wall of the block to seal the breech. To open the breech, the block is merely rotated in the opposite direction until the loading recess again comes into alignment with the bore. The block remains in the breech during the operation of opening or closing the breech.

SLIDING-WEDGE BREECHBLOCK. - General. - A sliding-wedge breechblock is rectangular in cross section and slides in a rectangular recess, under the action of an operating lever which opens and closes the breech. The block may slide either horizontally or vertically, depending

upon the particular design of the breech mechanism. Where the motion of the breechblock is vertical, the mechanism is classified as the drop-block type (Figure 12). Where the motion is horizontal, the block is called a horizontal sliding-wedge breechblock (Figure 13.)

Operation. - Figure 14 illustrates the general operation of a sliding-wedge breechblock. In *A*, the breechblock is open, ready to receive the ammunition. The cartridge is shoved into the breech almost to a seated position, as shown in *B*. In *C*, under the action of the operating mechanism, the breechblock slides over the breech face. The breechblock is beveled on its forward face. This bevel forces the cartridge to a seated position, and the breechblock seals the cannon, which is then ready for firing.

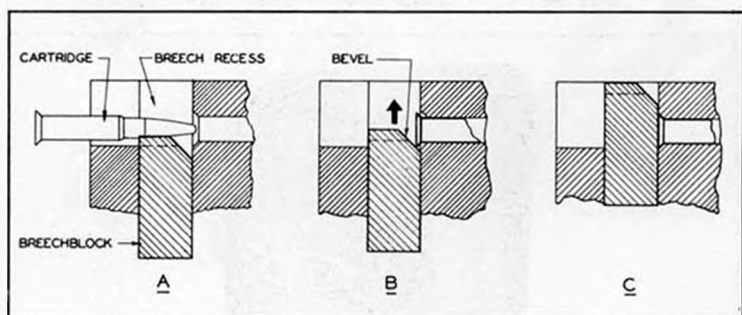


Figure 14 -- Operation of sliding-wedge breechblock

SEMI-AUTOMATIC BREECH MECHANISM. - General. - A semi-automatic breech mechanism is one in which some of the operations of opening and closing the breech, and of loading or extracting the cartridge, are performed manually, and others are performed automatically by utilizing the energy of recoil or the pressure of the powder gases. The sliding-wedge system is particularly adaptable to semi-automatic operation.

Operation. - The operation of a semi-automatic breech mechanism is illustrated schematically in Figure 15. *A* shows the system at rest, with the operating crank (connected to the breechblock) on the cannon, and the operating cam (see Figures 15a and 15b) mounted on a frame which is part of the carriage. As the cannon recoils (*B*), the crank slides under the cam. The cam then automatically returns to its original position. During counter-recoil (*C*), the crank, which is free to rotate, strikes the fixed cam. This causes the crank to rotate, thereby opening the breechblock downward where it is locked open. As the crank rotates, it also stores up energy in a coil spring. Insertion of a round of ammunition releases the breechblock and causes the block to close under the action of the coil spring.

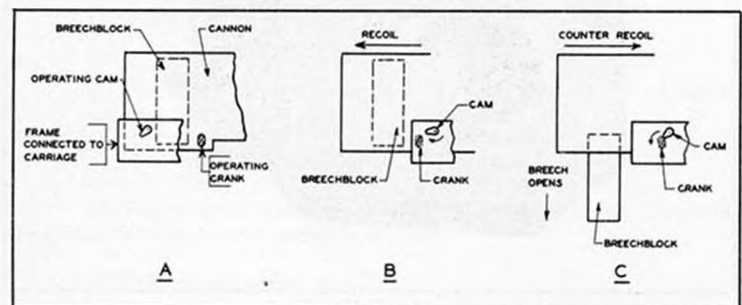


Figure 15 -- Operation of semi-automatic breech mechanism

EXTRACTOR. - An extractor is a mechanical device for withdrawing a cartridge case from the chamber of a cannon. The operation of one type of extractor is illustrated in Figure 16. Opening the breechblock causes the extractor to move against the flange on the base of the cartridge case, thereby forcing the case out of the cartridge chamber.

OPERATING MECHANISMS

A breechblock operating mechanism is a device which unlocks and withdraws the breechblock from the breech, swings the block clear of the breech recess, and then returns it to the firing, or closed, position after loading. There are two types of operating mechanisms: namely, carrier-supported and tray-supported.

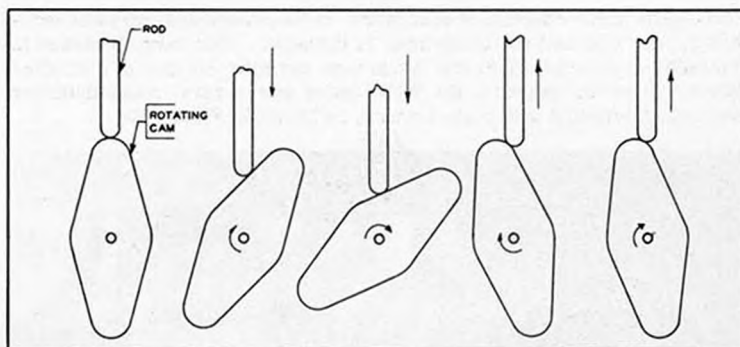


Figure 15a -- Rotating cam

A cam is a moving part whose surface either imparts motion to, or receives motion from, another part by sliding contact. Figure 15a shows a rotating cam imparting motion to a rod which is in contact with the cam surface. Figure 15b illustrates the up and down motion received by a projecting cam from a horizontally moving bar.

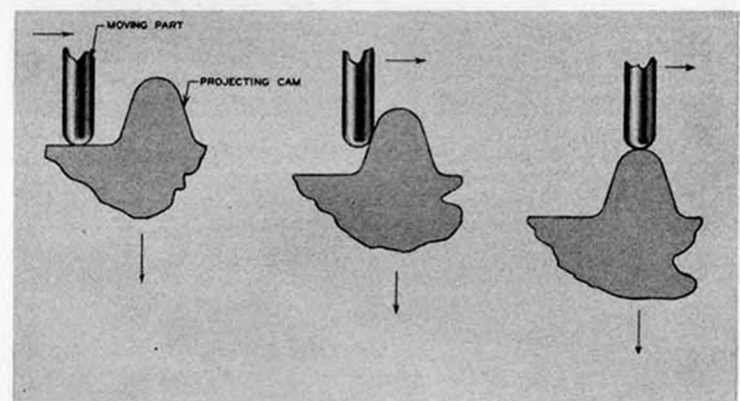


Figure 15b -- Projecting cam

CARRIER-SUPPORTED OPERATING MECHANISM. - Operation. - This type of mechanism performs two cycles in opening or closing the breechblock, as follows:

- (1) It rotates the block until the threads on the block are disengaged from the threads of the breech.
- (2) It then withdraws the block from the breech recess and swings it clear of the breech.

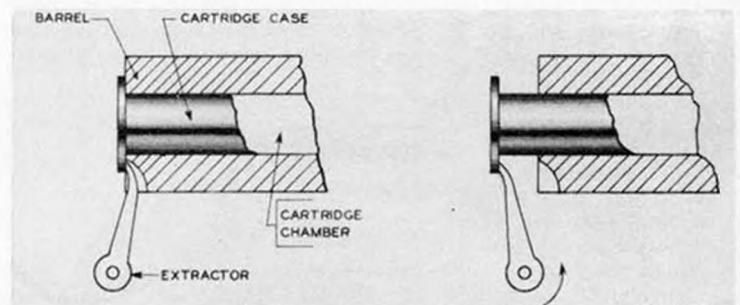


Figure 16 -- Extractor

Breechblock carrier. - A breechblock carrier is a breechblock support which is hinged to the breech section of a cannon. The carrier may be hinged either vertically or horizontally, thereby causing the block to swing open from the breech by:

- (1) A horizontal swing (see Figure 17), or
- (2) A vertical swing (see Figure 18.)

Operating lever. - This is a crank or lever which unlocks and withdraws the breechblock from the breech and returns it to the firing position. (See Figure 17.)

TRAY-SUPPORTED OPERATING MECHANISM. (See Figure 19.) **Operation.** - This type of operating mechanism is used on the older

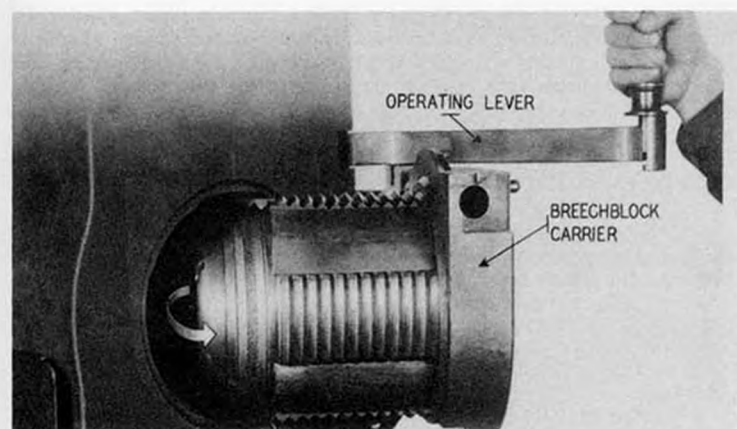


Figure 17 -- Horizontal-swing breechblock carrier

large-caliber cannon. It accomplishes three cycles of motion in opening or closing the breech:

- (1) It rotates the block until its threaded sectors are disengaged from the threaded sectors of the breech.
- (2) It translates the breechblock to the rear, pulling it out of the breech recess onto a tray.

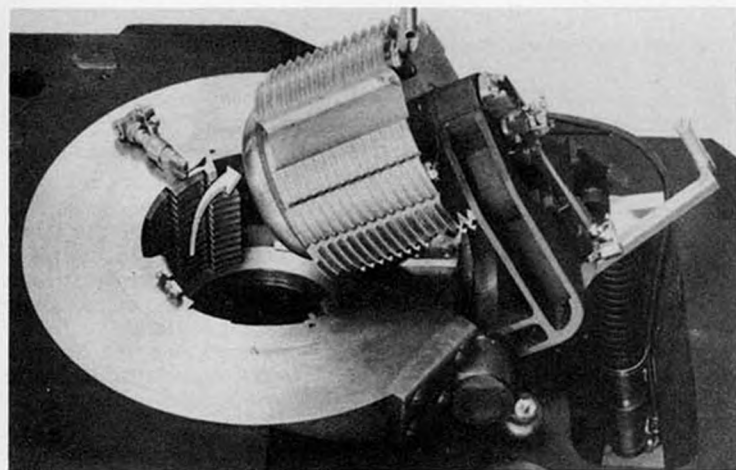


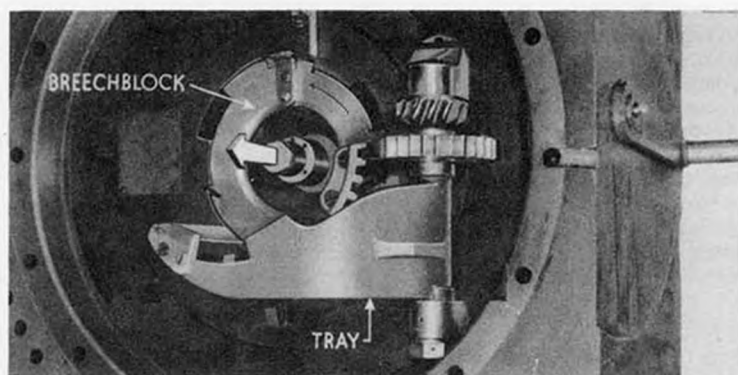
Figure 18 -- Vertical-swing breechblock carrier

- (3) It then swings the block and the tray, as a unit, away from the breech, leaving the cannon free for loading.

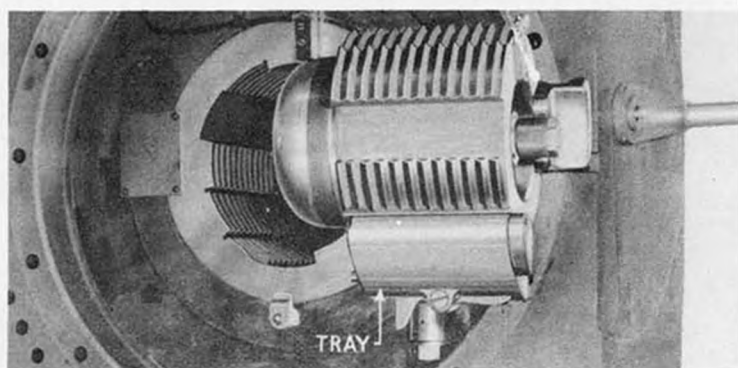
Breechblock tray. - The breechblock tray is a wide tray, hinged to the breech of a cannon, which supports the breechblock when it is withdrawn and when it is swung clear of the breech.

FIRING MECHANISMS

A firing mechanism is a device which causes the ignition of the primer which, in turn, ignites the propelling charge of a round of ammu-



Closed



Open

Figure 19 -- Tray-supported operating mechanism

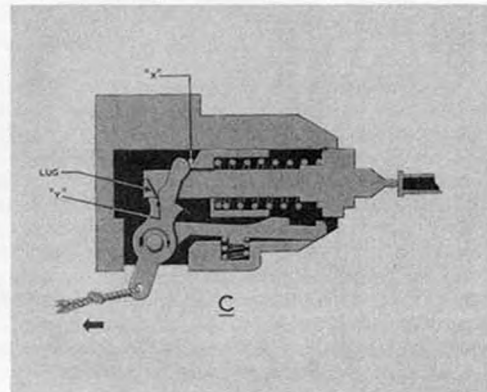
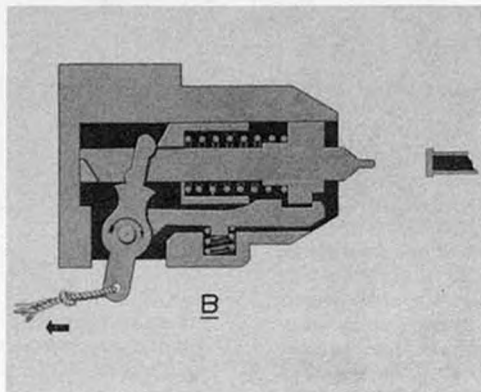
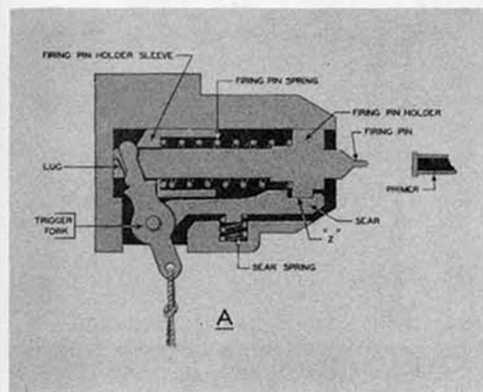
nitition. There are four principal types of firing mechanisms, namely: continuous-pull, inertia, percussion-hammer, and electric.

CONTINUOUS-PULL FIRING MECHANISM. - General. - This type of firing mechanism is used on cannon firing fixed ammunition. The complete operation of a continuous-pull firing mechanism is effected by one continuous pull of the lanyard. Actually, there are three phases in the firing cycle:

- (1) **Cocking phase.** (Figure 20, B.) - In this phase, the first part of a pull on the lanyard compresses the firing pin spring.
- (2) **Firing phase.** (Fig. 20, C.) - In this phase, the remaining part of the lanyard's movement disengages the sear, thus allowing the spring to expand and force the firing pin against the primer, firing it.
- (3) **Retracting phase.** - In this phase the lanyard slacks, and the firing mechanism parts return to their position at rest (Figure 20, A).

Firing lock. (Figure 20.) - The firing lock is a modern continuous-pull firing mechanism which is in general use in our service. The complete assembly is installed in a recess provided in the breechblock. A pull on the lanyard rotates the trigger fork clockwise, which forces the firing-pin holder sleeve forward, thus compressing the firing-pin spring (Figure 20, B). A further pull on the lanyard causes the sleeve to continue forward and to cam down the sear, disengaging the sear from the firing-pin

Figure 20 -- Continuous-pull firing mechanism



holder. The firing-pin holder then flies forward under pressure of the firing spring, and the firing pin strikes the primer, setting it off (Figure 20, C). Upon release of the lanyard, the firing-lock parts return to their positions at rest (Figure 20, A) in the following manner: The firing spring presses forward on the firing-pin holder and rearward on the sleeve. When the spring expands (Figure 20, C), it forces the sleeve rearward against the trigger fork at point "X". The trigger fork, in turn, presses against lugs on the firing-pin holder at point "Y". Due to a longer lever arm, the action of the sleeve on the trigger fork overcomes the reverse pull of the firing-pin holder on the fork. Therefore, the trigger fork rotates rearward, drawing the firing-pin holder back until it is engaged again with the sear at point "Z" (Figure 20, A).

(1) Cocking phase. (Figure 21, B.) - In this phase, the cocking lever is rotated clockwise. The lower end of the lever bears against lug "A", moving the guide rearward and compressing the firing spring until lug "B" passes the sear. Under the action of the sear spring, the sear then jumps across the guide in front of lug "B". The firing spring is now fully compressed and tends to shoot the guide and firing pin forward. However, lug "B" bears against the sear, which prevents the guide from flying forward. The system is now cocked, ready for firing.

(2) Firing phase. (Figure 21, C.) - In the firing phase, the sear is pushed down across the guide and is disengaged from lug "B". This releases the guide, which flies under the pressure of the firing spring.

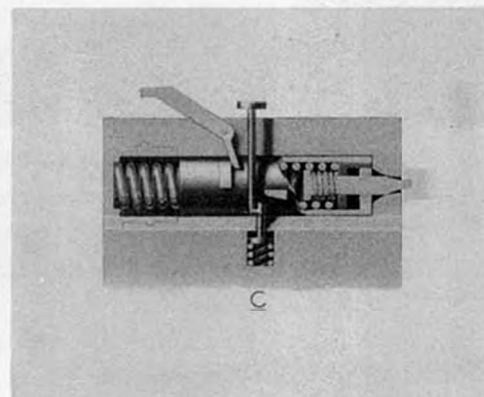
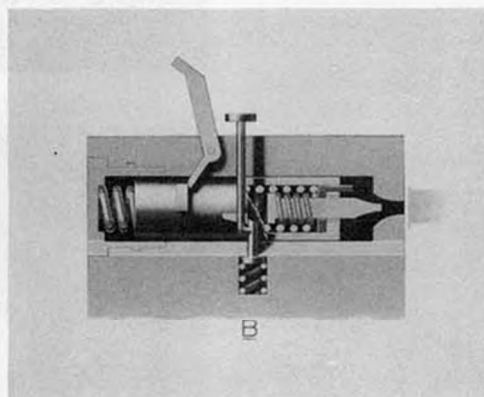
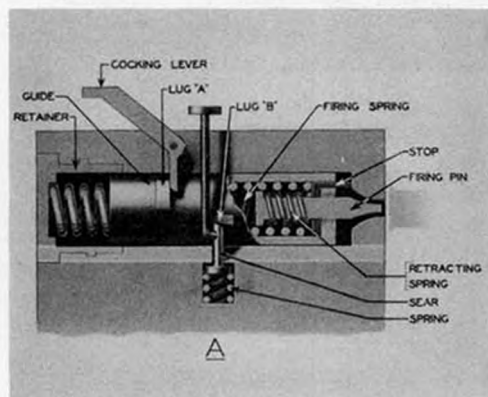


Figure 21 -- Inertia firing mechanism

INERTIA FIRING MECHANISM. (Figure 21.) - Description. - The essential parts of an inertia firing mechanism are as follows: guide, firing pin, firing spring, cocking lever, sear, stop, retracting spring, and retainer. The complete assembly is installed in a recess provided in the breechblock and is held in place by the retainer. The guide has two lugs on its outside circumference, namely: lug "A" and lug "B". The firing pin is screwed to the guide and for all practical purposes is integral with it. The moving parts are the guide (with firing pin attached) and the stop. The guide slides against the breechblock walls. The stop and the retracting spring both slide inside the guide on the firing pin. The forward end of the retracting spring bears against the stop, and the other end bears against a shoulder on the rear end of the firing pin. Figure 21, A shows the system at rest.

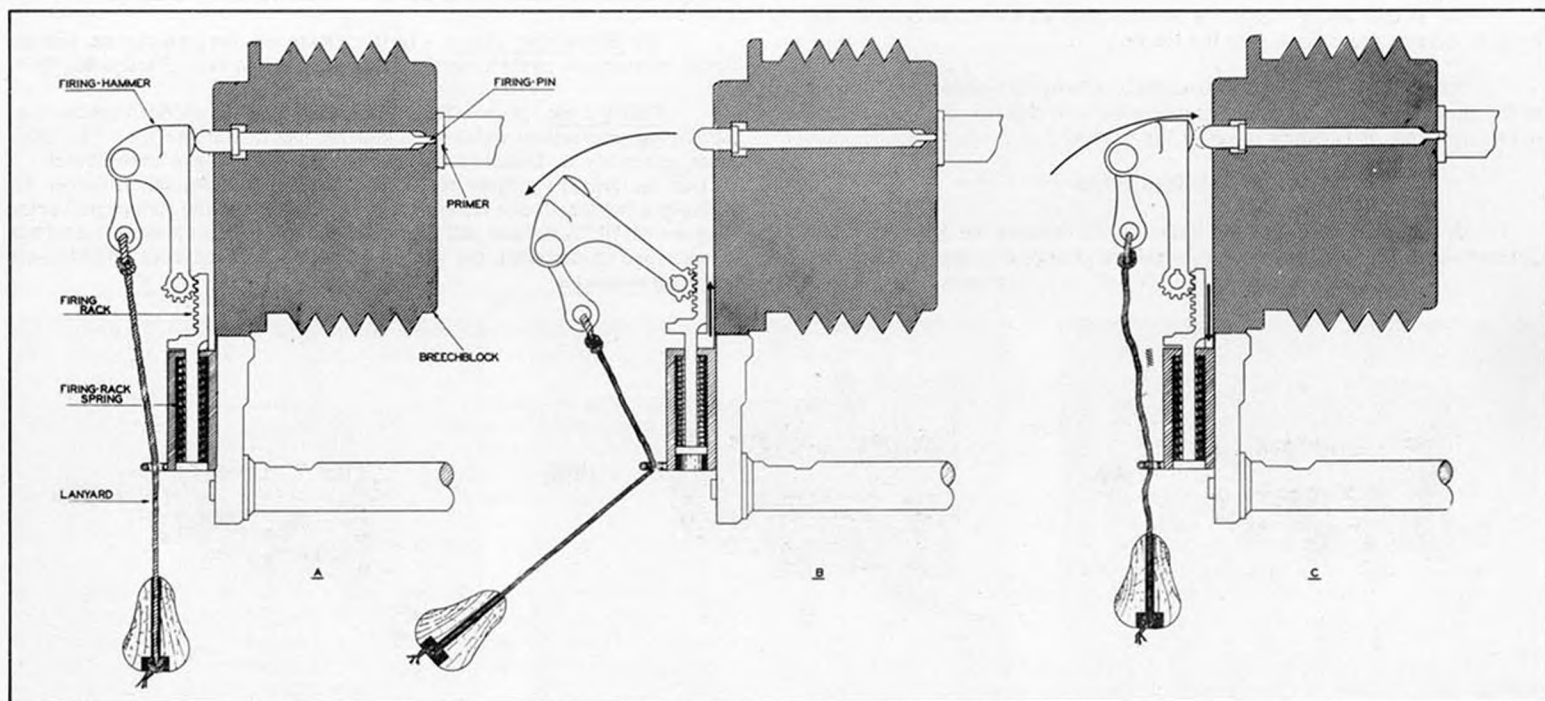
Operation. - There are three phases in the operation of this firing mechanism.

The stop strikes the forward end of the breechblock; the guide continues forward until it, too, strikes the breechblock; and the firing pin hits the primer, firing it. The retracting spring is compressed between the stop and the shoulder on the firing pin.

(3) Retracting phase. - In order that the firing pin may not be sheared off as the breechblock is opened, it must be retracted, or pulled back, into the breechblock. This is accomplished under the action of the retracting spring, as follows: The compressed retracting spring pushes rearward on the firing pin and is restrained only at its forward end by the stop and breechblock. The guide (with firing pin attached) is free to move to the rear. Thus, the compressed retracting spring expands, pulling the firing pin back into the breechblock. The system is then at rest (Figure 21, A) ready for subsequent cocking and firing.

PERCUSSION-HAMMER FIRING MECHANISM. - A percussion-hammer type of firing mechanism is one in which a hammer, actuated by

Figure 22 -- Percussion-hammer firing mechanism



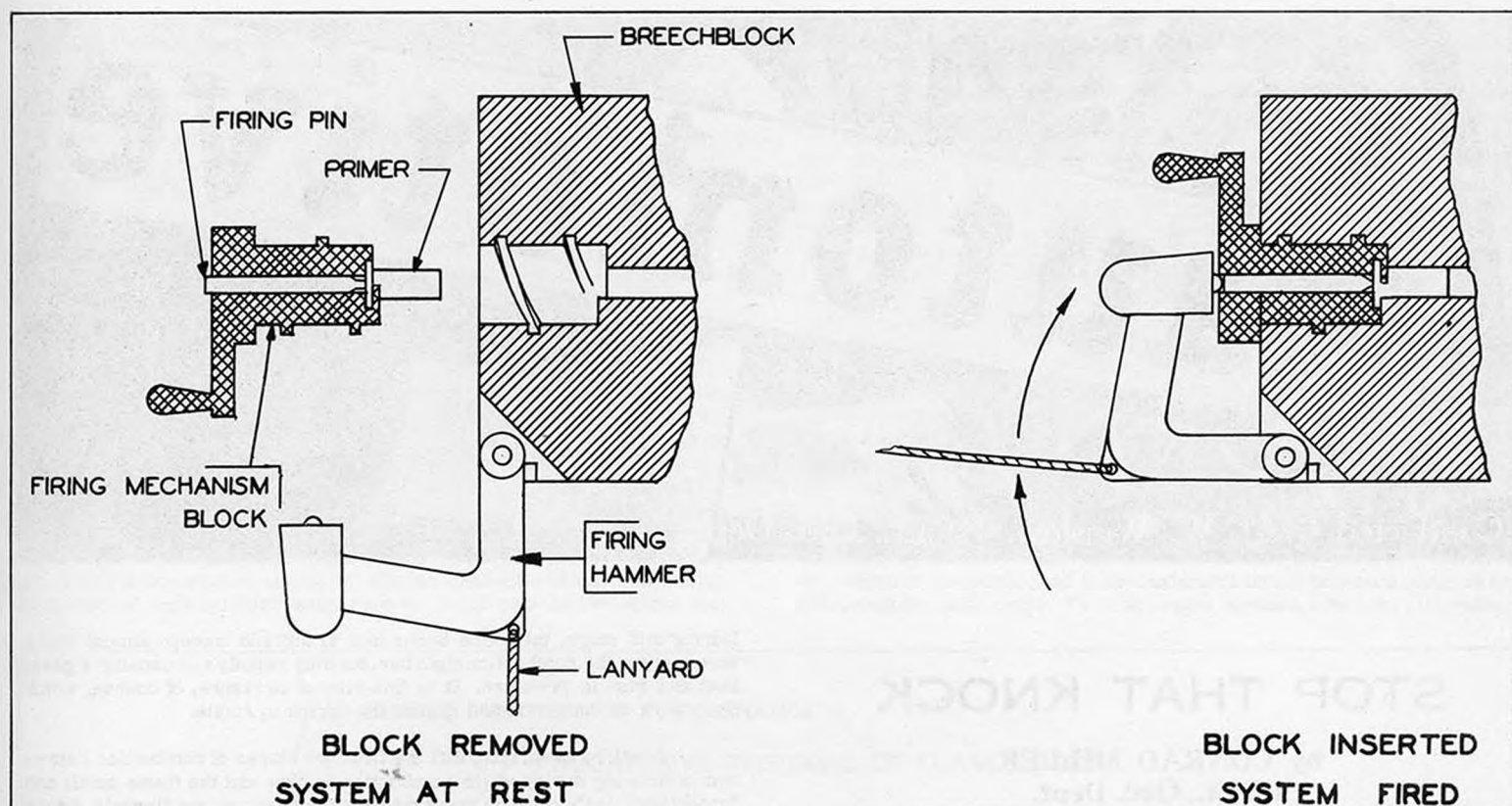


Figure 23 -- Firing mechanism block

the pull of a lanyard, strikes the firing pin and fires the cannon. Figure 22 schematically shows the operation of one type of percussion-hammer firing mechanism. In Figure 22, A the system is shown at rest. Teeth on the firing hammer arm engage teeth on the rack, and the firing-rack spring holds the system in position. In Figure 22, B, the firing hammer is pulled to the rear by the lanyard. This pulls the rack upward, thereby compressing the firing-rack spring. In Figure 22, C, the lanyard is released; the rack is pulled down by the compressed spring; and the hammer flies upward striking the firing pin which fires the primer.

FIRING MECHANISM BLOCK. - A firing mechanism block (Figure 23) is a detachable part of a percussion-hammer type of firing mechanism. It contains a firing pin and a seat into which a primer is inserted. With a primer inserted in the block, the entire firing mechanism block is then screwed into a recess provided in the breechblock. After firing, the firing mechanism block is unscrewed from the breechblock, the old primer case is removed, and a new primer is placed in the firing mechanism block ready for firing the next round. A firing hammer strikes the firing pin, which in turn strikes the primer.

ELECTRIC FIRING MECHANISM. - An electric firing mechanism uses a firing magneto in circuit with an electric primer. One side of the line is connected by an insulated wire to the primer, and the other side is grounded to the frame of the cannon. Electric current flowing from the magneto sets off the primer.

SAFETY DEVICES

There are various forms of safety devices designed to prevent accidents. These devices include;

- Those which prevent operation of the firing mechanism when the breechblock is not fully closed.
- Those which prevent firing when the cannon is not in battery.
- Those which prevent firing when the cannon is disconnected from the recoil system.

OBTURATOR

OBTURATION. - Definition. - Obturation is the prevention of the rearward passage of powder gases into the threads and other parts of the breech mechanism. These gases, which have great velocities and high

temperatures, would soon erode and ruin the breech mechanism and would materially affect the ballistics of the cannon if a means of obturation were not introduced.

How effected. - (1) In cannon using fixed or semifixed ammunition, obturation is performed by the cartridge case, which expands, under pressure in the bore, to a tight seal against the walls of the powder chamber.

(2) In cannon using separate-loading ammunition, an obturating device must be included in the breech mechanism to prevent the rearward escape of powder gasses. The DeBange obturator is used exclusively in our service.

THE DeBANGE OBTURATOR. - The DeBange obturator is illustrated diagrammatically in Figure 24. A mushroom head is mounted on a spindle which is attached to the breechblock. Between the mushroom head and the breechblock is a plastic pad made of asbestos, tallow, and

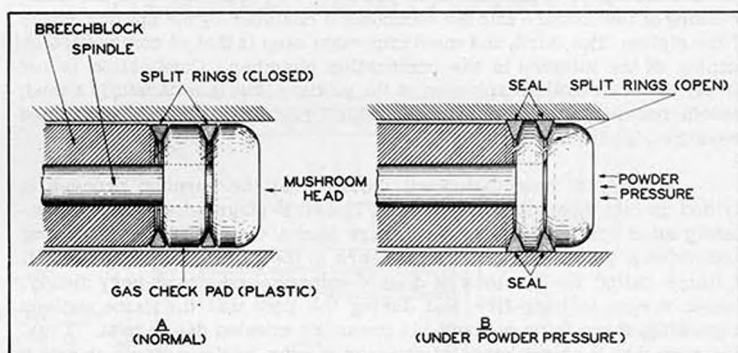
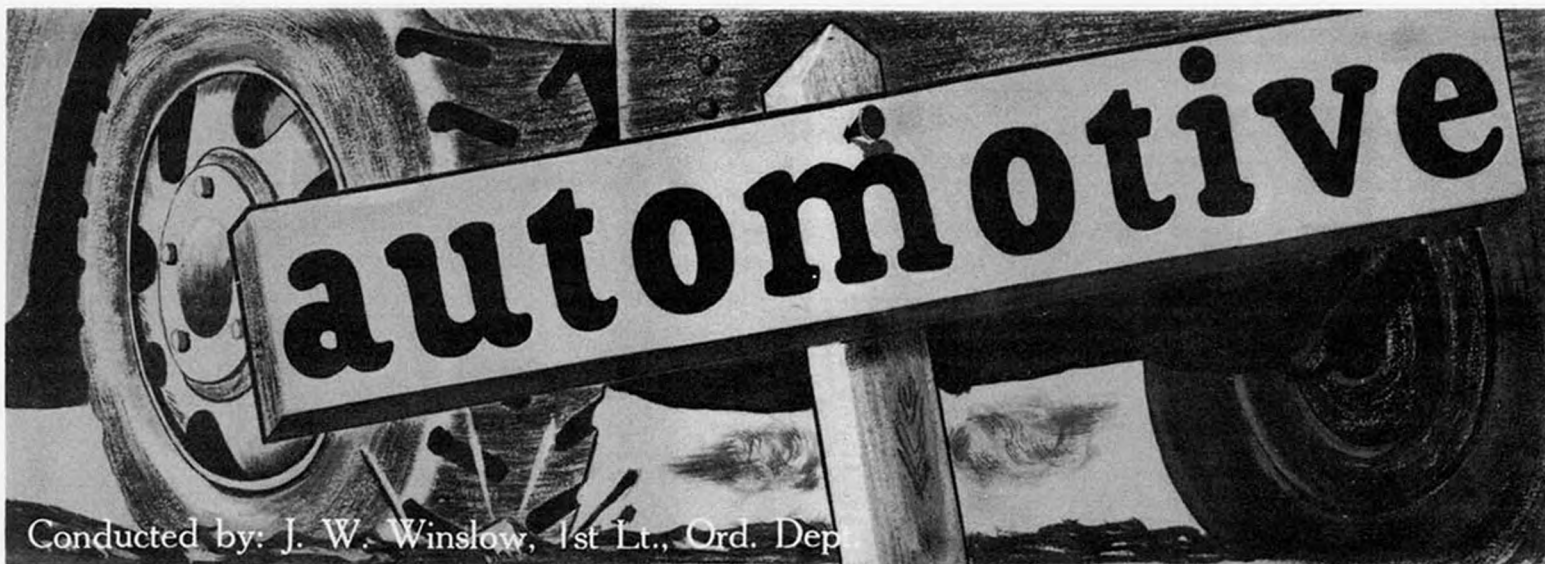


Figure 24 -- DeBange obturator

paraffin. This pad is called the gas check pad. Two steel split rings, which are ground to seat accurately in the breech recess, encircle the gas check pad, as shown. When the cannon is fired, the gas pressure acts against the mushroom head, which compresses the plastic pad, as shown in Figure 24, B. This causes the pad to expand radially against the split rings, which in turn expand to make a gastight seal against the breech recess wall. After firing, the gas pressure is dissipated; the plastic pad returns to its normal shape; the split rings contract to their original size; and the breechblock is then free to open.



STOP THAT KNOCK

by CONRAD MILLER
1st Lt., Ord. Dept.

One of the most common yet most damaging mal-functions of the gasoline engine is detonation; more popularly called "pinging" or "knocking". This undesirable phenomenon, so common in modern high compression engines, places engine parts under high stress, decreases power, increases fuel consumption and shortens bearing life. Even worse, in its most violent form it may shatter pistons, fracture cylinder heads or in other manner put an engine out of action. In order that the causes and prevention of detonation be better understood it is desirable that combustion be discussed from two viewpoints: Normal combustion, and combustion with detonation.

NORMAL COMBUSTION

In an engine incorporating either the two stroke or four stroke cycle, the first step in the cycle is the charging of the cylinder with a combustible mixture of gasoline vapor and air. The second step is the compressing of the mixture into the combustion chamber by the upward sweep of the piston. The third, and most important step is that of combustion or burning of the mixture in the combustion chamber. Combustion is not simply an uncontrolled explosion of the mixture, but is a carefully timed, smooth burning of the fuel and air which results in a pre-determined pressure rise in the cylinder.

A study of combustion will reveal that the burning process is divided up into three distinct stages. The first stage takes place immediately after spark. As soon as a spark jumps the gap of the spark plug electrodes a small ball of flame appears in the gap. This tiny blue ball of flame called the "nucleus of flame" enlarges and grows very slowly, almost seems to hang-fire, and during the time that the flame nucleus is growing, there is no measurable pressure created due to heat. Thus, it is seen that the first stage of combustion, the nucleus stage, causes a lag in burning. As the nucleus enlarges it leads to the second stage of combustion — the "hatching-out" stage. This second stage consists of tearing apart the nucleus so that it sends streamers of flame into the adjacent mixture in the combustion chamber. The fingers of flame which shoot out from the tiny nucleus cause enough heat to give only a slight rise in pressure and temperature of the whole charge of fuel-air, so that even the second or hatching stage of combustion represents a lag in the real business of creating a pressure rise in the cylinder.

The feelers of flame which represent the hatching period of the burning process lead to the third or "propagation" stage of combustion.

During this stage, the flame burns in a "front" and sweeps almost like a wave across the combustion chamber, burning rapidly and causing a great heat and rise in pressure. It is this rise of pressure, of course, which does work on the piston and causes the engine to rotate.

It will be seen, then, that the first two stages of combustion represent a time lag during which combustion is slow and the flame small and "uncertain". In the third or propagation stage, however, the flame is strong and sweeps from the vicinity of the spark plug to the most remote points in the combustion chamber — great heat and pressure rise accompanying the flame. But in all events, it is noted that the burning is progressive like the burning of smokeless powder as opposed to the action of TNT.

COMBUSTION WITH DETONATION

In a detonating cycle, the cylinder is charged in a normal manner, compression takes place as usual, spark occurs properly near the end of compression, the first two stages of combustion are perfectly normal, and then the third stage or propagation of the flame starts. It is during the third stage of combustion that detonation takes place.

During the third stage of combustion the flame sweeps rapidly from the vicinity of the spark plug out toward the walls of the combustion chamber. The portions of the chamber through which the flame has passed contain dead, inert, nonburnable gases. The portion of the chamber yet untouched by the flame contains highly compressed, heated, combustible gases. As the flame races through the chamber it further compresses and heats these yet unburned gases ahead of it, compressing and heating them to high temperatures. Under these circumstances and with certain fuels, this extreme heating of the un-burned portion of the charge causes it to ignite spontaneously and explode violently. This is detonation.

It is seen, then, that detonation is the uncontrolled instantaneous explosion of the last portion of the charge to burn, and is caused by the heating and compressing of the un-burned portion of the charge by the rapidly burning flame front.

Detonation should not be confused with pre-ignition. Detonation takes place late in the burning process after spark has occurred. Pre-ignition, on the other hand, is an igniting of the charge during the compression stroke sometime before spark occurs and is caused by some form of hot spot within the cylinder such as an overheated exhaust valve head, hot spark plug or incandescent piece of carbon. Pre-ignition may lead to detonation or vice versa, but the two are separate and distinct phenomena.

Detonation harms an engine and its performance in many ways. The sudden uncontrolled explosion of the last portion of the charge to burn increases the pressure so rapidly that the confined gases in the combustion chamber rap sharply against the cylinder head and walls causing the well known "knock". It is hard to believe that the pressure rise can be so sharp and violent as to cause this metallic-like hammering. On the other hand, it is easy to visualize the ill effects of this sudden

pressure. Parts which are designed to stand the normal stresses of slow controlled pressure rise, are suddenly subjected to terrific shock loads, the result being that structural failure often results. In some cases of persistent violent detonation, pistons have been shattered, rings broken, cylinders burst, heads cracked and other sudden failures observed. Lesser ill effects of detonation are overheating, broken spark plugs, overloaded bearings, high fuel consumption, loss of power, and vastly shorter periods of operation between overhauls.

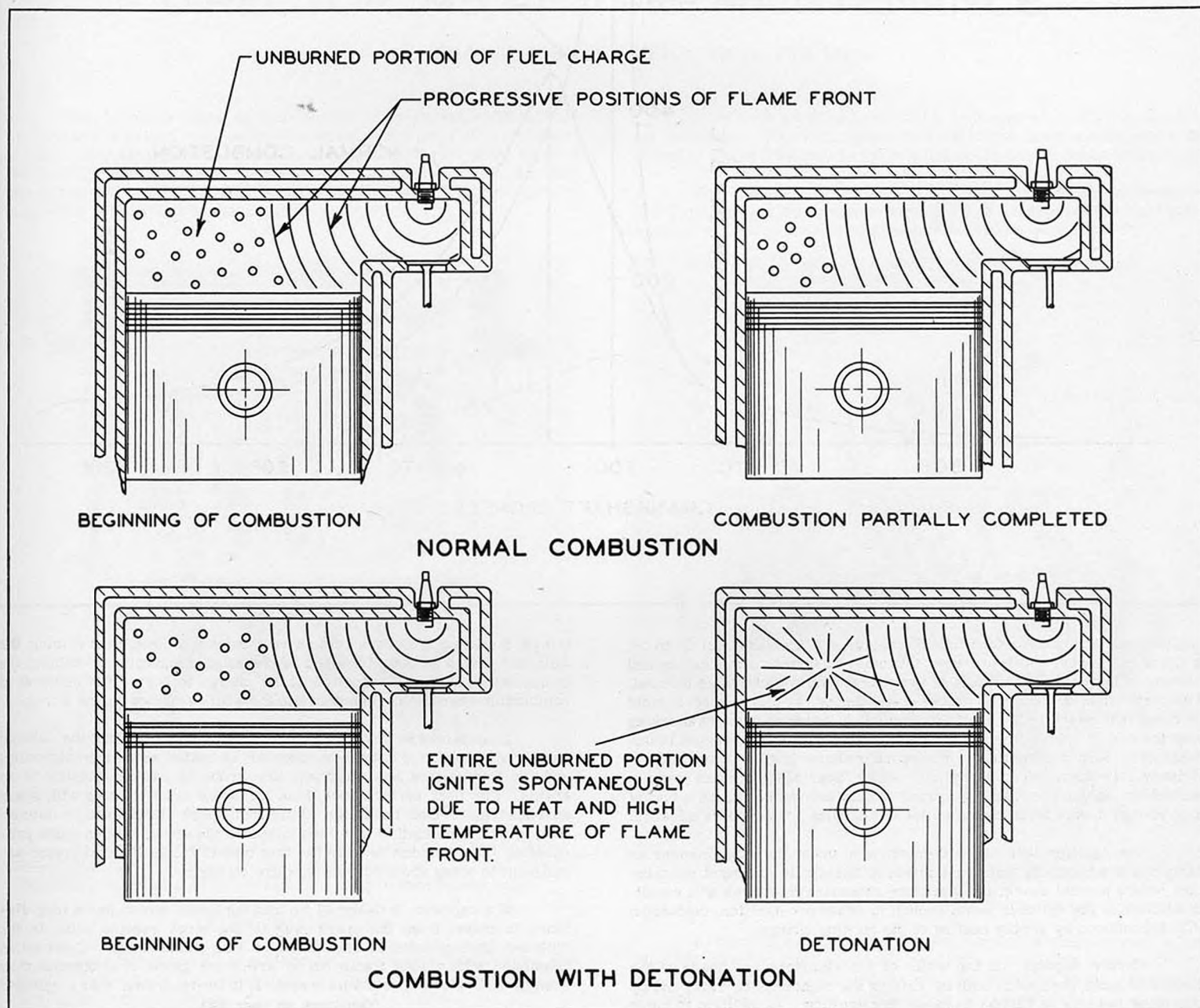
SOME CAUSES OF DETONATION

The use of a low octane fuel will cause an engine to detonate. It is understood, of course, that no one octane fuel can be classed as "High octane" or "Low octane"; the term is purely relative and refers to the ability of a fuel to resist detonation or self-ignition due to high temperatures and pressures. Octane number, so called, has nothing whatsoever to do with the starting qualities, vapor-lock qualities, heat value or latent heat of a fuel. It simply relates to its ability to resist detonation. Therefore, if an engine will perform as specified with proper spark timing on a fuel of, say, 60 octane gasoline, it will not perform one iota better on 100 octane gasoline! If, on the other hand, the engine detonates while running on 60 octane gasoline, the use of a fuel of higher octane number will suppress the detonation and improve the performance of the engine. A high compression engine requires a higher octane fuel than a low compression engine of similar characteristics. An engine which runs at high cylinder temperatures requires a higher octane fuel

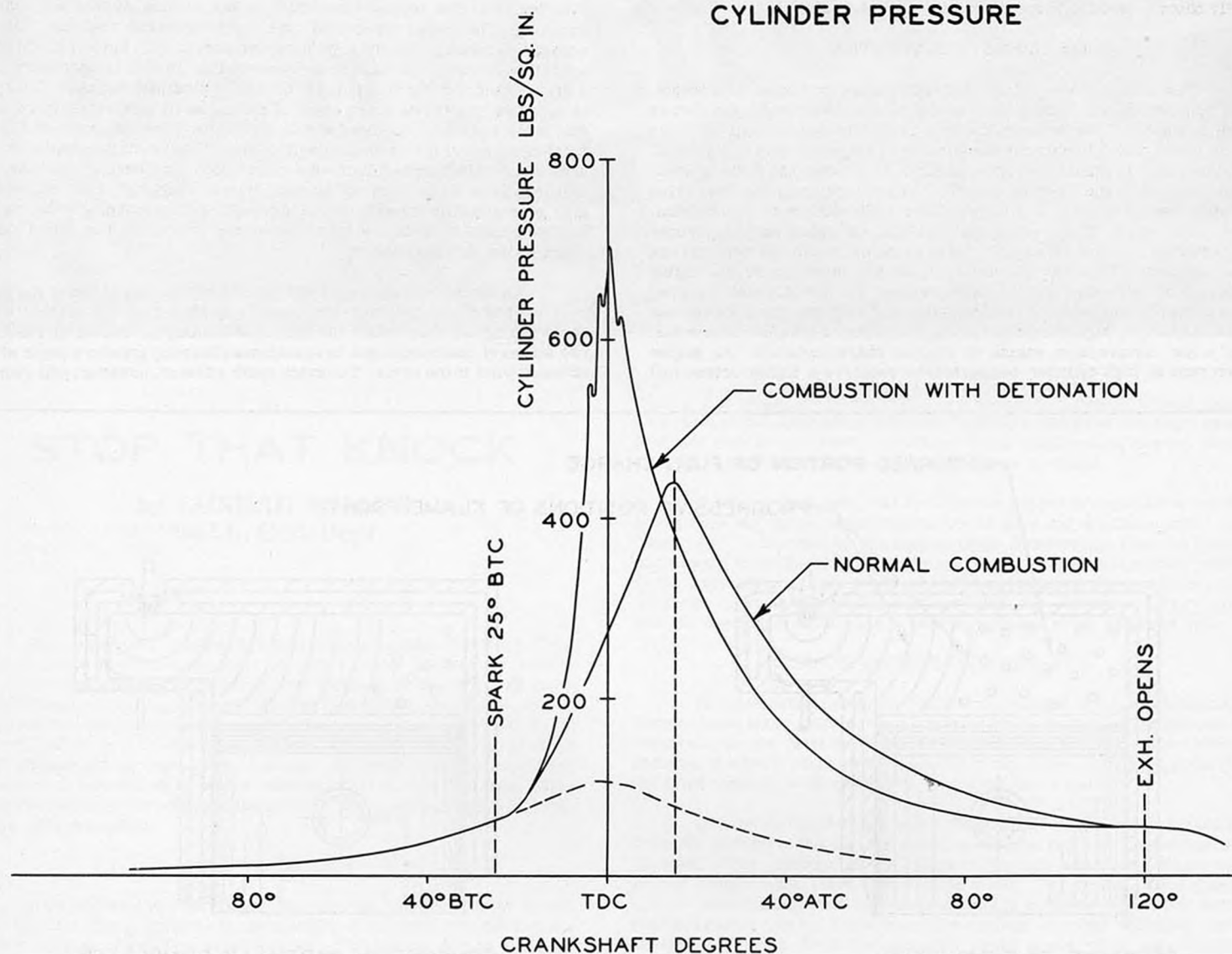
than a similar cylinder of lower temperature. A cylinder of given compression ratio and large bore generally requires a higher octane fuel than another cylinder of the same ratio but smaller bore.

Anything which adds heat or pressure to the last portion of the charge to burn within a cylinder will aggregate detonation. (Review again, now, what detonation is.) Therefore, it is obvious that heating of the cylinder head due to mal-functioning of the cooling system will induce knocking. The radial air-cooled tank engine presents a special case as regards detonation due to high head temperatures. Since full throttle operation causes great heat flow to the cooling fins, it is necessary that a great quantity of air flow across the fins to dissipate the heat. This air is supplied by a fan on the flywheel of the engine; it is obvious, therefore, that if the engine is operated at full throttle and the fan prevented from rotating rapidly, the cylinders will overheat badly and detonation in its worst form will hammer inside the combustion chambers. This undesirable condition is brought on by tank drivers "lugging" their engines in high gear with open throttle. Nothing could be more damaging to the engine and the condition should be corrected where observed. The use of lower gears is the obvious answer.

An engine running at normal speeds has its spark timed to occur near the end of compression stroke and slightly before top center. This early timing is used to offset the effects of burning lag caused by the first two stages of combustion and have maximum burning pressure occur at an efficient point in the cycle. Too much spark advance, however, will reduce



EFFECT OF DETONATION ON CYLINDER PRESSURE



engine power and cause detonation. Excessive spark advance builds up too much pressure near top dead center, this causes a further compressing and heating of the unburned portion of the charge and detonation is induced. The correction, of course, is proper spark timing. In this respect it must be noted that retarding the spark excessively in order to suppress knocking with the use of low octane gasoline in a high compression engine is undesirable. Such retardation of the spark reduces engine power and efficiency, increases fuel consumption, causes "popping-back", and leads to burned out exhaust valves. An engine should always be run on a fuel of high enough octane value to resist detonation with proper spark advance.

Pre-ignition will cause detonation in much the same manner as early spark advance in that pre-ignition is simply an igniting of the mixture before normal spark, and therefore excessive pressures will result. In addition, if the cylinder is hot enough to cause pre-ignition, detonation is being induced by simple heating of the burning charge.

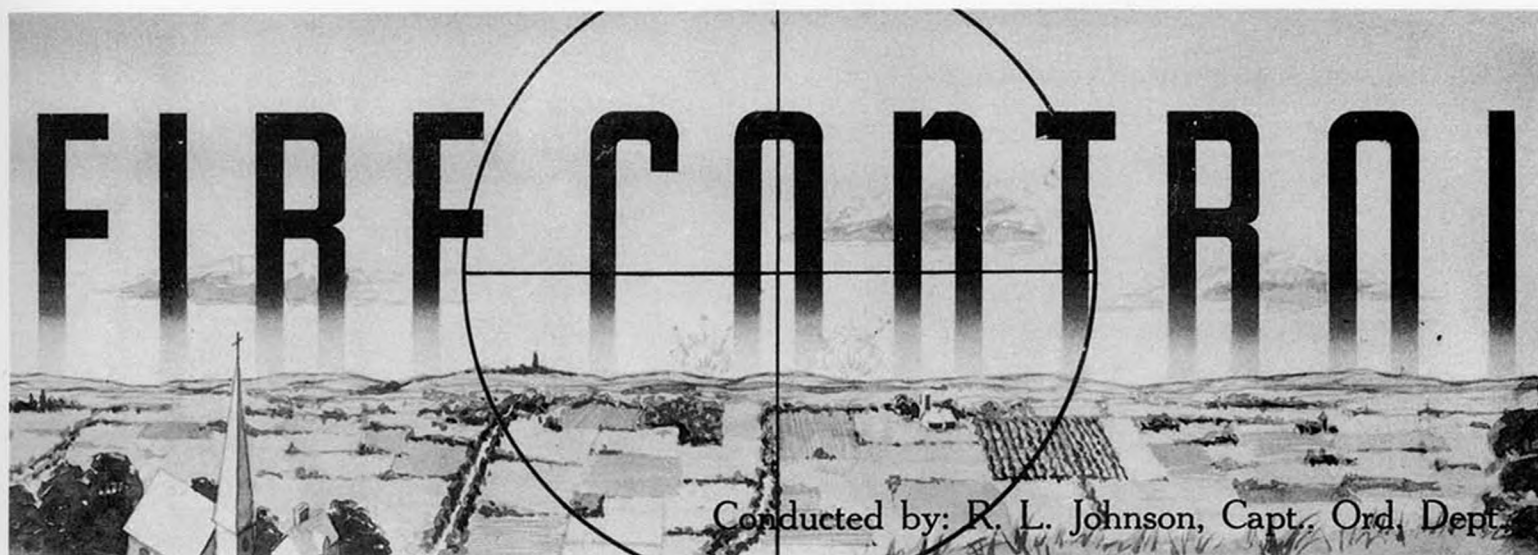
Carbon deposit on the walls of the cylinders and heads of the pistons induces detonation both by raising the compression ratio and by providing hot bits of carbon to cause pre-ignition. In addition to these

things, a coating of carbon acts as an insulator to heat, thus raising the wall and piston temperature and aggravating detonation by raising the temperature of the last portion of the charge to burn. The removal of combustion chamber carbon deposits therefore reduces engine knock.

Lean mixtures have such burning characteristics that the exhaust valve region of the combustion chamber is heated more than normally, and for this reason lean mixtures are prone to causing pinging in an engine. For best performance, lean mixtures must be used with spark advanced more than normally. Advanced spark itself induces detonation, and in combination with lean mixtures the effect is even more pronounced. The obvious remedy for this type of trouble is carburetor adjustment to bring about correct mixture strength.

If a cylinder is designed so that the flame within has a long distance to travel from the spark plug to the most remote point in the cylinder, that cylinder is said to have a long flame travel. Combustion chambers with a long flame travel are more prone to detonation than similar ones with a short flame travel. It is obvious, then, that a cylinder

(Continued on page 502)



Conducted by: R. L. Johnson, Capt., Ord. Dept.

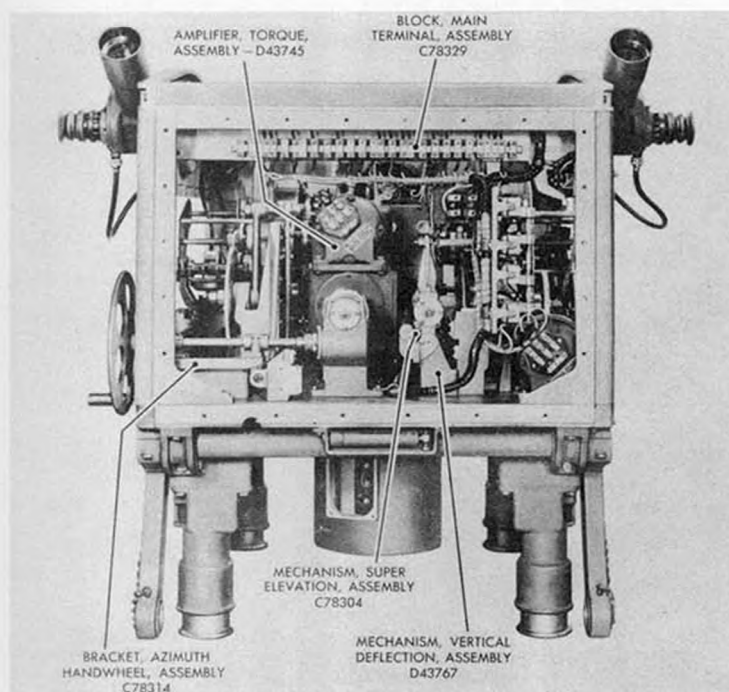
DIRECTOR, M5 AND M6, MAINTENANCE

by BRIAN O. MONTGOMERY, 1st Lt., Ord. Dept.

The following notes on maintenance of the Director, M5 and M6 are extracts from the Ordnance School text on maintenance of the director. Similar information should be available to field personnel in the form of a technical manual in the very near future. The number assigned to this manual is TM 9-1659. It may be secured through the usual channels of supply for publications of like nature.

Turn each levelling knob until it is in approximately the center of its movement. Place the director on the tripod, making certain that the plungers are well seated. Level both bubbles by use of the levelling knobs.

Slue the director through 360° azimuth. Both bubbles should be level at all points within a tolerance of 1-1/2 divisions of the vial. If the bubbles will not remain level an adjustment must be made.

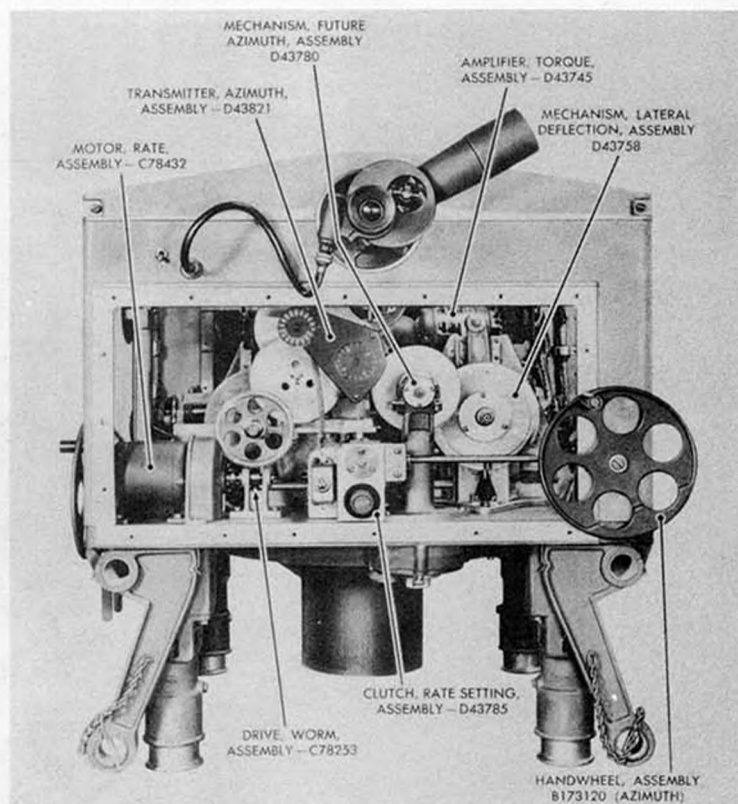


Director, AA, M5, front view, covers removed

Tests and adjustments of the torque amplifier of the Director, M5 and M6, were published in the October issue of THE ORDNANCE SERGEANT and should be referred to for maintenance of that unit.

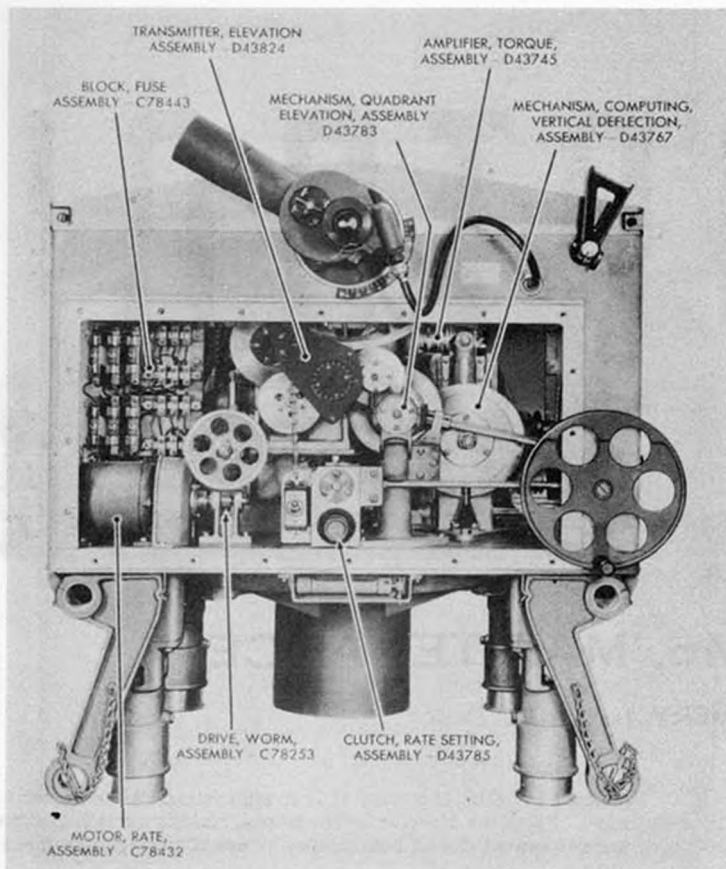
LEVELLING DIRECTOR

Place the tripod on a surface which is approximately level and which is sufficiently firm to support the weight of the director without allowing the tripod to settle.

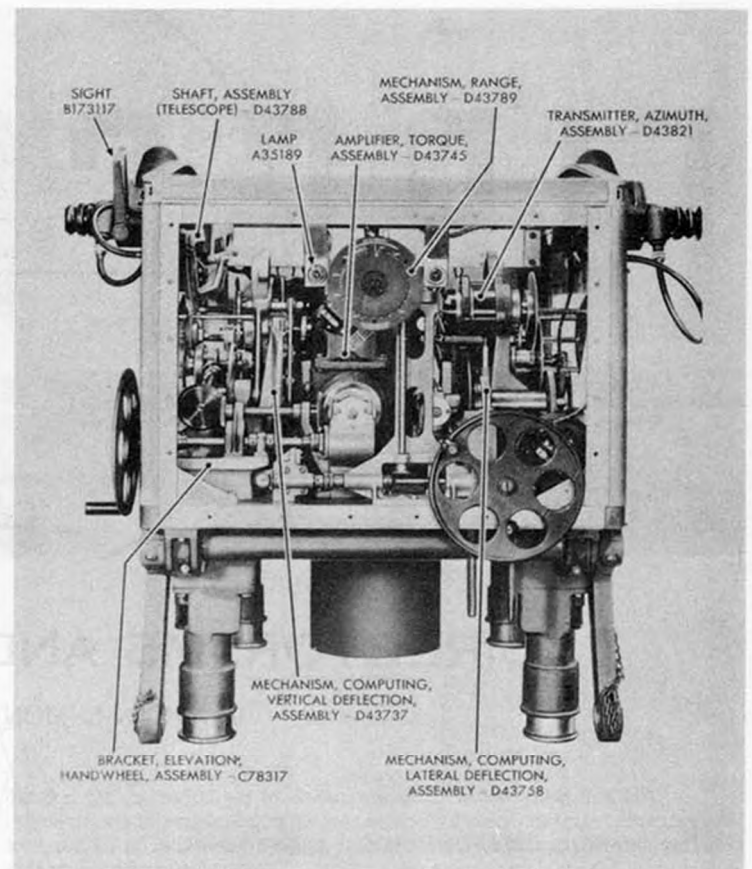


Director, AA, M5, azimuth side, covers removed

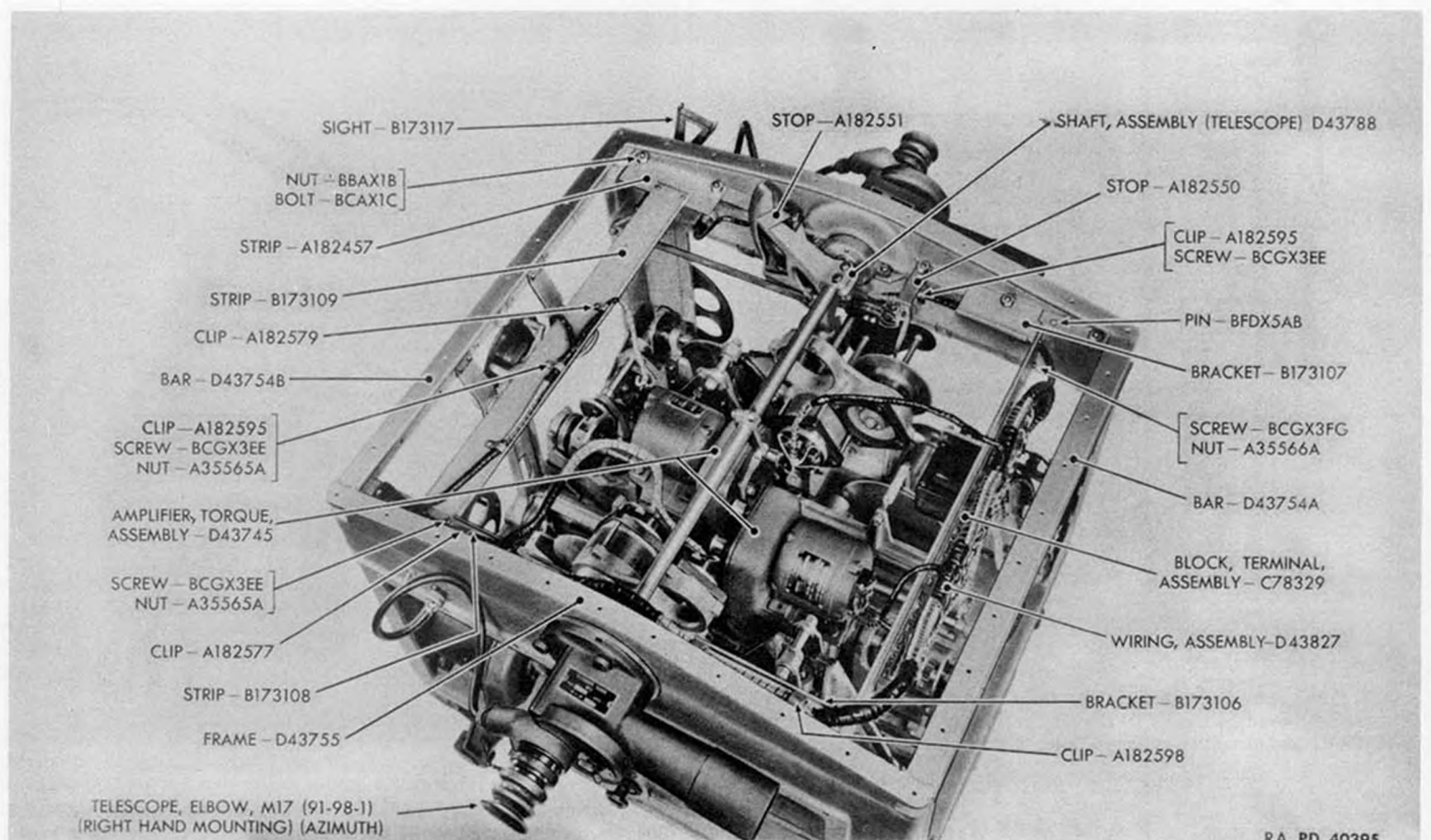
Arbitrarily assign each of the levelling knobs a number, i.e., 1, 2, 3. Slue the director until one of the levels is parallel with levelling knob 1 and 2. Roughly level this bubble with the levelling knobs. Disregard the movement of the other bubble during this adjustment.



Director, AA, M5, elevation side, covers removed

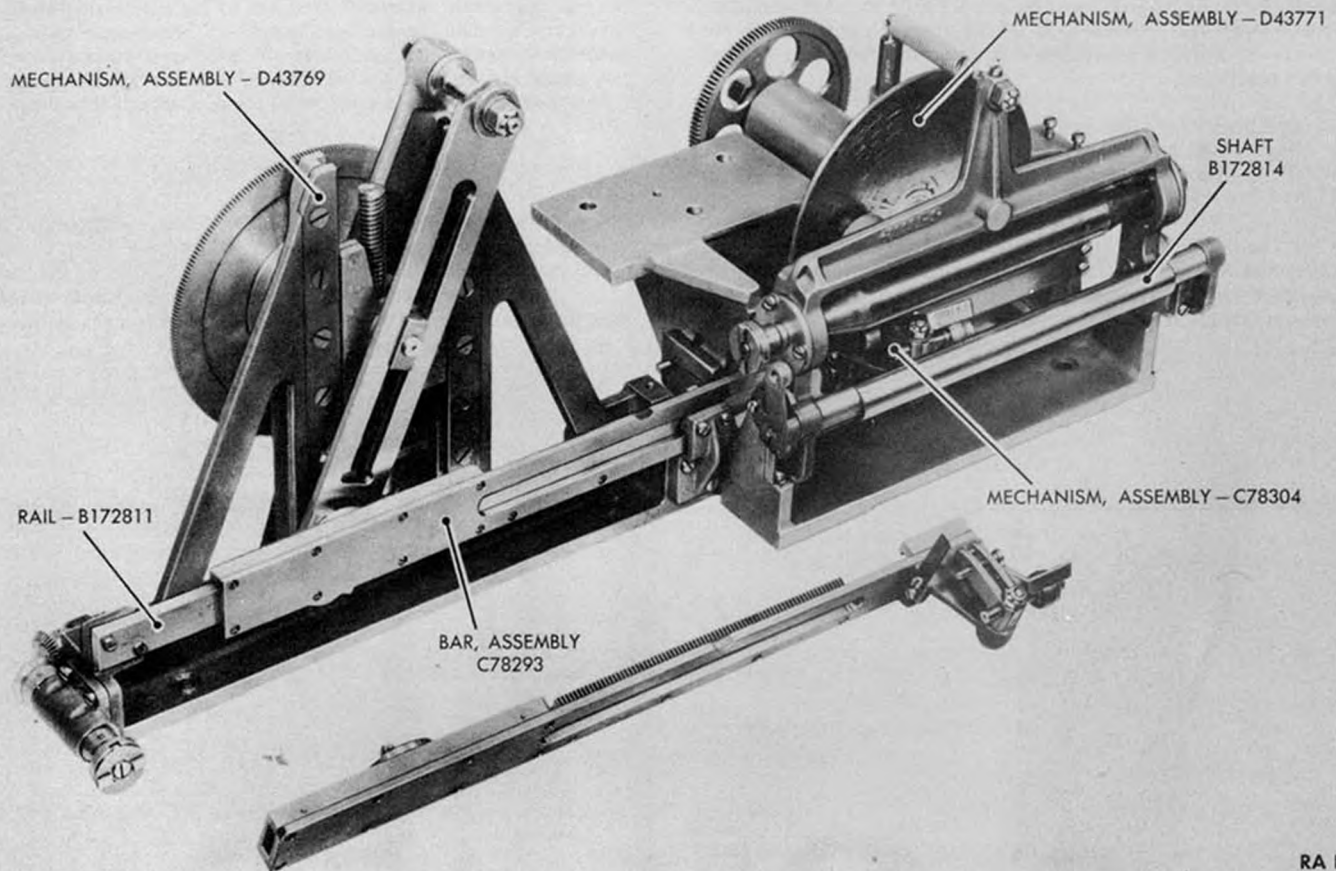


Director, AA, M5, rear view, covers removed

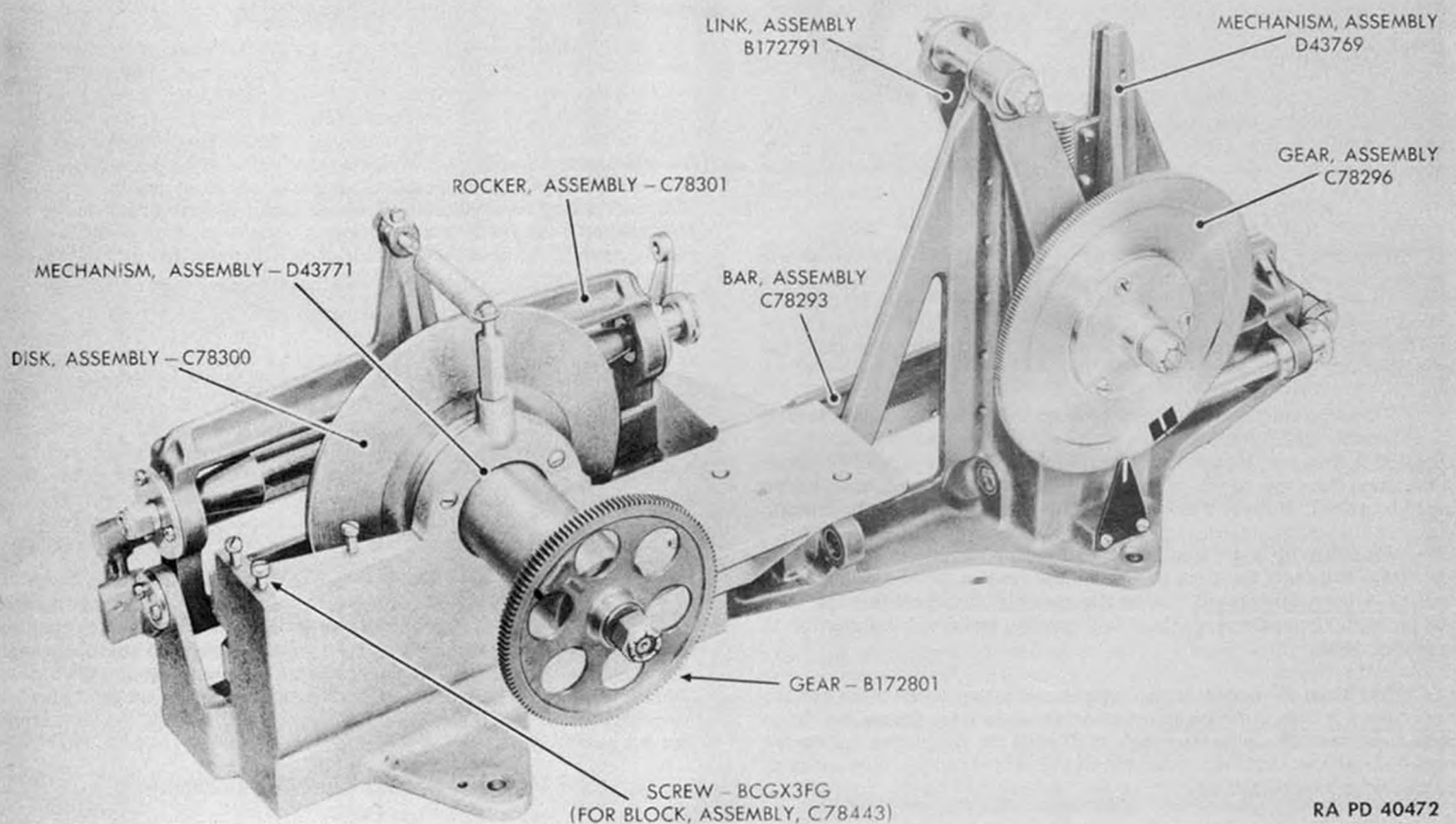


Director, AA, M5, top view, covers removed

RA PD 40395



Vertical deflection mechanism, assembly, D43767. Assembled view and additional view showing relation of connecting bar, assembly, C78293, and super elevation mechanism, assembly, C78304.

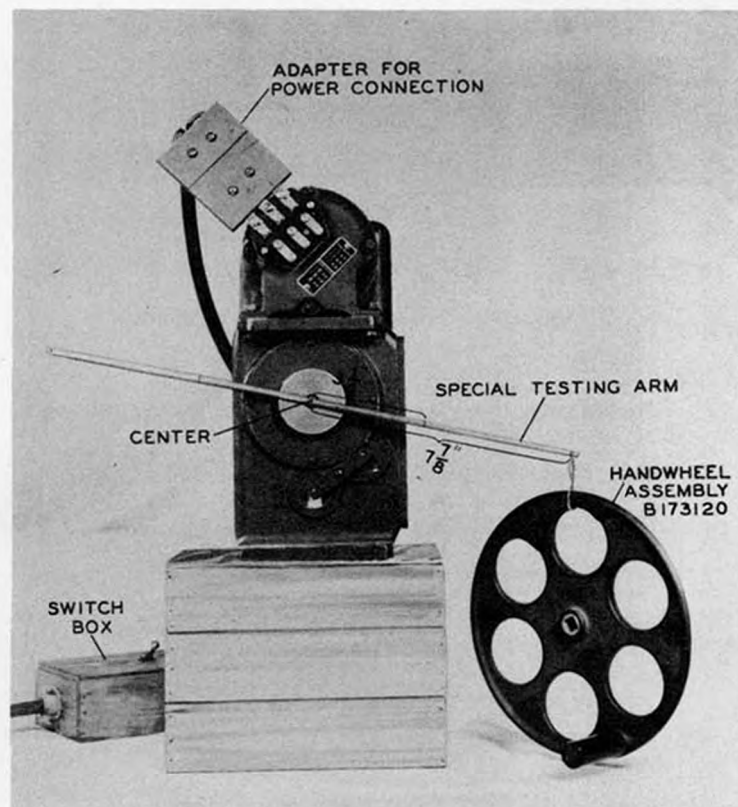


Vertical deflection mechanism assembly, D43767, assembled view, Director, AA, M5

Slue the director 180°. Turn levelling knob 1 and 2 until the bubble returns halfway to the level position. Loosen lock nut of level assembly and by means of a pin wrench raise or lower the assembly until the bubble indicates level. Repeat this procedure until the bubble remains level at each of the two positions.

Slue the director 90°. By use of levelling knob 3 move the bubble to indicate level. This bubble should now remain level at all points throughout 360°. In the event it does not, then the preceding steps must be repeated.

As soon as the bubble will remain level throughout 360° traverse of the director, the other bubble may be brought to indicate level merely by loosening the lock nut and raising or lowering the assembly as necessary. Check the lock nuts on both assemblies to insure their tightness.



Field test of a torque amplifier for amplification.

ADJUSTING RANGE STOP AND RANGE DIAL

The range stop must allow ten full turns of the range handwheel. If it does not, check that the pins in the range shaft extend through in the proper direction. These pins engage the stop nut and if one is through the shaft in the wrong direction it will change the movement of the range handwheel by 1/2 turn. If both pins extend through in the wrong direction the movement will be changed by one full turn.

When the range stop is farthest from the range handwheel it is at the minimum range position. The range dial should indicate datum line range. If it does not, loosen the dial and rotate it to the proper position. At the same time the marks on the strips and sliders of both multipliers should be aligned. If these marks do not align, make the following checks:

(1) When the marks on the lateral multiplier do not align and the gear on the bottom of the time screw and the gear at the end of the range shaft have been disengaged during disassembly, it is probable that they have not been remeshed properly. Disengage the two gears and remesh at the proper joint.

(2) When the marks on the lateral multiplier do not align and the gears have not been disengaged it will be necessary to remove the range mechanism and lift up on the range shaft until the range stop nut can be rotated about the shaft until the marks are aligned and the stop nut is at the minimum range position.

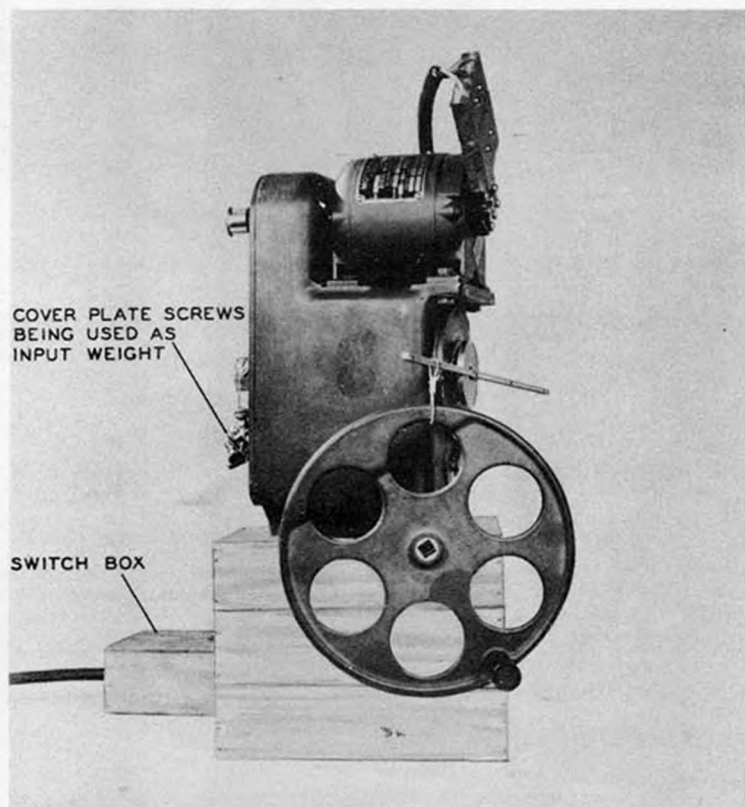
(3) When the marks on the strip and slider of the vertical multiplier do not align at the minimum range position it will be necessary to remove

the screws holding the range mechanism to the base. Slide the range mechanism to the rear until the gear on the range shaft and the gear on the range mechanism can be disengaged. Rotate the gear on the range mechanism until marks on the strip and slider are in alignment. Remesh the gears and replace the screws. Check that the range dial is still at datum line range, if it is not, loosen the dial and set it to the proper position.

ADJUSTING RATE STOPS

The adjustment of the rate stops of both the elevation and azimuth mechanism is accomplished in the same manner.

Prior to assembly of the rate setting clutch into the director, check that the linear travel of the rate setting clutch stop nut assembly is 23/32".



This travel may be adjusted by loosening the headless screw on the stop and turning the stop until travel of the nut is correct. This adjustment will rarely have to be made and should not be attempted unless the travel is obviously wrong.

Rotate the pinion which engages with the rack until the stop nut assembly is engaged at the stop nearest the clutch knob. Shift the position of the bar assembly by manually turning the deflection gear until the end of the bar assembly is 7-1/8" from the end of the rail nearest the multiplier end of the computing mechanism. Now engage the rate setting clutch with the rack. A slight movement, not to exceed 1/16" in either direction, may be made with the bar assembly to permit meshing the pinion and rack. Replace the three screws holding the rate setting clutch in place. Push in the clutch knob. Turn the handwheel to move the stop nut from one stop to the other. Check that the end of the bar assembly does not strike the shaft running from the handwheel to the tracking mechanism, and that it does not strike the pinion on the rate setting clutch.

With any suitable measuring device determine the distance between the end of the rail and the end of the bar assembly at one stop position. Now turn the handwheel until the nut is at the other stop position. Again measure the distance from the end of the rail to the end of the bar assembly. The difference between these measurements must be 6" plus 1/8" or minus 0". If this distance is not correct, recheck the linear travel of the nut assembly.

ADJUSTING FOR ZERO DEFLECTION

Turn the range handwheel until the range dial is at the datum line. Push in the rate setting clutch knob and turn handwheel of the mechanism

being adjusted until the link of the multiplier appears to be in a vertical position. Turn the range handwheel from the minimum range stop to the maximum. Note the fine dial of the mechanism being adjusted. This dial must not move in excess of one line's width. If it does, it means that the link is not truly vertical and it will have to be shifted slightly by means of the elevation or azimuth handwheel. The handwheel should be blocked during this adjustment to prevent its shifting.

ADJUSTING STATIONARY COLLAR OF THE RATE SETTING CLUTCH

Do not change the position of the link as determined in the preceding adjustment. Loosen the nut which clamps the collar in place. It may also be necessary to loosen the screw guide for the collar. Check that this collar can now be rotated easily in either direction.

Pull clutch knob out slowly, manually rotating the stationary collar until it meshes accurately with the sliding member of the clutch. Note that the position of the link has not been changed. Tighten the clamping nut. Caution: Do not force this nut. It is comparatively easy to break the casting on some clutches if the nut is tightened too much.

To check the accuracy of the setting, remove the wedge and turn the handwheel until the zero deflection marks are within 1/2 mark's width of being aligned. Pull out the clutch knob and note that the stationary collar will cause these marks to come into accurate alignment. As a further check turn the range handwheel from minimum to maximum and note whether the fine dial moves in excess of the tolerance. If it does, the adjustment will have to be made again.

SETTING FIRING AZIMUTH DIALS

Set the lateral deflection to zero and pull out the rate setting clutch knob. Turn the azimuth handwheel until the lining up pins can be inserted. Insert both pins. The firing azimuth dials should now read zero. If they do not, loosen the screws which clamp the dials to the spindles and rotate the dials to the proper position. Do not harm the small dowels, which are on the end of the spindle, when the dials are being reclamped.

SETTING THE QUADRANT ELEVATION DIALS

Set the vertical deflection to zero and pull out the rate setting clutch knob.

Swing the mechanical stop, which is toward the front of the director, out of the path of the segment gear. Turn the elevation handwheel until the segment gear becomes disengaged, being careful to hold the pinion to prevent sudden unwinding of the antibacklash gear. Hold the segment gear out of engagement. Continue to turn the elevation handwheel until the lining up pin can be inserted. Insert the lining up pin. Lower the segment gear until it touches the pinion of the quadrant elevation mechanism. From the point of contact count twenty-five teeth in a clockwise direction on the pinion and mark the tooth for identification. Remove the lining up pin. Lift up the segment gear slightly, turn the pinion counterclockwise until the marked tooth will engage with the segment gear. Wind the antibacklash gear five teeth in the proper direction then engage the segment gear.

Now turn the pinion clockwise until the lining up pin can again be inserted. Insert the lining up pin. Loosen the screw holding the coarse dial and set it to read 80°. Set the fine dial to read zero. Remove the lining up pin. Swing the stop back into the path of the segment gear.

ADJUSTING ELEVATION MECHANICAL STOP

Set vertical deflection to zero and pull out the clutch knob. Turn the elevation handwheel to increase elevation to 94°. The stop should be against the segment gear at this point. Tighten the stop in place so that it will operate at 94° plus or minus 2°. Decrease elevation to -12° and set the other stop to operate at -12° plus or minus 1°. Note that the stops may be swung in an arc, thus increasing or decreasing the travel of the segment gear. The stops must be tightened securely in order to prevent a camming action with the segment gear and the consequent change in travel. The purpose of these stops is to prevent disengagement of the segment gear under normal manual operation conditions only. Allowing the segment gear to coast into the stops at high deflection rates will soon cause the gear to become disengaged and possibly ruined.

ADJUSTING THE ELEVATION LIMIT SWITCH

Set the vertical deflection to zero and pull out the clutch knob. Turn the elevation handwheel until the quadrant elevation dials read ap-

proximately 85°. Loosen the two brass screws which hold the limit switch to the bracket and slide the switch until the roller starts to engage with the lug on the segment gear and tilt the switch until the contact points just start to open. Tighten the two screws.

Turn the elevation to about 90°. Turn on power. Turn the elevation handwheel slowly to decrease elevation. Note the reading when the motor is cut on. This should be 85° plus or minus 1°. The motor should cut on easily, without humming or jumping. If the switch does not cut the motor on within the tolerance given, it must be readjusted as before. If the motor hums or jumps when it starts, it means that the two contact arms are not closing at the same time, cutting in one phase ahead of the other. Both phases must be cut in at the same time, within 1/2°. To correct this the contact arm or arms will have to be bent slightly. The breaking of each phase may be checked best with an ohmmeter, but power must be off during this check. Increase elevation to check that the switch will cut the motor off at the proper reading.

In a similar manner check that the limit switch will cut the motor off or on at -5° plus or minus 1°. If any adjustment is necessary at the lower limit the upper limit will have to be rechecked, or vice versa.

In the event the maximum adjustment of the limit switch is not sufficient to meet these requirements it may be necessary to change the mesh of the segment gear one or two teeth in the proper direction.

ALIGNING THE TELESCOPES

Level the director. Zero vertical deflection and pull out the clutch knob. Turn the elevation handwheel until the quadrant elevation dials read zero. Insert the lining up pin in the quadrant elevation transmitter. Place both telescopes on the director in their respective positions.

The elevation telescope should be pointed at zero angle of site. This may be checked by means of a testing target, on the horizon, or by means of a special fixture and a gunner's quadrant. If the angle of site is not zero, loosen the two clamping bolts which clamp the segment gear to the telescope shaft and shift the telescope to the proper position. Tighten the clamp and recheck.

The lines of sight of the azimuth and elevation telescopes must be parallel within 1 mil in azimuth and in elevation. This alignment may be checked by means of a testing target on which two sets of crosshairs are drawn whose centers are 29-3/8" apart. This target should be placed at about 200 yards from the director. If it is to be used to check zero elevation it should be in the same plane as the telescopes of the director.

Turn the elevation handwheel until the reticle of the elevation telescope is superimposed on the left hand crosshair of the testing target. See instructions above for setting the telescope to zero angle of site. Traverse the director in azimuth to align the vertical reticle line of the elevation telescope on the target.

If the reticle of the azimuth telescope is not now superimposed on the right hand cross hair, it may be shifted in the vertical plane by means of the four screws which hold the clamping ring of the flange. Remove the azimuth telescope and loosen these four screws, retaining enough friction to hold the telescope in any position. Replace the telescope and shift it manually until the horizontal reticle line is superimposed on the crosshair of the testing target. Remove the telescope, tighten the screws. Recheck. If any movement in the lateral plane is necessary it is probably the result of foreign matter underneath one of the telescopes. However, improper tightening of the four screws may also cause the telescopes to be incorrectly aligned.

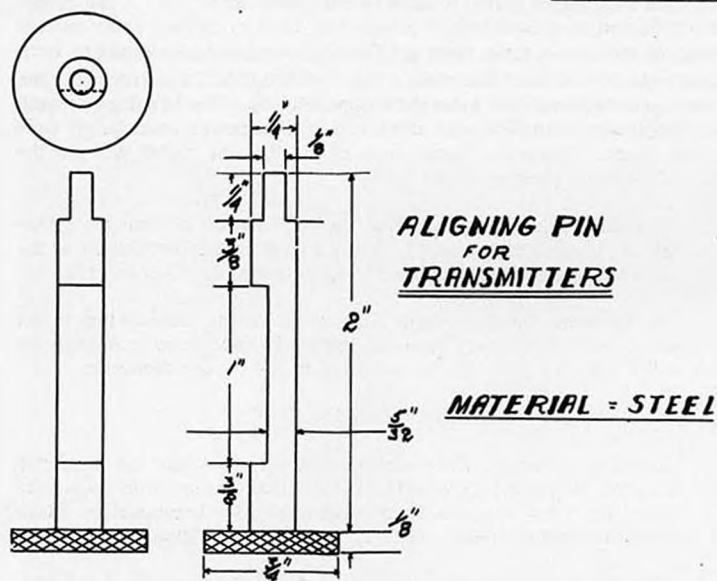
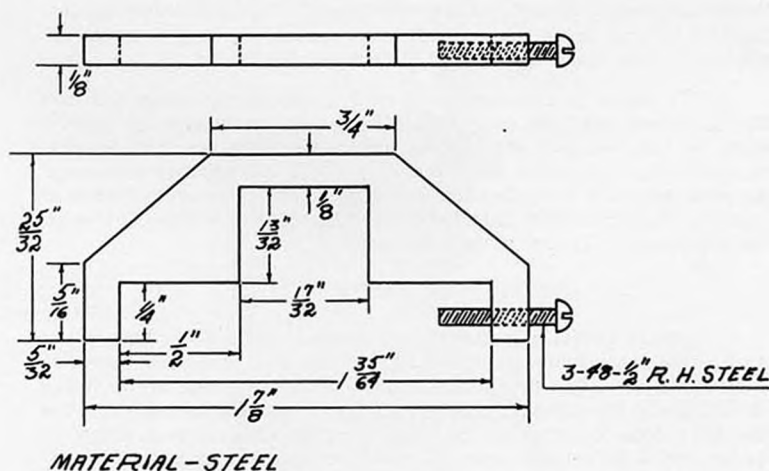
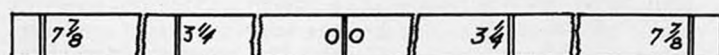
ALIGNING THE OPEN SIGHT

Align the horizontal reticle line of the elevation telescope on a distant object. The line of sight over the open sight should intersect the same object.

Adjustment of the open sight in the vertical plane may be made by loosening the thumb screw and shifting the sight to the proper position. Any adjustment in the horizontal plane which may be necessary is probably the result of a bent open sight or shaft. If these cannot be satisfactorily adjusted, replace them with serviceable items.

VERTICAL PLUMB TRAVEL

Level the direction accurately. Establish a thin plumb line of sufficient length to remain in the field of view through a 45° movement of the azimuth telescope.

RULE - SPECIAL**TO DETERMINE TRAVEL OF BAR ASSEMBLY****TORQUE ARM HOLDING TOOL****ARM FOR OUTPUT COUPLING USED IN
FIELD TEST FOR AMPLIFICATION**

MATERIAL - 3/16" X 3/16" X 1/16" STEEL

The vertical reticle line of the azimuth telescope should follow this plumb line from 0° to 45° within 1 mil. If an adjustment is necessary, place a shim under the pads of the azimuth telescope flange assembly.

In order to allow this work to be done inside, or at a very close working distance, a peep sight and a meniscus spectacle lens may be utilized. Place the lens inside the peep sight so that its center is directly opposite the peep hole. This should allow a working distance of around 10 or 15 feet.

To further facilitate this check, draw the tolerance on two small white cards and place one at the top of the plumb line and the other at the

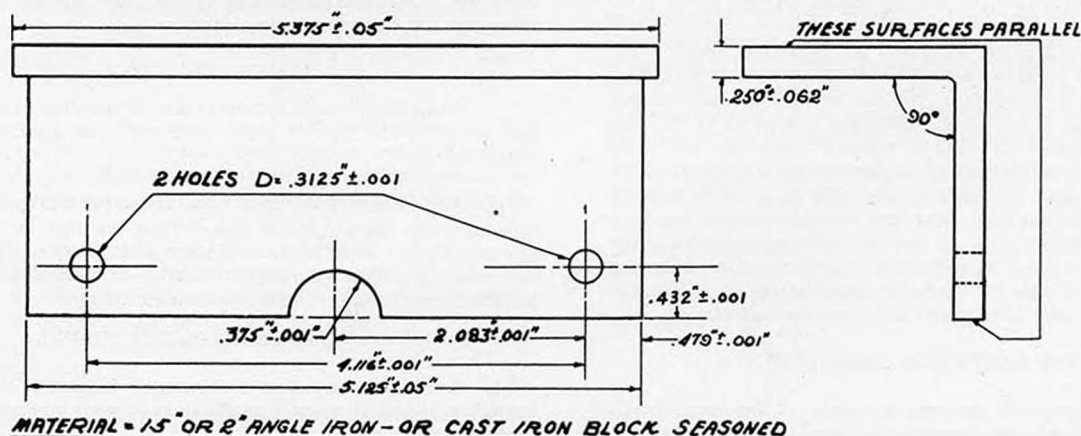
bottom. These cards will give a ready reference as to whether the reticle line will remain within the specified tolerance.

Draw three lines about 1 inch long and equidistant apart. The distance between each of these lines will represent the tolerance and may be determined by measuring the distance from the telescope to the plumb line at the point where the card will be placed. The lines should be 1/1000 of this distance apart.

Place the center line of the card directly behind the plumb line. The two outside lines will now represent the tolerance.

Depress the telescopes to about zero elevation.

Traverse the director until the vertical reticle line of the azimuth telescope intersects the plumb line. Elevate the telescopes to 45°. Note where the reticle line falls on the card which is placed at the top of the plumb line. Repeat the check by depressing the telescope to zero. Do not move the director during these checks. (Continued on page 503)

FIXTURE FOR SETTING TELESCOPES DIRECTOR M5 & M6



Conducted by: J. E. Dempsey, Capt., Ord. Dept.

SPECIAL ORDERS

by JOSEPH J. LINDSAY
S. Sgt., Ord. Dept.

Due to the large increase in volume of Special Orders which are issued at any command, it is important that we consider the correct arrangement and contents of a Special Order.

There was a young second lieutenant who, in 1918, appeared before a promotion board. The president of the board, a gruff old colonel, asked

HEADQUARTERS FORT BLANK

Fort Blank, Illinois
September 30, 1942

SPECIAL ORDERS)
No. 225)

1. PAC AR 615-5 and upon recommendation of his orgn comdr, Pvt JOHN SMITH 13089990, 150th Ord. Co, is hereby appointed Cpl.

2. Secret.

3. PAC AR 605-115, 1ST LT JOHN JONES 034567, Ord Dept is granted a three (3) day lv of absence on or about Sept 30, 1942.

4. PIC telg Sixth Serv C dated 23 Sept 42, Sgt RAYMOND SMITH 6543211 Hq Co, this station is transferred in gr to 456th FA Regt and WP fr this sta by rail to FT Holley reporting upon arrival thereat to the CO for duty.

IGF meal tickets will be provided UP par 2 AR 30-2215 a/o \$1.00 per meal when meals are taken in the dining car or \$0.75 per meal when taken elsewhere for one (1) man for seven (7) meals.

TO RT. TDN FD 31 P431-02 A 0425-23

5. Having reported this sta for dy the following named EM are assigned to orgn as shown effective this date:

458th Ordnance Company (MM)

Pvt. BROWN, John E. 3089908
Pvt. JOHNSON, John J. 4398765

Pvt. SMITH, Willie 678988
Pvt. JAMES, James 125835

32nd Ordnance Company (HM)

Pvt. RICHARDS, Henry 38750637
Pvt. GREEN, Samuel 234567890

Pvt. WHITE, Joseph 670005
Pvt. JONES, Harry 33074562

By Order of Major MEYERS:

WILLIAM C. BLACK,
Capt., Ord. Dept.,
Adjutant.

OFFICIAL:

WILLIAM C. BLACK
Capt., Ord. Dept.
Adjutant

the lieutenant to name the three great classes of military orders. The lieutenant gulped a couple of times and came up with this one: "Orders, counter-orders, and disorders! You will not find his answer in any regulation, yet he was right. Carelessly published orders call for counter-orders, which causes disorder and confusion. In publishing any order it should be clear and concise.

Special orders may be issued by any command from a regiment on up to the War Department. Any organization lower than a regiment will publish only Orders without the designation "General" or "Special", except a battalion when operating as a special unit.

Special Orders are used as a means of publishing directives which would effect the status of any individual, group, detachment, organization, or unit. It may deal with the appointment, transfer, reduction, promotion, assignment, discharge or retirement of any individual. In fact, anything which would effect a change in status of an officer or enlisted man is done by special order, except the appointment of privates first class, which is done by orders issued by the company. So we can see how important it is to publish our orders in such a manner that they may be easily understood by all concerned. The appointment of boards of officers, courts-martial and courts of inquiry are also published in Special Orders.

Now, let's take a look at the contents and arrangement of a Special Order. Broken down into parts we have: (1) The Heading. (2) The Designation. (3) The Body. (4) The authentication.

THE HEADING

In the heading we will find the designation of the headquarters from which the order is being issued, followed by the location of the headquarters and the date of the order.

THE DESIGNATION

The designation will contain the Special Order Number which has been assigned to that particular order. EXAMPLE: "SPECIAL ORDER NO. 225. Special orders are numbered in a single series for each calendar year, beginning with number one (1) for the first day of the year on which an order is issued, and giving the next number to each following day on which an order is published. This does not imply that a number will be assigned to every day of the year. EXAMPLE: If Special Order No. 225 were issued on Wednesday, September 30, 1942, and we did not issue an order on Thursday or Friday, the number for Saturday's Special Order would be No. 226.

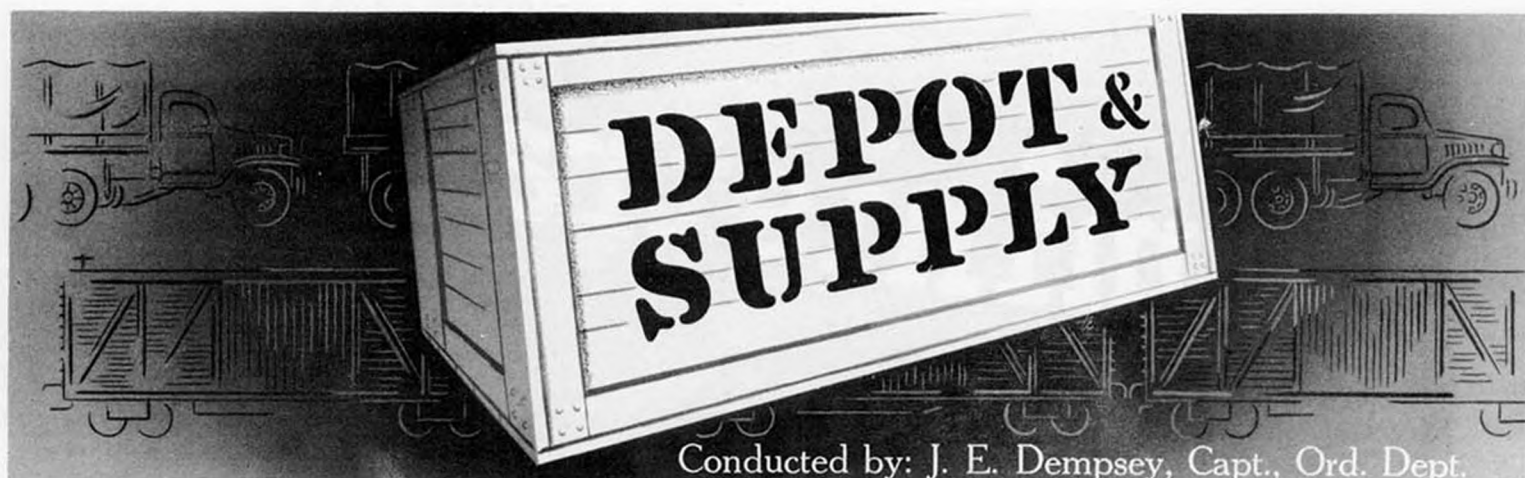
THE BODY

Perhaps, this is the most important part of a Special Order. The body of an order may contain any number of paragraphs; each paragraph will be numbered consecutively. In many cases, each paragraph will be a complete order within itself.

In the body you should be able to immediately find six important component parts, namely, What is to be done, Who is to do it, When, Where, How, and Why. If these can be found, the body will be complete.

During peace-time the body was heavily loaded down with phrases and clauses so that no part of the order might be interpreted in two or more ways. Now, however, with the greatly increased volume of orders

(Continued on page 503)



INVENTORY AND INSPECTION REPORT

by LOUIS H. PAQUIN, Sgt., Ord. Dept.

In previous articles published in this section, various phases of property accounting have been taken into consideration. One of the important phases of property accounting is the correct method of disposing of unserviceable property.

There are two classes of unserviceable property, namely, Class I Property — That property that has been worn out through fair wear and tear in the public service, or property that has been declared obsolete, and Class II Property — That property that has become unserviceable through means other than fair wear and tear.

In this article we are concerning ourselves with the proper disposition of Class I Property only. There are two methods of disposing of this class of property — The first and one most frequently used is that of placing the property on an Inventory and Inspection Report (I&I Report) W.D., I.G.D. Form No. 1, for the action of an Inspecting Officer. The second is accomplished by placing the property on a Report of Survey, W.D., A.G.O. Form No. 15. When the latter method is used, the report is forwarded in triplicate to the Commanding Officer who takes action as indicated in paragraph 9a, AR 35-6640, that is, he may approve of the report of survey without the action of a surveying officer. In this particular article however, the former method is the one to be reviewed.

In view of the fact that we are concerning ourselves with the class of property that is to be placed before an Inspecting Officer for disposition, let us list a few officers who are authorized to inspect property for condemnation.

- a. Officers of the Inspector General's Department.
- b. Chiefs of Supply Arms and Services and their commissioned assistants on duty at Headquarters of Service Commands and tactical divisions may be designated to inspect property pertaining to their arm or service when such property is of such technical nature as to require inspection by an expert.
- c. Experienced officers may be appointed by Commanding Generals of Service Commands to inspect property for condemnation at posts or stations when immediate action is required and no inspector general is available.

Class I property (property worn out through fair wear and tear) which is to be placed on an I&I Report is divided into two general classifications, namely, Supervised — That property, the disposition of which is supervised by the Chief of the Supply Arm or Service concerned, or by the Commanding Generals, Service Commands, when such supervision is delegated to them in the announced policies of the Chiefs of Supply Arms or Services; Non-supervised — That property the disposition of which is not supervised by the Chiefs of Supply Arms or Services.

As we are dealing with ordnance property it is appropriate to note the Ordnance property that is listed as "supervised". These are

reviewed in War Department Circular No. 202, 1941, as follows: All articles of Ordnance material listed in Standard Nomenclature Lists (SNL) A-1, B-1, C-1, D-1, D-2, E-1, F-1, F-2, F-3 and G-1; all ammunition either complete rounds or finished components issued to troops, and all machine tools and other equipment with a unit value in excess of \$200 used in manufacturing or maintenance operations.

As stated before, supervised property may be placed on an I&I Report for action of an inspector, but before such action may be taken, the responsible officer will submit a list of such property through channels to the Commanding General, Service Command (See Figure 1) requesting prior authority for submitting the property for the action of an inspector and requesting advance specific instructions as to disposition of the property, including the designation of depots or arsenals to which articles will be shipped if such disposition is deemed desirable.

HEADQUARTERS FORT BLANK Fort Blank, Illinois	
141.81	September 20, 1942
SUBJECT: Inventory and Inspection of Property for Condemnation	
TO : THE COMMANDING GENERAL, 6th Service Command, Chicago, Illinois	
1. Pursuant to instructions contained in paragraph 3a (2) Army Regulations 20-35, March 6, 1941 and War Department Circular 202, 1941, it is requested that authority be granted to place the following listed article of supervised ordnance property on an Inventory and Inspection Report for the action of an Inspector.	
GROUP G-1 1 ea. CAR, half-track, M2 reg. no. 006408 ser. no. 352-2148 motor no. 24824674	
2. In connection with the above, it is further requested that disposition be given.	
For the Commanding Officer: ROGER BACON Captain, Infantry Adjutant	

Fig. 1

Non-supervised property may be placed on an I&I Report for action of an inspector without obtaining prior authority therefor.

In view of the preceding paragraphs it appears that the first step in disposing of Ordnance property that has become unserviceable through fair wear and tear is to ascertain whether or not such property is supervised.

Separate I&I Reports will be prepared for the following: Property pertaining to different Supply Arms and Services, property listed as supervised and property not listed as supervised.

PAGE 1

INVENTORY AND INSPECTION REPORT

(Articles ^{are} ~~are~~ designated as ^{supervised} ~~unsupervised~~)

Of Ordnance property. Pertaining to Fort. Blank, Illinois
(Class, QM, medical, etc.) (Station or organization)

Accountable officer Capt. Vernon Green Ord. Dept. Inspected at Fort. Blank, Illinois

On September 25, 1942 By Lt. Col. John Perry, I.G.D.
(If special inspector, state authority and date)

REPORT BY RESPONSIBLE OFFICER			DISPOSITION BY INSPECTOR					
1	2	3	4	5	6	7	8	9
ARTICLES (If the condition of property is due to fair wear and tear, state so after last item in this column. If not, state circumstances.)	Quantity	Total cost price, if not known, estimate it	To be continued in service	To be destroyed	To be turned in for re-issuance of parts	To be turned in to salvage	To be sold	To be turned in to depot for disposal
GROUP G-1		Estimated						
CAR, half-track M2 reg. no. 006406 ser. no. 352-2148 motor no. 24824674 Manufactured and issued from RIA. Issued to 82nd F.A. Bn. 6/13/40. Has been in continuous service since issue.	1	1200.00						
The condition of this property is due to fair wear and tear in the public service.								

16-11223

Fig. 2

In the preparation of an I&I Report, the responsible officer will prepare and sign two copies listing the property to be inspected. When the property to be inspected is listed as supervised, the additional words "these articles are listed as supervised" will be shown immediately below the title "Inventory and Inspection Report". Provisions have been made on W.D., I.G.D. Form No. 1, for a similar statement concerning controlled items. This can easily be converted to the new purpose by deleting the word "controlled" and typing the word "supervised" in its place. The words "are not" have been deleted from Fig. 2, to show that the item involved is supervised.

Assuming that the Commanding General of the Service Command has approved our request to place the Ordnance vehicle on I&I Report by 1st Indorsement to the communication in Fig. 1, we are now ready to place the item on the I&I Report (See Fig. 2.)

The page number is entered, especially when the report contains more than one page.

The first item of information needed on the blank form is the appropriate supply arm or service concerned. Second, the station from which the report is being submitted, or the organization if it is being reported from any particular organization. Next, the accountable officer's rank, name and branch of service in that order followed by the name of the Post, Camp, or Station at which the inspection is taking place. The rank, name and branch of service of the inspecting officer comes next, completing the heading. If the inspecting officer is a special inspector

appointed by the appropriate commanders already enumerated, the authority and date would also be included in this space.

After the heading is complete, it will be noted that the form is divided into two sections, one entitled Report by Responsible Officer, the other entitled "Disposition by Inspector". The first section contains three columns. Column one is devoted to the description of the item and the stock number. However, the stock numbers are seldom used in reporting Ordnance material. The description will include the SNL Group, the correct nomenclature, and in the case of serially numbered items (except those listed in WD Circular No. 202, 1942), will be listed singly, giving serial number, arsenal or other initial, date of issue and length of time they have been in service together with such other special information peculiar to the article as may be required. This information may be given in Column 1, using more than one line if necessary, or on a list attached to the I&I Report. It must also be noted whether or not the condition of the property was due to fair wear and tear. If not, the circumstances must be stated. The serially numbered items that no longer will be listed singly are: rifles, including automatic, semi-automatic, and machine; Carbines, pistols, revolvers, shotguns, submachine guns, machine guns, 20mm guns,

PAGE 1

INVENTORY AND INSPECTION REPORT

(Articles ^{are} ~~are~~ designated as ^{supervised} ~~unsupervised~~)

Of Ordnance property. Pertaining to Fort. Blank, Illinois
(Class, QM, medical, etc.) (Station or organization)

Accountable officer Capt. Vernon Green Ord. Dept. Inspected at Fort. Blank, Illinois

On September 25, 1942 By Lt. Col. John Perry, I.G.D.
(If special inspector, state authority and date)

REPORT BY RESPONSIBLE OFFICER			DISPOSITION BY INSPECTOR					
1	2	3	4	5	6	7	8	9
ARTICLES (If the condition of property is due to fair wear and tear, state so after last item in this column. If not, state circumstances.)	Quantity	Total cost price, if not known, estimate it	To be continued in service	To be destroyed	To be turned in for re-issuance of parts	To be turned in to salvage	To be sold	To be turned in to depot for disposal
GROUP G-1		Estimated						
CAR, half-track M2 reg. no. 006406 ser. no. 352-2148 motor no. 24824674 Manufactured and issued from RIA. Issued to 82nd F.A. Bn. 6/13/40. Has been in continuous service since issue.	1	1200.00						
The condition of this property is due to fair wear and tear in the public service.								

16-11223

Fig. 3

37mm guns, field glasses, clinometers, watches, pocket and wrist, time interval recorders and compasses. Column 2 is reserved for quantities, column 3 for the total cost price. If the cost price is not of record, it will be estimated and the word "estimated" will be typewritten over the estimated figure. The cost shown in Fig. 2, is estimated. Figure 2 shows the I&I Report as it will appear before the inspecting officer arrives to inspect the property. The property should be arranged for inspection by the inspector in the order that it appears on the I&I Report. When the inspecting officer makes the inspection he is accompanied by the responsible officer who should be ready to answer any question concerning the property. The inspector will examine every article with care, using his best judgment in making correct disposition for he will be held responsible for the action taken on the inspected property. It is especially brought out in the Army Regulations that the property will not be condemned by an inspector merely because it is worn or shabby in appearance. The inspecting officer should show all items to be salvaged by marking them IC (inspected

and condemned), and mutilate or mark items to be turned in for reclamation of component parts.

Disposition is shown by the inspecting officer in the last six (6) columns of the I&I Report as he inspects the property. This is done by entering a number in the appropriate column. There are six (6) columns each of which is devoted to a different possible disposition of unserviceable property. For example, if one of the items on the report is SLING, Gun, M1907 (Leather), and there are twelve such slings and the inspecting officer decides that six should be destroyed and six continued in the service, he will enter the figure 6 in the column "to be continued in service" and the figure 6 in the column "to be destroyed". Figure 3 shows the report after disposition has been made.

There are actually eight possible dispositions that may be given on I&I Reports although the forms only indicate six. These eight possible dispositions are as follows: (1) to be continued in service (2) to be turned into depot or arsenal (3) to be turned in for reclamation of component parts (4) to be destroyed (5) to be sold (6) to be turned in to salvage (7) to be used as target materials (8) as directed by the Chief of Supply Arm or Service concerned. When such unserviceable property is to be used as target material, the letters "TM" will be entered in the column "To be Sold" under disposition on the I&I Report. There are no instructions showing the proper method of indicating the "announced policies of the Chief of Supply Arm or Service". It is logical to assume then that the actual disposition will be written in if no provisions are made for the given disposition on the printed form. After disposition has been indicated on the I&I Report, the inspecting officer will sign the certificate on the back of the report certifying that he has carefully examined the articles and has disposed of them, keeping the public interest uppermost in his mind. This record is now complete. (The responsible officer signs the first certificate on the back of this form certifying that the articles have been examined by him personally, that the property has not been previously condemned and requires the action of an inspector.)

QUANTITY		STOCK NO.	ARTICLE	UNIT	UNIT COST	TOTAL COST
ORDERED	SHIPPED					
	1		GROUP C-1 CAR, half-track, M2 XXXXXXXXXXXXXXXXXXXX	ea		
<u>COMPLETE SHIPMENT</u> Total weight 5000 lbs. B/L WQ-6741129 Shipped by freight (LCL) (CB&Q)						
This item is to be shipped to Rock Island Arsenal for repair and reconditioning in accordance with instructions contained in 1st Ind. (141.81) Hq. 6th Service Command, dated 9/24/42. The Inventory and Inspection Report concerned dated 9/25/42 is filed as a sub-voucher to this shipping ticket in the office of the Ordnance Property Officer, Fort Blank, Illinois.						
VERNON GREEN Capt. Ord. Dept. Ord. Prop. Officer						

ARTICLES LISTED IN COLUMN "ORDERED" HAVE BEEN RECEIVED UNLESS OTHERWISE NOTED IN COLUMN "SHIPPED."

(NAME) (RANK) (ORGANIZATION)

Fig. 4

to be continued in service."

I CERTIFY that the articles "to be destroyed" on this I. & I. Report have been destroyed in my presence.

Par. 7, AR 20-35

Received the articles "to be turned in for reclamation of component parts" on this I. & I. Report.

Reclamation Officer.

Par. 6b (3), AR 20-35

Received the articles "to be turned in to salvage" on this I. & I. Report.

Salvage Officer.

I CERTIFY that this inventory, consisting of _____ sheets, is correct in every particular; that each article enumerated has been examined by me personally, has never been previously condemned, and is, in my opinion, unserviceable or unsuitable for further public use here, and requires the action of an inspector.

Responsible Officer.

I CERTIFY that I have carefully examined the articles enumerated within, and that the disposition recommended is, in my judgment, the best for the public interest.

Inspector.

at or Corps Area Command

The disposition of the two signed copies of the I&I Report will depend upon whether the property reported is supervised or non-supervised. On articles not listed as supervised, the action of the inspector is final. The original copy of the report is given to the accountable officer for use as a property voucher. The duplicate copy is forwarded to the Commanding General of the Service Command for his information and for eventual file in the office of the property auditor when the property involved is carried on a stock record account. When the property has been previously dropped from accountability and listed on the "Company Property Book" of an organization, the duplicate copy of the I&I Report may be destroyed due to the fact that the copy is not required for the property auditor's file as the account of property on the Company Property Book is not audited. Disposition is made immediately and the voucher in the hands of the accountable officer becomes valid as soon as the proper disposition is complete. In the case of supervised articles, both copies are forwarded through channels to the Commanding General of the Service Command who will note his action there on in the appropriate section of the I&I Report and forward both copies to the Chief of Supply Arm or Service concerned, unless authority to take final action has been delegated to the Service Command. The Chief of the Supply Arm or Service will indorse his approval or other action on both copies and transmit them to the Chief of Finance for final action under authority of the Secretary of War and distribution. When action has been taken by the Chief of Finance, both copies of the report will be returned to the Commanding General of the Service Command who will retain the duplicate copy and forward the original copy to the accountable officer for file as a property voucher. It will not become a valid voucher, however, until final disposition of the property has been made.

It is important to note that supervised property is not to be disposed of until final action has been taken on the I&I Report, that is, until the original has been returned for use as a voucher. Then it does not become a valid voucher until the property has been disposed of in accordance with the disposition shown on the report. In case the disposition includes items that are to be salvaged, destroyed, or reclaimed, the officer in charge of such disposition will sign a certificate to the effect that the correct disposition has actually been made before the report becomes a valid voucher. In case the disposition involves the shipment of property, the shipping ticket and not the I&I Report becomes the valid voucher. The I&I Report becomes a sub-voucher to the actual property voucher. Whenever property is shipped to a depot or arsenal as a result of an approved I&I Report, the shipping ticket, bearing a statement of the disposition of the property and containing other information necessary to identify the I&I Report will be used, as stated above, as the voucher instead of the I&I Report.



WAR DEPARTMENT
UMATILLA ORDNANCE DEPOT
Hermiston, Oregon
October 7, 1942

Editor
THE ORDNANCE SERGEANT
The Ordnance School
Aberdeen Proving Ground
Aberdeen, Maryland

Dear Sir:

In the August 1942 issue of THE ORDNANCE SERGEANT there was a very interesting and enlightening article by L. W. Hathaway, T. Sgt., Ord. Dept., called "The Preparation of a Bill of Lading".

Sgt. Hathaway has explained the subject in a simple and straightforward manner which should be very useful to anyone in the field, should they suddenly be called upon to make some shipments on Government Bills of Lading.

However, the writer feels that in his interpretation of Rules 10 and 12 of Consolidated Freight Classification No. 15, Sgt. Hathaway has missed the point. In his explanation of the rates he uses a tank for his example. He says, "A tank travels fifth class while a weapon is considered first class. Because the weapons are attached, the entire unit will be shipped first class, and therefore at the highest rate. Should the weapons be detached, separate bills of lading would be made out,

and the weapons will take first class, and the tanks, fifth class. In making a shipment which includes items of different classes, a separate bill of lading must be made out for each class. Therefore, even though the weapons travel in transit on the same car as the tank, two bills of lading are necessary to make the shipment."

My main intention in this letter is to point out that according to the generally accepted interpretation of Rules 10 and 12 it does not matter how many articles are billed on one bill of lading they will still take the rate classification to which they are entitled, provided that they are not in the same box and are shipped at one time by one consignor to one consignee and destination. Further, as in the case of the tank, with or without weapons, such items are generally given a rate under a heading regardless of their component parts. Ex: In the Consolidated Freight Classification No. 15 there are several items of classification for tanks. One is as follows: 34460 - Army tractor tanks with guns mounted thereon, including necessary equipment of tools and towing cable properly secured inside tanks or boxed and shipped with tanks, loose or in packages . . . LCL 2nd class - minimum carload 40,000 - Carload Rating 40-6-A.

I fully realize that the field services have neither the time or facilities for checking upon the more complicated details of freight classifications and rates. However, in closing in substantiation of my preceding statements I quote the Consolidated Freight Classification No. 15, Rules 10 and 12, also Rule 20 inasmuch as it is referred to in Rule 12.

RULE 10. MIXED CARLOADS

Section 1. Except as otherwise provided in this Classification, when a number of different articles, for which ratings or rates are provided when in straight carloads, are shipped at one time by one consignor to one consignee and destination, in a mixed carload, they will be charged at the straight carload rate (not mixed carload rate) applicable to the highest classed or rated article contained in such mixed carload and the carload minimum weight will be the highest provided for any article in the carload.

Section 2. Subject to the conditions of Section 1, when the aggregate charge upon the entire shipment is made lower by considering the articles as if they were divided into two or more separate carloads, the shipment will be charged accordingly, see Note. Note. - When the two or more carloads are loaded in one car the minimum weight for each separate carload shall be that applicable for a car of length not in excess of 40 feet 7 inches.

Section 3. When the aggregate charge upon the entire shipment is less on basis of carload rates and minimum carload weight (actual or authorized estimated weight to be charged for if in excess of the minimum weight) for one or more of the articles and on basis of actual or authorized estimated weight at less than carload rate or rates for the other article or articles, the shipment will be charged for accordingly. On articles included in carload shipments on which less than carload rates are applied, carload package requirements will apply, not subject to increased charges provided in Rule 5. Charges on articles in packages shall not be higher than on the same articles loose.

Section 4. If a lower charge would result under the application of Sections 1, 2, or 3 of this rule than under the provision for a specific carload mixture, such lower charge will apply. This rule will not apply upon articles for which carload ratings or rates are not provided nor upon shipments of Live Stock. Rule 24 will not apply to mixed carload shipments when any article in the carload would be subject to Rule 34 if shipped in straight carloads.

RULE 12. LESS CARLOAD SHIPMENTS, STRAIGHT OR MIXED

Unless otherwise provided and subject to minimum charges provided in Rules 13 and 29:

Section 1. Single LCL shipments of one class will be charged for at actual or authorized estimated weight and at rating applicable.

Section 2. Except as provided in Rule 20, single LCL shipments of two or more classes, when each class is in a separate package, will be charged at actual or authorized estimated weight, and at the rating applicable to each class.

Section 3. The charge for a package containing freight of more than one class will be at a rating provided for highest classed freight in the package, and on shipments subject to CL rating the highest CL minimum weight provided for any article in the package will apply. All the articles need not be specified on shipping order or bill of lading, but on LCL shipments only one of the articles taking highest rating, and on CL shipments one of the articles taking highest rating, and one of the articles taking highest CL minimum weight; in such instances following notation must also appear

(Continued on page 504)



Conducted by: F. P. Bingert, M. Sgt., Ord. Dept.

EARLY AMERICAN MECHANICS

by WARREN GREENE OGDEN
2nd Lt., Ord. Dept.

PART II

Francis A. Pratt was born at Woodstock, Vermont. When he was eight years old his family moved to Lowell. He was a mechanic from boyhood but he had the good fortune to be apprenticed as a machinist with Warren Aldrich, a good mechanic and a wise teacher. At twenty, Mr. Pratt went to Gloucester, New Jersey, where he was employed first as a journeyman, later as a contractor. In 1852 he came to the Colt Armory, where he worked for two years. He then accepted the foremanship of the Phoenix Iron Works in Hartford.

Amos Whitney was born in Maine and moved to Lawrence, Massachusetts, where he served his apprenticeship with the Essex Machine Company which built cotton machinery, locomotives and machine tools. He came from a family of mechanics. His father was locksmith and machinist, his grandfather was an expert blacksmith, his great-grand father was a manufacturer of agricultural tools, and he is of the same family as Eli Whitney of New Haven, and Baxter D. Whitney, the veteran tool builder of Winchendon. In 1850 both he and his father were working at Colt's factory in Hartford. In 1854 Amos Whitney joined Pratt in the Phoenix Iron Works, where they worked together for ten years, the former as a contractor, the latter as superintendent.

In the summer of 1860 Pratt and Whitney rented a small room and, in addition to their regular employment, began doing work on their own account, that is to say, manufacturing the small winder for the Willimantic Linen Company. Mr. Whitney's father-in-law acted as pattern maker, millwright, bookkeeper and general utility man. The following February they were burned out, but were running again a month later in other quarters. Here they continued to spread from room to room until all available space was outgrown. They succeeded from the very start, and at once became leaders and teachers of other mechanics. Both Pratt and Whitney were thoroughly familiar with gun manufacture, and the business was hardly started when the outbreak of the Civil War gave them more than they could do. In 1862 they took into partnership Monroe Stannard of New Britain, each of the three contributing \$1200. Mr. Stannard took charge of the shop, as Pratt and Whitney were still with the Phoenix Iron Works. Within two years the business had increased to such an extent that they gave up their positions at the Phoenix works and in 1865 erected the first building on their present site. From \$3600 in 1862 their net assets grew in four years to \$75,000, and during the three years following that they earned and put back into the business more than \$100,000. In 1893 it was reorganized with a capitalization of three million dollars. Since that time it has become a part of the Niles-Bement-Pond Company.

Soon after the Franco-Prussian War, an agent of the company visited Prussia and found the royal and private gun factories equipped with old and inferior machinery. Mr. Pratt was sent for, and returned to Hartford with orders from the German Government for \$350,000 worth of gun machinery. During the new few years Mr. Pratt made no less than ten trips to Europe, taking orders aggregating over two million dollars worth of machinery. When the panic of 1873 prostrated the industries of the United States, Pratt & Whitney had orders, mostly foreign, which kept them busy until 1875. Their equipment of the three royal armories of Spandaw, Erfurt and Danzig resulted in an improvement in quality of output and a saving of 50 percent in wages. Pratt & Whitney's production of gun-making machinery alone has run into many millions of dollars, and there are few governments which have not at one time or another purchased from them.

For many years the Pratt & Whitney tool-room lathes were the standard for the country. Later their leadership was materially affected by the Hendey Machine Company of Torrington, Connecticut, who built a high grade tool-room lathe having the change-gear box which has since been applied to nearly all types of machine tools. The change-gear box is one of the important contributions to tool building made in recent years. Among the later developments introduced by Pratt & Whitney is the process of thread milling, and they have designed a full line of machines for this work.

Two companies, both in New England, have been conspicuous for their leadership in tool building and the introduction of precision methods in manufacture. One of them, the Pratt & Whitney Company, we have considered. The other, the Brown & Sharpe Manufacturing Company, of Providence, also calls for special notice.

More than a hundred years ago . . . when old men remembered serving under George Washington and young men looked forward to the day when the 44 miles between Boston and Providence would be spanned by a railroad . . . David Brown and his son Joseph were building fine tower clocks in Pawtucket, Rhode Island.

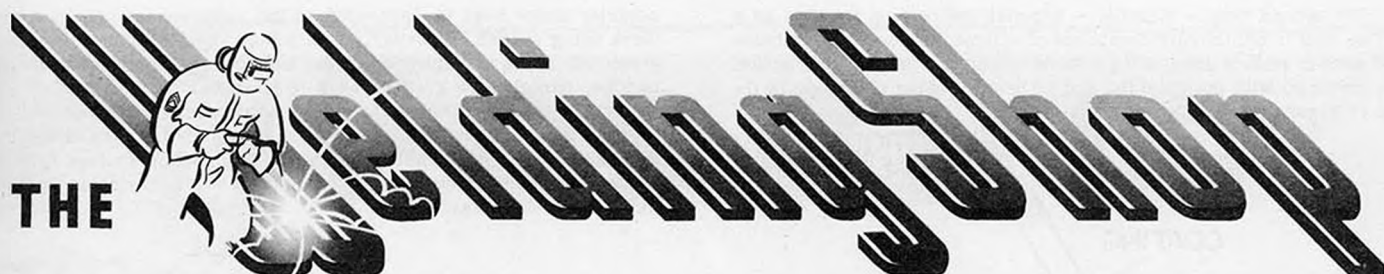
But in 1831, young Joseph R. Brown, having turned 21, resolved to go into business for himself, and opened a shop on his own account, making small tools and lathes. And so successful did his venture prove, that two years later his father joined him and their business went forward in a little shop in Providence, Rhode Island.

This was the beginning of the firm which is now the Brown & Sharpe Manufacturing Company.

David Brown retired in 1841 and for twelve years Joseph directed the Company, turning his attention toward raising the standard of accuracy in machine shop practice.

In 1850 he invented and built a linear dividing engine which was, so far as is known, the first automatic machine for graduating rules used in the United States. It was fully automatic, adapted to a wide variety of work and provided with devices for correcting the inaccuracies of the machine as built, and such as might develop on account of wear.

(Continued on page 504)



Conducted by: W. G. Sylvester, Capt., Ord. Dept.

THE ELECTRIC ARC

In electric arc welding, the heat intensity can be controlled by varying the current and the voltage settings on the machine and by selective use of the proper polarity for the particular type welding electrode being used.

In order to protect the weld metal from oxygen and nitrogen effects of the air, during the time that it is liquid and solidifying, some form of protection must be had in the arc stream. When molten metal is not protected from the atmosphere, it will absorb nitrogen and become partly oxidized, thus causing the metal to become brittle. To prevent this condition from occurring the electrodes are designed to have a wire core with a suitable coating. The coatings on metallic arc welding electrodes are generally more than merely fluxing agents, such as the fluxes employed in certain oxyacetylene welding applications. These fluxes when used with the oxyacetylene welding process dissolve or reduce the oxides and other impurities so that the metals can be united more readily to form the weld; they may also contain materials which make the weld metal or filler metal more fluid.

Types of Electrode and Electrode Coating

The various types of metallic arc electrodes may be grouped and classified as bare electrodes, thinly coated or light-coated electrodes and shielded-arc or heavy coated electrodes.

Bare Electrodes. - Bare electrodes are made of wire containing a definite composition, the surface of which has not been treated by the addition of special coatings, other than those materials retained from wire drawing operations. These coatings are required in wire drawing operations and their slight stabilizing action on the arc is only incidental. Finished annealed wire is also classified under this type. A diagrammatic sketch of the transfer of metal across the arc with a bare electrode is illustrated in Figure 1.

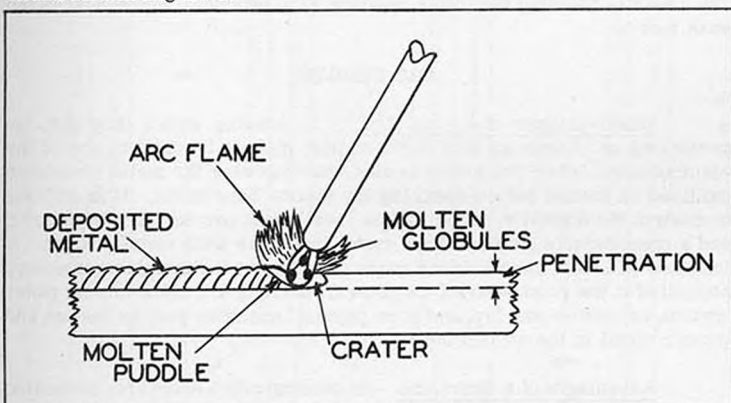


Fig. 1 -- Molten metal transfer with bare electrode

Thinly Coated or Light Coated Electrodes. - Thinly coated or light coated electrodes are made of wire of a definite composition, the surface of which has a thin coating applied by either a washing, dipping, brushing, tumbling, spraying or drawing process to improve the stability and characteristics of the arc stream. These coatings are chiefly iron oxides and titanium dioxide.

Functions of Coatings on Light Coated Electrodes. - Coatings on the light coated electrodes will in general serve the following functions:

1. They dissolve or reduce impurities such as oxides, sulphur and phosphorus and thus keep them out of the weld deposit.
2. They reduce the adhesive force between the molten metal and the end of the electrode or change the surface tension of the molten metal so that globules of molten metal leaving the end of the electrode are smaller and more frequent, making the flow of molten metal more uniform.
3. They increase the arc stability by introducing materials readily ionized (changed to small particles with an electric charge) within the arc stream.

Some of these coatings may produce a slag, but it is quite thin and does not function in the same manner as the shielded arc slag type electrode.

Shielded Arc or Heavy Coated Electrodes. - Shielded arc or heavy coated electrodes are made of wire of definite composition, the coating of which is of appreciable thickness. These coatings have been designed to improve the physical properties of the weld deposit. They also control arc stability and, as a result, increase the speed of welding and the ease of welding in the vertical and overhead positions. These electrodes are manufactured by the extrusion, wrapping, heavy-dipping processes or combinations of these methods or other means.

Shielded arc or heavy coated electrodes are easily identified by their heavy extruded coating. This coating performs various functions other than that of shielding the arc and molten metal. Without this protection, which is quite thorough in the shielded arc electrode, oxygen would readily combine with the molten metal of the weld deposit, thus removing many of the desirable alloying elements, causing porosity and oxidizing, or burning the weld. Nitrides would also be found in the weld deposit, caused by reactions between nitrogen and the various elements in the molten state. These nitrides will be in solution with the weld deposit or partly precipitated, that is, separated out in the form of hard particles. Oxides and nitrides in the weld deposit cause brittleness, which results in low ductility and, in some cases low strength and poor resistance to corrosion. The heavy extruded coatings on shielded arc or heavy coated electrodes protect the weld deposit by both chemical and mechanical action.

Types of Shielded Arc Electrodes. - The especially designed coatings of the heavy coated or shielded arc electrodes are manufactured in two general types, namely: cellulose coatings and mineral coatings. Combinations of both types are also used. The cellulose coated shielded types are derived from wood pulp, sawdust, cotton, or more recently from the various compositions secured from the manufacture of rayon. The mineral coated shielded types are manufactured from metallic oxides, which are often used in the form of natural silicates, such as asbestos and clay, or in specially manufactured forms of silicates. Other materials used for electrode coatings consist of burnt sugar, gums, starches, also some low melting point spars. To simplify these two types of shielded or heavy coated electrodes further, it should be pointed out that the first type - cellulose - depends upon a gaseous shielding or covering for protection around the arc stream as well as a slag covering over the weld

deposit. The second type — mineral — depends entirely on the slag as a shield. The slag is principally composed of silicon dioxide and aluminum oxide and acts to reduce the cooling rate of the molten metal. The action in an arc obtained with the shielded arc or heavy coated electrode is illustrated in Figure 2.

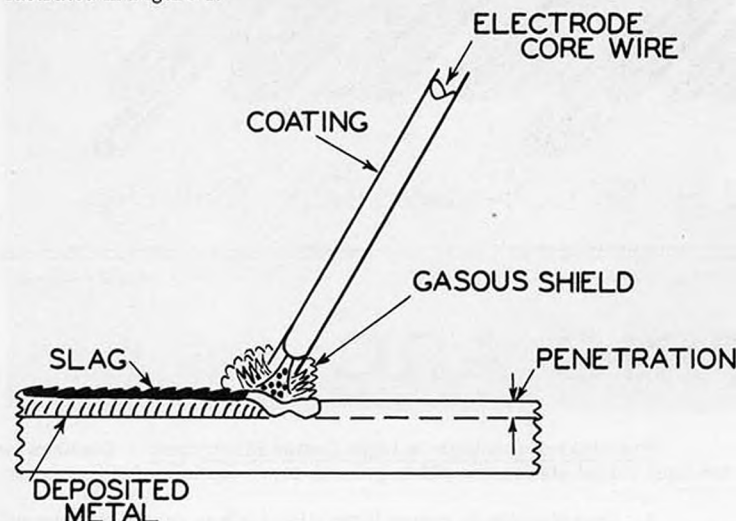


Fig. 2 -- Arc characteristics of coated electrode

Functions of coatings on Shielded-arc Electrodes. — Some of the outstanding functions of the shielding of the arc stream and weld deposit by shielded-arc electrodes may be summarized as follows:

1. To produce a reducing or non-oxidizing atmosphere around the arc, so as to avoid contamination of the metal in the arc by oxygen and nitrogen from the air and to preserve the alloying elements which have an important effect on the physical properties of the weld deposit.
2. To reduce impurities, such as oxides, sulphur, and phosphorus continuously so that these impurities will be kept out of the weld deposit. To furnish materials to the arc which will increase the arc stability, and to steady the arc voltage, so that the arc will flow smoothly without spattering or wandering.
3. To break up the globules of molten metal leaving the end of the electrode into fine, small particles by reducing the attractive force between the molten metal and the end of the electrode or by changing the surface tension of the molten metal.
4. To provide those ingredients (oxides and silicates) which, when melted, will form a slag over the molten metal. This slag, being quite slow to solidify, holds the heat and allows the metal to solidify and cool slowly. This slow solidification allows dissolved gases to escape and permits solid impurities to float to the surface. The slow cooling also has an annealing effect on the weld deposit, giving it a refined grain structure.
5. To change the physical characteristics of the weld deposit by introducing materials through the coating which will alloy with the weld metal deposited. The fluxing action of the slag, also, will produce better qualities of weld metal and permit welding at higher speeds.
6. To insulate the sides of the electrode so that the arc is concentrated at the end of the electrode into a confined area. This is important and will facilitate welding in a deep "U" or "V" groove.
7. To produce a cup, cone, or sheath at the tip of the electrode, which acts much like a crucible providing a mechanical shield, concentrating and directing the arc, reducing the heat losses, and increasing the temperature at the end of the electrode.

Polarity of Welding Current. — The polarity recommended for use with a particular type of electrode is established by the electrode manufacturer. The polarity of a welding current may be either "straight" or "reversed". In straight polarity the electrode is always negative and the current travels in the welding circuit as shown in Figure 3. In reversed polarity the electrode is positive and the current travels in the welding circuit as shown in Figure 4.

In general for all mild steel bare or lightly coated electrodes straight polarity is used. When this type of electrode is used in straight

polarity more heat is developed at the positive side of the current or work being welded. However, when coated electrodes are used the gases given off in the arc may alter the heat conditions so that the opposite is true, namely, the greater heat is produced on the negative side. In general, electrode coatings affect the heat conditions differently depending upon their composition. One type of heavy coating may obtain the most desirable heat balance using straight polarity while another type of coating on the same electrode may provide a more desirable heat balance using reversed polarity.

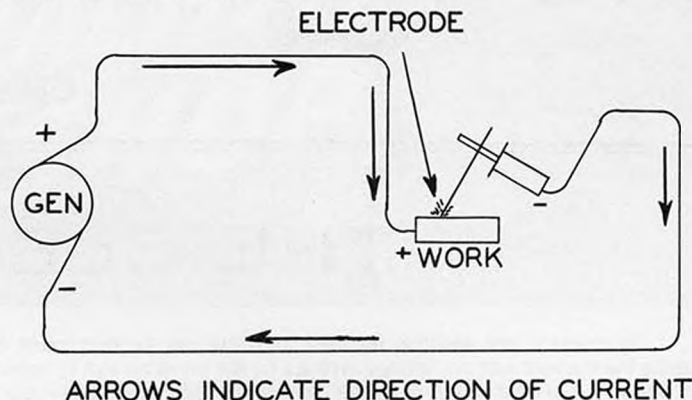


Fig. 3 -- Straight polarity

In welding non-ferrous metals such as aluminum, bronze, monel, nickel, and also some heavy coated electrodes, reverse polarity is used. Reverse polarity is also used with some electrodes for making welds in the vertical and overhead positions. The proper polarity can be recognized by the sharp crackling sound of the arc. Improper polarity for a given electrode will cause the arc to give off a hissing sound and will make it difficult to control the welding bead.

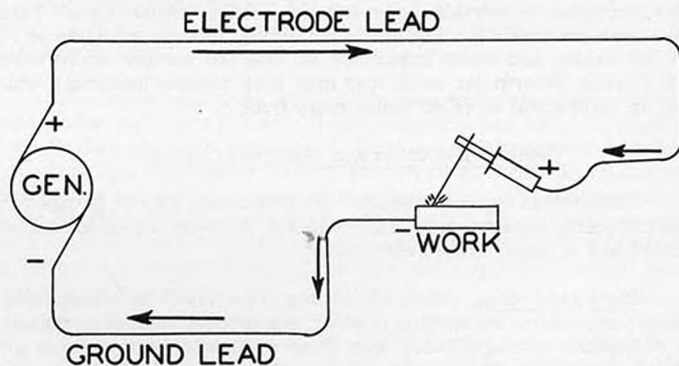


Fig. 4 -- Reverse polarity

Polarity has considerable effect on the melting rate of electrodes. The polarity yielding the lower melting rate produces more heat in the base metal.

ARC LENGTH

Disadvantages of a Long Arc. — In welding with a long arc, the protecting arc flame, as well as the molten globule leaving the end of the electrode, will whirl from side to side, thus allowing the metal to become oxidized or burned before reaching the molten base metal. It is difficult to control the direction of the molten metal as it passes through the arc, and a considerable portion of the metal is lost as weld metal spatter. A long arc will melt the electrode more quickly, but the metal is not always deposited at the point desired. In general, the long arc leads to poor penetration, excessive overlap, and poor physical qualities such as burned and porous metal in the welded bead.

Advantages of a Short Arc. — In welding with a short arc, the molten metal leaving the end of the electrode will pass through the arc under good protection from the atmosphere by an enveloping arc flame. Better control of the weld metal deposited on the plate and better weld metal quality will be obtained in the welded bead. In general, a short arc gives maximum penetration and better physical qualities, and deposits the maximum amount of metal at the point of welding. Porosity, overlap, and weld metal spatter are kept at a minimum.

(Continue on page 505)



FORGING

Conducted by: W. G. Sylvester, Capt., Ord. Dept.

PRACTICAL FORGING PROBLEMS

All practical forging problems require the use of one or more of the following basic forging operations:

Straightening
Binding
Drawing out
Punching
Twisting
Forge Welding

In addition to the above, tool forging requires heat treatment to complete the problem and render it serviceable. This requires a knowledge of hardening and tempering, operations which can be satisfactorily accomplished using the facilities normally available with a forge.

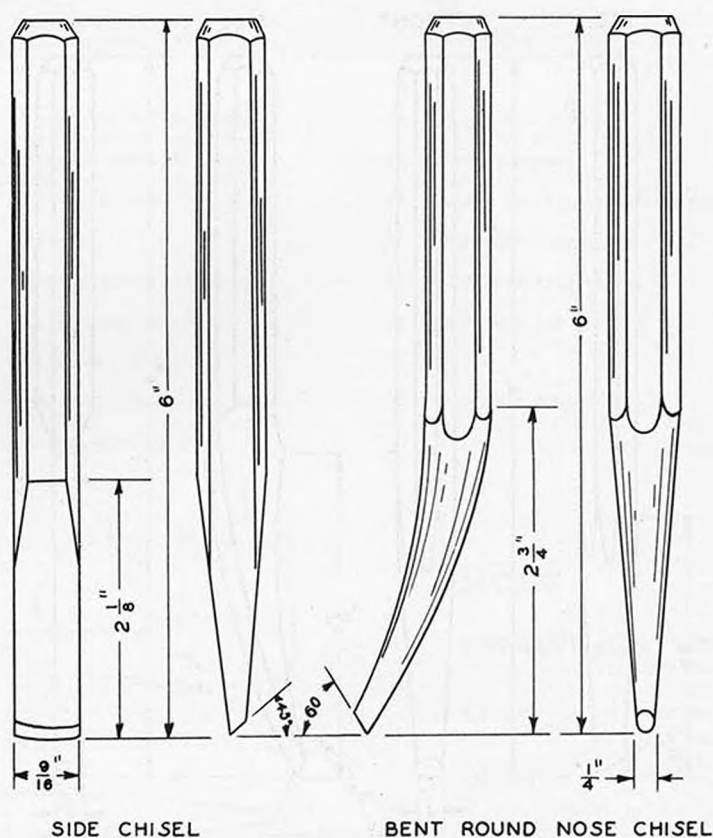
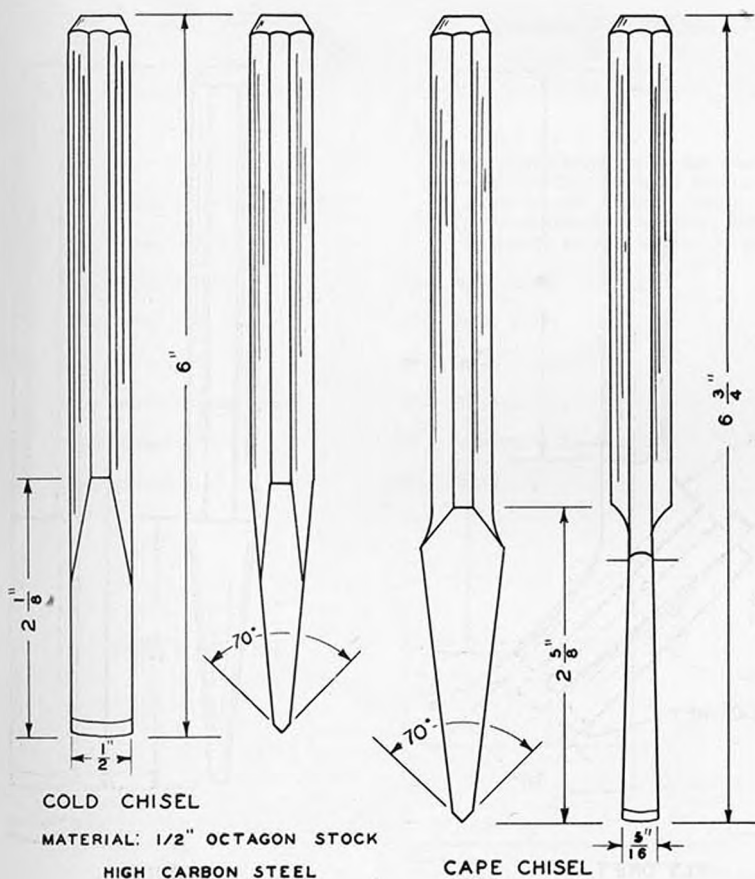
The more simple forging problems involve but one or two of the basic forging operations. These having been accomplished, they can then be combined as required in the fabrication of a chain swivel or other item.

Dimensional control of the forging problem is dependent upon careful stock calculation, proper sequence of operations, and proper execution of each of the basic forging operations required of the finished piece.

A rational approach to this goal can be had only through repeated forging of simple practical problems designed to develop proficiency in the basic forging operations. The successful accomplishment of more complicated forging problems will then depend on the blacksmith's experience and ingenuity to combine these basic operations.

The October issue of THE ORDNANCE SERGEANT presented a number of working drawings illustrating several of the basic forging operations, and combinations of these basic operations to produce desired results.

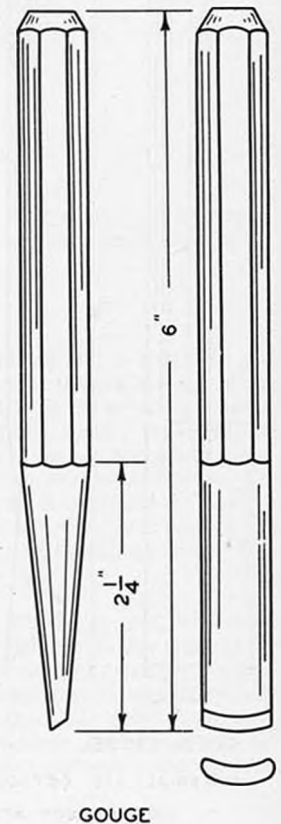
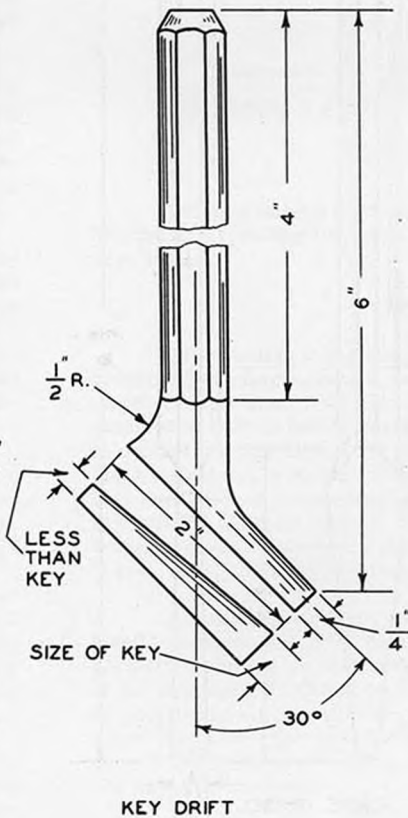
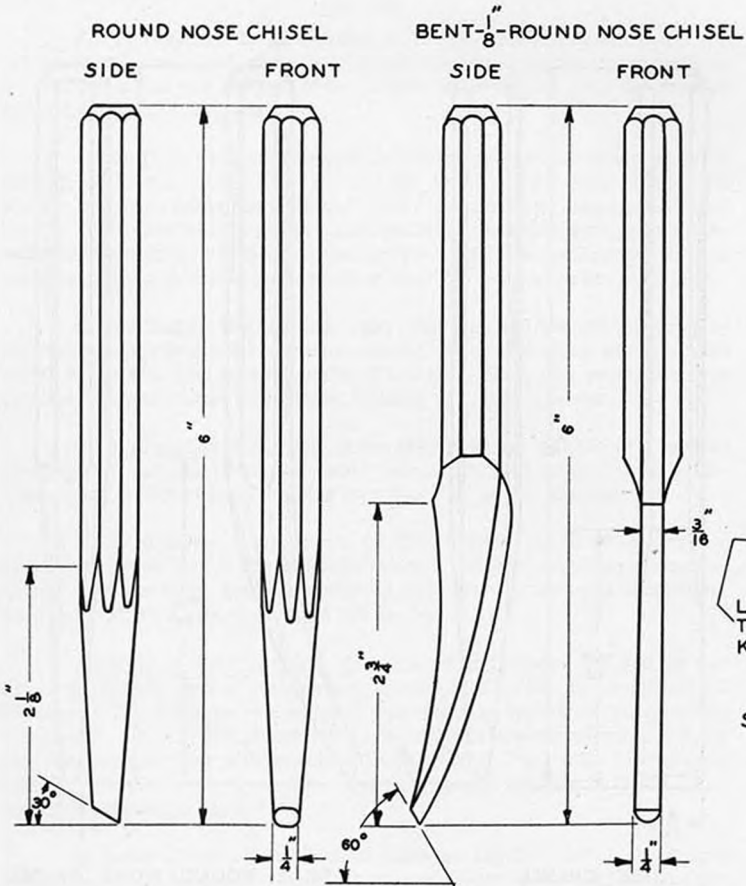
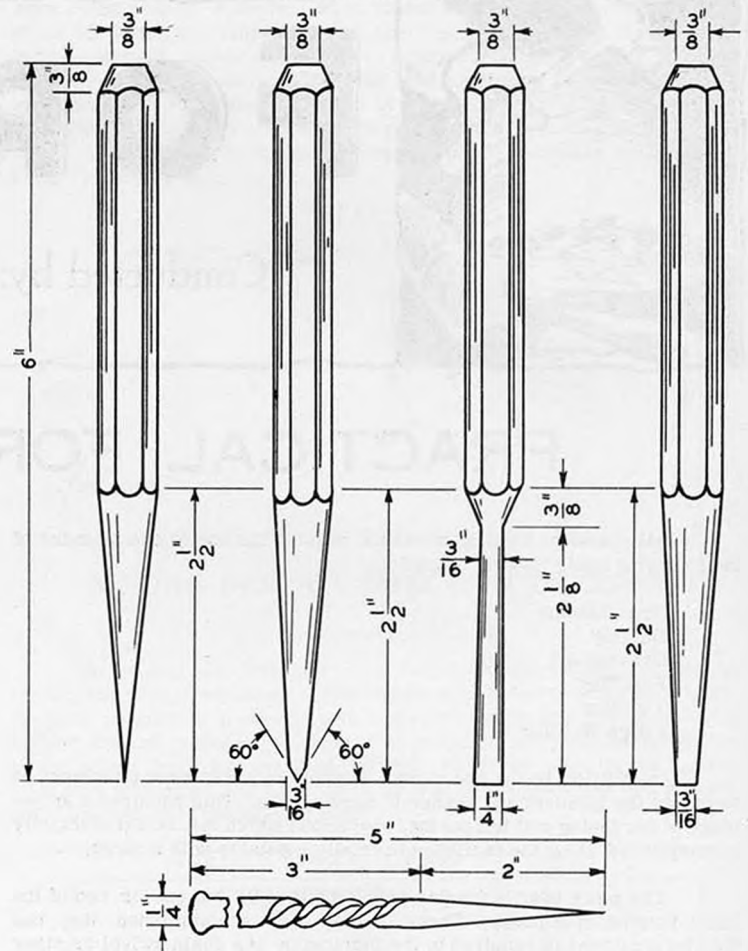
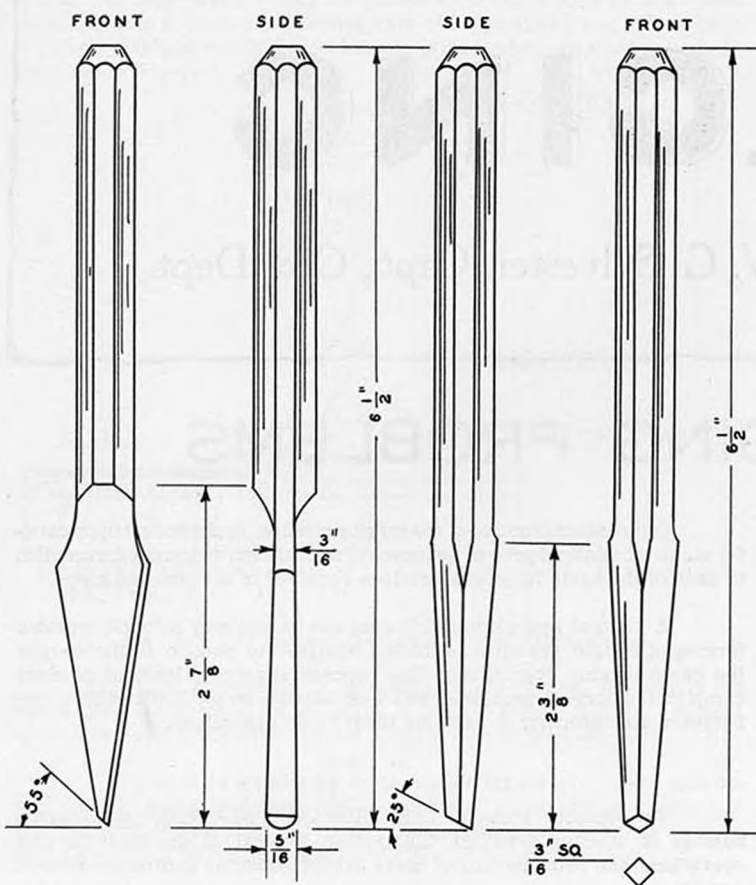
The drawings presented here are intended to illustrate forging problems which require tool forging, hardening, and tempering operations.

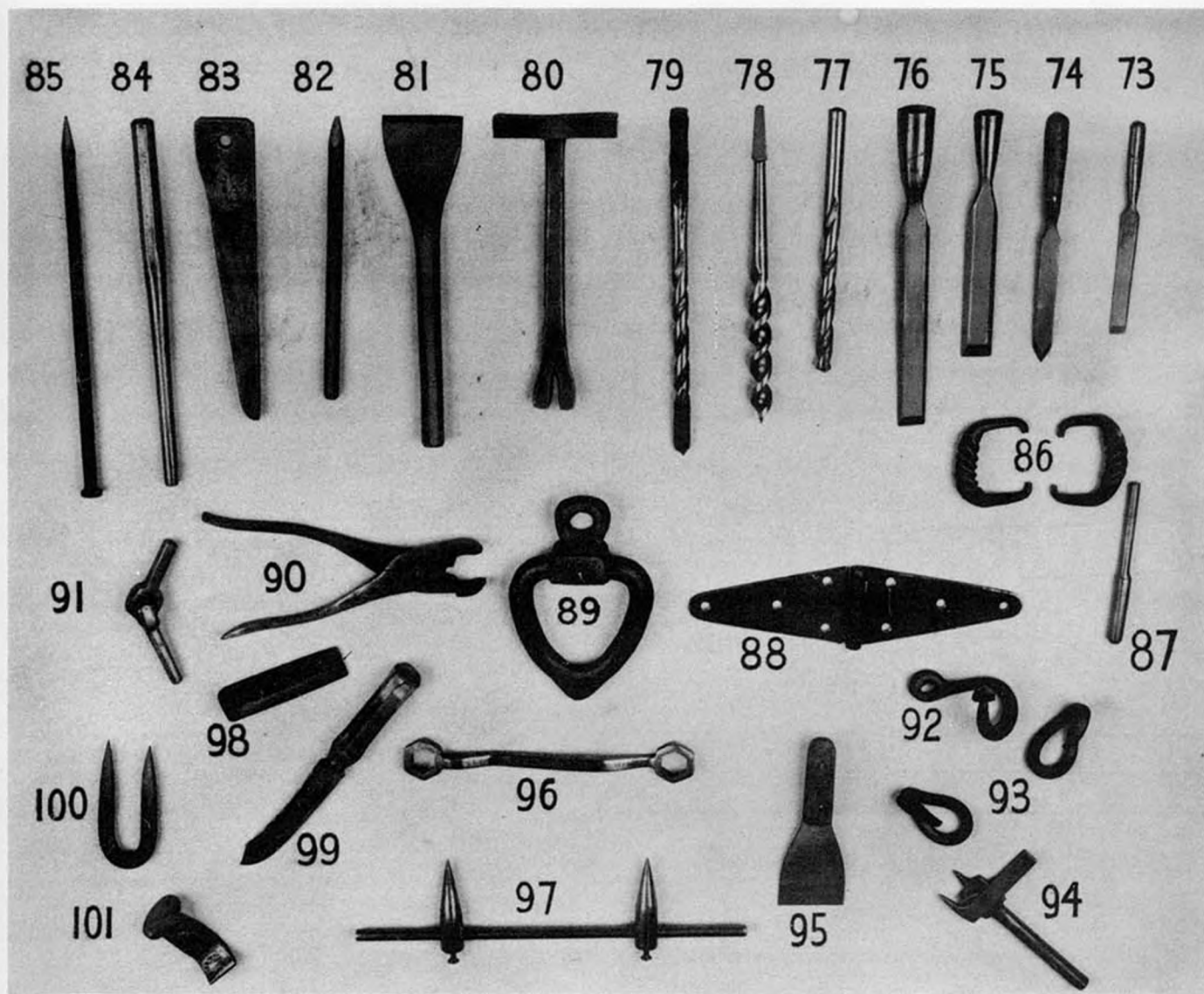


1/2 ROUND NOSE CHISEL

DIAMOND POINT CHISEL

CHISELS AND PUNCHES





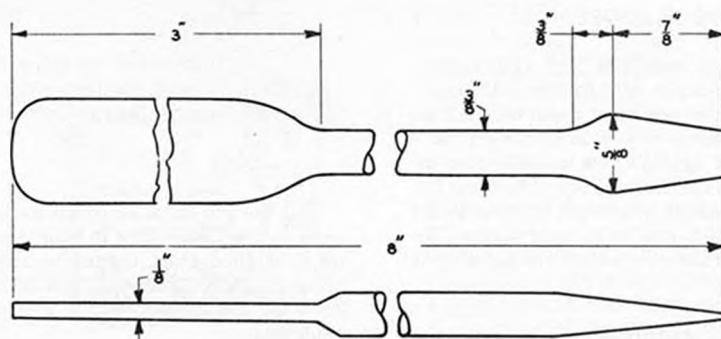
73. Wood chisel - $\frac{1}{2}$ "
 74. Wood chisel - diamond point
 75. Wood chisel - $\frac{7}{8}$ "
 76. Wood chisel - $\frac{3}{4}$ "
 77. Twist drill - $\frac{1}{2}$ "
 78. Wood bit - $\frac{5}{8}$ "
 79. Twist drill - development
 80. Crate opener
 81. Floor chisel - 2"

82. Bull chisel
 83. Drill drift
 84. Drift pin punch
 85. 40 penny nail
 86. Ornamental handles
 87. Drift - $\frac{1}{4}$ "
 88. Hinge
 89. Self aligning swivel
 90. Slip joint pliers
 91. Universal joint
 92. Pig tail single tree hook
 93. Single tree hooks

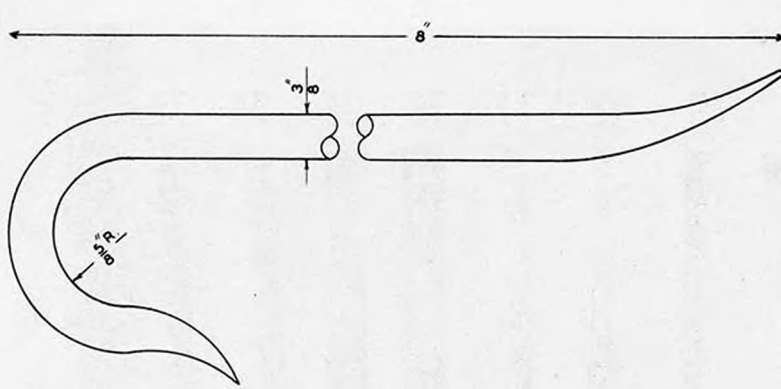
94. Adjustable wood bit
 95. Paint scraper
 96. Double end box offset wrench
 97. Machinists' trammels
 98. Wood splitting wedge
 99. Hunting knife
 100. Staple
 101. Cobbler's hammer

The articles shown in the photo above, products of the Forge shop at The Ordnance School, are in continuation of those shown in the October issue of THE ORDNANCE SERGEANT, and show considerable variety, both in process involved and skill required, as well as in the purposes of the articles shown.

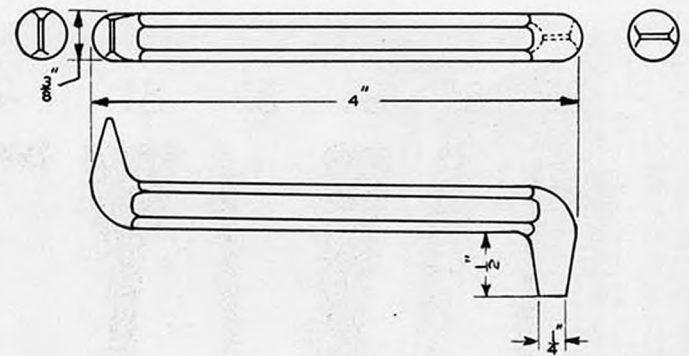
SCREWDRIVER



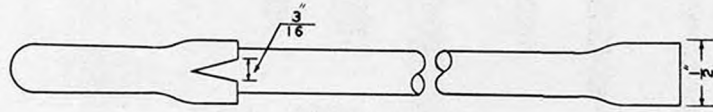
MORE
 DRAWINGS
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 PAGE



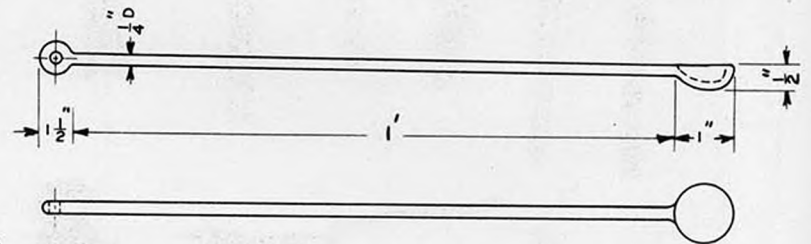
WREAKING BAR



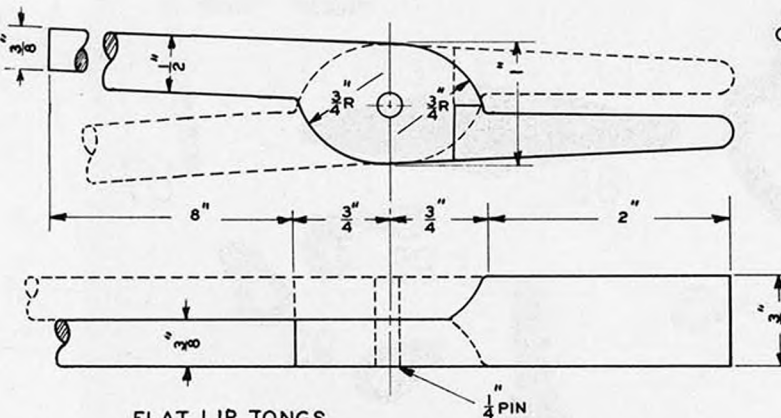
OFF SET SCREWDRIVER



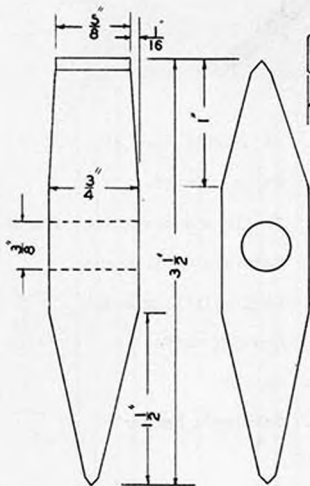
FLAT LIP TONGS



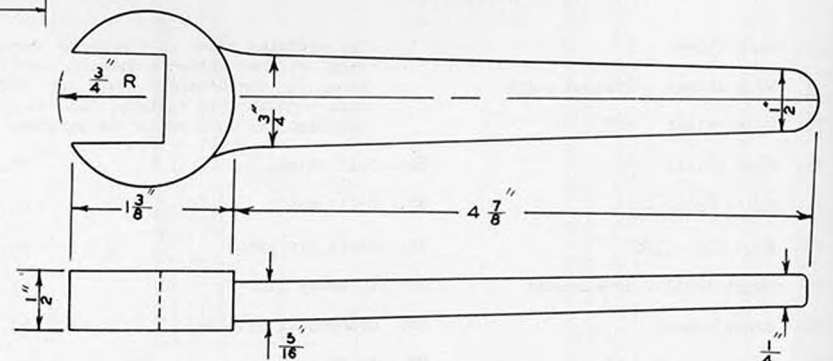
FLUX SPOON



S-WRENCH



SLAG HAMMER



BOX WRENCH

DON'T FORGET YOUR CHANGE OF ADDRESS

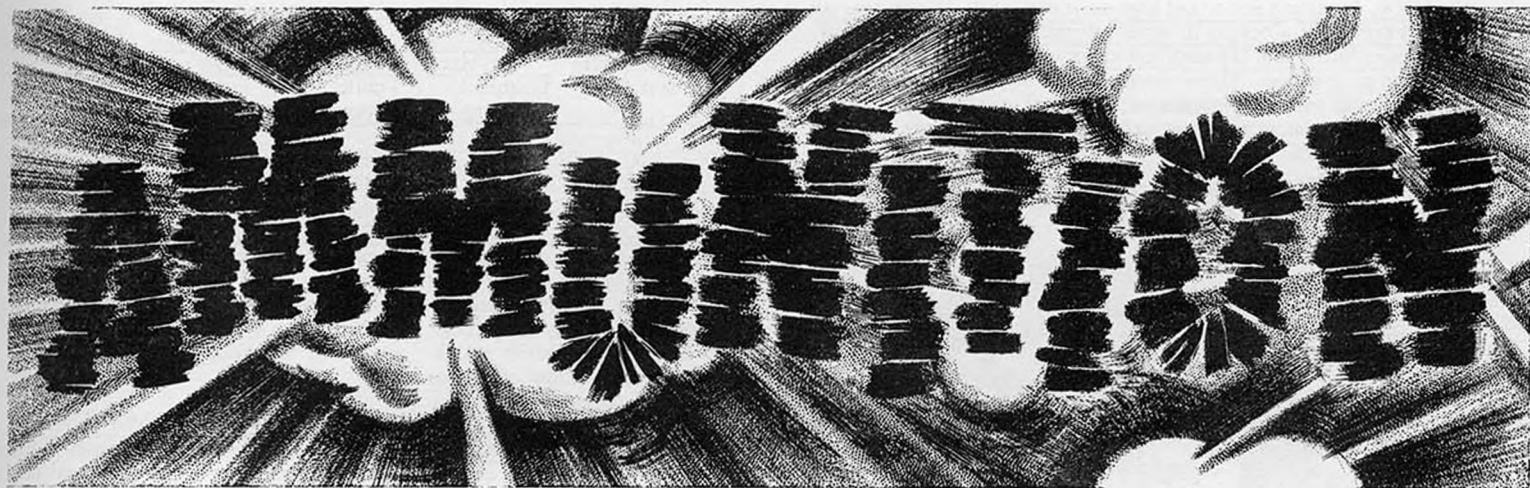
In spite of repeated warnings, a few copies of THE ORDNANCE SERGEANT are returned every month, because of incorrect addresses caused by changes of addresses which have not been reported. As we have warned month after month, such addresses are immediately cancelled. And as we have lamented time and again, a few months later we will receive a letter stating that the magazine has not been received for several months. Of course not. You knew where you were, but how would we know? But remember this, back issues are scarce articles. We prefer that you send us your change of address as soon as you know what it will be.

DON'T FORGET YOUR CHANGE OF ADDRESS.

NOTES

Don't write for an index to volume 4. No special index will be published. Instead, the December issue will include an index for the six issues of volume 4 (July to December, inclusive).

Do you know all about Recovery and Evacuation? If you don't you need not feel lonesome in your ignorance of this subject, but you can get off to a good start toward learning about it by reading the December issue of THE ORDNANCE SERGEANT. It won't contain all there is to know on the subject, but it will increase your general knowledge considerably.



Conducted by: R. J. Russo, Capt., Ord. Dept.

STORAGE OF AMMUNITION

by H. W. SIESHOLTZ, 2nd Lt., Ord. Dept.

PART II

As explained in Part I of this article (See THE ORDNANCE SERGEANT for October), strict adherence to all safety rules, and the use of care and common sense will prevent the start of a fire or subsequent explosion. It is a matter of military foresight and necessity, however, to make provisions for the possibility of an explosion. If an explosion does occur in a magazine, or if fire breaks out in it, two very important factors must be taken into account. First, it is necessary to limit the amount of ammunition and explosives lost by an explosion in any magazine to as small a quantity as is possible. Second, the ammunition stores must be set up so that an explosion in one magazine will not explode ammunition contained in another or cause damage to railways and other such equipment and installations. Provision is made for these two important factors by the common sense practice of providing a maximum limit on the amount of ammunition and explosives that may be stored in a magazine; and secondly, by regulating the distances between adjacent magazines containing a given amount of ammunition so that the explosion or fire may not be transmitted one to the other. The necessary data are set up under what are called "Quantity-Distance Tables". These tables, as the name indicates give:

- The list of explosives and types of ammunition to which any given table applies.
- The distance the magazine must be from other magazines for various amounts of explosives contained therein.
- The maximum amount of explosives that can be stored in the magazine.

With these provisions and principles set forth, the Quantity-Distance Tables are here presented:



CLASS 1: Small-arms Ammunition. - This is principally a fire hazard and no limit has been placed on this class.

CLASS 2: Smokeless powder, pyrotechnics, and chemical ammunition containing phosphorus. These materials may deteriorate and become unsafe. They burn with intense heat but do not usually form missiles or generate pressures which will seriously damage adjacent magazines.

QUANTITY-DISTANCE TABLE FOR CLASS 2

Pounds of explosives (not over)	Unbarricaded distance* in feet from nearest			
	Inhabited building	Public Railway	Public Highway	Magazine
10,000	150	150	150	100
100,000	300	300	300	200
200,000	375	375	375	250
500,000**	600	600	600	400

*Reduction of distances to one-half for barricades is permitted only in case of concrete igloo or emplacement magazines.

**Maximum permitted in any one magazine.

CLASS 3: Point-detonating fuzes, powder train fuzes, antitank mine fuzes, mechanical time fuzes, minor caliber base-detonating fuzes, combination time and percussion fuzes, anti-aircraft fuzes; packed separately in boxes.

These usually explode progressively, not more than a box or two at a time. Serious pressure not generated, missiles are small and light.

QUANTITY-DISTANCE TABLE FOR CLASS 3

Pounds of Explosives (not over)	Unbarricaded distance* in feet from nearest:			
	Inhabited Building	Public Railway	Public Highway	Magazine
50	400	400	400	60
200	400	400	400	100
1000	400	400	400	180
5000**	400	400	400	300

* Reduction of distances to one-half for barricades is permitted only for concrete igloo or emplacement magazines.

** Maximum weight permitted in one magazine. However, not more than 50,000 fuzes of any one model, nor more than 150,000 fuzes of any number of models, will be stored in one magazine without prior approval of the Chief of Ordnance.

CLASS 4: Fixed and semifixed high explosive shell, trench mortar ammunition, fragmentation bombs in wooden containers, grenades, shrapnel of all calibers, fuzed and unfuzed, and blank ammunition for cannon — packed in boxes or bundles. These usually explode progressively a few boxes at a time, and many explosions of individual rounds are of a very low order. Serious pressure are not usually generated, and most missiles will fall within 200 yards.



Effect of explosion on hollow tile and wood construction. Building was 1250 feet away.

QUANTITY-DISTANCE TABLE FOR CLASS 4

Pounds of explosive (not over)	Unbarricaded distance* in feet from nearest:			
	Inhabited Building	Public Railway	Public Highway	Magazine
50	1200	1200	1200	60
500	1200	1200	1200	140
1,000	1200	1200	1200	180
50,000	1200	1200	1200	225
500,000**	1200	1200	1200	300

* Reduction of distances to one-half for barricades is permitted only in case of concrete igloos or emplacement magazines.

**Maximum permitted to be stored in any one magazine.

CLASS 5: Separate and unfixed shell, loaded with Explosive D, fuzed or unfuzed. These usually explode one shell at a time and usually with low order. The missiles are limited as to number and range, and most of them fall within 400 yards.

QUANTITY-DISTANCE TABLE FOR CLASS 5

Pounds of explosive (not over)	Unbarricaded distance* in feet from nearest:			
	Inhabited Building	Public Railway	Public Highway	Magazine
1000	1200	1200	1200	100
25,000	1200	1200	1200	200
650,000**	1200	1200	1200	300

* These distances will not be reduced by barricades except that one-half these distances is authorized for concrete igloos and emplacement magazines.

** Maximum permitted to be stored in any one magazine.

CLASS 6: Major and Medium caliber base-detonating fuzes, bomb fuzes, boosters and bursters for high explosive and chemical shell and bombs — packed separately in boxes. These usually explode progressively by piles. Structural damage is usually limited to adjacent magazines. Missiles are light and usually fall within 200 yards. The number involved in any explosion is limited by making the piles small and separating them by prescribed distances. A maximum of 5000 pounds of explosives is permitted in each pile and the piles should be at least two feet apart. If this method of stacking is complied with, the quantity to be considered is the amount in one pile; otherwise, the total amount of explosives in the magazine is taken and the Table for Class 9 is used (Authority: TM 9-1900, p. 146).

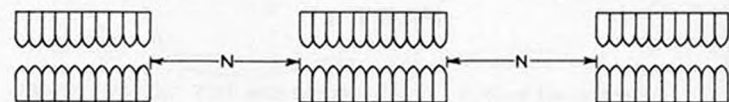
QUANTITY-DISTANCE TABLE FOR CLASS 6

Pounds of explosive (not over)	Distance* in feet from nearest:			
	Inhabited Building	Public Railway	Public Highway	Magazine
50	240	140	70	60
200	240	140	70	100
5,000	1500	900	450	200
100,000**	1500	900	450	300

* These distances will not be reduced by barricades nor by storing in concrete igloo or emplacement magazines.

**Maximum weight permitted in one magazine: however, not more than 50,000 fuzes of any one model, nor more than a total of 150,000 fuzes of any number of models will be stored in one magazine without prior approval of the Chief of Ordnance.

CLASS 7: Separate and unfixed shell of all calibers, except those loaded with Explosive D. This class comprises those shell which are not assembled with cartridge cases. Shell up to 10 inches in caliber are stored on their sides with the piles one shell wide. The shell should face nose to nose and base to base in adjacent piles. The quantity of explosives in any one pile should not exceed 15,000 pounds, and the distance between each pile should be one and one-half times the length of the shell. The quantity of ammunition to be considered will then be the maximum quantity in any one pile, and distances may be reduced accordingly, provided the lateral (side to side) distance is in excess of 16 feet. Where the lateral distance is less than 16 feet, the total quantity shall be the maximum quantity in any row. Thus, if there are three piles of shell in a single row as shown here, then, if the distance N is greater than 16 feet the quantity of explosive to be considered will be that contained in one pile.



If, however, the distance N is less than 16 feet, the entire row shall be considered as one pile.

Where compliance with the above rules is impossible, as in underground magazines, due to the necessity of conserving space, then: The total amount of explosive material in the magazine will be the quantity to be considered; and the distances to be observed will be taken from classes 9 and 10.

QUANTITY-DISTANCE TABLE FOR CLASS 7

Pounds of explosives (not over)	Distance* in feet from nearest:			
	Inhabited Building	Public Railway	Public Highway	Magazine
25,000	1800	1800	1800	200
500,000**	1800	1800	1800	300

* These distances will not be reduced by barricades nor by storing in concrete igloo or emplacement magazines.

**Maximum permitted in any one magazine.

CLASS 8: Primers, primer-detonators for bombs, grenade fuzes, and blasting caps, packed in metal containers and wooden boxes. All in a magazine may explode at one time, but as the total amount of explosives is small and they are not closely confined, structural damage is usually limited to adjacent magazines. Light missiles are formed which have a very limited range.

QUANTITY-DISTANCE TABLE FOR CLASS 8

Pounds of explosive (not under)	Distance* in feet from nearest:			
	Inhabited Building	Public Railway	Public Highway	Magazine
50	240	140	70	60
500	720	430	220	140
5,000	1200	720	360	300
10,000	1500	900	450	300
15,000	1610	970	490	300
20,000**	1740	1040	520	300

* Distances may be halved by effective barricades (natural ground features or artificial at least 4 feet from magazine and at least 3 feet thick at top, and high enough so a straight line from the top of the barricade and the top

of the side wall of the magazine will pass above any magazine to be protected and 12 feet above any public highway or railway).

**Maximum permitted in any one magazine.

CLASS 9: Flashlight powder, demolition blocks, spotting charges, bulk low explosives, bulk priming explosives, bulk initiating explosives such as tetryl, bulk high explosives as TNT and Explosive D.

CLASS 10: Demolition bombs, fragmentation bombs in metal crates, photoflash bombs, and HE anti-tank mines. All in a magazine may explode at one time. If this happens, structural damage, caused by pressure generated, is not likely to occur at the distances given in the table and most missiles will fall well within these distances.

QUANTITY-DISTANCE TABLE FOR CLASSES 9 AND 10

Pounds of explosive (not over)	Distance* in feet from nearest:			Magazine
	Inhabited Building	Public Railway	Public Highway	
50	145	90	45	60
100	240	140	90	80
200	360	220	110	100
300	520	310	150	120
400	640	380	190	130
500	720	430	220	140
600	800	480	240	150
700	860	520	260	158
800	920	550	280	165
900	980	590	300	170
1,000	1020	610	310	180
1,500	1120	680	340	210
2,000	1200	720	360	230
3,000	1320	790	390	260
4,000	1420	850	420	280
5,000	1500	900	450	300
6,000	1560	940	470	300
7,000	1610	970	490	300
8,000	1660	1000	500	300
9,000	1700	1020	510	300
10,000	1740	1040	520	300
15,000	1870	1120	560	300
20,000	2010	1200	600	300
25,000	2140	1290	640	300
30,000	2280	1370	680	300
40,000	2550	1530	760	300
50,000	2800	1680	840	300
75,000	3310	1990	1000	400
100,000	3630	2180	1090	400
150,000	3800	2280	1140	800
200,000	4060	2440	1220	800
250,000**	4310	2590	1300	800

* Distances may be halved by effective barricades.

**Maximum permitted in any one magazine.

CLASS 11: Chemical ammunition, except ammunition containing phosphorus. Chemical shell, bombs, and grenades stored and issued by the Ordnance Department are not considered to be an explosive hazard and no limit has been placed on this type of ammunition as far as quantities and distances are concerned. For the purposes of storage, however, chemical ammunition is divided into 4 groups as follows:

GROUP A: Basicants (HS; M1)

GROUP B: Toxic, irritant, and smoke producing compounds (CG, PS, NC, KJ, CA, DA, DM, FM, CN, Cl, FS, CNS, CNB).

GROUP C: Spontaneously inflammable (Phosphorus).

GROUP D: Incendiary and readily inflammable (TH, F8, HC, CN grenades, DM grenades, CN-DM grenades).

Munitions from two or more groups will not be stored together without the specific approval of the Chief of Ordnance.

CLASS 12: Explosives such as ammonium nitrate, DNT, and wet nitrocellulose. These materials are insensitive and can only be detonated by very strong initiation. When stored in an area where there is a possibility that explosives may be projected into them, they will be stored in accordance with the regulations for class 9 explosives. When stored in an area of fire hazards only and separated by inhabited building dis-

tances from areas containing explosives, these materials may be stored in accordance with the regulation for smokeless powder.

SEPARATION OF EXPLOSIVES WHICH MIGHT INITIATE AND PROPAGATE AN EXPLOSION

Explosives and ammunition components loaded with explosives, differ one from the other in the ease with which they can be made to explode. For example, blasting caps are loaded with mercury fulminate which is an extremely sensitive explosive. Therefore, blasting caps always present the danger of exploding due to rough handling or fire. On the other hand, an explosive such as TNT is relatively insensitive to shock, and if it takes fire, it will burn invariably just as a non-explosive inflammable material would. TNT, however, can be detonated by an explosion of mercury fulminate. It is obvious, therefore, that it would be injudicious to store blasting caps and TNT in the same magazine. If a fire occurred in the magazine, the resultant explosion of the blasting caps would explode the TNT; whereas if TNT had been stored alone, it would have merely burned without an explosion; and the fire could have been fought by the fire-fighting crews. Other types of ammunition present exactly the same or an analogous problem so that it is necessary that certain of these be stored separately from the others to lessen the danger involved. No explosive or ammunition component may be stored with any other type unless authority is given to do so. The authority for so doing is given by the Ammunition Storage Chart. This chart is given herewith. The "X" in the intersection of a horizontal row with a vertical column authorizes that these two items may be stored together. When two items are stored together, additional items may be stored with them only if each of the additional items is authorized for storage with all of the other items. If an "X" does not appear at the intersection of a row and column, the two items may not be stored together in one magazine except in certain exceptions outlined following the chart.

AMMUNITION STORAGE CHART

GROUPS See paragraph 117 for use of chart and exceptions		Bulk black powder, saluting, practice bombs, and smoke puff charges	TNT (bulk) and demolition blocks	Dynamite	Explosive D	Smokeless powder, bulk or charges	Small-arms ammunition	Fixed and semifixed HE shell and shrapnel	Blank ammunition for cannon	Separate loading shrapnel	Fragmentation bombs (wood crates)	Light mortar shell (81-mm and less)	Grenades, fragmentation and practice	Antitank mines, practice	Fuzes, time and detonating	Primers and primer detonators	Detonators, blasting and percussion caps	Grenade fuzes	Adapters, boosters, and bursters	Fuzes, antitank mine	Demolition bombs	Fragmentation bombs (metal crates)	Separate loading shell	Antitank mines, HE	Pyrotechnics
A	Bulk black powder, saluting, practice bombs, and smoke puff charges		X	X	X																				
B	TNT (bulk) and demolition blocks			X	X																				
C	Dynamite					X																			
D	Explosive D						X																		
E	Smokeless powder, bulk or charges							X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
F	Small-arms ammunition							X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
G	Fixed and semifixed HE shell and shrapnel							X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
H	Blank ammunition for cannon							X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
I	Separate loading shrapnel							X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
J	Fragmentation bombs (wood crates)							X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
K	Light mortar shell (81-mm and less)							X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
L	Grenades, fragmentation and practice							X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
M	Antitank mines, practice							X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
N	Fuzes, time and detonating							X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
O	Primers and primer detonators							X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
P	Detonators, blasting and percussion caps							X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Q	Grenade fuzes							X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
R	Adapters, boosters, and bursters							X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
S	Fuzes, antitank mine							X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
T	Demolition bombs							X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
U	Fragmentation bombs (metal crates)							X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
V	Separate loading shell							X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
W	Antitank mines, HE							X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
X	Pyrotechnics							X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Y	Chemical amm., gr. A (vesicant)							X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Z	Chemical amm., gr. B (gas and smoke)							X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
AA	Chemical amm., gr. C (phosphorus)							X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
AB	Chemical amm., gr. D (burning)							X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
AC	Bombs, photoflash							X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
AD	Flashlight powder							X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Stored separately

Exceptions to the storage chart: When the total quantity of explosive or chemical fillers in a magazine is 1,000 pounds or less, certain exceptions to the Storage Chart are authorized by TM 9-1900. These exceptions are:

1. Any combination of items in Group A and Group B may be stored in one magazine.
2. Any combination of items in Group C and Group D may be stored in one magazine.
3. Any combination of items in Group H and Group L may be stored in one magazine.
4. Small-arms ammunition and any combination of items in Groups I, J, and L may be stored in one magazine.

5. Small-arms ammunition and items in Group M may be stored in one magazine.

APPENDIX I

The Ordnance Safety Manual and pertinent Technical Manuals and Technical Regulations present specific information on the safety precautions and dangers involved in handling certain types of explosives and ammunition. A brief description of these properties is herewith presented for several important types of explosives and ammunition.

BLACK POWDER. - Black powder is an extremely treacherous explosive and must be treated with every respect. It is extremely important that non-sparking tools, such as wooden mallets and wedges, be used to open the black powder containers lest a spark cause the powder to explode. Handlers of black powder should ground themselves frequently by touching a pipe or other grounded metal outside the magazine to carry away any static electricity built up in the body. Non-sparking safety shoes should be worn by those handling the explosive. Powder must also be protected from moisture as it is absorbed readily by the explosive and thus deteriorates.

Black powder fires result in an explosion and therefore no attempt can be made to fight the fire. All that can be done is to prevent fires from reaching the stores of black powder. Once they are reached, the fire-fighting crews should withdraw 800 feet from the magazine and seek cover. Adjacent magazines should be protected.

Black powder can be inactivated by water; therefore, empty containers of black powder should be washed with water, and any spilled powder should be swept up and the spot washed with water. Spilled powder can be destroyed by dumping in water.

HIGH EXPLOSIVES (TNT, Explosive D, Tetrayl). These explosives should be protected from undue shock, friction, or sparks. If a fire starts, they will usually burn in the early stages without explosion; therefore, such magazine fires can be fought. If, however, the fire gains any headway, an explosion may result, and fire-fighting forces should then be withdrawn to protect other magazines. Boxes should be opened with safety tools. (See Fixed ammunition for additional details in fire-fighting).

SMOKELESS POWDER IN BULK AND IN SEPARATE LOADING CHARGES. - Smokeless powder presents chiefly a fire hazard. Such fires cannot be fought due to the intense heat, and fire-fighting crews should be halted at least 200 yards from the fire and utilized to prevent spread of the fire. Explosions usually do not occur in such fires unless the powder gases resulting from the fire are unduly confined.

Heat and moisture are detrimental to smokeless powder, and magazines should protect against these two elements. Personnel should take care that no sparks are generated in a magazine either due to static body electricity, nails in shoes, or failure to use non-sparking tools.

SMALL-ARMS AMMUNITION. - These form principally a fire hazard due to the smokeless powder content and the wooden boxes. Small-

arms should be protected against moisture and excessive heat by using sufficient dunnage to raise the boxes off the magazine floor and to provide space for air to circulate between the boxes. It is important to retain the lot number of small-arms ammunition as otherwise it falls into Grade 3 (unservicable) ammunition. Rounds removed from boxes and assembled to machine gun belts should be tagged with the lot number to preserve its lot number and identity if the rounds are returned for storage. Small-arms boxes have an air-tight metal liner to protect the ammunition from moisture. If the boxes are opened and some rounds removed, the metal liner should be replaced and sealed with friction tape around the edges.

Fires in small-arms magazines can usually be brought quickly under control without undue danger to fire-fighting crews.

FIXED AND SEMI-FIXED AMMUNITION. - This comprises ammunition which is assembled with cartridge cases containing the propelling charge of smokeless powder. This type of ammunition has as its principle hazard the possibility of explosion due to fire breaking out in a magazine. For this reason, inflammable material in a magazine should be reduced to a minimum. In addition, protection against the weather should be given by the magazine construction, and the bundles or boxes containing the rounds should be raised off the floor by dunnage. There is a danger involved in this type of ammunition due to the comparatively sensitive booster and fuze explosives; therefore, the rounds should not be handled roughly nor should the temperature in the magazine be permitted to be excessively high. In storing this type of ammunition, various types and calibers should be stored in one magazine, rather than putting the entire stock of one type in one magazine. This is to prevent losing all of a given type if the magazine should take fire. For those types of fixed ammunition which are shipped unfuzed, fuzes should be assembled at least 100 feet from the magazine.

If a fire breaks out in an above ground magazine, personnel should make every effort to control the fire immediately, but will evacuate the magazine once the fire reaches the ammunition itself, due to the possibility of an explosion. Fire-fighting crews will then direct their operations to protecting adjacent magazines. In such cases, personnel will approach no closer than 500 feet, and fire-fighting equipment will not be brought closer than 1000 feet to the fire.

If a fire breaks out in an igloo magazine and personnel are present they should attempt to bring the fire under immediate control. Failing this, or if the fire is discovered from the outside of the magazine, no personnel being present in the magazine, the same rules as laid down for above-ground magazines will apply. No attempt should be made to enter the magazine.

GRENADES AND TRENCH MORTAR AMMUNITION. - The same precautions follow for this type of ammunition as for Fixed and Semi-fixed.

SEPARATE LOADING SHELL. - The precautions and fire-fighting methods for this type are the same as for Fixed and Semi-fixed ammunition. Since these shells are usually not boxed or crated, it is necessary to protect the copper rotating bands by rope grommets or some other effective means to avoid cutting or damaging them.



Section of World War powder plant used as a post war "dump" for 52,000,000 pounds of smokeless powder, stored in metal lined wooden boxes. Storage classed as "temporary".



Same scene after fire, probably started by spontaneous combustion, which started at one end and spread quickly.

FRAGMENTATION BOMBS IN WOODEN BOXES. - These bombs are not subject to mass detonation, and present a hazard similar to fixed ammunition. Storage principles and fire-fighting methods are the same as for semi-fixed and fixed ammunition.

DEMOLITION BOMBS AND FRAGMENTATION BOMBS IN METAL CRATES. - Fragmentation bombs in metal crates are more subject to mass detonation in case of fire than those stored in wooden boxes; therefore, they are grouped with demolition bombs which have a very high percentage of high-explosive and are very liable to mass detonation. This class of explosives is one of the most dangerous type, and extreme precautions should be taken with them. It should be kept in mind that if a fire occurs in the magazine causing one bomb to explode, that, in all probability, the entire contents of the magazine will explode. In case of fire, the same rules apply for this class as for fixed ammunition.

FUZES, PRIMERS, DETONATORS, BOOSTERS. - This class of ammunition is loaded with very sensitive explosive compounds. Care should be taken that they are not subjected to any shocks in handling or to excessive magazine temperatures. The quantity stored in any one magazine should be as small as is possible. If a fire occurs in a magazine where personnel are working, they should attempt to put it under control immediately. Failing that, or where the fire is discovered from the outside of the magazine, fire-fighting crews should attempt to put out the fire with their equipment. If it appears that the fire has gained too much headway, the crews should withdraw, and try to prevent spread of the fire. Limited explosions may be expected in fires from these materials.

PYROTECHNICS. - This class of materials requires protection against moisture and high temperature. Mainly, they present an inflammable hazard. Those of them which have an expiration date should have observed proper instructions for their disposal as given in OFSB 3-9 and other pertinent technical regulations and instructions. Fire-fighting methods for this type are the same as for smokeless powder.

CHEMICAL AMMUNITION. - This type of ammunition should not be stored with any other type due to the difficulty involved in fighting fires where chemical ammunition may burst and hamper the fire-fighting crews in their efforts. As shown under Class 11, chemical ammunition is divided into four groups. The safety requirements for these different groups are as follows:

Group A Vesicants. - Magazines should have concrete floors. Each officer, man, or fireman whose presence may be required in the magazine should have a gas mask, the protective clothing, rubber boots, and gloves. Also on hand as decontaminating agents and first aid should be: Chloride of lime, kerosene, flannel cloths, sodium bicarbonate boric acid, soap, washing facilities.

Group B, Toxics, irritants, smoke-producers. - Magazines should have concrete floors and ample ventilation. Special equipment should be: gas masks, gloves; and as first aid: sodium sulfite, saturated alcoholic solution of lye, litters, wool blankets. Masks will be carried at all times in the magazines.

Group C, spontaneously inflammable, phosphorus. - Magazines should have concrete floors with elevated sills to permit flooding the floor with water. Since phosphorus will not burn if kept out of contact with air, it is only necessary to keep it submerged in water to keep it from burning. Therefore, tubs or barrels should be on hand filled with water and should be large enough to contain the largest shell stored in the magazine. First aid equipment should include rubber gloves and boots, sponges, pails, and copper sulfate solution. If any phosphorus gets on the skin, liberal quantities of copper sulfate should be applied to neutralize it.

Group D, incendiaries and readily inflammable. - No water should be used in these magazines. Special precautions necessary are to maintain extreme vigilance to prevent fire. Accepted methods of combating fires should be used for combating incendiary fires, keeping in mind that a heavy stream of water played on an incendiary may cause an explosion due to a reaction between the incendiary and the water, if the incendiary is burning.

In the storage of chemical ammunition, the arrangement should permit ready inspection for leaks. Further, the ammunition should be so stored that any leaking ones may be readily removed. A responsible officer or foreman should always be present when a magazine door is opened to detect leaking shells by the odor. Fires will be fought until brought under control.

APPENDIX II

Every magazine containing explosives and ammunition should have posted on the outside in a conspicuous place a copy of O.O. form 5991, an illustration of which is presented here.

STORAGE AND CARE OF EXPLOSIVES

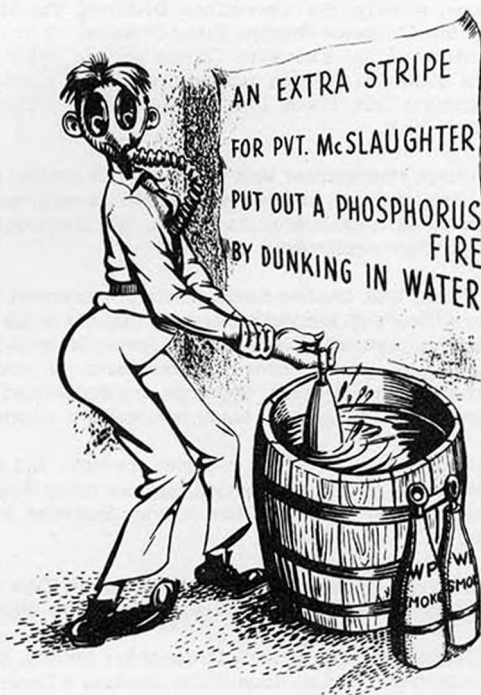
GENERAL INSTRUCTIONS

1. Always handle explosives and ammunition carefully.
2. Remove dirt, grit, and foreign materials from containers and ammunition before placing in storage.
3. Do not store explosives and ammunition in damaged containers.
4. Keep all containers in magazine effectively closed so that the contents cannot be handled, examined, or removed.
5. Store each lot separately. Make the piles stable. Provide for a free circulation of air to all parts of the pile. Raise containers and ammunition off the floor by dunnage.
6. Do not open, repair, pack, or repack containers in or within 100 feet of magazine, except as permitted by Ordnance Safety Manual No. 7224.
7. Do not keep empty containers, tools, or other materials in magazine.
8. Absolute cleanliness and order must be maintained.
9. Use only electric lanterns and flashlights approved by the Ordnance Safety Manual.
10. Do not smoke, or bring matches into magazine.
11. Do not allow unauthorized persons in or near magazine.
12. Keep magazine spark tight, with ventilators well screened, and no openings around doors or foundations.
13. Keep doors securely locked. Close doors while cars are being placed or while engine, speeder, or tractor is passing, or in immediate vicinity.
14. Keep the ground around this magazine free from any inflammable material.
15. Wear safety shoes or rubbers if black powder is stored in magazine.
16. Post conspicuously one or more copies of these rules in magazine.
17. See Ordnance Safety Manual No. 7224 for detailed instructions.

APPENDIX III

Authority for tables and regulations given in the above article were obtained from the following references:

Ordnance Safety Manual: O.O. Form No. 7224
 Technical Manual, Ammunition General, TM 9-1900
 Ordnance Department Safety Bulletin No. 26 (Feb. 9, 1942)
 O.O. Form No. 5991
 A. R. 700-10 (Supplies - storage and issue)





Conducted by: Ordnance Section, Army Air Forces

THE ORDNANCE SECTION ARMY AIR FORCES

by
GLENN H. STALEY
1st Lt., Ord. Dept.

Across the Potomac River from Washington, adjoining the grounds of the National Capitol Airport is the Headquarters of the Army Air Forces, one section of which is of particular interest to Aviation Ordnance Personnel. The mission and organization of that section is outlined by the following paragraphs.

The Ordnance Section, Army Air Forces, renders advice to the Commanding General of the Army Air Forces, his staff, and the several operational and administrative agencies in his office on all Ordnance matters. This section exercises technical supervision of personnel and materiel in the Army Air Forces.

The organization of this section is shown in Chart No. 1. It has a control division to coordinate and supervise the activities of the three main divisions; namely, the Operations Division, The Materiel Plans Division, and the Ordnance Service Plans Division. It is composed of a Chief of Section and his Executive Officer and, in order to adequately carry out its duties of section administration, is subdivided into an Office Management Unit, Fiscal Unit, Mail and Record Unit, and General Correspondence Unit.

The Office Management Unit has charge of civilian personnel and matters pertaining thereto, such as records of leaves, preparation of data rosters, manning and organization charts, etc., and also supplies and keeps a record of all office equipment.

The Fiscal Unit handles funds, allots procurement authorities to the Ordnance Officers of Air Forces and Commands in the United States for such things as payment of civilian employees, labor and material for sand loading bombs, procurement of spare parts for maintenance not available through general issue. Records are maintained and required reports submitted on status of all funds received and allotted.

The Mail and Record Unit receives, records and distributes all mail. It maintains a file of publications, such as Army Regulations, War Department Circulars, Ordnance Field Service Bulletins, etc. and issues and maintains office supplies.

The General Correspondence Unit handles overflow typing and the preparation of copies of correspondence for the entire office.

The first of the three main divisions of the section, the Operations Division, is subdivided into an Ammunition Section, a General Supply and Equipment Section, and an Ordnance Units Section. Through these sections,

the Operations Division collects, maintains records, and analyzes carefully the status of Ordnance materiel and personnel in units of the Army Air Forces throughout the world with view to taking necessary action to correct disproportionate and erroneous allocation. In effecting this action, any and all War Department agencies are contacted.

The Ammunition Section maintains detailed records of the status of all ammunition supply to units in the Army Air Forces throughout the world. It checks requirements of all Army Air Force Units for training Ammunition and represents the Army Air Forces on all matters concerning training and test ammunition requirements at conferences called by G-3 of the War Department General Staff. It also maintains records of AMSA's, and status of stocks for all training and test ammunition, taking steps to insure the adequate supply of training ammunition to all units of the Army Air Forces as authorized. This section also computes supply requirements for combat ammunition required by all Army Air Force Units within the Defense Commands or overseas stations. It receives, reviews and procures necessary action to be taken on all requests for AMSA's or direct supply of combat ammunition, and sub-allots to the Continental United States Air Forces and Commands ammunition supply authorities on releases obtained from the Chief of Ordnance. It also clears the Commanding General, Services of Supply on the items of ammunition commonly used by Ground and Air Forces before requesting releases for this ammunition from the Chief of Ordnance. An additional function of the Ammunition Section is to gather and maintain a file of data concerning the proper storage and maintenance of ammunition in the field and makes use of special data together with inspections of field installations to disseminate corrective information where needed.

The General Supply and Equipment Section checks all movement orders regarding Ordnance equipment and follows up to see that the reported shortages are filled. It maintains an accurate record of all T/BA's, T/A's, and T/O's and checks the Ordnance Service Plans Division on any proposed changes in allowances and with the Materiel Plans Division on any modification of existing equipment. Credits are requested from the Chief of Ordnance for items peculiar to Army Air Forces which are allocated to Army Air Force Units. Reports of controlled items received periodically from Aviation Ordnance Units in the field are checked in this section, to make sure that Army Air Force Units receive a proportionate share of these items.

The Ordnance Units Sections maintains a classification data card on Ordnance Officers assigned to the Army Air Forces and assigns and classifies Ordnance personnel, both commissioned and enlisted, to Army Air Force Units. Arrangements are made through the Chief of Ordnance for proportionate quotas of enlisted men and officers to attend technical schools. A record of the status of all controlled and principal items of Ordnance equipment in the possession of Ordnance Units in the Army Air Forces is maintained.

Another of the main divisions assembles, studies, evaluates, and disseminates information concerning all Ordnance Materiel and Ammunition used by the Army Air Forces and is known as the Materiel Plans Division. It checks the performance of the Ordnance Materiel in the hands of troops and renders technical advice to concerned directorates of the Army Air Forces. Data is gathered on requirements for Ordnance materiel for all types of military aircraft and appropriate action is recom-

mended for proper procurement authority. This division is also subdivided into sections.

The Ammunition Section secures, assembles and files all information pertaining to items of ammunition used by the Army Air Forces, allied, and enemy Air Forces. It disseminates within allowed limits information on all matters of aircraft ammunition to Aviation Ordnance Personnel in the field and maintains close liaison between the Headquarters of the Army Air Forces and the Chief of Ordnance on matters concerning ammunition used in aircraft weapons. Important test firings of air craft ammunition are attended and detailed reports submitted to interested agencies. This section also receives, reviews, and investigates all ammunition malfunction reports from Aviation Ordnance Personnel in the field. If the fault lies in design, appropriate recommendations of technical nature are made to prevent recurrence. Bomb function reports are also compiled and studied in this section.

The General Supply and Equipment Section develops and designs special handling and maintenance equipment of Ordnance Items used in the Army Air Forces. Instructions are published on care, preservation and maintenance in the field of Aviation Ordnance Items, such as Bomb Service Trucks, Bomb Lift Trucks, Bomb Trailers, Aircraft Cannon and motor vehicles of all types.

The Requirements Section confers with various directorates of the Army Air Forces, the Chief of Ordnance and Navy Bureau of Ordnance on proposed items of Ordnance for use in the Army Air Forces. A close liaison is maintained with all Commands of the Army Air Forces on all matters pertaining to Aviation Ordnance Materiel. Requirement programs for all types and quantities of Ordnance Materiel used by the Army Air Forces are prepared and submitted for approval to concerned Army Air Force directorates. This section also reviews and recommends changes to technical publications on Army Air Force Ordnance Materiel. Requirements are computed for training allowances of ammunition and general supplies based on the training program contemplated for the Army Air Forces. Drawings of new or proposed types of Aviation Ordnance Ma-

teriel are prepared by this section and submitted through the Chief of Industrial Service.

The Ordnance Service Plans Division, the third main division, procures and recommends plans for Ordnance service procedure in the Army Air Forces. This includes suggestions for the personnel and equipment to accomplish the mission of the Ordnance Department, as well as establishing supply, storage and maintenance procedures to be followed. In order to accomplish this, the division is subdivided into three sections.

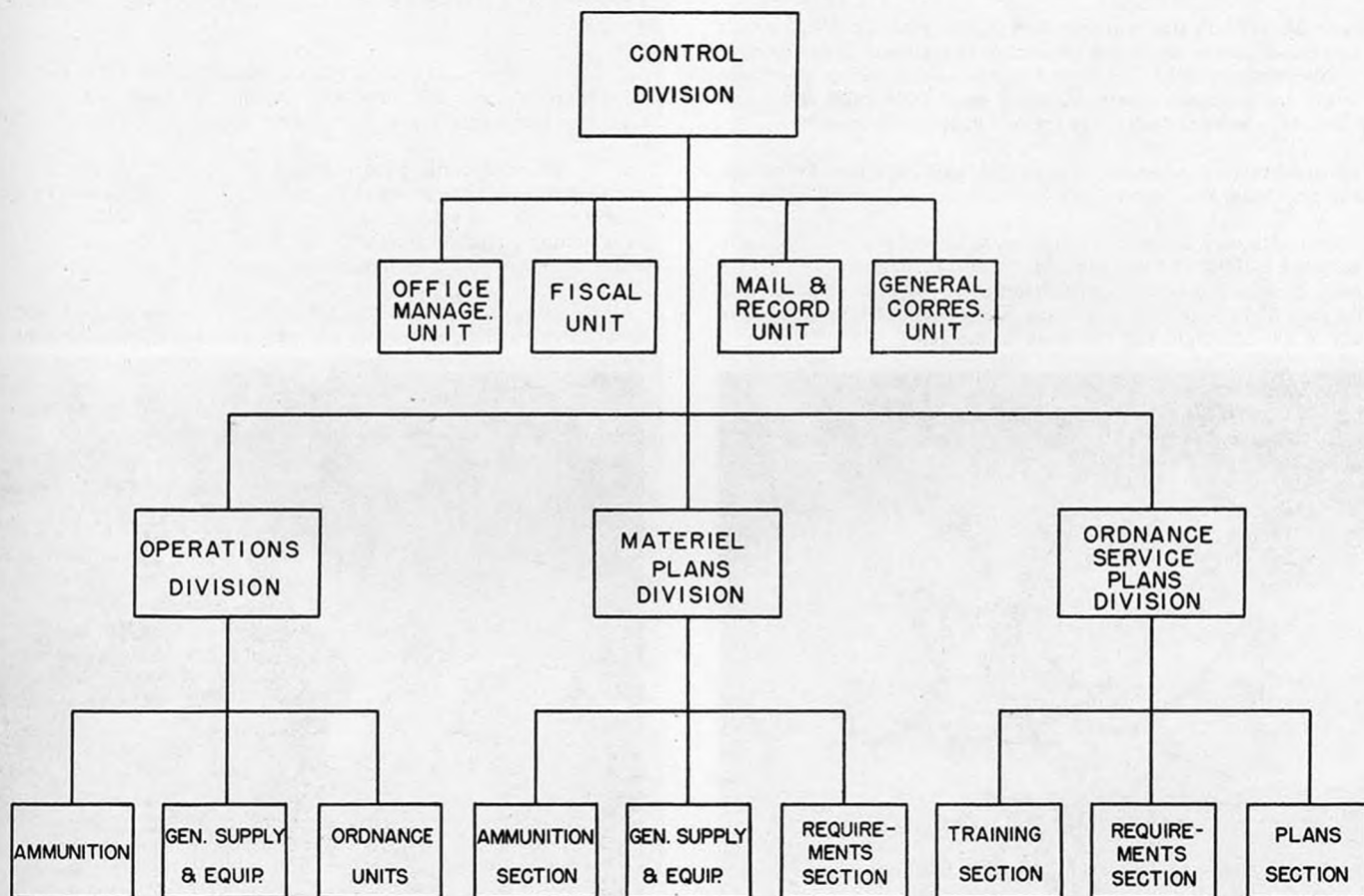
Training Section reviews training programs and training publications to effect corrective measures. It also collects and maintains records of available information on all Ordnance activities within the Army Air Forces. The pertinent directorates of the Army Air Forces are coordinated with matters pertaining to training programs of Ordnance Units in the Army Air Forces.

The Requirements Section prepares new T/O's and recommends changes in existing T/O's for all Ordnance Units and sections of Army Air Force Units. It also checks and recommends changes in pertinent T/BA's. A check is maintained on the availability and suitability of Ordnance facilities in the field, and such inspections as are required are conducted to insure proper compliance with established standards.

The Plans Section coordinates plans for Ordnance Service Procedures with tactical directorates of the Army Air Forces. It plans and develops operating procedures for all Ordnance Units serving the Army Air Forces, and procures standards to be met by all Aviation Ordnance Units, including personnel, equipment and facilities.

To summarize, the various divisions described above combine to form a complete unit, the Ordnance Section, Army Air Forces, which is the center of the huge network of Aviation Ordnance now providing Ordnance service in all of its many phases to the units of the Army Air Forces stationed in the United States and throughout the world.

ORDNANCE SECTION HEADQUARTERS ARMY AIR FORCES



ORDNANCE TRAINING ACTIVITIES



Conducted by: G. D. Meixel, 1st Lieut., Ord. Dept.
Secretary, The Ordnance School

AKRON SECTION, THE ORDNANCE SCHOOL

The development of modern aircraft with higher flying speeds, greater range of operation and more deadly bombing techniques presented new problems in anti-aircraft defense. The high flying speed, and dive bombing tactics call for a defense gun of extreme accuracy and high speed operation. The wide field of operations of enemy planes in a "total war" requires the utmost in mobility.

The Bofors 40mm Automatic Anti-aircraft gun, director controlled, and firing highly explosive shells, is a high speed, accurate, and hard hitting gun for use in the 2500 yard range.

The Bofors gun as built in this country was redesigned by the Firestone Tire and Rubber Company from the British model of the Bofors to adapt it to American production methods and mass production. This has been accomplished, yet all the accuracy of a fine precision built machine has been retained.

Regardless of how fine a weapon this gun may be, its effectiveness is limited to the ability of Ordnance personnel to maintain and service it properly. The accuracy built into the gun by fine engineering, precision machine work, and accurate assembly, would be of little avail if the men servicing the piece were not properly trained in its maintenance.

This necessitates the establishment of a training school for Army personnel in servicing the Bofors gun.

At first with only a few to be trained, a class room was set up in the gun assembly building at Firestone, where men in charge of operations in the assembly of the gun could each instruct the class in their particular work on the gun. This course was set up on a three-week basis, two weeks on the study of the carriage, and one week on the gun.

The school has a capacity of 25 men per week. Two classes operate simultaneously, one studying the gun, the other the carriage. Up to this date two hundred and fifty students have completed the course of instruction.

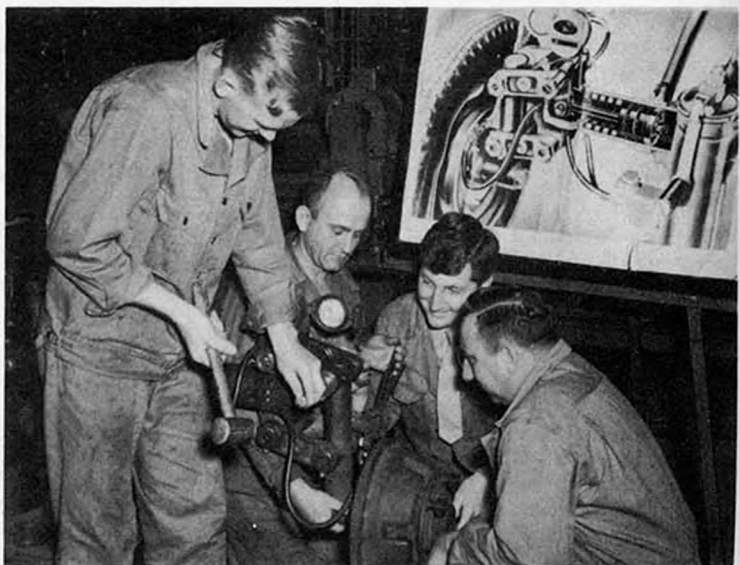
Since the number of men to be trained has increased, and production has been stepped up, the old plan has been discarded, and the present school set up with full time instructors and the course revised to be covered in two weeks. The class rooms were moved out of the assembly plant and set up in a separate school building away from the noise of the assembly line, where extensive brake school instructions were being held.

The school consists of two units. One unit is for instruction on the gun, with a class room where the instructor lectures on the gun as he disassembles it, and a shop space equipped with suitable tools and equipment where students disassemble and assemble the gun under supervision of the instructor.

The other unit consists of a combined class room and shop where two complete guns and carriages, together with the necessary tools and equipment, are available to completely dismantle and rebuild the carriage.

After dismantling the mount, the various units are disassembled and reassembled and the gun mounts rebuilt. This is followed by instruction in and practice of setting the gun down in firing position, and returning it to traveling position. Particular attention is called to proper leveling, as a gun off level cannot be accurate.

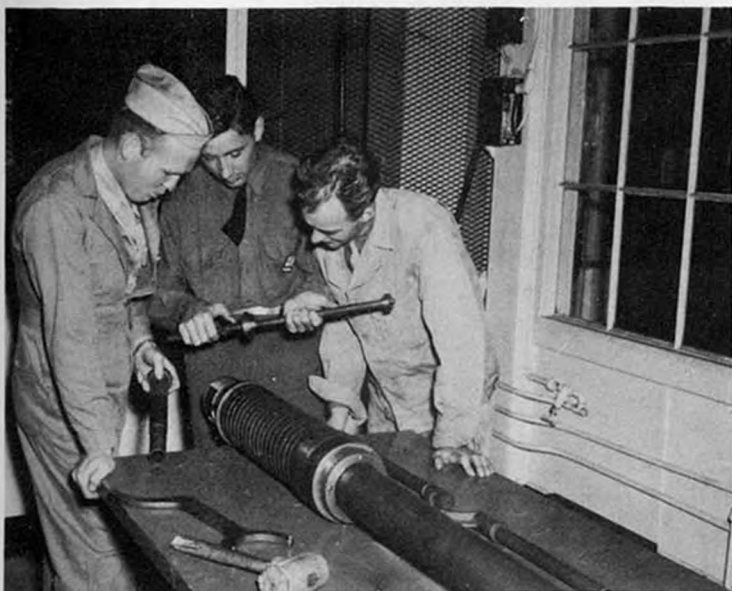
Lectures precede the actual work on the mounts, and a wiring demonstration unit, blueprints and enlarged photos, showing cross sections





and phantom views of the various units, are available for reference as the students work under the direction of the instructor.

Throughout the course, safety is stressed, even to avoiding a skinned knuckle.



In a tour of the assembly plant where the student sees parts grow into subassemblies and subassemblies into completed guns, where he sees the inspection of parts, sub-assemblies, and completed guns by both Ordnance and Firestone inspectors, and where he sees each gun tested for actual operation, he is impressed with the precision and accuracy of every operation.



And as the gun rolls out the door with its covers securely fastened, and a board high above records units completed, he knows that he is going to get the equipment to do his job.

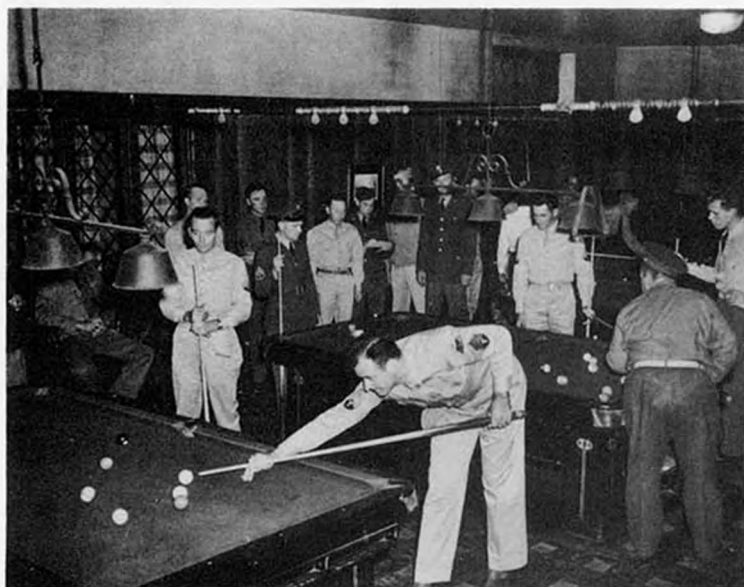
At the completion of the two week training period, the students are graduated and returned to their respective units to form a nucleus for training others in maintenance and service of the 40mm Gun and Carriage.

The students are quartered at the Y.M.C.A., which is located in the downtown section and is considered one of the best in the United States.

All students are extended full membership privileges which includes use of billiard tables, bowling alleys, swimming pool and gymnasium.

They are served breakfast and evening dinner at the "Y", and a noon lunch is served at the Firestone Club, which is just a short walk from the class room.

The population of Akron treats the soldiers as their own, and numerous invitations are received for students to attend dances, weiner roasts, dinners and other social functions.



LIBRARY

Conducted by: J. M. Kelleher, Master Sergeant, Ord. Dept.

LIST OF ORDNANCE SCHOOL PUBLICATIONS

NOTE: Ordnance School publications are furnished to ordnance organizations on requests sent to the Commandant, The Ordnance School, Aberdeen Proving Ground, Maryland. These publications are not furnished to individuals. Requests for War Department publica-

tions should be sent to the commanding general of the appropriate service command. Publications indicated by a double asterisk (**) are in process of revision. Those indicated by a single asterisk (*) are now in preparation.

- NUMBER TITLE
- OS 9-8 Telescopes, B. C. M1915 and M1915A1
- OS 9-9 Telescope, Panoramic, M6
- OS 9-10 Finder, Range, 80-Centimeter Base, M1914M1
- OS 9-11 Finder, Range, 1-Meter Base, M1916
- OS 9-12 Finder, Range, 80-Centimeter Base, M1917M1
- OS 9-14 Telescopes, M5 and M5A1
- OS 9-16 Telescope, Panoramic, M1
- **OS 9-18 Ammunition - General
- Vol. 1. Military Explosives and Small-Arms Ammunition
- Vol. 2. Trench Warfare and Artillery Ammunition
- Vol. 3. Aircraft Bomb and Pyrotechnics.
- Vol. 4. Chemical Munitions, Destruction of Unserviceable Ammunition and Duds, Storage, Appendices, and Index.
- OS 9-19 Circle, Aiming, M1
- **OS 9-20 Artillery Ammunition
- Vol. 1. Primers, Fuzes, Adapters, and Boosters:
- Ammunition for:
- 20-MM Guns, M1 and M2
- 37-MM Guns, M1916, M1A1, M1A2, M3, M4, and M5
- 40-MM Gun, M1
- 57-MM Gun, M1
- 2.95" Mountain Gun
- Subcaliber Guns
- Vol. 2. Ammunition for:
- 3" Antiaircraft, Seacoast, and Field Guns
- 75-MM Guns and Howitzers
- 90-MM Antiaircraft Gun
- 105-MM Howitzers and Antiaircraft Guns
- Vol. 3. Ammunition for:
- 155-MM Field Guns and Howitzers, M1917-17A1-18
- 240-MM Howitzer, M1918
- 14" Guns
- **OS 9-24 The Transportation of Ammunition - General Information
- OS 9-28 Quadrant, Gunner's, M1
- OS 9-29 Company Officer's Manual
- Vol. 1. Leadership, Company Correspondence, Morning Reports, Daily Sick Report, Mess Management, and the Company Fund.
- Vol. 2. Supply, Boards of Officers, Courts-Martial, and an Administrative Check List.
- *Vol. 3. Duty Roster, Service Record, Furloughs, Passes and Delays, Reports Required, and Procedure to be Followed in Case of Death.
- OS 9-31 Automotive Electricity for In-Line Engines
- **OS 9-36 Depot and Supply Administration
- Vol. 1. Procurement of Property, Receipt and Shipment of Property, Accounting for Property, and Issue of Stock
- Vol. 2. Lost, Damaged, or Unserviceable Property; Storage of Public Property; Depot Planning and Operation; and an Appendix.
- **OS 9-39 Regulations for Bomb Handling Drill
- OS 9-41 Manual for Ordnance Instructors
- Vol. 1. Methods of Instructing.
- Vol. 2. Job Analysis and Course Planning.
- OS 9-42 Oil Gear, Remote-Control Systems, M1, M3.
- OS 9-44 Test and Adjustment of the Sight, M1901 (French)
- OS 9-45 20-MM Automatic Guns, M1 and AN-M2
- OS 9-48 Fundamentals of Artillery Weapons
- OS 9-49 Aircraft Depth Bomb, Mk. XVII
- OS 9-50 37-MM Automatic Gun, M4
- OS 9-51 Remote-Control System, M2
- **OS 9-55 Handbook for Ordnance Officers
- Vol. 1. (This publication covers briefly the organization of the Army and the Ordnance Department, including the various ordnance organizations and installations found in the field, and presents information concerning the technical operations carried on by those organizations and installations.)
- Vol. 2. (This publication gives a brief description of the major items of ordnance materiel. There is also a resume of publications available pertaining to the functions of the Ordnance Department. Subjects of a general military nature such as leadership, military discipline, customs of the service, and military law are also covered. A brief discussion of protective measures and motor transport is given in the latter part of this manual.)
- TM 9-2005 Ordnance Materiel - General
- (This manual consists of 7 volumes and contains information of a general character required for the identification and use of the materiel described. The weights and measurements are given

for each piece of equipment. In addition, ballistic data is tabulated for each gun.)

- Vol. 1. Rifles, Shotguns, Bayonets, Pistols, and Revolvers.
- **Vol. 2. Automatic Rifles, Machine Guns, and Mounts.
- **Vol. 3. Infantry and Cavalry Accompanying Weapons.
- Field Artillery

Film Strip Lecture Notes

- FS 9-9 20-MM Automatic Gun, M2
- FS 9-10 Gun, 75-MM, M1897A4, and Carriage, Gun, 75-MM, M2A3 (Lecture No. 1)
- FS 9-11 Gun, 75-MM, M1897A4, and Carriage, Gun, 75-MM, M2A3 (Lecture No. 2)
- FS 9-20 U. S. Rifle, Cal. .30, M1
- FS 9-21 Part I, Disassembly and Assembly (Third and Fourth Echelon)
- FS 9-21 U. S. Rifle, Cal. .30, M1903A1
- FS 9-22 Part I, Nomenclature and Inspection (Third and Fourth Echelon)
- FS 9-22 U. S. Rifle, Cal. .30, M1903A1
- FS 9-22 Part II, Nomenclature and Inspection (Third and Fourth Echelon)
- FS 9-23 U. S. Rifle, Cal. .30, M1
- FS 9-23 Part II, Inspection and Repair (Third and Fourth Echelon)
- FS 9-24 Browning Machine Gun, Cal. .50, M2
- FS 9-24 Part I, Disassembly and Assembly (Third and Fourth Echelons)
- FS 9-26 Howitzer, 105-MM, M2A1, and Carriage M2, Howitzer, 105-MM, M2
- FS 9-26 Part I, Basic Disassembly and Assembly
- FS 9-27 Howitzer, 105-MM, M2A1, and Carriage M2, Howitzer, 105-MM, M2
- FS 9-27 Part II, Nomenclature, Disassembly and Assembly of Units, Inspection
- FS 9-28 Gun, Automatic, 37-MM, M4 Part I
- FS 9-29 Gun, Automatic, 37-MM, M4 Part II



OBSERVE! REMEMBER! COMPARE!

(Continued from page 433)

Yes, gentlemen, today is indeed a commencement for you. Your transition period is now completed. You are being launched upon a new career with gold bars. They symbolize far more than mere ornaments to your uniforms. They add new responsibilities not only to your official, but also to your private lives.

When you leave this hall you will carry away new authority and consequently new responsibilities. Let me review briefly for you some of these. First, there is your duty to your nation. She has this date conferred upon each of you one of the highest honors within her power to give during time of war. Your debt to her is more than one of gratitude, it is one of duty. I charge each of you to develop both that high sense of duty which will give to her your maximum ability at all times, and the courage to meet the greatest sacrifice of all, if necessary, in her defense.

Second is your duty to the subordinates you lead. Treat them fairly and justly. Be kind and considerate in your dealings with them. Be sharp and firm only when this fails. A vacillating policy breeds confusion. Remain cool and collected when facing hardship or danger so that the will of the group may rest safely in your hands. So lead them that no American mother need feel distrust in you.

Third is your duty to your military superiors. You are a necessary part of a large team. Remember that all members of a team cannot call the signals. Military orders are intended to be obeyed without question. Carry out your part of the plan so that the "old man" can always feel confidence in you. Be courteous, respectful, and tactful in your dealings with all officers, and greater rewards will be your gain.

Lastly, I wish to discuss your responsibility to society, the American public, your family, neighbors, and friends. Today the American soldier is treated with the highest respect. The public always turns its head to see a well-groomed soldier. The officer naturally gets even closer scrutiny. For that reason, the uniform you wear, be it in ranks or in a public place, is symbolic, not just of Lieutenant Jones, but more, of every officer in the armed forces. Civilian morale, which is important to

military victory, can be affected by the appearance and demeanor of combat troops. Each officer, wherever he may be, is a sample of the leadership within our armed forces. Again I charge you to guide your personal conduct at all times so that no one shall ever have cause to lose his respect for you and for the uniform you are privileged to wear.

Dark days are ahead for all of us. The news chroniclers all too frequently relate setbacks. But the preponderance of our might will eventually assert itself and our enemies shall cry "kamerad" long before we have had time to punish them effectively for their crimes. Let us make sure that we shall emerge victorious, not only on the battlefields, but at the peace tables as well. Let us once and for all crush this rabble who plunge modern civilization into darkness with every succeeding generation.

We have a dirty job to do. Let our children and our grandchildren work out the complex problem of lasting peace. It is our lot to fight and in that fight there are no rules except those dictated by fear of retaliation. Let us tighten our belts, steel our courage, and give our enemies a taste of the medicine they have been dishing out to their neighbors.

And when it is over it is my hope that we can all return to our peacetime pursuits to enjoy again in even fuller measure those great blessings a thoughtful Provider has placed here on earth for our use.



ARTILLERY REPAIR TRUCK

(Continued from page 435)

- 1 WRENCH-SET, socket, heavy-duty, double-hex., C.V.S., 1/2-inch square drive. Composed of:
 - 1 CASE, metal
 - 1 HANDLE, cross, C.V.S., 1/2 inch square
 - 1 HANDLE, hinge, C.V.S., 1/2-inch square
- 13 SOCKET: 7/16, 1/2, 9/16, 19/32, 5/8, 21/32, 11/16, 3/4, 25/32, 13/16, 7/8, 15/16, and 1 inch
- 1 WRENCH-SET, socket heavy-duty, double-hex., C.V.S., 3/4, inch square drive. Composed of:
 - 1 CASE, metal
 - 1 EXTENSION, C. V. S., 8-1/2 inch
 - 1 EXTENSION, C. V. S., 17 inch
 - 1 HANDLE, combination tee, C.V.S., 20-inch
 - 1 HANDLE, ratchet, C. V. S., 20-inch
- 10 SOCKET: 15/16, 31/32, 1, 1-1/16, 1-1/8, 1-1/4, 1-3/8, 1-7/16, 1-1/2, and 1-5/8.

KIT — ARTILLERY MECHANIC'S

Three artillery mechanic's kits are issued with each vehicle. These sets of standard hand tools, composed of a 5/8 inch machinists cold chisel, thickness gage, center punch, and an adjustable pipe wrench, together with an assortment of drifts, files, hammers, pliers, screwdrivers, and stones, and sets of pin punches and crescent wrenches, contained in a steel tool box, permit employing three groups of mechanics at positions well divorced from each other.



WELDING TRUCKS

(Continued from page 444)

- 1 CHISEL, hand, cold, 1/2 in. width of bit, 7/16 in. stock, 6 in. long
- 1 CHISEL, hand, cold, 3/4 in. width of bit, 5/8 in. stock, 7 in. long
- 1 CHISEL, hand, diamond point, 3/8 in. point
- 1 CHISEL, hand, round, nose, 3/8 in. width of bit, 5/8 in. stock, 7 in. long
- 1 CHISEL, hand, round, nose, 1/4 in. width of bit, 1/2 in. stock, 6-1/4 in. long
- 1 DRIFT, brass, straight, 3/4 in. round, 6 in. long

- 1 FILE, flat, bastard, 12 in.
 - 1 FILE, half-round, second cut, 10 in.
 - 1 FILE, round, second cut, 10 in.
 - 1 FRAME, hacksaw, pistol grip, adj. 8 in. to 12 in., 3-1/4 in. depth throat
 - 1 GLOVES, welders, 14 in. unlined, pr.
 - 1 GOGGLES, eyecup, chippers, with 50mm lens, clear, pr
 - 1 HAMMER, machs., ball peen, 12 oz., handled
 - 1 HAMMER, machs., ball peen, 24 oz., handled
 - 1 HAMMER, slag, comb, chipper and wire brush (Airco 927-0227)
 - 3 HANDLE, file, 1-1/4 in. x 4-1/4 in.
 - 1 PLIERS, combination, slip joint, 10 in.
 - 1 PUNCH, center, 5 in.
 - 1 PUNCH, solid, 3/4 in. stock, 1/4 in. point diameter, 7-1/2 in. long.
 - 1 RULE, steel, tape, rapid, 6 ft. long, Mezural type
 - 1 SCREWDRIVER, common, normal duty, 4 in. blade
 - 1 SCREWDRIVER, common, normal duty, 8 in. blade
 - 1 POCKET SCRIBER, 3/8 in. diameter, handled
 - 1 SQUARE, combination, 12 in. blade, w/centering and square head
 - 1 WRENCH, adjustable, single, end, 8 in.
 - 1 WRENCH, adjustable, single end, 12 in.
- SUPPLIES
- 1 BLADE, hacksaw, 10 in., 24 teeth, doz.
 - 1 BRUSH, scratch, painters, handled, 7/8 in. x 14 in.
 - 1 LENS, 50mm, for chippers goggles, pr.

OUTFIT, WELDER'S, Oxyacetylene, complete, welding and cutting 2 (Consisting of:)

- 1 ADAPTER, regulator, acetylene to commercial or "Airco" tank
- 1 ATTACHMENT, cutting 80°-90° angle head, w/head nut
- 1 BOX, tool, steel, Type IV
- 1 CAP, thread guard
- 2 CASE, canvas (for tips, cutting attachment and mixing head)
- 2 CLEANER, cutting tip, cutting jet
- 2 CLEANER, cutting tip, pre-heating jet
- 6 CLEANER, welding tip
- 1 CONTAINER, for tip cleaners
- 6 FLINT, torch lighter
- 2 GOGGLES, welders, eyecup, medium shade, 50mm lens w/clear cover lenses, pr.
- 1 HOSE, acetylene, 1/4 in., two red braid, 25 ft. w/connection
- 1 HOSE, oxygen, 1/4 in., two green braid, 25 ft. w/connection
- 1 KEY, acetylene tank valve
- 1 LIGHTER, torch
- 1 REGULATOR, multi-stage, acetylene, with 1-80 lb. and 1-500 lb., 2-1/2 in. diameter pressure gages.
- 1 REGULATOR, oxygen, multi-stage, with 1-150 lb. and 1-3000 lb. 2-1/2 in. diameter pressure gages
- 1 TIP, cutting, for metal, 1/8 in. to 1 in. thick
- 1 TIP, cutting, for metal, 1 in. to 3 in. thick
- 1 TIP, for radiator repairing
- 1 TIP, welding, for metal, 1/32 in. to 1/16 in. thick
- 1 TIP, welding, for metal, 1/8 in. to 3/16 in. thick
- 1 TIP, welding, for metal, 1/4 in. to 3/8 in. thick
- 1 TIP, welding, for metal, 1/2 in. to 5/8 in. thick
- 1 TIP, welding, for metal, 1 in. and over
- 1 TIP, welding to be used for heating purposes

Quantity
per truck

OUTFIT, WELDER'S, (Continued):

- 1 TORCH, welding, w/connection
- 1 WRENCH, regulator
- 1 WRENCH, welding torch

SUPPLIES, TRUCK

- ACID, muriatic, 8 oz. bottle 1
- ASBESTOS, cement, retort, 5 lb. sack 1
- BLADE, hacksaw, 10 in., 24 teeth, doz. 4
- BLOCK, carbon, 1 in. x 6 in. x 12 in. 1
- BRUSH, acid & grease, 3/8 in. wide, 3/4 in. long bristles, 5-1/4 in. handle 12
- BRUSH, acid, twisted wire handle, 6 in. 12
- CONTAINER, acid bottle 1
- ELECTRODE, heavy-coated, aluminum, 5/32 in., 5 lb. pkg. 1
- ELECTRODE, heavy-coated, bronze, 1/8 in., 5 lb. pkg. 1
- ELECTRODE, heavy-coated, manganese, 1/8 in. for hard surfacing 10 lb. pkg. 1
- ELECTRODE, heavy-coated, for machine weld on C.I., 1/8 in. 10 lb. pkg. 1

ELECTRODE, heavy-coated, reverse polarity, 3/32 in., 15 lb. pks.	1
ELECTRODE, heavy-coated, reverse polarity, 1/8 in., 25 lb. pkg.	1
ELECTRODE, heavy-coated, reverse polarity, 5/32 in., 50 lb. pkg.	1
ELECTRODE, heavy-coated, reverse polarity, 3/16 in., 25 lb. pkg.	1
FLUX, aluminum, in 1/4 lb. container	4
FLUX, brazing, general purpose, in 1 lb. container	1
FLUX, for cast-iron welding, in 1 lb. container	1
GLASS, cover, clear helmet and hand shield, coated	25
PAPER, asbestos, 1/16 in. thick x 37 in. wide, 50 lb. roll	1
PASTE, soldering, 1 lb. container	1
ROD, carbon, 1-1/4 in. round x 12 in.	5
ROD, welding, alloy steel, hard surfacing, 3/16 in., 10 lb. pkg.	1
ROD, welding, aluminum, 5% silicon, 1/8 in., 5 lb. pkg.	1
ROD, welding, bronze, 1/16 in., 1 lb. pkg.	1
ROD, welding, bronze, 1/8 in., 15 lb. pkg.	1
ROD, welding, cast-iron, gray, 3/16 in., 10 lb. pkg.	1
ROD, welding, copperized, 1/16 in., 5 lb. pkg.	1
ROD, welding, copperized, 1/8 in., 10 lb. pkg.	1
SOLDER, tin-lead, half and half, 1/4 in. x 1/4 in. bars, 5 lb. pkg.	1
SOLDER, tin-lead, wire, 5 lb. spool	1
SOLDER, wire, 1/16 in. diam. x 5-1/2 ft. length, spool	1
ZINC, for cutting acid, 1 lb. pkg.	1

"FIRE POWER"

(Continued from page 453)

Consider the following words, and a great many others might be added to the list. The dictionary will not list them as synonyms. The soldier in combat with his body and his life at stake might well ask "WHY?"

Carelessness, malfunction, inefficiency, failure, neglect, injury, thoughtlessness, pain, indifference, death.

These words are not synonyms in ordinary usage, but they all are closely related in warfare—they all are associated with the same result, military defeat and personal suffering.

YOUR PAY AINT HAY!

Spend some of it for
WAR BONDS



THE MARK 13 WAR HEAD

(Continued from page 456)

such a manner that the loop stops at the top of the nose ring. Lead the arming wire down through the impeller channel and under four of the impeller blades. From here the wire should go on through the pipe plug head, which has been drilled to receive it, and secured there with two #3 Fahnestock clips, located aft of the pipe plug. The arming wire should then be cut approximately two inches beyond the clips. After installing the arming wire the impeller guard should be replaced.

When the torpedo is dropped, the arming wire is pulled out and upon entry into the water the impeller is forced to turn by the stream of water flowing through the impeller channel. As the impeller revolves the motion is transmitted through the impeller channel. As the impeller revolves the motion is transmitted through the gear train to the arming gear. As the arming gear revolves, the arming screw is forced upward by means of the threads mating with the threads in the arming gear. As the arming screw is forced upward, it draws the safety lugs with it, permitting the two arming balls to drop from the annular groove in the firing pin guide into the cavity provided by the upward movement of the safety lugs. At the same time, the detonator safety chamber has been revolving with the arming gear and forcing the detonator holder out of the safety chamber up into the cavity in the booster. At this time the detonator can be fired but it will not detonate the booster and the main charge until the four flash holes in the detonator holder are uncovered. It takes 370 turns of the impeller to permit the arming balls to drop from the annular groove in the firing pin guide, and for the arming screw to draw upward far enough for the stopballs to engage the annular groove in the arming screw, causing the arming screw to idle for the rest of the torpedo's run.

As the torpedo continues its run, the arming gear is still revolving, consequently the detonator safety chamber is still revolving. This continues to force the detonator holder upward for 780 turns of the impeller, when the flash holes are fully uncovered and then the detonator holder idles for the remainder of the run. It takes approximately 411 yards to fully arm the exploder mechanism. The war head will then detonate upon impact with any object if the torpedo has a speed of greater than about seven miles per hour.

When the torpedo strikes the target with sufficient force, it jars the firing ring from its resting place on the firing ring fingers. Resting on the firing ring is the trigger plate, a flat brass plate, which is tipped at the same time the firing ring is tipped. This action of the trigger plate is transmitted to the trigger cap, which has a rounded base and is forced straight upward, when there is any tipping of the trigger plate. When the trigger cap is raised, the three firing balls can drop into the annular groove in the trigger cap. Previously the firing balls were held in place by the shoulder in the trigger cap above the groove, but the raising of the trigger cap brings this groove opposite the groove in the firing pin guide and hence permits the firing balls to drop out. When these balls drop out of the groove in the firing pin guide, they release the guide and firing pins, which are then driven up against the detonator caps by the compressed firing spring. This spring has been compressed by the cocking of the exploder mechanism and further compressed by the arming of the exploder.

When the firing pin guide is released, the follower is forced up by the trigger spring so that it will keep the firing balls in the groove of the trigger cap and not permit them to drop

below against the follower or in the bottom of the trigger cap. If they were permitted to do this, it would not be possible to cock the exploder after test firing.

It is to be noted that the exploder mechanism is shipped in the cocked and unarmed position. After test firing the mechanism, it must be cocked before it is unarmed, or the arming balls will not permit cocking of the mechanism.

The anti-countermining device is installed for the purpose of making the exploder mechanism inoperative when subjected to any nearby explosion. Thus, it would be impossible for any ship to explode shells or depth charges near the torpedo and detonate the war head before it has reached its target. When the concussion reaches the exploder mechanism, if it is greater than 26.9 lbs./sq. in. it forces the anti-countermining diaphragm in and this movement is transmitted through a system of levers and rods to the rack and fork. The rack and fork, geared to a spring clutch, is forced in and the fork slips over the top of the trigger cap, keeping the trigger cap in its normal position and not permitting it to be forced upward when the firing ring is tipped. The fork remains over the cap until the spring clutch releases it and permits the spring tension on the bell crank to draw the fork and rack out. The spring clutch, which is geared to the vertical shaft and hence to the gear train, will release its tension on the rack after the impeller has taken 25 revolutions or approximately 13 yards have been covered by the torpedo. This also makes the torpedo safe if deeper than 50 feet in the water and provides a means for making the torpedo safe if it is ever necessary to remove an armed exploder mechanism.

In storage of the warhead, it is sometimes

advisable to coat the head with heavy oil or grease to protect it from the elements. It can be stored in the regular magazine area. Usually the base plate of the exploder should be removed, and

after heavily coating the exploder cavity with grease, a wooden plug or cover of some type should be used to cover the cavity. The exploder mechanism and base plate should be stored

inside, well protected from the weather and from dust and dirt. The detonator and booster should be stored in fuze huts or inside somewhere with the usual precautions for that type of explosives.



FIELD SERVICE MODIFICATION WORK ORDERS

(Continued from page 457)

4. Drawings required to Apply Modifications:

NOTE: No drawings will be necessary for the application of this work order.

5. Parts affected by Modification:

(a) New parts Required:

Name	Pc. Mk. or Drg. No.	Quantity
Clamp-Priming Tube	201047	4
Clip-Priming Tube to Intake Pipe	201081	4
Distributor-Engine Primer	201082	1
Elbow-Primer	200974	5
Gasket-Intake Pipe to Cylinder	200323	5
Grommet-Priming Tube Clamp	201089	4
Intake Pipe Assy. (Cylinder 1-2-3-8-9)	201037	5
Lockwasher-Priming Tube Clamp Screw	200956	2
Lockwasher-Priming Tube to Intake Pipe Clip Screw	200956	2
Lockwire-Primer Distributor to Intake Pipe Screw	200202	
Nipple-Primer Distributor to Intake Tube	200975	5
Nut-Priming Tube Clamp Screw	200958	2
Nut-Priming Tube to Intake Pipe Clip Screw	200957	4
Packing-Intake Pipe	200347	5
Plug-Primer Distributor	200845	4
Screw-Primer Distributor to Intake Pipe	200971	2
Screw-Priming Tube Clamp	200966	2
Screw-Priming Tube to Intake Pipe Clip	200964	4
Tube Assy.-Priming (Cylinder #1)	201041	1
Tube Assy.-Priming (Cylinder #2)	201040	1
Tube Assy.-Priming (Cylinder #3)	201043	1
Tube Assy.-Priming (Cylinder #8)	201042	1
Tube Assy.-Priming (Cylinder #9)	201039	1
Washer-Priming Tube to Intake Pipe Clip Screw	200154	8
Washer-Priming Distributor to Intake Pipe Screw	200952	2

(b) Discarded Parts: None.

(c) Procurement of Parts Required:

- (1) Where procured: Rock Island Arsenal.
- (2) Date Available: Now

6. Special Tools, Jigs and Fixtures:

Name
Mechanic's Hand Tools
Tool Roll

(The above tools and facilities should be available)

7. Special Instructions:

- Applied by: Automotive Mechanic and Helper.
- Time required: 4-1/2 hours
- Procedure of Operation.
Remove old induction tubes and replace with new, as supplied in kit. Mount engine primer distributor block to No. 1 induction tube. Care should be exercised when fastening these primer lines to prevent vibration or gasoline leaks.
- Arsenal or Field Operation: Both
- Comments with reference to published FSMWO's: None
- Disposal of discarded parts:
May be dropped in accordance with A.R. 35-6640
- Classification:
"This Work Order is classified in the Red Group, and therefore will be completed at the earliest practicable date. A monthly Progress Report should be forwarded to this office listing the number of

each of the Field Service Modification Work Orders, classified in the RED Group, applied during the current month and the number yet to be applied in your Service Command."

8. Remarks:

This work order applies to forty-one Continental Wright Engines, Serial No. 117901 to 117941 having the single cylinder priming systems. This modification will be applied only at such times as engines are removed from vehicle or during the 100 hour inspection.

9. Date approved for publication:

By order of the Chief of Ordnance:

H. R. KUTZ
Brig. General, Ordnance Department
Chief, Field Service Division



VICKERS MACHINE GUN

(Continued from page 461)

by firing and any overflow of water caused by heat expansion, beyond its normal level, from the water jacket have passed through the steam tube arrangement, through the flexible hose group and into the condensing device, where the water has been conserved and the vapor has reverted to form.

Application of "Care and handling after firing", is next in order. (See THE ORDNANCE SERGEANT for December.)



STOP THAT KNOCK

(Continued from page 470)

with a spark plug located in the center of the combustion chamber will have a shorter flame travel and a lower tendency to detonation than a cylinder with one spark plug located at the chamber wall. Some combustion chambers, however, are constructed so that it is impossible to centrally locate the plug. In such cylinders, the length of flame travel is cut in half by using two spark plugs, one in each wall, diametrically opposed. Many of the radial tank engines have cylinders so constructed. Since two spark plugs are used to cut down the flame travel distance and the consequent tendency to knocking, it should be obvious that to run this type of cylinder on one set of plugs is to invite violent detonation. An engine with dual ignition and two spark plugs per cylinder should NEVER be operated on one set of plugs. This rule applies with special strength when the engine is operating under load. Inversely, the one exception to the rule is when the magnetos are tested - engine without load.

PREVENTING DETONATION

In the discussion on causes of detonation, many preventive measures were outlined. For convenience and further reference, a list of such measures is presented herewith.

1. Use a fuel suitable to the engine. Remember that if the engine runs free from detonation with a given fuel and correct spark advance,

then no higher octane fuel is required. Octane rating has no bearing on other qualities of the gasoline. It is only a measure of its resistance to detonation.

2. Never "lug" an engine down to low speed with the throttle wide open. This applies with special force to radial tank engines which depend upon a fan for cylinder cooling. Fan must be kept up to speed. Remember that an overheated engine is likely to detonate and detonation sometimes can't be heard in a radial tank engine under load.

3. Maintain the cooling system in liquid cooled engines at peak efficiency, keep the thermostat adjusted properly. Clean out the radiator and water passages regularly. Sluggish coolant circulation causes hot spots which, in turn, induce detonation.

4. Scrape carbon from cylinders and pistons whenever "sooting-up" is evidenced. Clean spark plugs at same time.

5. Seat valves by proper grinding and lapping, adjust valve clearances as specified. A leaky exhaust valve will overheat badly and cause knocking.

6. Tune engine so that the spark timing is correct. Too much spark advance will invite pinging, too much retard will cause overheating of exhaust region of combustion chamber.

7. Always run dual ignition engines on both sets of plugs. Running on one plug per cylinder allows engine to knock.

8. Richness of mixture should be maintained at proper value. Lean mixtures tend to cause overheating and detonation.

9. Avoid full throttle operation, especially if fuel of low octane value is being used. Full throttle operation, when accompanied with low speed, results in high pressures, high temperatures, and detonation.



DIRECTOR MAINTENANCE

(Continued from page 476)

CHECKING BACKLASH IN AZIMUTH

Turn the range handwheel until the range dial indicates datum line range. Aline the lateral zero deflection marks and pull out the clutch.

Locate several reference points throughout 360° in the field of view. Check that the large knob of the orienting clutch is tight. The small knob must, of course, be loose. Turn the azimuth handwheel until the vertical reticle line of the azimuth telescopes intersects the first reference point, without overrunning. Record the reading of the firing azimuth dials. Continue to turn the handwheel in the same direction for about 5 revolutions, then reverse direction until the vertical reticle line again inter-

sects the reference point. Do not overrun. Record the reading of the firing azimuth dials. The difference between the first and second readings must not be more than six minutes. The width of each line graduation is roughly three minutes. Check backlash at each of the other reference points.

If the backlash is excessive at any point, it will be necessary to make a complete check of the gear train in azimuth. Note particularly the differential mechanisms. If necessary replace them with serviceable parts. Be especially careful not to lean against the director throughout this adjustment.

The remaining adjustments and problems for checking the adjustment will be published in the December issue of THE ORDNANCE SERGEANT. Don't miss them.

"NOTES IN BRIEF"

Drawings of special tools needed for maintenance of the torque amplifier on a Director M5 or M6 are included in this issue. The notes on adjustment and disassembly of the torque amplifier appeared in last month's issue.

Attention is invited to the picture showing field test of a torque amplifier for amplification on page 474 of this issue.

IMPORTANT: Pending modification of the packing chest and accessory chest for Directors M5 and M6 through the medium of Field Service Modification Work Orders, an inspection should be made of all of these items now in the field with a view to preventing unnecessary damage to expensive parts.

Accessory chest - The white pine strap across the top of the can containing the extra transmitter becomes split and the bolt breaks through, thus freeing the can which then strikes the rate motor and torque amplifier and breaks them. This may be prevented by replacing the white pine strap with a strap of 5/8" plywood.

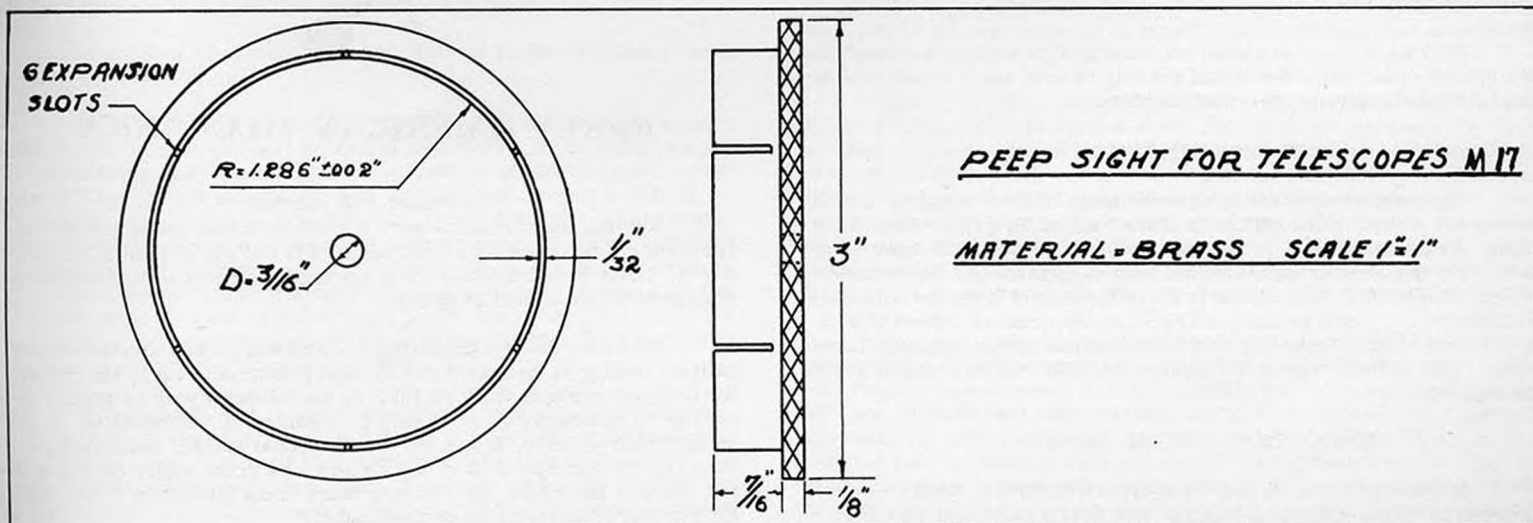
Packing Chest - Some packing chests tend to leave the director slightly loose and it slides from side to side during shipment, causing the torque amplifier to break loose. If shipment is to be made, inspect the chest and add additional felt or rags on the buffing blocks as necessary.



SPECIAL ORDERS

(Continued from page 477)

which must be published, it was found that there was a great necessity for cutting down or "streamlining" every administrative order, and a shorter



form has been adopted. The use of abbreviations and symbols in place of long and drawn out phrases and clauses have been authorized. This does not mean that the principles of clearness and conciseness should be violated.

Some of the new principles which have been adopted are as follows

(a) Abbreviations authorized in AR 850-150 and those in general use will be used whenever practicable to the fullest extent. Names of cities and towns will not be abbreviated.

(b) Reference such as CASC - Corps Area Service Command; RTC - Replacement Training Center; ACFS - Air Corps Flying School; AAB - Army Air Base; AAFAS - Army Air Forces Advanced Flying School, are authorized.

(c) Telegraphic English will be used in all orders, with the elimination of all unnecessary words and phrases such as "will report for duty", "assignment to duty and station".

(d) Authorized code symbols which may be used.

DP -- By direction of the President
 WP -- Will proceed to
 AD -- Active Duty
 TDN -- Travel directed is necessary in the military service
 TPA -- Travel by privately owned conveyance is authorized
 DS for officer's travel is authorized, AR 605-180

(e) Other symbols which are widely used.

TD -- Temporary Duty
 UP -- Under the provisions of
 IC -- In compliance with
 PAC -- Pursuant to authority contained in
 PIC -- Pursuant to instructions contained in
 IGF -- It being impracticable for the Government to furnish cooking facilities for rations in kind
 TO NT -- The Transportation Officer will furnish necessary transportation.
 TO RT -- The Transportation Officer will furnish necessary rail transportation.

(f) A system of block paragraphing should be used to prevent the use of identical opening phrases in orders which effect more than one person.

Paragraphs of special orders which contain secret or confidential information will be published in the day's special order by showing in the body of the order only the paragraph number followed by the word "Secret" or "Confidential", whichever it may be, but the contents of the paragraph will not be shown. The contents of either of these types of paragraphs will be furnished to the individuals who would be immediately concerned as an extract of the order.

The grades of officers, Army nurses, warrant officers, flight officers, will be abbreviated with their names and grades appearing in capital letters. Grades, names, and Army serial numbers of an enlisted man will be in italics when printed, and underscored when typed or reproduced by mimeograph process.

If all these points are taken into consideration in making up the body of a special order, the order should not only be brief but it should also be clear enough for anyone concerned to interpret.

THE AUTHENTICATION

The authentication will include the name of the commander who is issuing the order. If the officer is of the rank of Brigadier-General or above: By Command of _____ will be used, with only his last name being used and it should be written in capital letters. EXAMPLE: By Command of General BROWN. If the officer is below the rank of Brigadier-General; By Order of _____ will be used. EXAMPLE: By Order of Colonel SMITH. It will then be signed by an Adjutant or some other designated subordinate officer. The Official seal of the organization will then be stamped above his signature.

EXTRACTS OF SPECIAL ORDERS

In most cases you will find that a Special Order will contain several paragraphs. Each of these paragraphs will be of a particular importance

to either one individual or to several groups of individuals. Take the case of travel orders, each individual will need a number of copies, so instead of giving him the entire special order, extract copies of the paragraph which pertains to that individual will be made up.

The extract will contain the same heading and the same Special Order No. with the words "EXTRACT" will also appear at the bottom of the page. The official seal or stamp must also be placed on all extract copies of an order.



BILLS OF LADING

(Continued from page 481)

on shipping order and bill of lading: "And other articles classified the same or lower".

Section 4. When the LCL description of an article specifies an individual minimum weight per package or piece (see Note), no provision being made for packages or pieces weighing less than the specified individual minimum, the total charge for a number of packages or pieces of a lesser weight shall be the same as would accrue on a like number of similar packages or pieces, each of the specified individual minimum weight.

Section 5. When the LCL description of an article in bundles specifies an individual minimum weight per bundle, no provision being made for the article loose, a single loose article or piece weighing as much as or greater than the specified individual minimum weight per bundle, shall be charged for as a bundle.

Section 6. When an article is differently rated LCL according to different weights of shipping packages or loose pieces (see Note), the total charge for a number of packages or pieces of a lesser weight shall be no greater than the charge for a like number of similar packages or pieces each of greater weight.

Note. - This refers to the shipping package or loose piece of freight and not to an inner container or article inclosed in an outer package.

(a) Expires with March 19, 1942, unless sooner changed, cancelled or extended. (This rule is continued in effect due to suspension in Investigation and Suspension Docket No. 5039.)

RULE 20. PARTS OR PIECES CONSTITUTING COMPLETE ARTICLE
 Parts or pieces constituting a complete article, received as one shipment, on one bill of lading, will be charged at rating or rate provided for complete article.

I hope this may help throw a little light upon a subject which frequently seems rather complicated and confusing.

Very truly yours,

Collins Weston
 Senior Traffic Clerk
 Trans. Division



EARLY AMERICAN MECHANICS

(Continued from page 482)

Various improvements were made in this machine within the next few years and two more were built, one in 1854 and one in 1859, essentially like it. These three machines are in use today and doing work which meets modern requirements of accuracy.

Soon after the first graduating machine was put into use, the vernier caliper, reading to thousandths of an inch, was brought out by Mr. Brown; the first was made as early as 1851. In the following year he applied the vernier to protractors. A writer, in speaking of the invention of the vernier caliper, says, "It was the first practical tool for exact measurements which could be sold in any country at a price within the reach of the ordinary machinist, and its importance in the attainment of accuracy for fine work can hardly be overestimated."

Mr. Brown did not have the market long, for in 1852 Samuel Darling also invented and built a graduating engine and began the manufacture of rules and squares at Bangor, Maine. He formed a partnership with Michael Schwartz, a saw maker and hardware dealer of Bangor. They soon became active competitors of J. R. Brown & Sharpe, and to this day mechanics here and there have scales marked "D. & S. Bangor, Me." Competition between the two firms became so keen that a truce was called in 1866, resulting in the formation of the partnership of Darling, Brown & Sharpe, which conducted this part of the business until 1892, when Darling's interest was bought out.

In the spring of 1868, Mr. Darling moved to Providence, bringing with him his graduating engine, machinery and six of his most experienced workmen. Darling's engine was built along radically different lines from Brown's. His machines and processes had been kept secret, and it was not until after the partnership was formed that Mr. Brown had opportunity of seeing them. Mr. Darling's original dividing machine is also still running at the Brown & Sharpe works, having been operated for over fifty years by John E. Hall, who remembers the time when Mr. Darling first brought his new partners to see it.

The Brown & Sharpe universal milling machine is indirectly connected with the percussion nipple which brought about their first screw machine. The hole in the nipple was drilled by twist drills which the Providence Tool Company were making for themselves. One day Mr. Brown came into the shop and watched the workman filing the helical grooves in tool-steel wire with a rat-tail file.

Mr. Brown appreciated the need of a machine to do this work, especially as he was just beginning to use such drills himself in the manufacture of the Wilcox & Gibbs sewing machines. He set himself at once to the task of developing a machine which would not only cut the grooves in twist drills, but would be suitable for many kinds of spiral milling, gear cutting, and other work which had up to that time required expensive hand operations. Little time was lost, and the first machine was built and sold to the Providence Tool Company, March 14, 1862. After passing through several hands it came back thirty years later into the possession of its builders and is now preserved by them for its historical interest.

The micrometer caliper was introduced by Brown & Sharpe in 1867. Although not the pioneers in the sense of being the inventors, they were the first to recognize the practical value of this tool for machinists, and to put it on the market. As in the case of the vernier caliper, the introduction of the micrometer caliper into everyday shop-work marked an important step in raising the standard of accuracy.

In one hundred years the Brown & Sharpe Company has grown from an obscure local shop into a great plant employing thousands, but its influence and its product represent a greater achievement. Many mechanics of high ability have gone to other shops, among whom are Henry M. Leland, former president of the Cadillac Motor Car Company; J. P. Slocumb, Horace Thurston, Elmer A. Beaman and George Smith, of Providence; Charles H. Horton, of Worcester; John J. Grant, of Boston; William S. Davenport of New Bedford; A. J. Shaw, of the Shaw Electric Crane Company, and H. K. LeBlond, of Cincinnati. Hundreds of others, however, as managers, superintendents, chief draftsmen and tool makers, have perhaps done more to spread throughout the country the methods and standards of accuracy which have made American machine tool builders the acknowledged leaders of the whole world.

Mr. Henry M. Leland, who was trained in the Providence Shop, says:

"The man who is responsible for this and who thoroughly demonstrated his rare ability and wonderful persistency in bringing out the accurate measuring tools and instruments, and the advanced types of more efficient and unique machinery, was the founder, Joseph R. Brown. I have often said that in my judgement Mr. Brown deserved greater credit than any other man for developing and making possible the great accuracy and the high efficiency of modern machine practice and in making it possible to manufacture interchangeable parts, because the Brown & Sharpe Company were the first people to place on the market and to educate the mechanics of the country in the use of the vernier caliper. They were also the first to make the micrometer caliper.

"I remember that in those early days people came to Brown & Sharpe from all over the world to consult with Mr. Brown in reference to obtaining great accuracy and securing difficult results which had been deemed insurmountable by other high-grade mechanics. The mechanical engineers are now searching the records for men who have made

themselves eminent in the industrial world as inventors and manufacturers; for a list of men to have honorable mention and to have their achievements and ability so recorded that the modern world may bestow upon them the credit and gratitude which they so richly deserve. Among these names I know of none who deserves a higher place than, or who has done so much for the modern high standards of American manufacturers of interchangeable parts, as Joseph R. Brown."



ELECTRIC ARC

(Continued from page 484)

ARC BLOW

A long arc and an improper angle of the electrode are factors which encourage arc blow in direct-current arc welding. Arc blow is less pronounced, in fact, virtually eliminated in alternating-current welding. To reduce arc blow in direct current welding the following steps may be taken:

1. Change the angle of the electrode.
2. Relocate the ground lead relative to the direction of welding, or use a multiple ground.
3. Use a back up strip or tack welds to heat more uniformly.
4. Use a magnetic shield to control the direction of the arc.

WELD METAL DEPOSITION

In metal arc welding there are several separate and distinct forces responsible for the transfer of molten filler metal and molten slag to the base metal. These forces act to control the direction of travel and the form in which the metal moves across the arc span. Some of these forces are also responsible for retaining the deposited metal in place on the work after having been transferred from the electrode through the arc space. Certain of these forces either aid or oppose the rate of metal transfer from the electrode to the work as they are a function of either the position of welding or the polarity of the welding circuit. The more important of these forces which affect either or both the transfer of metal from the electrode to the molten pool and the retention of the deposited metal in the pool are as follows:

1. Vaporization and condensation
2. Expansion of gases from electrode coatings
3. Gravity
4. Electro-magnetic
5. Electro-static
6. Electric
7. Pinch effect
8. Surface Tension
9. Expansion of gases in the metal electrode

Vaporization and Condensation. - The intense heat at the end of the metal electrode causes approximately ten per cent of the metal leaving the electrode to become vaporized. This metal is then condensed in the pool or crater on the work which is at a much lower temperature than the tip of the electrode. Approximately ninety per cent of the metal transferred across the arc is in the form of liquid globules or droplets which are not affected by this force.

Expansion of Gases from Electrode Coatings. - Gases are produced by the burning and volatilization of the coating on covered electrodes and are expanded by the heat of the boiling electrode tip. This rapid expansion of the gases projects the metal and slag of the electrode in the globular form away from the solid electrode tip and into the molten crater. The unburned coating extending beyond the metal tip of the shielded type electrodes controls the direction of the gas expansion and directs the molten metal globules into the weld metal crater formed in the base metal. This force is not present when welding with bare or light-coated electrodes.

Gravity. - Gravity is an important force in the transfer of filler metal in flat position welding. It should be noted, however, that it does not affect the rate of metal transfer as measured by the melting or burn-off rate of electrodes when welding in the down-hand or flat position as compared with the vertical and overhead welding positions. In the vertical and overhead positions, smaller electrodes must be used to avoid excessive loss of weld metal and slag. The molten puddle must be kept small as the surface tension of the deposited metal is unable

to retain a large volume of molten metal and molten slag in the weld crater. The effect of gravity in arc welding operations is a more serious factor from the standpoint of retaining deposited metal in the pool rather than the transfer of the metal from the electrode to the pool.

Electro-Magnetic Force. - Since the electrode tip acts as an electrical conductor the molten metal globule is also an electrical conductor and, as such, is acted upon by magnetic forces acting at 90° to the direction of the current flow. This force produces a pinching effect on the metal globules and acts to speed up the separation of the molten metal from the end of the electrode. It is particularly helpful in transferring metal in horizontal, vertical, and overhead position welding.

Electro-static Force. - This force is said to cause particles of metal containing carbon to move from the positive to the negative terminal of an electric arc circuit. It is based on the observation that in direct current welding between two carbon electrodes, some of the carbon which disappears from the positive terminal is deposited on the negative terminal. It is primarily a function of the arc polarity and therefore aids metal transfer when welding with reverse polarity (electrode positive). The intensity of this force is insignificant since welding is just as successfully performed using straight polarity (electrode negative).

Electric Force. - This force, produced by the voltage across the arc, acts to pull the small, pinched-off globules of metal regardless of the position of welding. This force is especially helpful where direct current, straight polarity mineral-coated electrodes (which do not produce large volumes of gas) are used. Since this force is most effective with straight polarity (electrode negative), in which case both the metal particles and the current flow from the positive to the negative terminal, it is opposed to the forces described as electro-static. However, the melting rate of straight polarity and reverse polarity electrodes are substantially the same, consequently the combined effect of these two forces is negligible.

Pinch Effect. - This force operates when a particle of molten metal short circuits the arc. The high current passing through the molten globule

at the time of the short circuit exerts a radial compressive force which tends to pinch the molten globule and detach it from the end of the electrode. This force operates intermittently as it is exerted only on the larger globules of metal and does not affect the smaller particles which pass through the arc space without shorting the electrode to the base metal being welded. Heavy coated electrodes produce comparatively small globules of metal, rarely short circuit the arc, and consequently are little affected by this force, the size of molten globules decreases with increase in carbon content. This is effected by the higher viscosity in molten globules given off from the lower carbon electrodes. Higher carbon electrodes are likewise little affected by this force for this reason.

Surface Tension. - This force keeps the filler metal and slag globules in contact with molten base or weld metal in the crater. It helps to retain the molten metal in horizontal, vertical and overhead welding and also to determine the shape of the weld contours. When a molten globule short circuits the arc, surface tension draws the metal into the molten pool, however, it is not instrumental in projecting particles of molten metal across the arc space.

Expansion of gases in the Metal Electrode. - Commercial steels contain dissolved gases, non-metallic inclusions and some of the more volatile elements such as manganese which are vaporized by the heat of the arc. The rapid expansion of these gases and vapors causes small particles of molten metal to be expelled from the tip of the electrode and directed toward the crater of the weld. These gases may also form below the surface of the molten metal at the tip of the electrode and produce small bubbles of molten metal because of the surface tension of the liquid. These bubbles will vary in size depending upon whether the gas evolution is general or localized. Once formed the bubbles may burst to form a fine spray of particles because of the gas pressure within, or when shorted across the arc the bubbles may be exploded by the high current passing through their thin film. It should be noted that many of the globules of metal passing through the arc space may be hollow driven by gases formed at the tip of the electrode. Inert gases dissolved in the metal electrode do not propel globules of metal through the arc space.

The only measure of success is "efficiency".

(See page 101, Volume 2, of THE ORDNANCE SERGEANT, if you have a copy). Originally the insignia came from the British, and under the name of Grenade it has long been the badge of Royal Engineers, Royal Horse Artillery, and the Grenadier Guards.

Probably for the first time in history this insignia is being worn by large numbers of the fair sex. In the past THE ORDNANCE SERGEANT has reproduced several pictures of Ordnance ladies in uniform, and in each case the uniform is adorned with the Ordnance bomb.

On this page the ladies of the Cleveland Ordnance District contribute their bit of beauty to adorn our pages, the photo being forwarded by Miss Dorothy Perkins, of 3425 Park Lane Drive, Parma, Ohio.



Among the many interesting items which come to the editor's desk are some which cannot be published. Some are used as suggestions for articles which appear later. Still others contain ideas of undoubted value to Ordnance personnel. They are presented here for your benefit.

According to BURSTS - OR DUDS, a publication issued by the Boston Ordnance District, the oldest current insignia in the Army is the bomb and flame of the Ordnance Department. It was adopted 110 years ago to be worn in the gold embroidery on the skirts of the long coats worn by artillery and Ordnance officers. In 1851 it was removed from the artillery uniform and has ever since been used to identify the Ordnance Department. The flame has been streamlined in recent years

