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ALLIED LAND FORCES HEADQUARTERS

SWPA

TECHNICAL INTELLIGENCE SUMMARY

No 5

AUGUST 1943

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ALLIED LAND FORCES HEADQUARTERS S.W.P.A.

TECHNICAL INTELLIGENCE SUMMARY

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JAPANESE 75 MM. FIELD A/A GUN

(Type 88)

(See NOTE re CALIBRE - page 77)

1. GENERAL.

The weapon is a Japanese 75 mm. Field Anti-Aircraft Gun-Type 88 - 1928 Model. Although designed primarily for an A/A role, the weapon has been used as a field gun. It is semi-automatic in operation and the rate of fire is estimated to be 15/20 rounds per minute. The weapon has a high degree of mobility and can be put into and out of action with great rapidity.

Items of general equipment examined were manufactured at the Osaka Army Arsenal. Sighting gear was produced by Mitsubishi, also at Osaka.

Miscellaneous Details.

Muzzle Velocity	720 meters per sec. 2360 feet " "
Increase in M.V. for each 1° rise in temp.	(.85 meters (2'9½".
Increase in M.V. for each 1% decrease in weight of projectile.	(1.52 meters (4'7".
Maximum Height.	(9100 meters (29848 ft.
Maximum Horizontal Range ..	(13800 meters (15080 yards
Fuse setting range	From 0 to 30.
Overall weight of gun ..	5830 lbs.

2. ORDNANCE.

(a) Miscellaneous Details

Weight of ordnance	1000 lbs.
Length of "	10'. 10.5"
Length of rifling	101.5"
Calibre	(75 mm. (2.956".
No. of lands	28
Width of lands	0.156".
Width of grooves	0.179".
Depth of grooves	0.029".
Twist of rifling	1.259 turns in 101.5" Uniform righthand twist.

Chamber -

Diameter at breech end ..	3.390".
" " neck	3.105".
Length	20.25".

Breech Mechanism -

Weight	62.5 lbs.

(b) Jacket and Breech Ring, made in one piece, fitting tightly over a liner of which about 4 ft. projects beyond the jacket at the muzzle end. Integral with the jacket are three sets of longitudinal projections (Fig. 6, 1) which are fitted with brass bearing strips (Fig. 1, 5). These form guides for the piece during recoil and recuperation on the cradle slides.

(c) Breech Mechanism is of the horizontal sliding block type arranged for Q.F. (i.e., Hand or semi-automatic working). The firing mechanism is designed for percussion firing.

Components of the breech mechanism are as follows :-

(i)	Breech closing assembly (Fig. 2,10) - consisting of a spring loaded plunger in a cylindrical housing through which passes a "Hand" and "Semi-auto" setting lever. (Fig. 2,11).	
(ii)	Bush, firing hole.	- (Fig. 3 ,1).
(iii)	Block, breech.	- (Fig. 3,29).
(iv)	Cam, actuating, sear.	- (Fig. 3,11).
(v)	Cover, cam and sear assembly.	- (Fig. 3,12).
(vi)	Cover, striker.	- (Fig. 3, 8).
(vii)	Extractors.	- (Fig. 3, 4).
(viii)	Lever, breech mechanism and shaft actuating.	- (Fig. 3, 2).
(ix)	Lever, cocking and firing.	- (Fig. 3, 7).
(x)	Lever, safe and fire.	- (Fig. 3,14).
(xi)	Lock, retaining, breech block closed - consisting of spring loaded plunger and spring and plunger retaining cover. X (See below).	- (Fig. 1, 2).
(xii)	Main spring.	- (Fig. 3,10).
xiii)	Nut, retaining, actuating shaft.	- (Fig. 3, 6).
(xiv)	Plunger, locking, L.B.M. X (See below).	- (Fig. 3,17).
(xv)	Roller-arm, actuating, shaft actuating.	- (Fig. 3, 5).
(xvi)	Sear.	- (Fig. 3,16).
(xvii)	Sleeves, plunger, locking.	- (Fig. 3,18).
(xviii)	Spindle, extractors.	- (Fig. 3, 3).
(xix)	Spring, actuating cam.	- (Fig. 3,13).
(xx)	Spring, plunger, locking.	- (Fig. 3,19).
(xxi)	Striker.	- (Fig. 3, 9).

(d) Action of the Mechanism at S/A.

(i) The breech is opened by swinging L.B.M. to the right. The toe of the L.B.M. at the same time forces the plunger of the breech closing assembly into its housing and compresses its spring.

The breech block is then held open by the extractors, which have been forced to the rear and which lock against shoulders on the face of the block.

(ii) The round is loaded into the chamber. The rim of the case carries the extractors forward, thus releasing the breech block which closes under the pressure exerted by the plunger of breech-closing assembly on the L.B.M. and shaft actuating gear.

(iii) On pulling the lanyard, the lever, cocking and firing, is turned in a clockwise direction. This causes the sear to be forced to the rear (by the rotation of the cam, actuating, sear) carrying with it the striker and compressing the main spring until a cam follower on the sear passes over a shoulder on the cam. This allows the sear and the striker to move forward on to the primer by the action of the main spring. When the lanyard is released, the spring actuating cam returns the striker and sear to an intermediate position.

(iv) The piece recoils carrying the roller-arm, actuating the actuating shaft, past a cam fixed on the side of the cradle. On run-out the roller-arm engages against the rear portion of the cam, is forced in a clockwise direction and thus opens the breech. The cam is allowed to rotate under pressure by a buffer cylinder, thus permitting the roller-arm to clear the cam and continue its forward movement.

(v) The extractors are forced to the rear, ejecting the case and holding the breech block open ready for the next round.

(e) To dismantle Breech Mechanism.

(i) Open breech and turn "Hand" and "Semi-auto" setting lever towards the breech. This retains the plunger of breech-closing assembly in its housing, disengaging it from the L.B.M. toe.

(ii) Half-close breech, unscrew nut, retaining actuating shaft, and slide roller arm off lower end of actuating shaft. Lift out the L.B.M.

(iii) Withdraw extractor spindle and slide out breech block and extractors.

(iv) Exerting pressure on the plunger of the breech-closing assembly (to prevent plunger and spring from flying out) turn the "Hand" and "Semi-auto" setting lever toward the muzzle and remove plunger and spring. To remove the parts from the breech block - rotate striker-cover one half turn either way and lift out; withdraw main spring and striker. With safe and fire lever horizontal, quarter turn cocking and firing lever outwards from the block and lift out.

(v) Withdraw cover, cam and sear assembly and, from it, remove sear, cam and spring actuating cam. Turn safety lever and fire lever down; lift out plunger which locks L.B.M. with plunger sleeve and plunger spring. Turn safety and fire lever in a clockwise direction to stops, then withdraw.

Assemble in reverse order.

(f) The Clinometer plane is situated on top of the breech ring and has three locating screws.

Lock, retaining, breech block closed - the plunger is forced into a recess cut in the rear face of the block when the lock is rotated one sixth of a turn.

Plunger, Locking, L.B.M. - As the L.B.M. closes the breech, it passes over the plunger depressing it and then allowing it to rise into a slot cut into the under side of the L.B.M. When the safe and fire lever is in the horizontal position it locks the plunger. This in turn locks the L.B.M. when the breech is closed. With the safe and fire lever turned upwards both the L.B.M. and the lever, cocking and firing are locked.

3. MOUNTING.

(a) Top Carriage. Frame

Single steel casting. (See Figs. 2 and 6). The frame turns on ball bearings set in the top of the pedestal, and is fastened to the pedestal by a tube which extends down through the base of the pedestal and is retained by a large nut. This frame is so designed as to amount the cradle, recoil and recuperator system, equilibrator system, elevating and traversing systems, and the sighting and laying apparatus. The general construction of the top carriage frame is shown in the accompanying photographs. Each of the components mounted on this frame will be treated separately. Levelling cross-bubbles are mounted at Fig. 10-1. They are partially covered by metal and can be rotated on a horizontal axis when not in use, so that the metal case protects the glass.

(b) Cradle.

The cradle consists of plates which are fastened to either side of the recoil mechanism forging, and which mount the elevating gear segments and trunnions. (See photographs). The trunnion bearings are two-piece yellow brass bushings with lubricating grooves.

(c) Recoil System.

The recoil system comprises a hydraulic buffer to regulate recoil, and a hydro-pneumatic recuperator to return the gun to its run out position. The whole system is inter-connected by a series of ports, and the various parts all act together both during recoil and runout.

The system is housed in a steel cradle the top of which is formed into two slides on which the gun moves. Four bores or cylinders are formed integral with the cradle and slides. Three lower bores, commencing at the rear, continue for about two-thirds of the cradle length. The fourth (above the other three) commences about the centre of the lower bores, running forward to the front of the cradle. These bores are inter-connected as follows :-

(i) A port connects the top cylinder, near the rear end, to approximately the centre of the centre lower cylinder.

(ii) Ports connect the centre lower cylinder, near its rear end, with the two lower cylinders on each side.

The gun is connected to the recoil system by a piston rod threaded on the rear end and attached to a lug on the breech ring by two bolts, one on each side of the lug. The front end of the piston rod terminates in a piston which slides in the upper cylinder. At the rear of the cylinder is a stuffing box through which the piston rod passes. The front end is sealed by a steel plug to prevent the entry of dirt etc. This plug is, of course never under pressure. Between the front side of the breech ring lug and a shoulder on the rod are four disc springs. Their function is to absorb the final shock of recoil when they come into contact with the stuffing box.

Within the centre lower cylinder, near its rear end, is a rotating sleeve valve, through which oil flows during recoil. The valve consists of two sleeves, the inner one rotating within the outer. The ports in the outer sleeve connect with the ports forming a passage from the centre lower to the two outer cylinders. The inner sleeve is rotated by means of a rod, which runs forward from the valve and projects through a stuffing box and gland in the front end of the cylinder. The rod is actuated through a bevelled segment attached to its projecting portion, and engages with a second bevelled segment attached to a linkage on the gun. As the gun is elevated or depressed, the rod, and hence the inner sleeve of the valve, is rotated altering the size of the ports and thus controlling recoil. The rear of the cylinder is closed by a head.

Within each of the two lower outer cylinders is a floating piston, the rear end of which is formed into a control plunger. This works within a control cylinder screwed into the rear end of each bore. The control plungers are tapered to control the recoil of the gun and end in a small bronze piston which operates in the bore of the control cylinder. Two parallel grooves within the bore of this cylinder allow a flow of oil past the piston and thus form a control during runout. An annular passage, formed near the front end of the control cylinder connects with the outside of the cylinder, allowing flow of oil during recoil. The rear ends of the two outer cylinders are closed by heads, through which project indicating rods. These rods are actuated from within by the floating pistons, and give an indication of their position when the gun is fully run out. The projecting ends of these indicating rods move over a roughly graduated scale and thus indicate the state of filling of the system. (A position about half way along the scale probably shows a correctly filled system). The front end of the left hand bore is closed by a head, containing a non-return air filling valve. The front of the right hand cylinder is closed by a blank head with an extension projecting into the bore, apparently to limit the movement of the floating piston.

When the system is filled, oil and air are distributed as follows :-

<u>Oil</u> - The upper cylinder behind the piston.
The lower centre cylinder.
The two lower outer cylinders behind the floating pistons.

<u>Air</u> - Under pressure in front of the floating pistons.

The system is filled with oil through a valve at the rear of the cradle, and the left hand lower cylinder with air through the non-return valve at the front.

The method of filling the right hand lower cylinder with air is not at present clear.

<u>Operation.</u>

As the gun recoils it draws the recuperator piston to the rear. This forces oil through the port into the centre cylinder at the bottom, whence it is throttled through the sleeve valve at the rear of the cylinder and passes into the floating piston cylinders from the outside of the control cylinder it passes into the annular orifice over the tapered portion of the control plunger and out through the front of the control cylinder, forcing the floating piston toward the front of the cylinder and compressing the air (or nitrogen). Recoil of the gun is retarded partly by throttling of the oil through the sleeve valve and over the tapered control rod, and partly by pressure exerted by the air.

When recoil has ceased, pressure of the air on the floating pistons, forces them to the rear. This drives oil back through the front end of the control cylinder, out through the annular passage to the outside of the control cylinder, through the sleeve valve into the centre cylinder and thence into the upper bore, thus forcing the piston and rod forward. This carries the gun to the run out position. The rearward movement of the floating pistons under influence of the air is controlled by the control plunger piston operating in the control cylinder, the rate of movement being controlled by the throttling action of the oil in the cylinder passing forward through the parallel grooves and over the piston. This controls the main oil flow rate and therefore the runout rate of the gun. Final shock of runout is absorbed by the disc springs on the recuperator rod.

There is an oil index at the rear of each recuperator cylinder. (See Fig. 2-14). According to a P.W., the index plug fully extended indicates low air pressure, low oil reserve, or both. Fully withdrawn, the plug is an indication of excessive air and/or oil. The gun is normally operated at mid point of the index travel.

Fig. 10-6 shows the valve for attaching the air-replenishing mechanism. Two air flasks (compressed gas cylinder) are carried by each battery. A wire-wrapped rubber hose is run from the flask meter to the recoil cylinder, and is attached by means of an adapter.

Recoil Data: (Taken from translation of 1931 firing table)

(i) Length of recoil (varies uniformly from a to b)

a. At Zero degrees elevation .... (1.4 metres
(55.12 inches

b. At 50 degrees elevation ...... (0.6 metres
(23.6 inches

c. From 50 deg. to 85 deg. ...... (0.6 metres

(ii) Type of liquid .... Anti-freezing, light fluid lubricating oil.

(iii) Amount of liquid .. Approximately 3.8 litres
231.8 Cu. Inches

(iv) Normal initial pressure, if air in air chamber .... (95 to 100 Kg.
(1349 to 1420 PSI

(d) Gear, balancing, gun.

Spring cable type. Two flat coil springs, one above the other, are located in the tube which extends down through the base of the pedestal. The cable, fastened to the bottom of the springs, runs over a pulley located above the tube on the top carriage, to a lug located on the bottom of the recoil system. (Fig 6-2). The equilibrating force is exerted at a point $7\frac{5}{8}$ inches below the axis of the trunnions, and 5 inches to the rear at zero degrees elevation. The two springs are separated by a bronze separator, and held in place by a bronze and steel cup at the lower end of the springs. The equilibrator tension is adjustable by means of locking nuts on the threaded cable extension. The pulley rotates on a bushing on the transverse shaft which contains the elevation spur gears.

(e) Elevating Mechanism. Figs. 5-1, 7-1 and 10-12 show the elevating segment gears. Fig. 12 shows the elevating mechanism. The rotation of the handwheel is transmitted through a gear train, to the transverse shaft which contains two pinions. These two pinions rotate against the segment racks, causing the gun to elevate and depress. Fig. 2-9 and 12-1 show the spur segment gear which turns the electric laying apparatus which is mounted at 2 of Fig. 12. No electrical components were recovered.

(f) Traversing Mechanism. (Figs. 13 and 2). The rotation of the handwheel is transmitted to a worm in part 13 of Fig. 13. This worm engages a ring gear which is fastened rigidly to the pedestal. The end of the worm shaft is keyed to receive a connecting element to the electric azimuth laying apparatus (probably matching pointer system) which is apperently mounted at 2 of Fig. 10. Fig. 2-4 shows the traversing handwheel lock.

(g) Pedestal. (See Fig. 5.) Heavy steel casting, mounting ring gear and bearing surface for top carriage movement in azimuth. Fig. 5-2 shows indents in the pedestal into which a travelling lock fits. This lock merely connects the "A" frame, (Fig. 2-15) which is part of the top carriage, to the pedestal.

Figs. 10-8 and 9 show two azimuth scales graduated in mils. The upper scale is graduated from 0 to 6400 mils in a clockwise direction. The lower scale is marked from 0 to 6400 mils in a counter-clockwise direction. The upper scale may be turned in azimuth for orientation, then set into position by set screws. The lower scale is movable. (See discussion of Course Angle, under Fire Control page 21)

The index to the bottom scale (Fig 10-14) is fastened to the top carriage frame. It is adjustable with respect to the frame. The adjustment is accomplished by moving the pointer on a brass track (Fig. 10-13) which is graduated from 0 to 600 mils to either side of the contre.

The pedestal is fastened to the base by means of studs. The studs extend upward through holes in the base of the pedestal and nuts complete the locking as shown in Fig. 2.

The Azimuth ring gear is a one piece steel gear, drive fitted and bolted into the top of the pedestal.

The bearing race is machined into the upper surface of the pedestal.

(h) Base. Single steel casting. This casting is fitted with the pedestal mounting studs, and is so designed as to mount the five outriggers and firing pads, and the axle assembly. (See Fig. 9). Details of the mounting of these components are dealt with under their separate headings.

(i) Out-Riggers and Jacks. Fig. 4 shows the gun in firing position. The out-riggers are constructed of steel plates, rivetted into tapering, box-type, beams 6 ft 7 inches in length from the pin hinge on the base, to the centre of the jack-screw at the end of the outrigger. The beam is 6-1/2" deep by 5" wide at the base end, and 4" deep by 3-1/4" wide at the jack screw end. Beams A and B are single-piece straight outriggers which come together in the travelling position (Fig. 6) to form the towing bar. Outrigger "A" is fitted with a spring loaded lunette (Fig. 4-1). Outriggers "C", "D", and "E" are of the same general dimensions, but are of two-piece construction with pin type hinges midway between the base and the jacks. This feature is to enable the outriggers to fold in towards the body in travelling position. Leg E folds clock-wise back on to itself, leg C and D rotate counter clockwise (see figs. 6 and 7). The outriggers are locked in this folding travel position by a locking bar (Fig. 6-3) which is pivoted on the central leg (d, Fig. 6) and wedges under a locking stud on each of the other two. The jack-screw ends are locked to the base end of the beams at Fig. 6-4 by a hasp arrangement which is kept in place by a spring catch. In the firing position the folding legs are securely locked at the hinge by a crank-type lock which rotates 180 degrees (Fig. 4-2) and locks over lip shown in Fig. 6-5. The five outriggers are limited in their swing so that they are 72 degrees apart in firing position.

Legs A, B, and D (Fig 4) are fitted with hand-jack screws which can raise the firing pads two feet off the ground. These three jacks are used first to raise the wheels off the ground. The wheels are then removed and the gun is lowered onto the firing pads (Fig. 9-12). The jacks on the other two outriggers are only long enough to lift the pads 8 inches, and are used in the levelling and cross-levelling of the gun in conjunction with the first three. The screw jacks may be seen in Fig. 4. They are turned by ratchet socket wrenches which are strapped to each outrigger in travelling. The pads at the foot of the jacks have holes to allow for stabilizing stakes to be driven into the ground. (See Fig. 5-4). The jack screws are equipped with metal covers which lock in place to keep dust and grit out of the threads in travelling (see Fig. 7).

(j) Firing Pads. (Figs. 9-12 and 4-3). There are five firing pads, one at the base of each outrigger. They are saucer-shaped discs, sixteen inches in diameter. They may be raised or lowered three inches by means of an internal thread in the outrigger hinge pin. This internal thread is turned by a crank and draws the threaded pad stud up into the base. The pad studs are keyed (Fig. 9-13) and do not turn in the raising or lowering. The cranks are clamped to the base when not in use.

(k) Wheel and Axle Group and Brake Assembly. The axle is a single steel beam running the width of the base, and bent upward at the ends. The wheel spindles are mounted on the vertical portions in such a manner that the axis of rotation of the wheels is parallel to the axis of the axle and vertically displaced five inches above it. (See Fig. 9.) The vertical portions of the axle ride in channels set into the base (Fig. 9-18). The axle is free to move up and down in these channels. The amount of travel is limited to approximately 1¼" by a lug extending outward from the base which rides in a slot in the vertical axle extensions. This upward motion is further controlled by the shock absorber piston (Fig. 9-6) which forces upward on the lever arm (Fig. 9-13). The fulcrum is at Fig 9-8, and the resultant force acts downward on the axle. Thus the road shocks are absorbed to a certain extent. The shock absorber consists of the cylinder (9-15) a coiled spring, and the piston (9-6).

Fig. 9-16 shows the brake assembly. Fig. 9-7 is the flange or mounting plate; 9-14, the brake drum and 9-3 the actuating lug, and hole in which it operates. The brake assembly is mounted as shown, being positioned by the four positioning lugs ABCD. The brakes are used only for parking; no provision was made on this carriage for travelling brakes. Fig. 9-1 shows the brake handle. This is rotated clockwise, turning a threaded rod in the lever arm which causes the lever 9-9 to be moved to the left in the photograph. 9-9 is fastened rigidly to a transverse tie rod which runs parallel to the main axle, and is supported in bearing brackets on the axle. Thus, when the upper end of 9-9 is moved to the left, the tie rod is caused to rotate. This rotation is transmitted to the square actuating shaft (9-3) which fits into a square hole in the end of the tie rod. A very slight rotation of the actuating lug causes the brake shoes to be cammed outward against the drum.

The rotation of the tie-rod is transmitted to a similar system on the right wheel. The movement of the actuating shaft required to set the brakes is very slight. A very high mechanical advantage is obtained in this system. 9-17 is an adjusting nut. This causes the actuating lever-arm (9-9) to rotate slightly, providing a means of adjusting for worn bands, etc.

Fig. 9-2 is the travelling lock lever. The lock consists of a half-round rod which extends downward into a circumferential groove in the brake handle preventing it from falling out in travelling.

The wheel assembly is held in place on the spindle by lock nut (Fig. 9-5) which screws on to the end of the spindle. This is kept in position by the spring-charged key in the end of the spindle (9-4). The key is pushed into the spindle while the lock nut is being screwed on, and is then allowed to protrude as shown, locking into key-ways in the nut, preventing it from turning.

Fig. 8 shows the wheel with rims and locking rings.

The tyres are a commercial heavy-duty type with the following information (in English) cast into the side walls:

Naigai Cord, (manufactured by)		PRINCE TYRE CO.
Heavy duty	-	36 x 6
Maximum load	-	2500 lbs.

Keep inflated to 90 lbs.

(1) <u>Platform</u>. General characteristics are shown in photographs. It is constructed of 0.083" sheet steel. Tool and accessory compartments are built into platform in space not occupied by the base. Fig. 5-3 shows the lid of one of these compartments.

(m) Seats. The seats and fuse setter are mounted on an "A" frame of light tubular construction. The top of the "A" is bolted to the rear of the top carriage frame and braced to the left side of the frame. The seats are mounted on extensions on either side of the cross-bar with foot rests at the bottom of the "A". The seats are stampings of thin sheet steel fastened to a rod as shown in Fig. 2-16. The height of the seat is adjusted by setting the wing nut which fastens the rod at the desired position. Fig. 2 shows the construction of the frame.

4. TRAVELLING POSITION. (See Fig. 6.)

To place the gun in travelling position as shown, a hand ratchet winch and gun slide is attached to the towing out riggers near the lunette, and a cable run from the winch, over the pulley (Fig. 2-17) to the lug on the breech ring (Fig. 1-4). The recoil piston rod is then disengaged from the breech ring (Fig. 1-3). The recoil piston rod is then disengaged from the breech ring at Fig. 1-3, and the gun elevated until the tube tends to slide to the rear. The tube is lowered slowly with the winch, and the gun elevated, until the breech ring rests on a pad on the winch slide.

The gun has a road clearance of 13½", and is 15' long, from lunette to rear-most extension, when travelling. See Fig. 6-5.

According to the testimony of a P.W. the prime mover is a six-cylinder, six-by-six truck, equipped with a power winch.

5. EMPLACEMENT.

1. A pit is dug, approximately three feet deep, and the earth thrown up around the edge until it is level with the trunnions. The hole is made large enough to accomodate the spread of the outriggers, and the floor is levelled.

2. Gun is lowered into pit with the power winch.

3. When the gun is in the final position, the three hinged outriggers are unfolded, and the long jack-screw of the centre one turned down to the floor of the pit. One jack-screw of the towing outrigger is set to the floor. The gun then has four-point suspension, two wheels, and two jacks.

4. The ordnance is now pulled into firing position by means of the hand winch. (The winch is left on the outriggers, and the tension kept on its cable during travel). The recoil piston is then fastened to the breech ring.

5. Towing outriggers are spread, and the three long jacks turned until the wheels are raised off the ground.

6. Wheels are removed by forcing the spring key (Fig. 9-4) inward, and turning the locking nut (Fig. 9-5) counter-clockwise two turns. Locking nut comes off, and the wheel is pulled off the spindle.

7. The remaining two outriggers are spread to their firing positions. At this position, the five beams are 72 degrees apart.

8. Gun is lowered onto the firing pads.

9. Gun is levelled and cross-levelled by means of the five jacks.

10. Firing pads are extended downward until they rest firmly on the pit floor.

11. Gun is ready for orientation and firing.

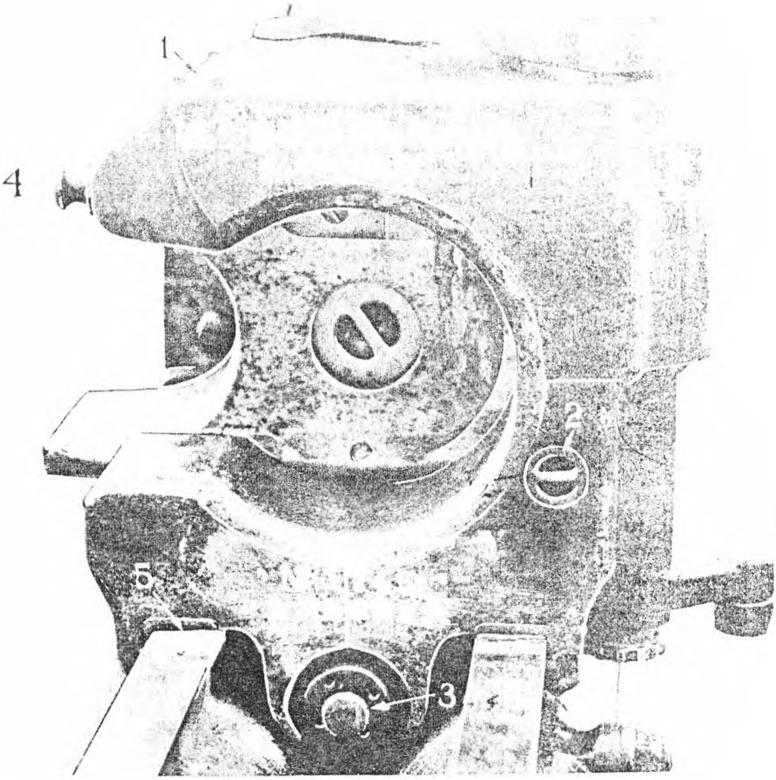


Fig. 1.

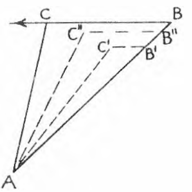
75 MM GUN

BREECH - REAR VIEW

6. FIRE CONTROL.

(a) Principle. The method used with this type of gun to predict the future position of a moving target in space, differs from both the linear speed, and angular rate of travel methods employed in our anti-aircraft systems. It is, however, based upon the linear speed of the target.

The basic principle may best be explained from the space triangle ABC, in which AB is the line of sight from the gun (A) to the present position of the target (B) BC is the distance through which the target will travel to the predicted position (C) in the time of flight of the projectile. AC is the line of sight to the future position of the target.



In that triangle: $\frac{\sin A}{\sin B} = \frac{BC}{AC}$

but, $BC = Sg \times t$

and $AC = Vp \times t$

Where Sg = ground speed of target, and Vp = average velocity of the projectile along AC.

Then: $\frac{\sin A}{\sin B} = \frac{Sg}{Vp} \frac{t}{t}$

It may be seen that the lead angle BAC may be computed if the target speed, angle of approach, and average projectile velocity under the range and elevation conditions at AC are known.

Sg and α_o (the angle of approach) are primary input data to the system. Vp is taken continuously from a curve which establishes slant range for instantaneous values of QE and altitude. At the beginning of the prediction cycle, QE is equal to α_o so an increment of lead is established using the average velocity of the projectile at AB. At AC', the value of QE has changed, causing a change in slant range and V^o, thereby establishing a new increment of lead. This cycle continues until, by a series of successive approximations, the lead angle is reached, where Vp x t is equal to AC, the future slant range.

Note: The term "Average Projectile Velocity" (Vp) has been used to simplify the general explanation. A mathematical analysis of the system was not conducted so the exact function of the slant range, and time of flight employed, is not known. It is some function of the velocity probably $(\frac{D}{t})$ where D = slant range, or, in the azimuth prediction, $(\frac{R}{t})$. Where R = horizontal range.

(b) Instruments and computing mechanism employed in the system.

(i) Off-carriage components.

a. Two-metre-base height and range finder.
b. Speed and course angle calculator.
c. Charge (propelling) temperature and wind corrector scale.
d. Spotting binoculars.

These instruments are located in the battery command post, and supply the following data to the guns:

Height Finder	- Ho, present altitude. This is assumed to remain constant throughout a prediction cycle.
Calculator	- αo, angle of approach (course angle) of target at the present position.
	- Sg, ground speed of target. This is also assumed to remain constant throughout the prediction cycle.
Corrector scale	- Pointing correction angles to be applied to the sights to correct for wind components and changes due to the initial temperature of the propellant charge.
Spotting binoculars	- Spot corrections.

The instruments are shown in fig. 18, 19, 20. No spotting binoculars have been recovered to date.

The data computed in these instruments is shouted from the C.P. to the guns. No telephone communications are used, according to the testimony of a captured gun-crew member. This P.W. also stated, that to his knowledge, only four computors were in operation with army AA batteries. These were frequently out of order and had to be shipped to Tokyo, as there were no provisions in the field for repair. There are mounting surfaces on this gun for data receivers, but they have never been used.

(ii) On-carriage Components:

a. Elevation Computing Apparatus.
b. Azimuth Computing Apparatus.
c. Auxiliary Elevation and Lead Corrector Disc.
d. Fuze Setter.

The various parts of these components are shown by the photographs and the accompanying nomenclature lists. The major parts of both the elevation and azimuth computing apparatuses are the same, so their functions may be described together.

Fan shaped plate (See Fig. 14). There is one of these plates on each side of the gun. It is a brass plate, quadrant-shaped to represent the elevation quadrant of the gun; from zero to ninety degrees. The face of the plate is swept by a radial arm which is rotated about the axis of the quadrant by QE. A pointer is mounted on the arm which may be translated along its length. The face of the plate is inscribed with two sets of curves which are plotted in polar co-ordinates, with the quadrant elevation as ϕ on both plates. The curves on the plates are plotted for the characteristics of one type of ammunition and fuze only; specific plates must be used for each type of ammunition.

(a) Elevation Plate:

Super elevation. The black set of curves on this plate (see Fig. 12 - curves marked 100, 500, 1000, etc.) are plotted with QE as ϕ and superelevation as ρ, for any given altitude. The curves are plotted at intervals of 100 metres of altitude from 100 to 8500 metres. The pointer is translated by turning the superelevation knob. The amount of rotation of this knob required to bring the pointer to the proper altitude curve is proportional to the superelevation angle under the given conditions of QE and altitude. This rotation is transmitted to the elevation sight through the differential, causing it to be moved through a reverse superelevation angle. The entire gun is then elevated to bring the cross-hairs back onto the target, and the superelevation angle has been added to the gun.

"Jido" or projectile velocity curves. (Jido is usually translated as automatic). These curves are inscribed in red on the plate, and are some function of the average projectile velocity for any given QE and range (or superelevation). The curves were not analysed, but in the light of what happens to the values taken from them, they are apparently plotted from the logarithmic values of average projectile speed, in seconds required to fly 500 metres, for any given values of QE and range. They are assigned numbers 39-72 for identification. These curves will be further discussed later, as they enter into the vertical deflection computations. For the present, it is established that when the superelevation arm is set at a Quadrant Elevation, and the pointer at a given altitude curve, the red line nearest to the pointer represents some function of the average velocity of the projectile under these conditions.

(b) Azimuth Plate:

Fuze Curves. The black curves on the azimuth plate are plotted with QE as ϕ and fuze graduations as ρ for any given altitude. The pointer is translated by rotating the fuze setting handwheel. The amount of rotation required to set the pointer on the given altitude curve at a given Quadrant Elevation, is proportional to the required fuze graduation under those conditions. This rotation is transmitted to the fuze setter continuously, so that it is always at the proper setting.

"Jido" curves. The red curves perform the same function on this side as they did on the elevation plate. Their values however, should differ, because of the fact that the Azimuth prediction is computed from the values of horizontal range, rather than slant range. The value of Vp then is not the average velocity of the projectile at all, but rather a velocity computed from $\frac{R}{t}$, where R =

horizontal range. The curves on this side are assigned numbers 1-38. The elevation curves are numbered from 39-72.

Computing Drums. The function of these drums is to compute the principal lateral and vertical deflection angles.

Each drum has a main section and an end section (see Figs. 15 and 16). These two sections are coupled together on a shaft by means of a spring-pressure friction clutch, so that they may be rotated as one drum, or the end section may be held and the main section turned with respect to it.

Elevation Drum. The main section of the drum is merely a set of curves plotted in rectangular co-ordinates. The abscissae are values of vertical deflection, and the ordinates, values of $(\frac{Sg}{Vp} \sin \epsilon_o)$. The scale nearest the main section is a logarithmically graduated scale of target speeds. The outer scale is an evenly graduated scale of logarithmic values of a function of the average projectile velocity. These are set in reference to a pointer (not shown in the photograph) which moves around the end section of the drum in a logarithmic relation to the $\sin \epsilon_o$.

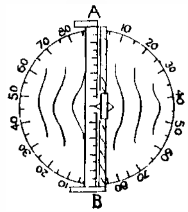
The main section is rotated with respect to the end until a reference arrow inscribed on the main section is opposite the correct target speed. The drum is then rotated as a unit by turning the drum rotating knob until the proper Vp value is set to the ϵ_o index. The logarithms have been algebraically added and the sum is equal to an ordinate x which is equal to $(\frac{Sg}{Vp} \sin \epsilon_o)$. The vertical deflection pointer is then translated until it is set to the given course angle curve. The pointer is translated by rotating the vertical deflection knob. The amount of rotation of this knob is proportional to the principal vertical deflection, and it is transmitted through the differential to the elevation sight, causing it to again move off the target in the inverse deflection angle. The angle is set into the gun as the tube is elevated to bring the cross-hairs back onto the target.

Azimuth Drum. The operation of this drum is similar to that of the elevation deflection computor, except for the fact that the $\sin \epsilon_o$ does not have to be considered in computing the azimuth lead. The only basic differences between the two, then, are that the abscissae are lateral deflections instead of vertical; and the index for the jido or Vp graduations is fixed rather than variable. The speed of the target is set in as on the elevation drum, and the cylinder is rotated as a unit until the ordinate $\frac{Sg}{Vp}$ has been reached. The lateral deflection is set into both sights, as the lateral deflection knob is turned to bring the pointer on to the proper course angle curve.

(c) Auxiliary Elevation Lead Correction Disc. This disc is shown in Fig. 10-7. It is graduated around the circumference of the face from 0 to 90 degrees twice (see diagram). The disc apparently rotates with ϵ_o. A scale graduated from zero to 600 mils above and below the centre line of the disc is mounted at points A and B in

Fig. 10-7 (see sketch) in such a manner that one side of the movable vertical index (Fig. 10-15) will indicate a mil correction on the scale. The movable index is caused to move downward an amount on the vertical scale proportional to a clock-wise lateral lead angle in mils, and upward for a counter-clockwise lead angle. The lower graduations are red, the upper black. This lead angle in mils is set in on the course angle index (Fig. 10-14) to correct for the change in the course angle brought about by moving the gun through the lateral lead angle. The course angle index slides on a brass track, graduated from 0 to 600 in red figures to the left, and 0 to 600 mils in black figures to the right.

AUXILIARY CORR.
DISC



The other pointer on the movable vertical index sweeps across curves which are inscribed on the face of the plate. These curves are numbered from 0 to 85 mils. The mil values taken from the curves are introduced into the vertical deflection mechanism by the auxiliary correction knob. The knob is rotated an amount proportional to the number of mils read on the correction disc, and this rotation simply causes the vertical deflection pointer to be moved laterally the same number of mils. The effect of this is to change the actual elevation lead angle by that number of mils. The exact reason for this correction in the elevation lead angle, due to the lateral lead angle, is not clear. It is quite possible that it corrects for an error introduced by the fact that the lateral deflection angle is computed in the horizontal plane using R_t as the projectile velocity function, while the vertical deflection computations use D_t, in the vertical plane.

Fuze Setter. The double fuze setter is shown in Fig. 17. It is mounted on a shelf fastened to the "A" frame which mounts the seats, as shown in Fig. 4-4. The two fuze setters are identical. The fuzed projectile is inserted into the fuze setter, and turned until the cutting key (Fig.21-A) fits into the key way (17A) allowing the fuze to drop down until the stud (21B) rides on the shoulder shown in the Fig. 17. The shell is then turned clock-wise, until the stud cams over a spring charged lock which prevents any further rotation in either direction. The fuze has been set, and is ready to fire.

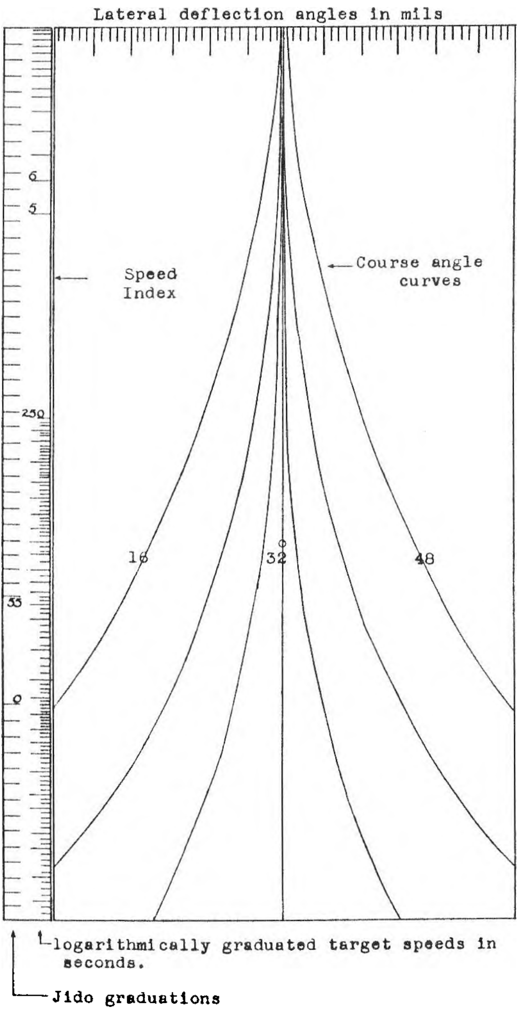
Setting. Rotation of the fuze setting handwheel causes the coupling (17-1) to turn. This in turn causes the upper section of the fuze setter, which consists of the setting scale, the top sleeve, and the spring charged lock, to rotate with respect to the index (17-3) and the keyway 17A.

Corrections. Rotation of the powder train correction crank causes the lower sleeve and keyway to turn in relation to the upper sleeve. The P.W. stated that these corrections are to compensate for the variation in burning rates of different batches of black powder used in

Fig. 15a.

FIRE CONTROL

Sketch of Lateral Deflection Drum
(Refer Fig. 15)

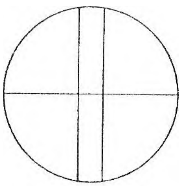


the train. The plus or minus values are stamped on each fuze container. There is no apparent provision for dead time correction.

The fuze is a four ring powder train fuze, the first and third rings moving with respect to the other two. It is not bore safe. The primer (Fig. 21-1) is set back onto the firing pin, (Fig. 21-2) as the shell is fired, and flashed up into the top ring and ignites the train. The maximum fuze-graduation is 30. seconds.

7. TELESCOPES.

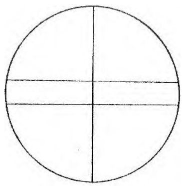
Both telescopes are the elbow type, and are mounted in the mounting sleeves shown in the photographs. There is a correction knob on each sight graduated in mils for the purpose of setting in constant or pointing corrections.



ELEVATION

TELESCOPE

RETICLE



AZIMUTH

TELESCOPE

RETICLE

8. THEORY.

The statements in the discussion of the computing apparatus pertaining to the mathematical operations performed are not backed by mathematical proof. They were conclusions drawn after a study of the operations which any computing mechanism would have to perform in order to supply Af and QE to the gun, from the input data which is supplied to the system. These mathematical operations were then assigned to the mechanism which appeared to perform the function. The conclusions were borne out by testimony of the P.W., and translations of various captured A.A. documents.

The prediction problems which must be solved in order to point the gun, will be treated here:

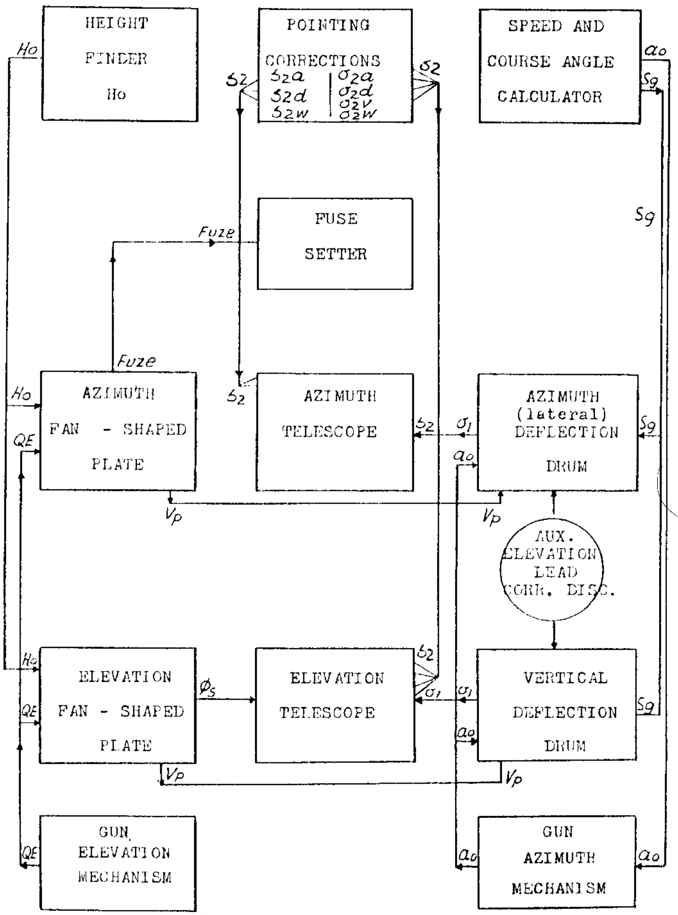
(1) Input data and source:

Ho, present altitude, (assumed constant) — Height finder

Sg, Ground Speed of Target (assumed constant) — Speed and course angle calculator

FIRE CONTROL.

Flow of Data Diagram.

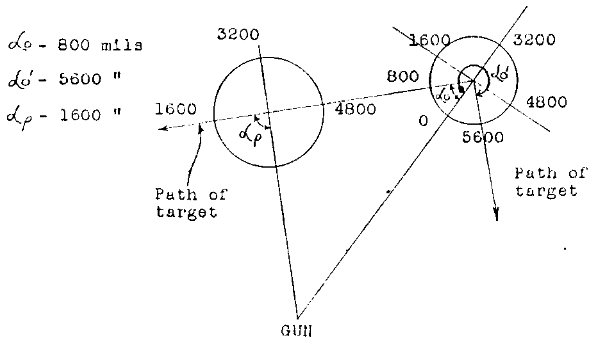


α_o, Course angle (angle of approach)	Speed and course angle calculator
ϵ_o, Present angular elevation	Elevation sighting mechanism.
Ao, Present azimuth	Azimuth scale.

(ii) Assumptions and definitions: The altitude of the target is assumed to remain a constant throughout the prediction problem. The ground speed of the target is also assumed a constant.

a. Ground speed: The target speed throughout this problem is graduated and computed in seconds. A speed of x seconds indicates that the target will move a distance of 500 metres in x seconds. The P.W. intimated that it is considered inefficient to state velocities in "miles per hour" or "feet per second", as it is harder to visualize the actual rate of travel than when a definite distance is understood to be traversed in a definite length of time.

b. Course Angle: This is the angle formed by the horizontal projection of the axis of the bore and the horizontal projection of the path of the target, measured in mils from zero on the line of sight in a clockwise direction away from the gun.

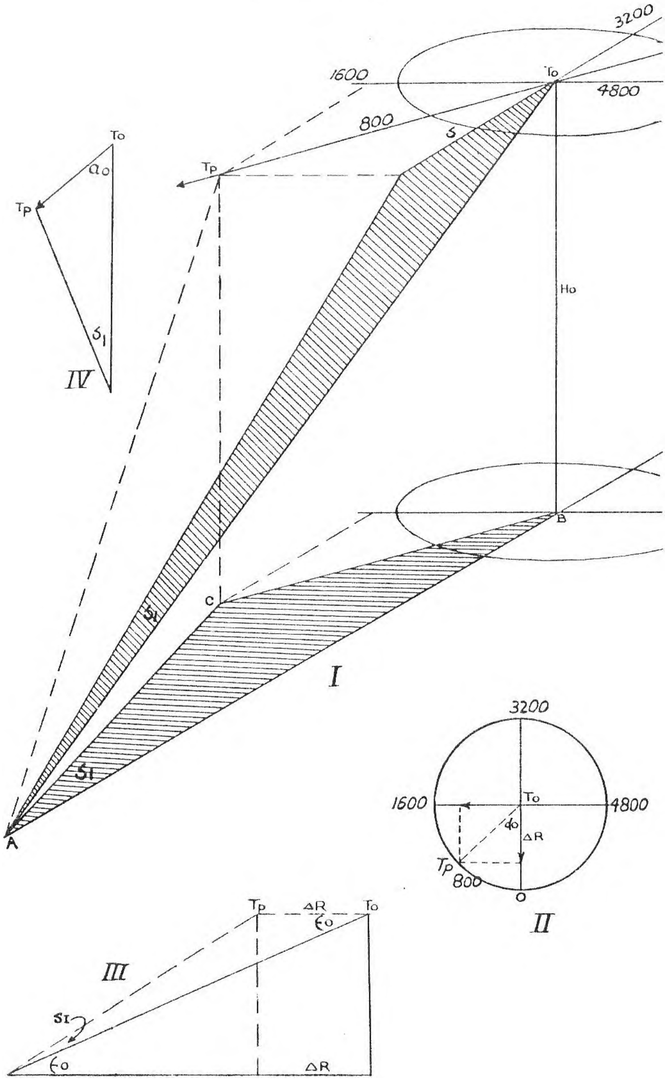


This angle is continually changing. The instantaneous values of course angle are supplied to the mechanism in the following manner.

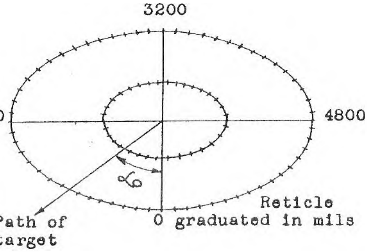
When a target is first sighted it is tracked by all guns and instruments. At the command "start" by the Battery Commander, the speed and course angle Calculator stops tracking, and allows the target to fly from the cross-hairs of its reticule, to the measuring ellipse (see sketch). At the same time a chalk mark is placed on the pedestal of each gun, directly beneath the course angle pointer (see Fig. 10-14). The guns have continued to track the target. The course angle calculator then corrects the course angle to the horizontal plane, and

Fig. A.

FIRE CONTROL



transmits the corrected value to the guns. The value transmitted is the course angle at the instant the chalk mark was placed on the pedestal. The movable course angle scale (Fig. 10-9) is then turned until the course angle received is set opposite the chalk mark. The instantaneous values of course angle may then be read from the scale as the pointer turns with the gun. The values are transmitted orally to the vertical and lateral deflection pointer operator.



MEASURING RETICLE IN THE TELESCOPE OF THE SPEED AND COURSE ANGLE CALCULATOR

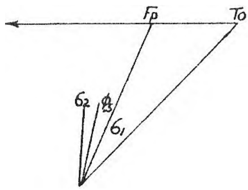
9. VERTICAL PREDICTION.

Vertical prediction or lead angle is made up of the following angles which are added to α_o:

σ_1 Principal vertical deflection

σ_2 Vertical pointing corrections

ϕ_5 Superelevation



a. Principal Vertical Deflection (see Fig. A)

In Fig. A-I, a target moving from To to Tp at an altitude Ho, will move through angle BAC in azimuth, and DAE in elevation, with respect to a gun at point A.

Fig. A-II shows the travel of the target broken down into its north-south and east-west component distances. The N-S component representing the change produced in horizontal range, and the E-W representing the lateral travel of the target at the horizontal range A B. The distance travelled by the target is equal to its velocity multiplied by the time of flight of the projectile:

$$\text{To Tp} = Sg \times t$$

The change in horizontal range, then, is:

$$Sg \times t \times \cos\alpha_o$$

In the vertical deflection triangle: Fig A-III

$$\frac{\sin\sigma_1}{\sin\epsilon_o} = \frac{Sg \times t \times \cos\alpha_o}{Vp \times t}$$

$$\sin\sigma_2 = \frac{Sg \;\cos\alpha_o \;\sin\epsilon_o}{Vp}$$

or

$$\sin\sigma_1 = Sg \times \left(\frac{t}{D}\right) \cos\alpha_o \sin\epsilon_o$$

The gun computing mechanism, then, must mechanically solve for the angle whose sin = $\frac{Sg \cos\alpha_o \;\; \sin\epsilon_o}{Vp}$

NOTE: The term "Vp" will again be used for the sake of clarity in explanation. It will be understood that this term merely represents the actual function of time of flight, range, or velocity used in solving for sin σ_1

The equation is mechanically solved on the vertical deflection drum. The drum is actually a set of curves plotted from rectangular co-ordinates, then rolled into a cylinder. Rotation of the cylinder with respect to an index changes the ordinate of a point on a curve, and translation of the vertical deflection pointer changes its abscissa. As stated previously, the curves are plotted for values of α_o or some function thereof, for varying values of vertical deflection as abscissae, and $\left(\frac{Sg}{Vp} \sin\epsilon_o\right)$ as ordinates. The mechanical operation of the drum has been discussed. The ordinates $\frac{Sg}{Vp} \sin\epsilon_o$ are computed on the drum itself. Values of Sg taken from the Speed and Course Angle Calculator, are divided by values of Vp taken from the jido curves. This division is apparently accomplished by subtracting logarithms. The end section of the drum, then, is, in effect, a slide rule for the purpose of dividing the velocities and multiplying the quotient by the sin ϵ_o . The latter quantity is brought into the problem by the moving ϵ_o index, which apparently rotates through angles which are proportionate to the sin of the angle of elevation as it changes from zero to ninety degrees. When the ordinate of a point on the course angle curve is established, the unknown deflection angle has been solved, and is introduced into the system as described under "Computing Drums".

b. <u>Superelevation ϕ_o</u> . The angle of superelevation above the line of sight require to compensate for the trajectory of a given type of ammunition at any given angular height and altitude was discussed under the "Elevation Fan-shaped plate". Firing table values of superelevation were plotted against angular height for given altitudes. These values were taken off the plate, and set into the gun as described.

c. <u>Vertical Pointing Corrections.</u> The vertical pointing corrections consist of the following added lead angles:

$\sigma_2 d$ - arbitrary or spot correction

$\sigma_2 d$ - correction angle due to changes of air density

$6_2 V$ - correction due to changes in muzzle velocity of projectile

$6_2 w$ - correction due to changes brought about by the range component of the wind.

$6_2 d$ - the amount of spot correction needed is determined by the location of the bursts, and is set in at the elevation sight correction knob. This knob is graduated in mils, and causes the sight to move off the target the required angle.

$6_2 d$ - the corrections due to changes in air density are probably computed at the command post from firing tables and meteorological data, and are set in at the elevation sight.

$6_2 V$ - corrections due to a change in muzzle velocity from the rated value are computed in mils at the Command Post and set in at the elevation sight.

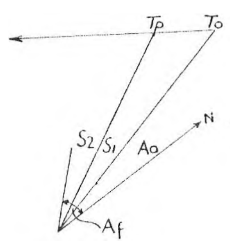
$6_2 w$ - this correction is computed from the charge (propelling) temperature and wind correction scale at the Command Post, and is set in at the elevation sight.

10. LATERAL PREDICTION:

The lateral prediction angle is made up of the following angles which are added to Ao to form Af.

S_1 Principal Lateral Deflection

S_2 Lateral Pointing Corrections



a. Principal lateral deflection (See Fig. A).

In Fig. A-1, the target moving from To to Tp causes a change in the azimuth of the gun equal to angle BAC. Fig A-IV shows the triangle formed by present horizontal range, future horizontal range, and path of the target. In Fig. A-IV, again, the lateral lead triangle:

$$\frac{\sin S_1}{\sin \alpha_o} = \frac{Sg \times \cancel{t}}{Vp \times \cancel{t}}$$

$$\sin S_1 = \frac{Sg \times \sin \alpha_o}{Vp}$$

The computation principle is the same as in the vertical deflection angle, but it is simplified due to the fact that ϵ_o does not enter into the computations. Sg is divided by Vp on the end section of the lateral deflection drum, thus establishing the ordinate of a point on the α_o curve. The lateral deflection is proportional to the amount of translation of the deflection pointer required to bring it onto the α_o curve in question.

b. Lateral Pointing Corrections.

S_1 - arbitrary, or spot, correction.

S_{2d} - correction due to drift.

S_{2w} - correction due to lateral wind component.

The mil values of the pointing corrections are computed at the Battery Command Post, and set into the azimuth telescope in the same manner as the vertical pointing corrections were set into the elevation telescope.

11. FUZE TIME.

Fuze graduations are plotted against angular elevations for given altitudes, on the fuze fan-shaped plate. These values are turned into the fuze-setter as described under the discussion of the azimuth plate.

12. PARALLAX.

There is apparently no provision made to correct for parallax between the guns and the Speed and Course Angle Calculator. The batteries are usually set up in a semi-circle, and not very far apart, with the command post in the centre; this tends to keep the error due to parallax at a minimum.

13. TRACKING SPEED.

The maximum target speed which this mechanism can track, is 223 miles per hour, or 500 metres in five seconds.

14. SUMMARY.

The following statements are opinions formed after close study of the weapon.

(i) The gun is well made. From the standpoint of manoeuvrability, it is a satisfactory weapon. The construction is light but strong, and all available space on the carriage has been utilized.

(ii) From the fire control standpoint, however, it is not an impressive weapon. There are many inherent errors in the fire control system such as:

(a) Errors due to the vocal transmission of data.

(b) Human errors in the operation of the various instruments and mechanisms, due to interpolations which cannot be made sufficiently accurately.

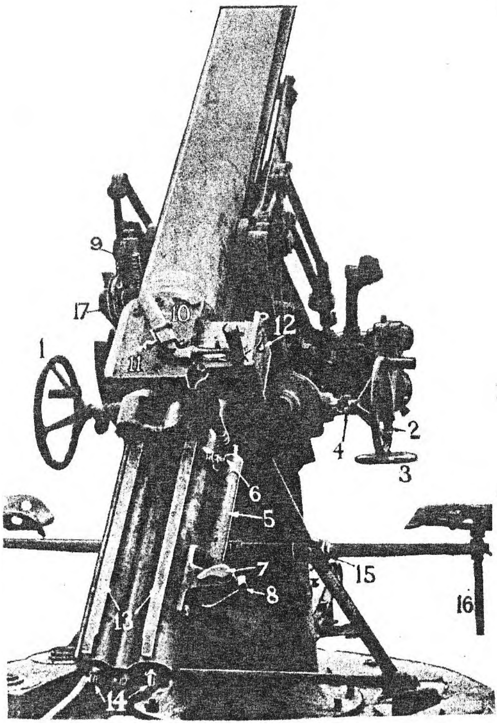


Fig. 2.

75 MM. GUN.

GUN ELEVATED - REAR VIEW

(c) Parallax error.

(d) Fuze dead time error.

(e) Error due to the variation in burning time of Powder-Train fuzes.

The above errors, coupled with the limits of range and tracking speed, make this gun an ineffective air defence weapon, when considered alone. A battery of these guns, however, could lay an effective anti-aircraft barrage. According to the testimony of the prisoner of war, this type of defence is frequently used.

ADDENDUM

TYPE 88 - 75 MM. FIELD A/A GUN

A captured enemy document recently received, entitled "SHIPPING A/A AND A/SUB DEFENCE", included "Tables of graduations for land firing distance plates" for a Type 88 7 cm. mobile A/A Gun loading a Type 90 A/A Pointed Shell.

This indicates that the 75 mm. A/A Gun described in this Summary has been adapted, with possible modifications, for ship-borne use.

(REPORT BY M.E.I.U.)

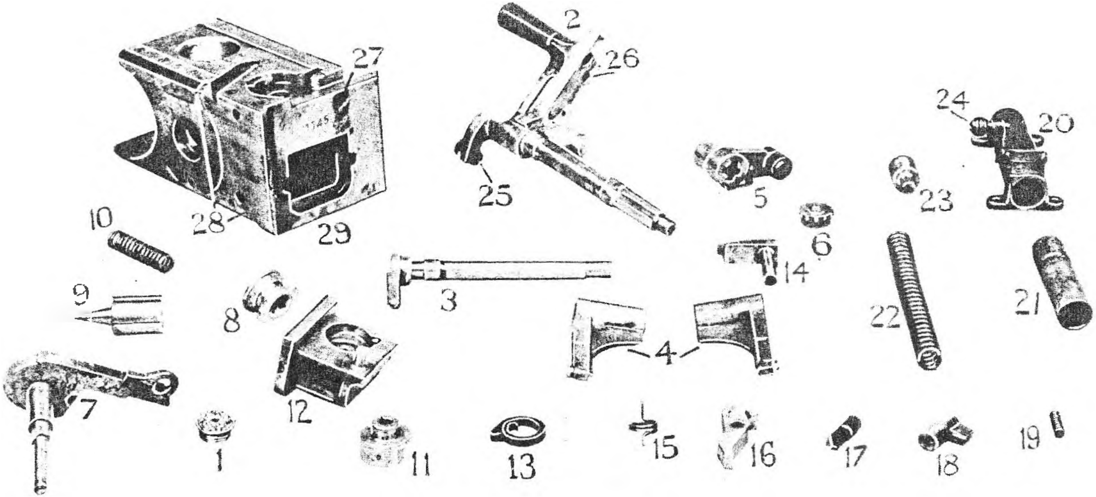


Fig. 3.

75 MM. GUN.

BREECH BLOCK DISASSEMBLED

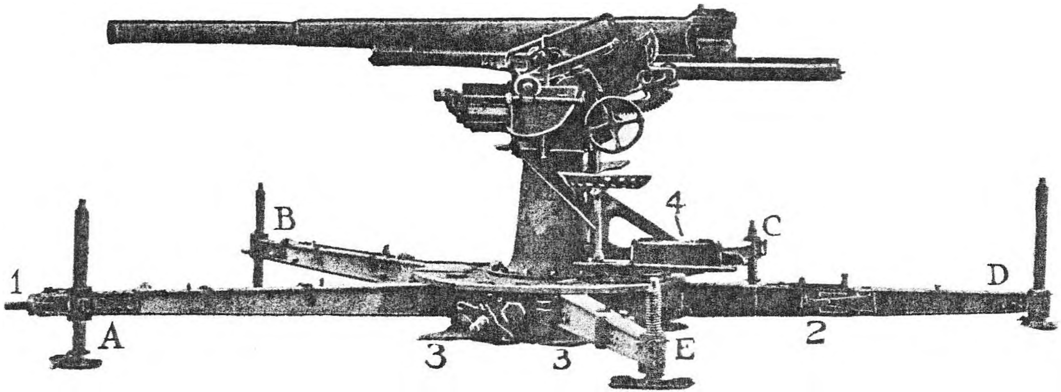


Fig. 4.

75 MM. GUN.

FIRING POSITION - ZERO ELEVATION

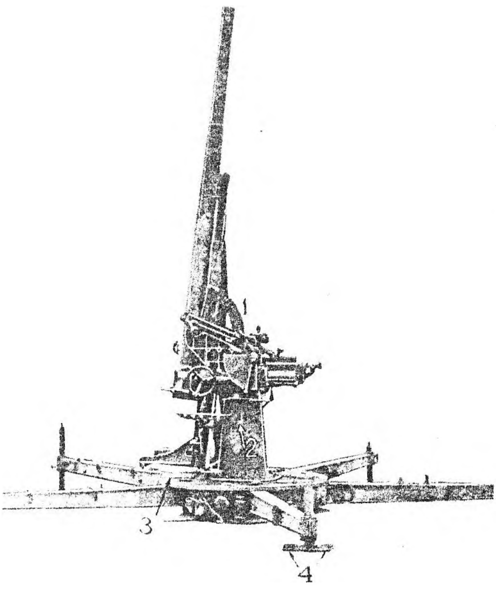


Fig. 5.

75 MM. GUN.

FIRING POSITION - 85 DEGREES ELEVATION

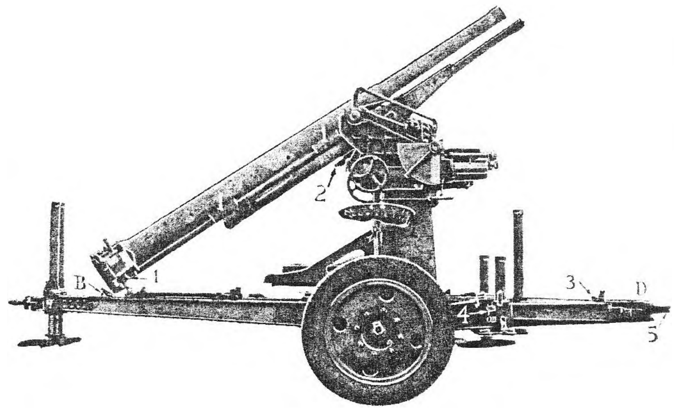


Fig. 6.

<u>75 MM. GUN.</u>

TRAVELLING POSITION.

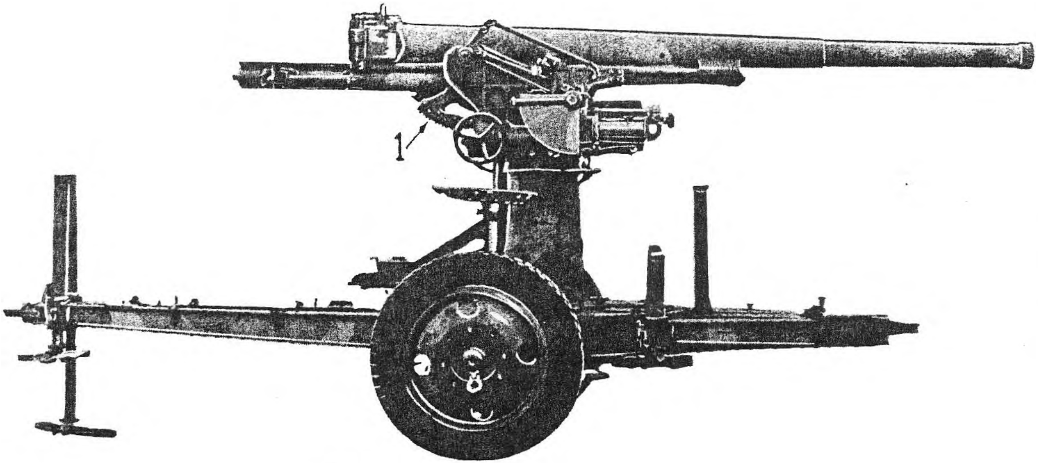


Fig. 7

75 MM. GUN. - SIDE VIEW

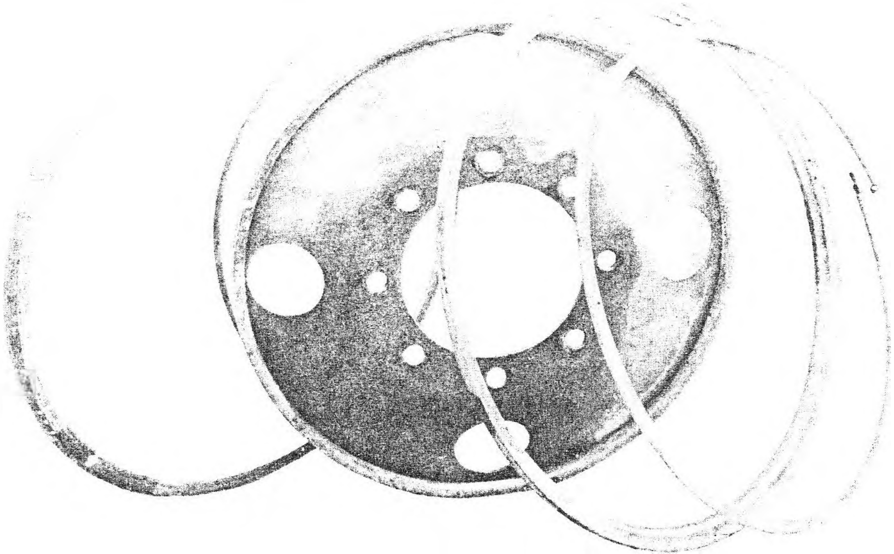


Fig. 8.

75 MM. GUN.   WHEEL ASSEMBLY

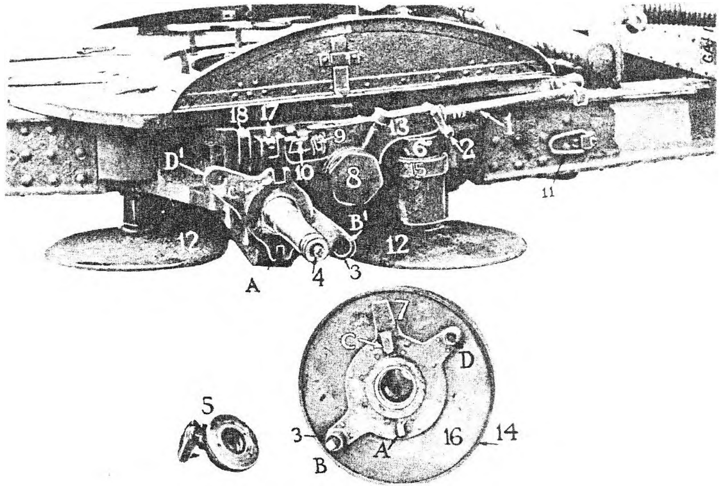


Fig. 9.

75 MM. GUN.

BRAKE AND WHEEL ASSEMBLY. SUSPENSION.

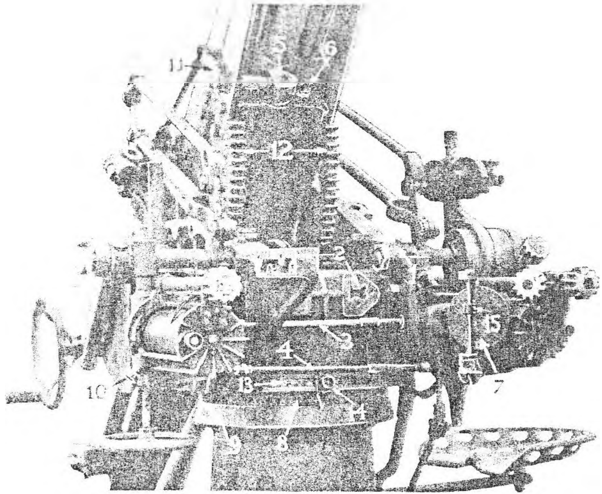


Fig. 10.

75 MM. GUN.

GUN ELEVATED - FRONT VIEW

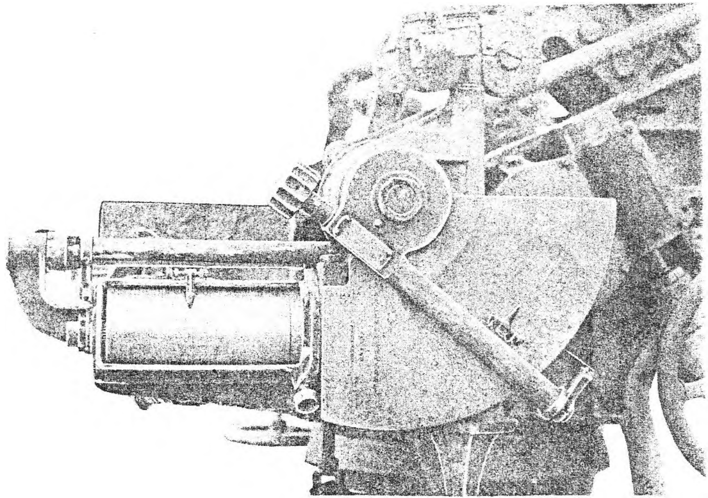


Fig. 11.

75 MM. GUN.

ELEVATING COMPUTING APPARATUS

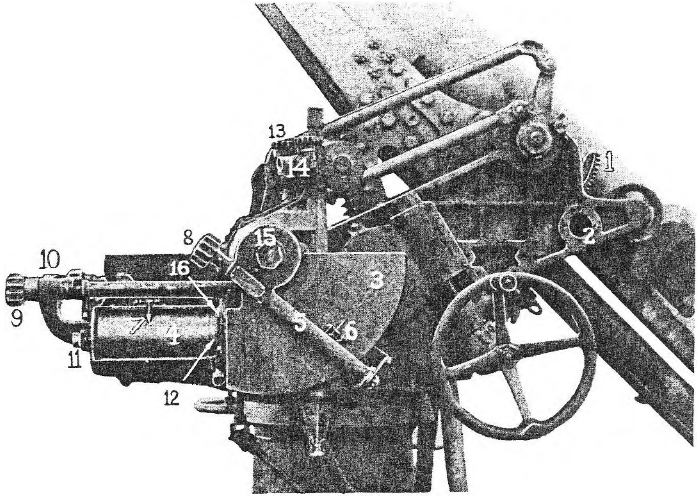


Fig. 12.

1. (Segment gear and mounting
   (surface for Electric laying
2. (apparatus.
3. El. Fan Shaped plate
4. Vertical deflection drum
5. Altitude pointer arm
6. Altitude pointer
7. Course angle pointer
8. Superelevation knob
9. Vertical deflecting knob
10. Auxiliary correction knob
11. Drum rotating knob
12. Target and projectile velocity scales in seconds.
13. Vertical pointing corr. Knob.
14. Elev. Telescope mounting
15. Differential
16. ϵ o pointer.

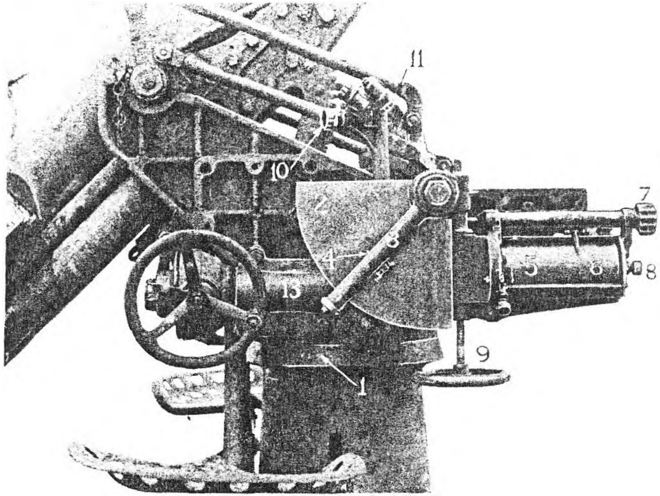


Fig. 13.

1. Movable course angle scale
2. Azimuth Fan shaped plate
3. Altitude pointer arm
4. Altitude pointer
5. Lateral deflection drum
6. Lateral deflection pointer
7. Lateral deflection knob
8. Drum rotating knob
9. Fuze setting handwheel
10. Sight elevating knob
11. Lateral pointing correction knob

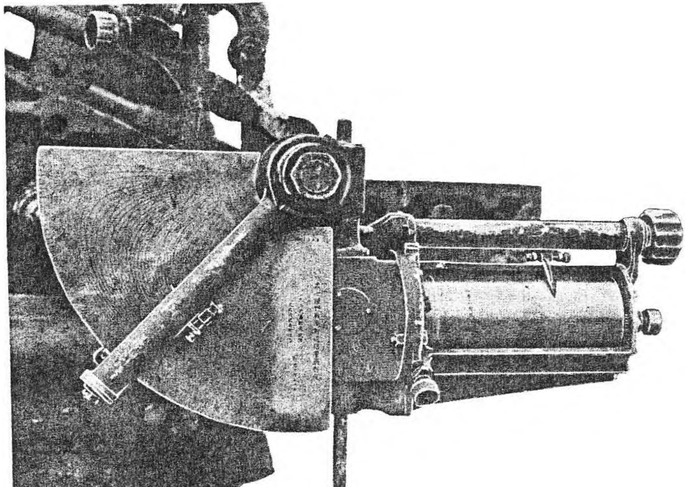


Fig. 14.

75 MM. GUN.

AZIMUTE COMPUTING APPARATUS

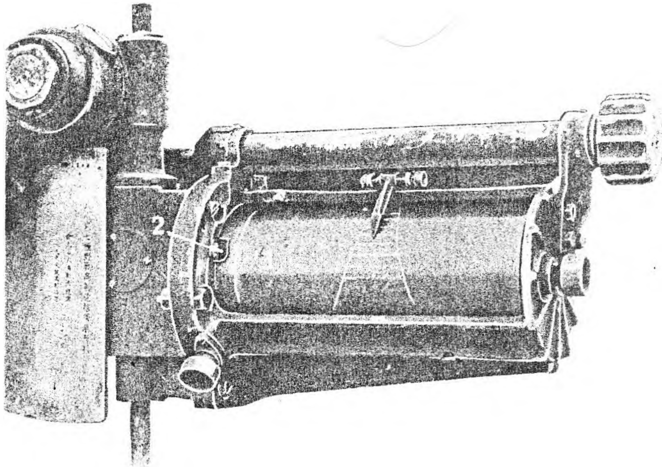


Fig. 15.

75 MM. GUN - LATERAL DEFLECTION DRUM
1. Speed Index
2. Jido Index

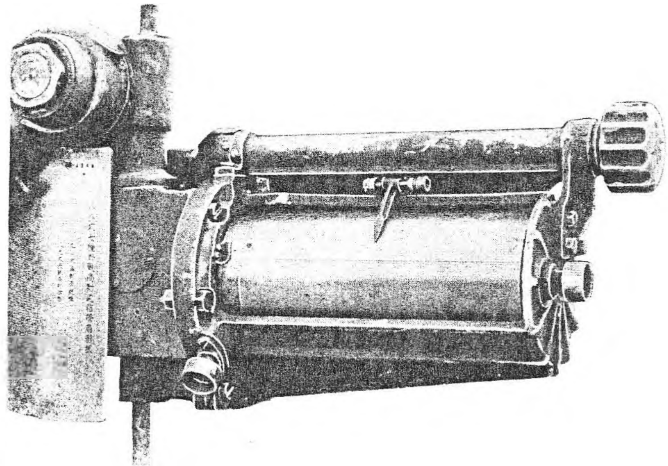


Fig. 16.

75 MM. GUN.

AZIMUTH COMPUTING APPARATUS

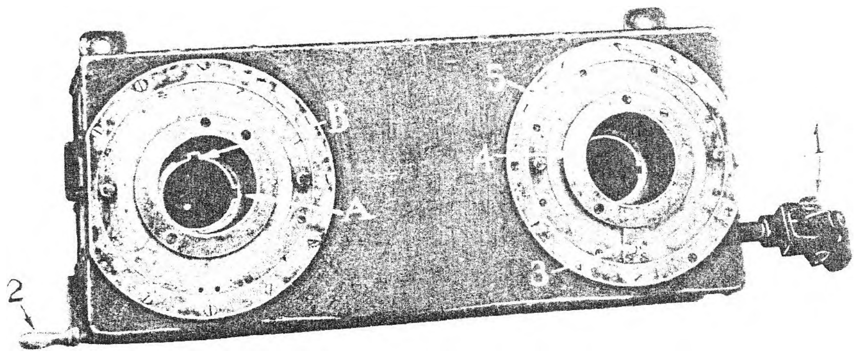


Fig. 17.
1. Coupling to handwheel shaft.
2. Powder train correction crank.
3. Setting index.
4. Setting scale.
5. Correction scale.

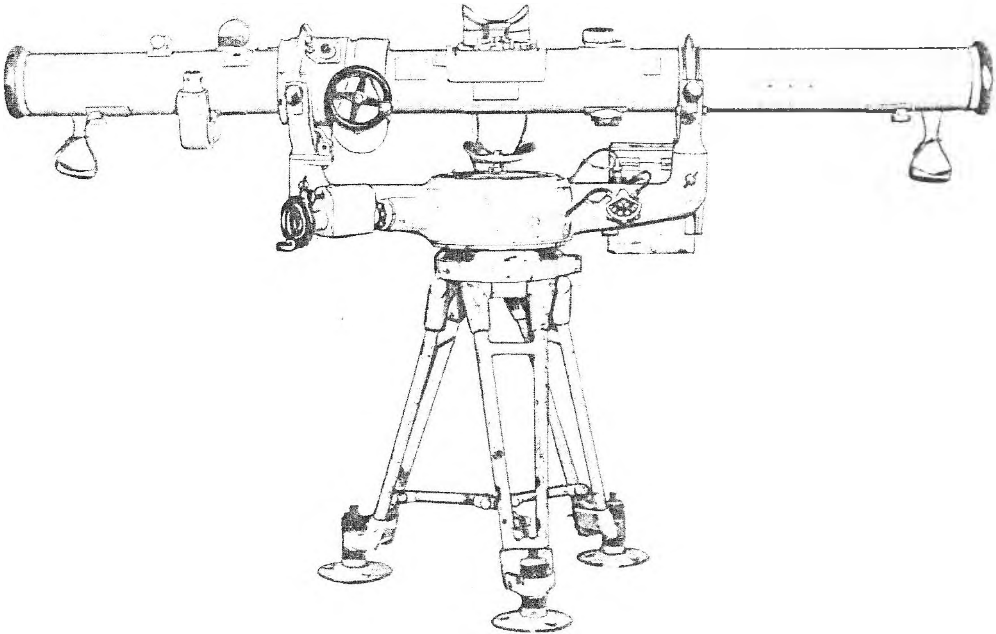


Fig. 18

HEIGHT FINDER.

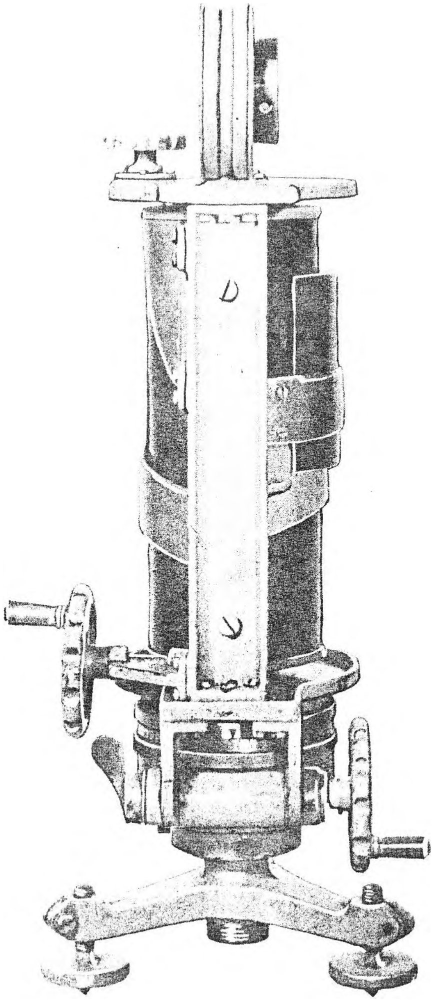


Fig. 19.

SPEED AND COURSE ANGLE INDICATOR.

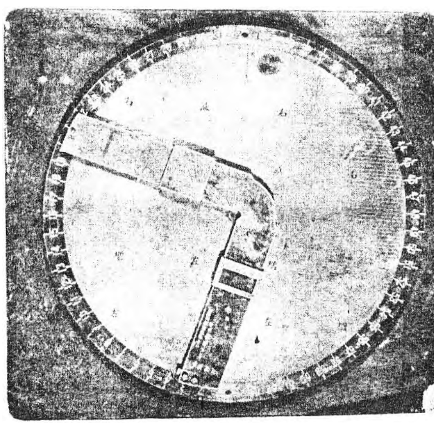


Fig. 20

CHARGE TEMPERATURE AND WIND CORR_CTION SCALE

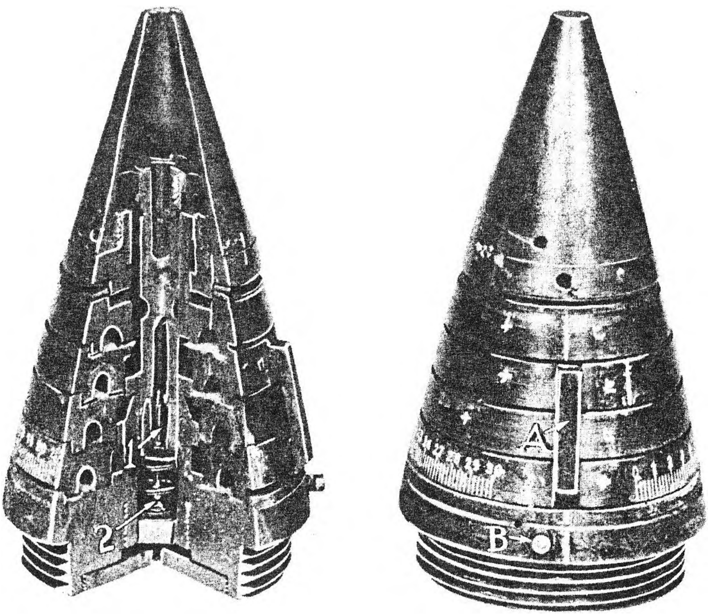


Fig. 21.

TYPE 89 30-SECOND POWDER TRAIN FUZE

FIRING TABLES

TYPE 88, 75 MM. FIELD A/A GUN.

1. GENERAL.

Following is a translation of a captured Japanese document headed - FIRING TABLES, DATED NOV 1931, FOR TYPE 88, 7 C.M FIELD A/A GUN (PRINTED PAMPHLET - SECRET No. 433) - N. of SOPUTA - 27 NOV '42.

Reproductions of the relevent trajectory observation charts appear as Appendices A, B & C to this Summary.

The document also contains further and confirmatory data concerning the weapon itself.

2. TRANSLATION.

MILITARY SECRET

Army Secret No. 433 — Pages 10, Illustrations 4

TYPE 88, 7cm FIELD A/A GUN
FIRING CHART
(Type 90 A/A Pointed Shell)

KOREA
23 - 7 - 41
73rd Butai

JU (戊) No.4 Part 1.
(T.N. The character for "JU" is one of the Zodiacal signs and could stand for 5 or E).

(Prepared by Army Dept. 2 Nov 1931.)

TYPE 88, 7cm FIELD A/A GUN

Barrel

Calibre (measured from tops of the "lands")	- 75 mm
Overall length (from muzzle to breech)	- 3.312 metres
Rifling (uniform right-hand twist, decreasing towards the muzzle)	- Angle of inclination 7°.
Weight of barrel (with the breech)	- 482 k.grm.

Gun Carriage.

Width of track (space between the tyre centres)	- 1.62 metres
Height of the axle above the ground (in firing position)	- 1.557 "
Weight of gun cradle	- 237 k.grm.
Weight of gun carriage, slide and base	- 1691 k.grm.
Vertical range of fire	- 0° - 85°
Horizontal range of fire	- 360°
Normal amount of recoil (Firing Angle 0°-50°)	- 1.4 metres - .6 metres.
Normal amount of recoil (Firing Angle 50°-85°)	- .6 metres.

Recoil and Counter-recoil Mechanism

Type of liquid	-	Anti-freezing, light fluid lubricating oil.
Amount of liquid	-	Approx 3.8 litres.
Normal initial pressure if air in air-chamber	-	95 K.grm to 100 K.grm.

Laying Gear

Smallest graduation of horizontal scale	-	10 mils($\frac{1}{640}$ of circumference)
Smallest graduation of fan-shaped scale	-	(Firing Angle 17.778 mils (1) (Elevation 100 metres
Smallest graduation of telescope support	-	Horizontal 2 mils Vertical 2 mils
Smallest graduation of clinometer	-	1.1111 mils (1/16 of degree)

Propellant

Type	Amount in K.grms			Igniting Charge (Five grain powder) in grms	Priming Charge Jodohaku in grms
	Slow	Medium	Fast		
No.3	1.425	1.390	1.350	15	3

(T.N. Jodohaku means, literally "Thrown out copper foil".)

Shell

Type	Fuse	Bursting charge in K.grms	Full weight of shell in K.grms
Type 90 A/A Pointed Shell	Type 89 Pointed A/A Fuse	Trinitrotoluene (fully filled and melted) Approx Amatol .385 (fully filled and compressed)	6.540

Weight of completely filled cartridge - Approx 8.97 K.grms

Trajectory Data.

Muzzle Velocity	-	720 metres
Normal compression	-	2750 K.grms
Increase of muzzle velocity for each 1° rise in temperature	-	.85 metres
Increase of muzzle velocity for each 1% decrease in weight of projectile	-	1.52 metres

HEIGHT 1000 metres - MUZZLE VELOCITY 720 metres. TYPE 90 A/A POINTED SHELL

		1000	2000	3000	4000	5000	6000	7000
Horizontal range (metres)		1000	2000	3000	4000	5000	6000	7000
Slant Range (metres)		1414	2236	3162	4123	5099	6083	7071
Quadrant Elevation (Reading in degrees & sixteenths of degree		45 11	27 15	20 13	17 16	16 06	16 07	17 06
Angle of Sight * (e.g., 45 11 = 45 11/16 degrees		45 00	26 09	15 07	14 01	11 05	9 07	8 02
Angular height		0 11	1 06	2 06	3 09	5 01	6 09	9 04
Deviation (in mils) :-	Above the horizontal	0.5	1.0	1.5	2.9	4.3	6.0	7.6
	Above the line of sight	0.3	0.9	1.7	2.8	4.2	5.9	7.7
Angle of inclination (Readings in degrees and minutes)		44 17	24 51	15 04	8 23	* 2 39	-3 00	-8 54
Remaining velocity (metres)		569	497	425	369	329	301	282
Time of flight (seconds)		2.2	3.7	5.7	8.2	11.0	14.2	17.7
Fuse Graduations (seconds)		4.7	7.5	11.1	15.0	19.2	23.5	27.8
50% Burst Zone (in mils) :-	Horizontal range	56	74	96	126	145	148	140
	Height	55	35	30	32	33	35	37
	Direction	1.2	2.6	4.7	8.1	13.4	21.4	32.6
50% Burst Zone (in mils) :-	Angle of sight	1.37	1.76	1.64	2.03	2.38	2.91	3.62
	Angle of direction	0.87	1.17	1.53	2.04	2.72	3.61	4.75
Height variation in metres (A) and Elevation Angle variation in mils (B)	With increase of 1/16 of degree of firing angle	A1.09	2.15	3.27	4.38	5.48	6.59	7.70
		B1.12	1.13	1.15	1.17	1.21	1.26	1.32
	With increase of 1 metre of muzzle velocity	A1.42	1.40	1.41	1.47	1.60	1.84	2.18
		B0.01	0.03	0.05	0.08	0.11	0.15	0.19
	With increase of 1 mm in density	A-0.09	-0.17	-0.27	-0.37	-0.47	-0.60	-0.75
		B 0.00	0.00	0.00	-0.01	-0.02	-0.03	-0.05
	With increase of 1 degree in atmospheric temperature	A 0.17	0.37	0.61	0.88	1.16	1.56	2.11
		B 0.01	*0.01	0.02	0.03	0.05	0.08	0.13
	With increase of 1% in weight of projectile	A-1.50	-0.80	-0.12	*0.50	1.04	1.66	2.51
		B-1.52	-0.61	-0.16	-0.08	-0.05	0.00	*0.09
	With 1 metre longitudinal (tail) wind	A 0.00	0.00	0.00	0.00	0.00	0.00	0.00
		B-0.11	-0.14	-0.18	-0.20	-0.22	-0.23	-0.23
Direction variation in mils with 1 metre cross wind :-	Above horizontal plane	0.22	0.31	0.44	0.59	0.77	0.94	1.10
	Above line of sight	0.16	0.28	0.42	0.57	0.76	0.93	1.09
Direction angle above the horizontal plane with 1 mil direction angle above the plane of sight (in mils)		1.41	1.12	1.05	1.03	1.02	1.01	1.01
Variation with 1/10th second fuse graduation :-	Horizontal range (metres)	20.76	25.21	25.05	24.10	23.30	22.86	22.65
	Height (metres)	20.25	11.68	6.74	3.58	*0.99	-1.27	-3.53
	Angular height (mils)	-0.26	-0.38	-0.49	-0.60	-0.72	-0.84	-0.97
Fuse graduation adjustment in seconds:-	Density plus 1 mm	0.0035	0.0065	0.0082	0.0110	0.0141	0.0173	0.0205
	Powder train temperature plus 1 degree	0.0012	0.0020	0.0029	0.0039	0.0050	0.0061	0.0072

HEIGHT 2000 metres - MUZZLE VELOCITY 720 metres. TYPE 90 A/A POINTED SHELL

Horizontal range (metres)	1000	2000	3000	4000	5000	6000	7000
Slant range (metres)	2236	2828	3606	4472	5385	6325	7280
Quadrant elevation (Reading in degrees and	64 02	46 06	36 05	30 06	27 03	25 11	25 07
Angle of sight *(sixteenths of degree	63 07	45 00	33 11	26 09	21 13	18 07	15 15
Angular height (e.g., 45 11 = 45 11/16 degrees	0 11	1 06	2 10	3 13	5 06	7 04	9 06
Deviation (in mils) :- Above the horizontal	0.8	1.2	1.8	2.6	4.1	5.6	7.4
Above the line of sight	0.4	0.8	1.5	2.5	3.8	5.4	7.1
Angle of inclination (reading in degrees and minutes)	62 36	42 52	29 51	20 16	12 10	* 4 47	- 2 22
Remaining velocity (metres)	491	445	393	349	316	291	272
Time of flight (Seconds)	3.8	5.0	6.9	9.2	12.0	15.1	18.7
Fuse graduations (seconds)	7.6	9.7	12.7	16.2	20.1	24.1	28.2
50% Burst Zone (in mils) :- Horizontal range	37	66	96	124	139	143	136
Height	72	65	62	62	61	58	54
Direction	1.8	3.4	5.8	9.6	15.5	24.0	36.0
50% Burst Zone (in mils) :- Angle of sight	1.26	1.77	2.03	2.28	2.65	3.21	3.83
Angle of direction	1.00	1.30	1.70	2.28	3.02	3.94	5.13
Height variation in metres (A) and Elevation Angle variation in mils (B) — With increase of 1/16 of degree of firing angle	A 1.09	2.18	3.28	4.39	5.50	6.63	7.76
	B 1.12	1.14	1.15	1.17	1.21	1.26	1:35
With increase of 1 metre of muzzle velocity	A 2.74	2.70	2.65	2.63	2.66	2.81	3.09
	B 0.01	0.03	0.06	0.09	0.12	0.16	0.20
With increase of 1 mm in density	A-0.37	-0.46	-0.61	-0.74	-0.88	-1.04	-1.24
	B 0.00	0.00	0.00	-0.01	-0.02	-0.04	-0.06
With increase of 1 degree in atmospheric temperature	A 0.66	0.93	1.30	1.73	2.20	2.75	3.43
	B 0.00	0.01	0.02	0.03	0.05	0.09	0.14
With increase of 1% in weight of projectile	A-1.59	-0.57	*0.60	1.64	2.57	3.48	4.57
	B-0.62	-0.24	-0.09	-0.06	-0.03	*0.02	0.11
With 1 metre longitudinal (tail) wind	A 0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-0.26	-0.30	-0.35	-0.39	-0.42	-0.45	-0.46
Direction variation in mils with 1 metre cross wind :- Above horizontal plane	0.06	0.50	0.58	0.71	0.85	1.00	1.15
Above line of sight	0.27	0.35	0.48	0.64	0.79	0.95	1.11
Direction angle above the horizontal plane with 1 mil direction angle above the line of sight (in mils)	2.24	1.41	1.20	1.12	1.08	1.05	1.04
Variation with 1/10th second fuse graduation :- Horizontal range (metres)	13.17	20.15	22.44	23.14	23.35	23.35	23.35
Height (metres)	25.41	18.60	12.88	8.54	5.02	*1.93	-0.96
Angular height (mils)	-0.20	-0.35	-0.49	-0.62	-0.76	-0.89	-1.03
Fuse graduation adjustments in seconds:- Density plus 1 mm	0.0056	0.0071	0.0093	0.0119	0.0146	0.0177	0.0206
Powder train temperature plus 1 deg.	0.0020	0.0025	0.0033	0.0042	0.0052	0.0063	0.0073

HEIGHT 3000 metres - MUZZLE VELOCITY 720 metres. TYPE 90 A/A POINTED SHELL

		1000	2000	3000	4000	5000	6000	7000
Horizontal range (metres)		1000	2000	3000	4000	5000	6000	7000
Slant Range (metres)		3162	3606	4243	5000	5831	6708	7616
Quadrant elevation	(Reading in degrees and	72 06	57 14	47 11	40 15	36 10	34 03	33 03
Angle of sight	x(sixteenths of degree	71 09	56 05	45 00	36 14	30 15	26 09	23 03
Angular height	(e.g., 45 11 = 45 11/16 degrees	0 13	1 09	2 11	4 01	5 11	7 10	10 00
Deviation (in mils) :-	Above the horizontal	1.5	1.7	2.3	3.1	4.3	5.7	7.4
	Above the line of sight	0.5	0.9	1.6	2.5	3.7	5.1	6.8
Angle of inclination (Reading in degrees and minutes)		70 24	53 41	40 25	29 41	20 22	11 22	2 56
Remaining velocity (metres)		416	388	354	323	298	274	257
Time of flight (seconds)		5.8	6.9	8.6	10.6	13.5	16.7	20.2
Fuse Graduations (seconds)		11.1	12.7	15.1	18.0	21.4	25.1	28.8
50% Burst Zone (in mils):-	Horizontal range	33	64	95	118	132	136	131
	Height	94	94	93	91	86	80	72
	Direction	3.6	5.3	8.2	12.6	19.3	28.8	42.0
50% Burst Zone (in mils):-	Angle of sight	1.25	1.76	2.07	2.40	2.85	3.40	4.01
	Angle of direction	1.26	1.59	2.05	2.67	3.49	4.44	5.69
Height variation in metres (A) and elevation angle variation in mils (B)	With increase of 1/16 of degree of firing angle	A 1.09	2.19	3.29	4.40	5.53	6.68	7.85
		B 1.12	1.14	1.16	1.18	1.22	1.27	1.37
	With increase of 1 metre of muzzle velocity	A 3.92	3.85	3.76	3.69	3.68	3.79	4.03
		B 0.02	0.04	0.06	0.09	0.13	0.17	0.21
	With increase of 1 mm in density	A-0.80	-0.90	-1.03	-1.16	-1.32	-1.51	-1.74
		B-0.00	0.00	0.00	-0.01	-0.02	-0.04	-0.06
	With increase of 1 degree in atmospheric temperature	A 1.53	1.84	2.25	2.78	3.38	4.09	4.91
		B 0.00	0.01	0.02	0.04	0.06	0.10	0.15
	With increase of 1% in weight of projectile	A-0.08	x0.89	2.10	3.27	4.36	5.56	6.92
		B-0.03	-0.04	-0.06	-0.05	-0.02	x0.05	0.15
	With 1 metre longitudinal (tail) wind	A 0.00	0.00	0.00	0.00	0.00	0.00	0.00
		B-0.41	-0.45	-0.50	-0.57	-0.61	-0.65	-0.66
Direction variation in mils with 1 metre cross wind :-	Above horizontal plane	1.27	0.86	0.82	0.89	0.99	1.12	1.25
	Above line of sight	0.40	0.48	0.58	0.71	0.85	1.00	1.15
Direction angle above the horizontal plane with 1 mil direction angle above the line of sight (in mils)		3.16	1.80	1.41	1.25	1.17	1.12	1.09
Variation with 1/10th second fuse graduation	Horizontal range (metres)	9.14	15.86	19.78	22.44	23.99	24.5	24.69
	Height (metres)	25.67	21.58	17.00	12.80	8.90	5.1	1.39
	Angular height (mils)	-0.18	-0.34	-0.50	-0.66	-0.82	-0.97	-1.13
Fuse graduation adjustment in seconds:-	Density plus 1 mm	0.0082	0.0095	0.0111	0.0132	0.0158	0.0185	0.0212
	Powder train temperature plus 1 deg.	0.0029	0.0033	0.0039	0.0047	0.0056	0.0065	0.0075

HEIGHT 4000 metres - MUZZLE VELOCITY 720 metres. TYPE 90 A/A POINTED SHELL

Horizontal range (metres)		1000	2000	3000	4000	5000	6000	7000
Slant Range (metres)		4123	4472	5000	5657	6403	7211	8062
Quadrant elevation (Reading in degrees and		76 15	63 06	53 03	49 07	44 15	42 02	40 10
Angle of sight *(sixteenths of degree		75 15	63 07	53 02	45 00	38 11	33 11	29 12
Angular height (e.g., 45 11 = 45 11/16 degrees		0 15	1 15	3 01	4 07	6 04	8 07	10 14
Deviation (in mils) :-	Above the horizontal	2.2	2.4	2.9	3.7	4.8	6.1	7.7
	Above the line of sight	0.6	1.1	1.8	2.6	3.7	5.1	6.7
Angle of inclination (Reading in degrees and minutes)		74 31	60 02	47 35	36 24	26 01	16 14	6 25
Remaining velocity (metres)		354	337	316	295	272	254	233
Time of flight (seconds)		8.4	9.3	10.9	13.1	15.7	18.8	22.5
Fuse Graduation (seconds)		14.4	15.7	17.7	20.1	23.0	26.2	29.4
50% Burst Zone (in mils) :-	Horizontal range	32	62	88	110	124	128	126
	Height	124	122	120	116	109	100	92
	Direction	7.1	9.1	12.5	17.8	25.5	36.3	51.5
50% Burst Zone (in mils) :-	Angle of sight	1.27	1.77	2.10	2.49	2.99	3.57	4.20
	Angle of direction	1.85	2.18	2.60	3.20	4.09	5.12	6.54
Height variation in metres (A) and Elevation Angle variation in mils (B)	With increase of 1/16 of degree of firing angle	A 1.10	2.20	3.31	4.44	5.58	6.74	7.92
		B 1.13	1.15	1.17	1.20	1.24	1.29	1.41
	With increase of 1 metre of muzzle velocity	A 4.93	4.84	4.75	4.65	4.64	4.76	5.01
		B 0.02	0.04	0.07	0.10	0.14	0.18	0.23
	With increase of 1 mm in density	A-1.33	-1.42	-1.53	-1.67	-1.83	-2.03	-2.30
		B 0.00	-0.01	-0.01	-0.02	-0.03	-0.05	-0.07
	With increase of 1 degree in atmospheric temperature	A 2.77	3.10	3.57	4.15	4.83	5.63	6.62
		B 0.01	0.02	0.03	0.05	0.08	0.12	0.18
	With increase of 1% in weight of projectile	A 2.46	3.25	4.30	5.45	6.65	8.01	9.69
		B 0.02	0.03	0.03	0.02	*0.02	0.09	0.20
	With 1 metre longitudinal (tail)wind	A 0.00	0.00	0.00	0.00	0.00	0.00	0.00
		B-0.56	-0.61	-0.67	-0.73	-0.78	-0.83	-0.85
Direction variation in mils with I metre cross wind :-	Above horizontal plane	2.28	1.37	1.17	1.15	1.20	1.29	1.41
	Above line of sight	0.55	0.61	0.70	0.81	0.94	1.07	1.22
Direction angle above the horizontal plane with 1 mil direction angle above the line of sight (in mils)		4.12	2.24	1.67	1.41	1.28	1.20	1.15
Variation with 1/10th second fuse graduation	Horizontal range (metres)	7.51	14.10	19.32	23.36	26.13	27.25	27.53
	Height (metres)	27.11	24.46	21.15	17.22	12.99	8.17	3.12
	Angular height (mils)	-0.18	-0.38	-0.57	-0.77	-0.98	-1.18	-1.38
Fuse graduation adjustment in seconds:-	Density plus 1 mm	0.0106	0.0116	0.0130	0.0142	0.0169	0.0193	0.0216
	Powder train temperature plus 1 deg.	0.0037	0.0041	0.0046	0.0052	0.0060	0.0068	0.0076

HEIGHT 5000 metres - MUZZLE VELOCITY 720 metres. TYPE 90 A/A POINTED SHELL

		1000	2000	3000	4000	5000	6000
Horizontal Range (metres)		1000	2000	3000	4000	5000	6000
Slant Range (metres)		5099	5385	5831	6403	7071	7810
Quadrant elevation	(Reading in degrees and	79 11	70 06	62 08	56 06	51 14	48 14
Angle of Sight	*(sixteenths of degree	78 11	68 03	59 01	51 05	45 00	39 13
Angular height	(e.g., 45 11 = 45 11/16 degrees	1 00	2 02	3 08	5 00	6 14	9 01
Deviation (in mils) :-	Above the horizontal	4.1	3.5	3.9	4.6	5.6	7.0
	Above the line of sight	0.8	1.3	2.0	2.9	3.9	5.3
Angle of inclination (Reading in degrees and minutes)		76 41	63 59	52 02	40 44	29 50	18 56
Remaining velocity (metres)		303	293	278	261	244	229
Time of flight (seconds)		11.3	12.3	13.8	15.9	18.5	21.7
Fuse Graduations (seconds)		17.4	18.6	20.2	22.3	24.7	27.4
50% Burst Zone (in mils) :-	Horizontal range	30	57	82	101	115	121
	Height	150	147	143	136	129	120
	Direction	13.0	15.4	19.5	25.8	35.0	48.0
50% Burst Zone (in mils) :-	Angle of sight	1.35	1.82	2.17	2.59	3.17	3.80
	Angle of direction	2.67	3.02	3.45	4.09	4.98	6.16
Height variation in metres (A) and Elevation Angle variation in mils (B)	With increase of 1/16 of degree of firing angle	A 1.11	2.22	3.35	4.49	5.65	6.83
		B 1.13	1.15	1.17	1.21	1.25	1.31
	With increase of 1 metre of muzzle velocity	A 5.75	5.68	5.59	5.54	5.56	5.70
		B 0.02	0.05	0.08	0.11	0.15	0.20
	With increase of 1 mm in density	A-1.90	-1.96	-2.06	-2.20	-2.38	-2.63
		B 0.00	-0.01	-0.01	-0.02	-0.04	-0.06
	With increase of 1 degree in atmospheric temperature	A 4.35	4.66	5.12	5.74	6.50	7.45
		B 0.01	0.02	0.04	0.07	0.10	0.16
	With increase of 1% in weight of projectile	A 5.41	6.08	6.99	8.10	9.41	11.01
		B-0.01	-0.01	-0.01	*0.02	0.07	0.14
	With 1 metre longitudinal (tail) wind	A 0.00	0.00	0.00	0.00	0.00	0.00
		B-0.72	-0.77	-0.83	-0.89	-0.95	-1.00
Direction variation in mils with 1 metre cross wind :-	Above horizontal plane	3.60	2.03	1.62	1.49	1.48	1.53
	Above line of sight	0.71	0.75	0.83	0.93	1.05	1.18
Direction angle above the horizontal plane with 1 mil direction angle above the line of sight (in mils)		5.10	2.39	1.94	1.60	1.41	1.30
Variation with 1/10th second fuse graduation	Horizontal range (metres)	7.31	14.20	20.00	24.88	28.91	31.32
	Height (metres)	31.10	28.90	25.63	21.43	16.43	10.77
	Angular height (mils)	-0.21	-0.47	-0.72	-0.98	-1.24	1.51
Fuse graduation adjustment in seconds:-	Density plus 1 mm	0.0128	0.0137	0.0149	0.0164	0.0182	0.0202
	Powder train temperature plus 1 deg.	0.0045	0.0048	0.0053	0.0058	0.0064	0.0071

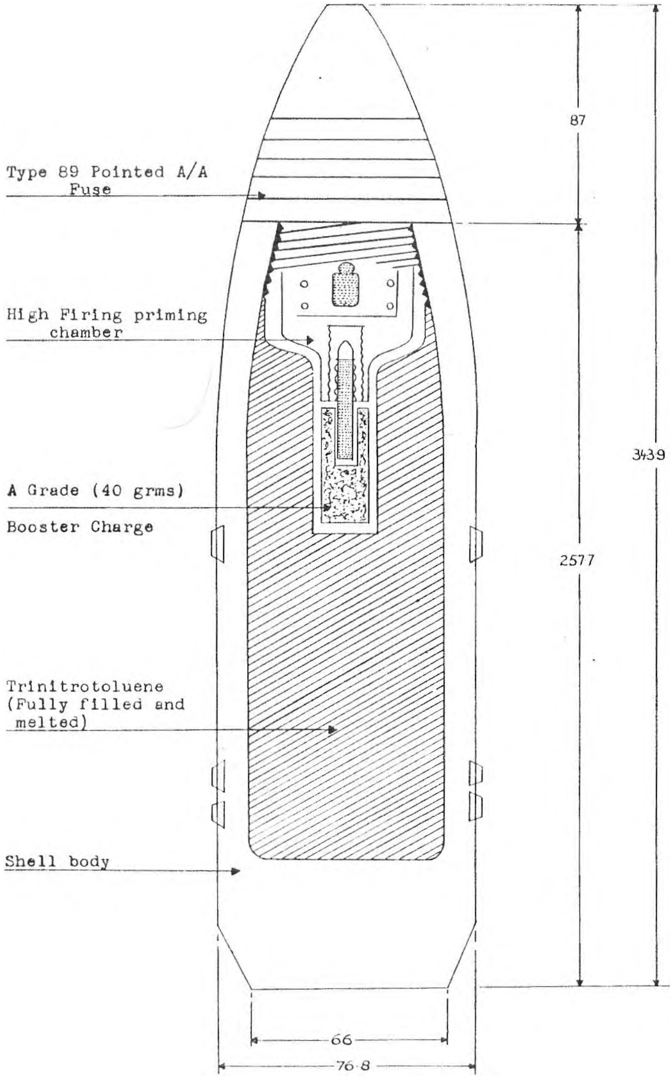
HEIGHT 6000 metres - MUZZLE VELOCITY 720 metres - TYPE 90 A/A POINTED SHELL

			1000	2000	3000	4000	5000	6000
Horizontal Range (metres)			1000	2000	3000	4000	5000	6000
Slant Range (metres)			6083	6325	6706	7211	7810	8485
Quadrant elevation (Reading in degrees and			81 11	74 01	67 06	62 00	57 15	55 05
Angle of sight , *(sixteenths of degree			80 09	71 09	63 07	56 05	50 03	45 00
Angular height (e.g., 45 11 = 45 11/16 degrees			1 03	2 08	3 15	5 11	7 11	10 03
Deviation (in mils) :-	Above the horizontal		6.3	5.1	5.2	5.9	6.8	8.2
	Above the line of sight		1.0	1.6	2.3	3.2	4.3	5.8
Angle of inclination (Reading in degrees and minutes)			77 53	65 54	54 17	42 43	30 42	18 17
Remaining velocity (metres)			257	250	238	225	211	196
Time of flight (seconds)			14.9	15.8	17.3	19.4	22.1	25.5
Fuse graduations (seconds)			20.2	21.1	22.5	24.4	26.5	28.7
50% Burst Zone (in mils) :-	Horizontal range		28	54	76	93	106	113
	Height		171	168	163	156	148	140
	Direction		22.4	25.2	30.3	38.3	49.8	66.2
50% Burst Zone (in mils) :-	Angle of sight		1.47	1.90	2.31	2.80	3.42	4.20
	Angle of direction		3.91	4.25	4.74	5.45	6.50	8.00
Height variation in metres (A) and Elevation Angle variation in mils (B)	With increase of 1/16 degree of firing angle	A	1.12	2.25	3.39	4.54	5.72	6.92
		B	1.14	1.16	1.18	1.22	1.27	1.34
	With increase of 1 metre of muzzle velocity	A	6.49	6.45	6.42	6.42	6.51	6.72
		B	0.03	0.06	0.09	0.13	0.17	0.22
	With increase of 1 mm in density	A	-2.49	-2.56	-2.67	-2.82	-3.04	-3.34
		B	-0.01	-0.01	-0.02	-0.03	-0.05	-0.07
	With increase of 1 degree in atmospheric temperature	A	6.25	5.53	7.00	7.87	8.55	9.67
		B	0.02	0.04	0.06	0.09	0.14	0.20
	With increase of 1% in weight of projectile	A	8.77	9.35	10.23	11.41	12.90	14.85
		B	-0.01	*0.01	0.02	0.06	0.12	0.22
	With 1 metre longitudinal (tail) wind	A	0.00	0.00	0.00	0.00	0.00	0.00
		B	-0.89	-0.93	-0.99	-1.05	-1.12	-1.17
Direction variation in mils with 1 metre cross wind :-	Above horizontal plane		5.29	2.88	2.18	1.93	1.84	1.86
	Above line of sight		0.87	0.91	0.97	1.07	1.18	1.32
Direction angle above the horizontal plane with 1 mil direction angle above the line of sight (in mils)			6.08	3.16	2.24	1.80	1.56	1.41
Variation with 1/10th second fuse graduation	Horizontal range (metres)		7.40	14.50	20.50	26.30	31.34	34.87
	Height (metres)		34.47	32.41	28.94	24.28	18.61	11.80
	Angular Height (mils)		-0.26	-0.57	-0.88	-1.21	-1.56	-1.91
Fuse graduation adjustment in seconds:-	Density plus 1 mm		0.0149	0.0155	0.0166	0.0180	0.0195	0.0211
	Powder train temperature plus 1 deg.		0.0053	0.0055	0.0059	0.0063	0.0069	0.0075

HEIGHT 7000 metres - MUZZLE VELOCITY 720 metres. TYPE 90 A/A POINTED SHELL

Horizontal Range (metres)		1000	2000	3000	4000	5000
Slant Range (metres)		7071	7280	7616	8062	8602
Quadrant elevation (Reading in degrees and		83 04	77 00	71 06	66 13	63 06
Angle of sight *(sixteenths of degree		81 14	74 01	66 13	60 04	54 07
Angular Height (e.g., 45 11 = 45 11/16 degrees		1 06	2 15	4 09	6 09	8 15
Deviation (in mils) :- Above the horizontal		9.7	7.2	7.0	7.6	8.6
Above the line of sight		1.4	2.0	2.8	3.8	5.0
Angle of inclination (Reading in degrees and minutes)		78 14	66 23	54 14	41 26	27 04
Remaining velocity (metres)		209	203	193	182	170
Time of flight (seconds)		19.1	20.1	21.6	23.9	27.0
Fuse graduation (seconds)		22.5	23.6	24.9	26.6	28.4
50% Burst Zone (in mils) :- Horizontal range		26	49	69	85	96
Height		191	187	181	173	166
Direction		36.9	40.7	47.4	57.9	73.9
50% Burst Zone (in mils) :- Angle of sight		1.64	2.04	2.53	3.11	3.81
Angle of direction		5.33	5.69	6.30	7.40	8.89
Height variation in metres (A) and Elevation Angle variation in mils (B)	With increase of 1/16 degree of firing angle	A 1.13	2.28	3.44	4.61	5.81
		B 1.14	1.17	1.20	1.24	1.30
	With increase of 1 metre of muzzle velocity	A 7.26	7.27	7.30	7.38	7.58
		B 0.03	0.07	0.10	0.14	0.19
	With increase of 1 mm in density	A-3.17	-3.25	-3.38	-3.59	-3.90
		B-0.01	-0.02	-0.03	-0.05	-0.07
	With increase of 1 degree in atmospheric temperature	A 8.46	8.76	9.36	10.09	11.20
		B 0.03	0.05	0.09	0.13	0.19
	With increase of 1% in weight of projectile	A12.73	13.33	14.32	15.73	17.64
		B 0.01	0.03	0.07	0.12	0.20
	With 1 metre longitudinal (tail)wind	A 0.00	0.00	0.00	0.00	0.00
		B-1.07	-1.11	-1.17	-1.23	-1.31
Direction variation in mils with 1 metre cross wind :-	Above horizontal plane	7.39	3.95	2.92	2.51	2.35
	Above line of sight	1.05	1.09	1.15	1.25	1.37
Direction angle above the horizontal plane with 1 mil direction angle above the line of sight (in mils)		7.07	3.64	2.54	2.02	1.72
Variation with 1/10th second fuse graduation	Horizontal range (metres)	7.35	14.50	20.85	26.80	32.03
	Height (metres)	35.29	33.16	29.60	24.75	18.87
	Angular height (mils)	-0.33	-0.67	-1.02	-1.39	-1.79
Fuse graduation adjustment in seconds:-	Density plus 1 mm	0.0168	0.0174	0.0183	0.0196	0.0209
	Powder train temperature plus 1 deg.	0.0059	0.0061	0.0065	0.0069	0.0074

Type 88, 7 Centimetre Field A/A Gun Charge
(Type 90, A/A Pointed Shell)



JAPANESE TWO METRE RANGE-HEIGHT FINDER.

1. GENERAL.

The Japanese range-height finder is a two metre base stereoscopic instrument for measuring ranges and altitudes and is equipped with traversing cradle (35) and tripod (36) as shown in the accompanying photographs and nomenclature list. The instrument is used in connection with the 75 mm field A/A gun described in this summary.

It may be used either as a range finder or height finder. When used as a range finder, the range-height lever, (Fig 2-7) is moved toward the observer, the height locking button (Fig 1-23) is pulled out and the height compensator knob (Fig 1-24) is moved one turn in a clockwise direction to the range position. The readings on the scale will then be ranges. When used as a height finder the range-height lever (Fig 2-7) is moved away from the observer to the altitude position, the height compensator knob (Fig 1-24) is rotated one turn in a counter-clockwise direction to the altitude position and is locked in that position by pushing in the height locking button. When measuring altitude, two systems of two oppositely rotating wedges each, are rotated by the elevating mechanism of the instrument, introducing to the range scale a factor propertional to the sine of the angular height and thus the range scale indicates altitudes.

2. BODY.

The main structural elements of the range-height finder are two concentric tubes; namely, a double walled body tube and an optical tube or bar. The purpose of the double walled body is to prevent sudden changes in temperature from affecting the accuracy of the instrument. This body tube consists of an inner and outer tube of such diameters that there is a space between them. This space, sealed at the ends, forms an air chamber, which acts as a heat insulator. The entire instrument is also hermetically sealed and filled with a dry gas, thus preventing the optical parts from becoming fogged due to condensation resulting from temperature changes.

The outer tube constitutes the base of, and serves as a cover or housing for, the instrument proper. It is constructed of sheet steel with aluminium alloy metal frames at openings and a heavy thimble of the same metal to which is attached the elevating mechanism. The tube is covered with a layer of heat resisting material covered with canvas, to retard temperature changes in the instrument.

The body is equipped with two gas ports (Fig 2-3) for filling the interior with a gas. The body (Fig 1-18) is supported by the cradle (Fig 1-35) through two body saddles (Fig 2-15) and rotates on a single ball bearing surface enclosed within the elevating gear mechanism housing (Fig 2-40). The elevating handwheel (Fig 1-25) rotates the body in elevation and the elevation is recorded on the elevation scale (Fig 2-8) which is calibrated to read from 0 to 88 degrees. The body is oriented in a horizontal position by means of the body levelling screws (Fig 1-30) and the height finder level (Fig 2-9) as a guide. The end windows (Fig 2-1) are slightly prismatic or wedge shaped thereby providing a means of adjustment. These windows are equipped with sun shades and also have covers to protect the windows when the instrument is not in use.

The eyepiece unit consists of two rhomboid prisms, the ray filter glasses and the eyepiece lenses (Fig 1-26) which are equipped with diopter adjustments (Fig. 1-29). The rhomboid prisms are mounted so that, with the eyepiece lenses, they can rotate about the fixed centres of the central prisms by moving the interpupillary lever (Fig 1 - 27) and thus adjusting the interpupillary distances to the individual observer, the range limits being 56 to 74 mm. The ray filter system (Fig 1-28) allows the selection of five filters for the eyepiece lenses as follows: greenish yellow, amber, clear, light blue and dark bluish green. A rubber headrest (Fig 2-39) is provided for comfort and assistance to the observer while operating the instrument.

The body is equipped with two open sights (Fig 1-5) and (Fig 1-10) mounted at one end of the body and near the eyepiece assembly respectively. The body is also equipped with a tracking scope (Fig 2-17).

An internal adjuster knob (Fig 1-6) is mounted at the left end of the body and is connected internally with a rotating wedge with an extremely small correction within the plane of triangulation. Movement of this knob operates a scale (Fig 1-22) which is graduated in black from 50 to 0 and in red from 0 to 50. The total movement of the knob is ten and one half turns. This adjustment shifts the left image horizontally with a total movement approximating the distance between two adjacent reticle marks.

The range adjusting knob (Figs 1 and 2-12) with a movement of eight and one half turns, shifts the system of two wedges horizontally in the body without changing their adjustment and also moves the range measuring scale (Fig 2-14) to read the proper range. This scale is graduated in units which are probably metres from 400 to 20000. The scale also has an infinity mark and graduations from plus 10 seconds to minus 10 seconds with the infinity mark in the centre, for the purpose of obtaining corrections to apply to the range. The instrument is equipped with a two metre sighting bar (Fig 2-20) to enable calibration at short ranges.
The height adjuster knob (Fig 2-13) with a total movement of fourteen turns operates a glass plate which bends the light from the left objective lens vertically, thereby obtaining vertical coincidence of the two images for stereoscopic vision.

The instrument is equipped with two change of power knobs (Fig 2-4), one at each end of the body. The magnification of the instrument is 20 and turning the right knob counter clockwise and the left knob clockwise one quarter of a turn reduces the magnification of the instrument by removing an internal lense at each end of the tube from the system.

The instrument has a field of view of 20° 15'. The body bears a nameplate with the trade mark NIKKO of the Japanese Optical Company, Tokyo, Japan.

3. <u>CRADLE</u>.

The base of the cradle is fitted and locked with the tripod locking wheel (Fig 2-21) to a removal tripod (Fig 1-36) with adjustable feet (Fig 1-37) facilitating the levelling of the instrument. The outer frame section of the cradle rotates about the central section of a self aligning double row NSK ball bearing. The frame section is supported by a single row of ball bearings. Rotating the azimuth engaging handwheel (Fig 1-33) in a clockwise direction locks the cradle frame to the traversing gear and the instrument can be adjusted in azimuth by operating the azimuth handwheel (Fig 1-31) and the azimuth gear change button (Fig 1-32) which has two speed positions and a neutral position geared in traversing or azimuth gear mechanism box (Fig 1-38). When the azimuth engaging handwheel is in an elevated position the cradle is in a slewing position and can be rotated freely. The azimuth scale (Fig 2-16) is graduated from zero to six hundred and forty, with each mark being equivalent to ten mils and can be rotated completely in either direction allowing orientation. The rotation of the frame of the cradle with reference to the azimuth scale indicates the azimuth of the instrument when properly oriented.

The cradle is equipped with a battery box (Fig 2-19) to supply electrical power for the reticle lights (Fig 2-11) and for any additional lighting needed in night observations. An electrical switch box (Fig 1-34) is attached to the cradle to allow regulation of the power supply to the lighting system.

4. OPTICAL SYSTEM.

A complete diagram and description of the optical system employed in the range height finder is as follows:-

(a) End Window: The end windows are slightly wedged having minimum and maximum thicknesses of .2370" and .2378" x 46mm in diameter and having an effective diameter of field of view of 42mm. The wedge contains plane surfaces on either side, and is ground from a single piece of glass. It is sealed within its mount with a translucent material having a green tint, and which has become hard and brittle. The wedge fits snugly within the mount which slides very snugly into the frame and is sealed with a rubber washer. It is held in place by three small rivets. Screw retainer washers hold the wedge tightly in place.

(b) Penta Prism: The penta prism is 42 mm thick with the side surfaces frosted. One frosted surface bears a P scratched about 5 mm. below the 90° corner. The other side bears the same letter in the same place and in addition has s450 scratched and pencil marking P-0 on its face. The light faces are constructed at 90° to each other and are 42 mm square. The silvered sides are symmetrical and are 42 mm wide and 45 mm long. The bottom is also silvered and is 42 mm wide x 25 mm long. The following markings were painted on the bottom (lb. 12.4. K.S.). The silvered portion was covered with a black paint.

(c) Change of Power Lens: The change of power lens is .243" thick x 43 mm in diameter with a field of view of 40 mm. This lens is made from one piece of glass and has a general appearance of flat faces. However, micrometric measurements show it to be approximately .0004" convex.

(d) Objective lenses:

(i) This objective lens is .242" thick x 44 mm in diameter with a field of view of 40 mm. It is a convex concave lens with convex side toward the penta prism. The radius of curvature of the convex surface is approximately 25 cm. and that of the concave side is approximately 15 cm. The thickness of this lens about the outside surface is .2450" and the thickness at the centre is .2115". This lens is made from a single piece of glass.

(ii) The second objective lens is separated from the other lens by a step spacer .157" in thickness. The second double convex lens is 44 mm in diameter with a 40mm field of view, and the centre thickness is .2825" with an outside thickness of .2040". The approximate radius of curvature of the convex surfaces are 18 cm and 12 cm respectively. This lens is made from a single piece of glass.

The above two objective lenses are held in a permanent fixture by threaded retainer rings with split bushing rings for cushions. The permanent fixture has a 10.5 mm maximum adjustment. Both above lenses had numerals 2875 scratched in their edges and also had directional arrows marked in pencil on the edges. Lens (1) also had CX marked in pencil on its edge and lens (2) had PX marked in pencil on its edge.

(e) Height adjustment Wedge: This wedge has an outside diameter of 23 mm and a diameter of field of view of 21 mm. It is made from a single piece of glass and has a minimum thickness of .1205" and a maximum thickness of .1350" at extreme positions. It is curved along a line normal to the wedge axis, the radius of curvature being about 10 cm. This wedge is fixed in a frame in the body which may be moved back and forth through the line of sight.

(f) Reticle: The reticle is a window .1935" in thickness and 19mm in diameter, with a field of view of 16 mm. The reticle marks are cut on one face and in line with the centre of the window. The reticle is constructed from a single piece of glass and is held in place against the window by a 360° washer spring.

(g) Window: The window is constructed with a square base 21 mm wide and a semicircular top, the total height being 32 mm. Its thickness is .2635", the thickness edge being completely silvered, except at its base which is polished and butts up against the artificial light prism which in turn is backed up by the artificial light bulbs. The window is constructed from a single glass crystal.

(h) Artificial Light Prism: This prism is rectangular in shape, 9 mm thick x 20 mm wide x 23 mm long. Its polished ends are open at the 9 mm x 20 mm ends, the remainder of the sides being completely silvered. A light bulb operating on 4 volts furnishes the artificial light for the reticle of night operation. The artificial light is diffused by passing through the artificial light prism and the window to the reticle.

(j) Measuring Wedges: The measuring wedges are actuated synonymously and calibrated with the range indicator. The wedges are set in a housing which is moved to its position on a lead screw. The wedges are held together in a frame and rotation of the wedges is effected by a differential. The main pinion driving the differential is driven by a keyed shaft and slides along this keyed shaft. The wedge frames are rotated on ball bearings, two sets each. No. 1 wedge is 33 mm outside diameter with a

32 mm diameter field of view. Its maximum thickness is .1290" — the minimum being .1180". It is held in a frame by screwed washers and has a notch for a definite setting. It is constructed from a single piece of glass. The edge bears the following markings FVD579. Wedge (2) has an outside diameter of 33 mm with a field of view diameter of 32 mm and having maximum and minimum thicknesses of .1270" and .1140". It is constructed from a single piece of glass and contains a location notch at the minimum thickness end of the wedge. It contains scratches FVP6 4 and a very light pencil marking 055 on the edge. This wedge is retained in its frame by means of screwed retainer rings.

(k) Range Height Wedge: Wedge (1) has an outside diameter of 44 mm and a field of view diameter of 42 mm. The extreme measurements of the wedge are .2380" and .2390". It is ground from a single piece of glass.

Wedge (2) has an outside diameter of 44 mm and a field of view diameter of 42 mm. The extreme measurements of the wedge are .2383" and .2397". It is ground from a single glass crystal.

The above wedges fit snugly into frames and are retained by screw washers. A set of two are used in this assembly. They are locked into a permanent frame which in turn is bolted to the main housing. Movement of the wedges is accomplished by a differential set of gearing.

(l) Sealing Lens: While this lens was not available for inspection it is believed to be a window only.

(m) Erecting Lens: This lens has concave convex surfaces and is constructed in 2 parts, i.e., from two pieces of glass glued together. It has an outside diameter of 10 mm with a field of view diameter of 8 mm. The rim thickness being .1680" and the centre thickness .1834". The radius of curvature of the convex face being approximately 12 mm and the concave face being about 20 mm. The lens is retained in its housing by a screwed retainer. This erecting lens also acts as a sealing lens of the rhomboid prism and prevents dust from accumlating on its surface.

(n) Ray Filters: Ten filters are contained in a single disc which, when set at any stop (or detent) causes like filters to fall within the respective field of view. There are five sets of filters namely greenish yellow, amber, clear, light blue and dark blueish green.

(o) Rhomboid prism: This prism is constructed in the shape of a parallelogram with the sides mirrored and at 45° with the line of view and the clear faces being normal to the line of view. The faces of the prism are comparatively large, thus permitting correct field of view regardless of the operators interpupillary distance. The prism is mounted in a frame which is fixed by means of pins to the body frame.

(p) Field Lens: The field lens and eye lens are held in the eye piece by means of screwed locking rings. The eye piece may be adjusted both to interpupillary distance which is calibrated from 56 mm to 74 mm and to correction for the eyes (this is graduated from plus 5 diopters to minus 5 diopters).

5. CARRYING CASES. (Figs 3 and 4)

(a) Range-Height Finder Body Carrying Case: The carrying case for the two metre Japanese height-finder is designed to permit transportation without materially affecting its condition, accuracy and to facilitate its set-up.

PARTS NOMENCLATURE.

Fig.3. (1) Floating sleeve clamp holders. Leather padded aluminium.
" (2) Leather cushions for instrument ends.
" (3) Holder for 2 metre sighting bar.
" (4) Box for tools, wiring etc.

This case is constructed of 16 gauge sheet metal with the edges reinforced with steel strips. To add further to the rigidity of the case, it is reinforced in three places with channel iron. The size of the case is 92" long x 15" wide by 16" high. The sleeve clamp holders (1), which cradle the height finder proper, have leather pads to protect the surface of the instrument. Their location relative to the case proper is maintained entirely by four sets of springs, and may be termed as floating. Jars in any direction will be absorbed by these spring cushions thereby protecting the range-height finder body as shown in the attached photograph. Leather cushions (2) are attached to the ends of the case for use as buffers and to protect the leather pads on the ends of the height finder. Item (3) shows holders for the two metre sighting bar. The flat wooden box (4) located in the bottom of the case is used to house wiring connection and miscellaneous tools used in making field repairs and adjustments. Other wooden receptacles not shown in the attached photograph provide recess facilities for eye piece covers, sunshades, tracking telescope covers, eye guards and the view finder. All of the receptacles including the holder for the two metre sighting bar are lined with a green felt. Leather straps which retain objects in receptacles have four $\frac{1}{8}$" x $\frac{7}{8}$" springs built in for flexible attachment.

The cover is supported on four hinges and its opening is limited by attached chains. It may be locked by two hasps. There are eight handles securely attached to the case indicating that eight men are used in carrying or handling this height-finder case. The weight of the empty case is 262 lbs. It is finished in gray paint.

(b) Cradle Carrying Case: The cradle carrying case is used for transporting the cradle and its accessories.

PARTS NOMENCLATURE

Fig 4 (1) Traversing handwheel and gear-box holder (wood felt lined).
" (2) Sleeve clamp holders (brass).
" (3) Rest for main traversing assembly (wood felt covered).
" (4) Split ring saddles (Cast aluminium leather pads).

Use and Construction:

The overall dimensions are 19" wide, 46" long x 18" deep. It is constructed of 16 gauge sheet metal reinforced at the edges and in three places within the case with channel iron. The traversing handwheel and gear-box holder (1) is constructed of wood and lined with felt. It has a locking strap attached which is made flexible by a section of four $\frac{1}{8}$" dia. x $\frac{7}{8}$" long springs built into it. There are two sleeve clamp holders (2) constructed of brass and used to carry the sleeve clamps. The traversing mechanism assembly rests on a hardwood pad (3) which is felt covered, the arms of which rest in the cast aluminium-alloy leather padded split ring saddles. Provisions are made to strap down the battery box without removal. The cover has three hinges, and its opening is limited by attached chains. It is locked with two hasps. Four handles are securely attached to the case, and it is believed four men are required to handle this article. The weight of the empty case is 127 lbs and it is finished with gray paint.

The following is the interpretation of Japanese figures on card on under side of cover (See Fig 4).

TABLE OF CONTENTS OF BOX

Number	Item
1	Supporting Carriage
1	Speed Change Device
2	Supporting Ring
2	Lifting Spanner
2	Spare Elec. Bulbs 1 For use with Scope 1 For use with Firing Panel.

6. SUMMARY.

An examination of the instrument indicates care in design and construction. Stainless materials, aluminium alloys and brass have been used freely and all parts made of ordinary steel have been coated with black enamel to eliminate possibilities of corrosion. All adjustable wedges, lenses, scales etc. are mounted in ball bearings. The machine work indicates that a very close tolerance was maintained. The wedges, windows, lenses and prisms appear to be exceptionally well constructed and without flaw, (i.e from a normal inspection). Piece markings (i.e. letters and numerals) are Arabic or Roman characters. As is customary most items have received a serial number which is common on all.

7. RANGE-HEIGHT FINDER NOMENCLATURE
(See Figs 1 & 2)

Fig 2 - 1. End windows and sun shades
" - 2. End window covers
" - 3. Gas ports
" - 4. Change of power knobs ($\frac{1}{4}$ turn)
" - 5. Open sight
" - 6. Internal adjustment knob ($10\frac{1}{2}$ turns)
" - 7. Range-height lever
" - 8. Elevation scale in degrees (graduated 0 to 88)
" - 9. Height finder level
" -10. Open sight

Fig 2 - 11. Reticle lights
" " - 12. Range adjusting and aligning knob (8½ turns)
" " - 13. Height adjuster correction knob (14 turns)
" " - 14. Range scale window
" " - 15. Body saddles
" " - 16. Azimuth scale (640 graduations in mils)
" " - 17. Tracking scope
" 1 - 18. Body
" 2 - 19. Battery box
" 2 - 20. Two metre sighting bar
" 2 - 21. Tripod locking wheel
" 1 - 22. Internal adjuster scale (graduated in black from 50 to 0 and in red from 0 to 50)
" " - 23. Height locking button
" " - 24. Height compensator knob (1 turn)
" " - 25. Elevation handwheel
" " - 26. Eye-pieces
" " - 27. Interpupillary adjustment lever and scale
" " - 28. Ray filter change lever and scale
" " - 29. Diopter adjustments
" " - 30. Levelling screws for body
" " - 31. Azimuth handwheel
" " - 32. Azimuth gear change button
" " - 33. Azimuth engaging handwheel
" " - 34. Electrical switch box
" " - 35. Cradle
" " - 36. Tripod
" " - 37. Adjustable tripod feet
" " - 38. Traversing or azimuth gear mechanism box
" 2 - 39. Rubber head rest
" " - 40. Elevating gear mechanism housing.

(REPORT BY C.O.O. USAFFE)

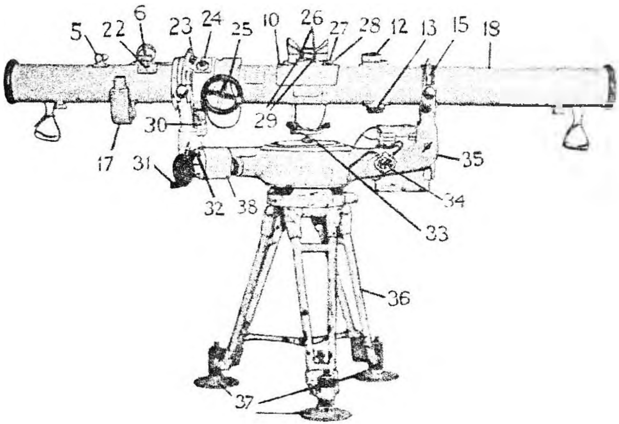


Fig. 1.

JAP. 2-METRE RANGE-HEIGHT FINDER.

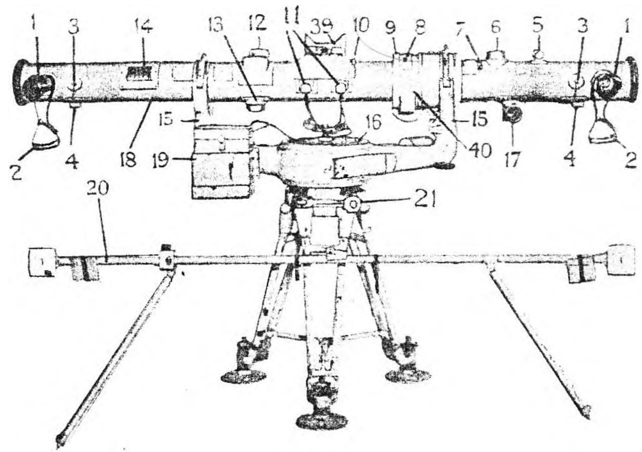


Fig. 2.

JAP 2-METRE RANGE-HEIGHT FINDER

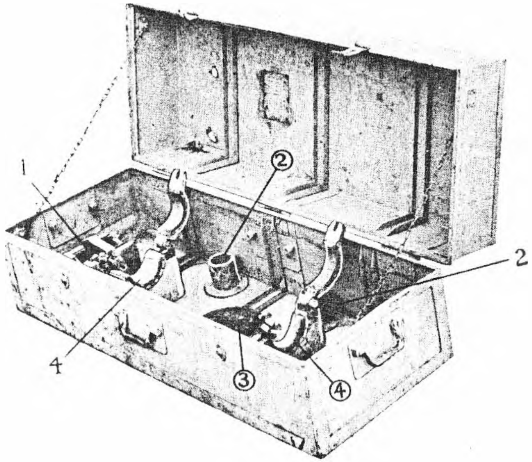


Fig. 4.
CRADLE CASE

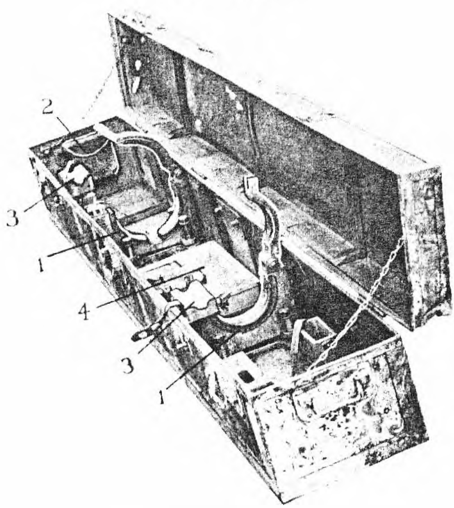


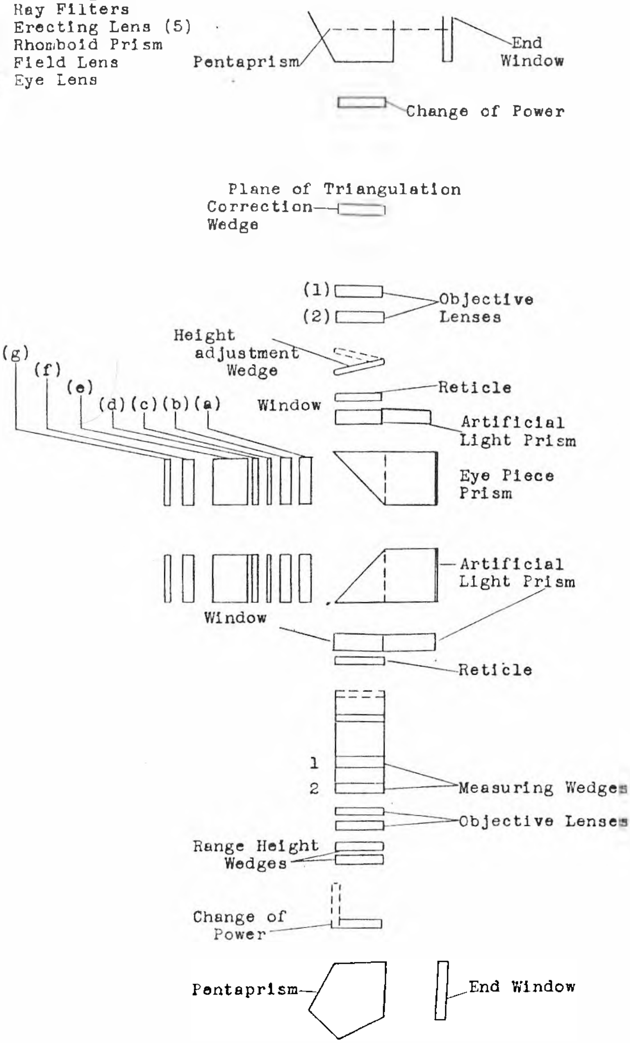
Fig. 3.

HEIGHT FINDER CASE
JAP. 2-METRE RANGE-HEIGHT FINDER

Fig. 5.

JAPANESE 2 METRE HEIGHT-RANGE FINDER

(a) Sealing Lens
(b) Erecting Lens (1)
(c) Ray Filters
(d) Erecting Lens (5)
(e) Rhomboid Prism
(f) Field Lens
(g) Eye Lens



COMPUTING DISC FOR USE WITH SOUND LOCATING APPARATUS IN CONJUNCTION WITH THE JAPANESE 75 MM MOBILE FIELD A/A GUN, TYPE 88.

1. GENERAL

The computing disc as shown in the accompanying photograph is only a part of the apparatus used to compute the firing azimuth and quadrent elevation from the data received from sound locator equipment.

Due to the fact that this is not a complete item, no attempt will be made to guess at its theory of operation. The following report is purely descriptive. A technical report will be published upon receipt of the entire computing apparatus.

The disc shown in the photograph bears this inscription in Japanese:

"Type 88, 7 cm field gun anti-aircraft"

2. DESCRIPTION.

The disc shown is sheet aluminium alloy approximately 3/64th of an inch thick. Its diameter 19¼ inches. The disc was mounted on an aluminium base casting. The base casting was approximately ⅛ of an inch thick, flat on top, with vertical sides about 1" deep. Radial ribs have been cast into the base for rigidity and strength.

It may be observed from the photograph, that the face of the plate is divided into three equal portions of 120 degrees each. These 120 degree portions are graduated around the arcs from zero to ninety degrees. In each portion there is a set of curves plotted in polar coordinates, with angles of elevation as theta, and some value in metres (probably altitude) as rho.

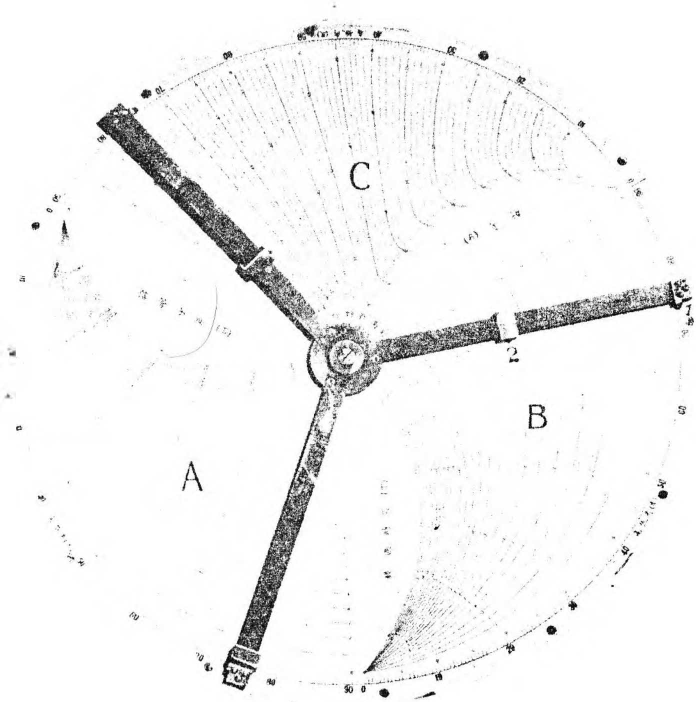
In portion A, the curves "tp" are for fuse graduations, from zero to thirty.

In portion B, the curves "T" are for time of flight of the projectile.

In portion C, the curves "Y" are for quadrant elevation.

The three radial arms shown in the photograph are spaced 120 degrees apart, and rotate together about a central bearing. The fixed index (1) on each arm will point to the same angular elevation as the indexes in the other two portions, because of the equal spacing of the plotted sections and the arms. The arms are uniformly graduated in units of 100 metres, from zero at the outer end to 5500 at the centre. Each arm has a sliding index (2) which may be set to a value in metres on the arm, and will locate a point on a curve on the plate.

(REPORT BY C.O.O. USAFFE)



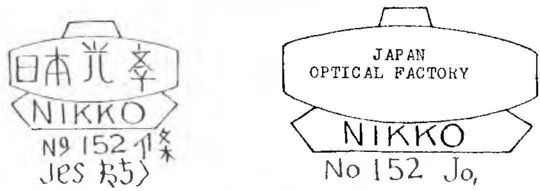
COMPUTING DISC FOR USE WITH JAP 75 MM. GUN

JAPANESE TARGET SPEED AND COURSE ANGLE CALCULATOR FOR USE WITH 75 MM MOBILE A/A GUN, TYPE 88.

1. GENERAL.

The following report was made from calculator No. 152, manufactured by the Japan Optical Factory.

Sketch No. 1



Name Plate. Jes NEji

Calculator No. 1938, bearing the same name plate, was also recovered. The inscribed drum and plate were aluminium, rather than brass, as on No. 152. The curves were similar in shape but appeared to have been arranged differently on the drum of No. 1938.

Reference is made to pages 48-56 of this Summary for further information on the fire control system employed with the Japanese 75 mm. Field A/A Gun, type 88.

The speed and course angle calculator is located in the Battery Command Post with a height finder, spotting binoculars, and correction tables. The 75 mm. A/A Battery usually consists of either four or six guns. The guns are set up in a semi-circle with the command post in the centre. Figs 1,2,3 and 4 show the instrument minus its telescope and tripod. The telescope has an elbow which causes the rays to be bent at an angle of approximately 135 degrees in the vertical plane of the line of sight. The elbow facilitates the tracking of high angle targets. Figs 2-1 and 3-1 show the telescope mounting wedge. There has been no tripod recovered to date. It is apparently similar to a surveyor's tripod, in that it is fastened to the instrument by means of a central threaded coupling, (see fig. 2-2). The instrument is levelled and cross-levelled by means of three adjusting screws and a level bubble (fig 3-2).

2. OPERATION.

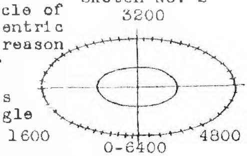
(a) The crew and its duties: A crew of three men is required to operate the Speed and Course Angle Calculator. No 1 man tracks the target. Traverse is obtained by rotating the azimuth handwheel (fig 3-3). Rotation of this handwheel causes the entire upper assembly to turn around the base. Elevation is obtained by rotation of the elevating handwheel (fig 1-1) which causes the telescope to elevate from zero to ninety degrees. The angle at which the telescope is elevated may be read from the indicating scale (fig 1-2). Rotation of the elevating handwheel also causes the sliding indices (fig 3-4 and 1-3) to move vertically, in amounts proportional to the change in angular elevation.

No 2 man stands to the right of No. 1 and reads the true target course angle from the course angle plate (fig 3-4 and 5). This man is also equipped with a stop watch.

No 3 man stands to the left of No. 1 (see fig 1). This man applies the altitude to the drum as it is received from the height finder. He also rotates the drum, setting the apparent course angle as received from No. 1. He then reads the correct target speed from the target speed scale (fig 1-4).

(b) Details of operating procedure: As a target is sighted, No. 1 proceeds to track in azimuth and elevation. When the target is centered in the cross hairs of his reticle, No. 1 informs No. 2 of this fact. No. 2 raises his left hand as a signal to the battery commander. When the telescopes of the entire battery are "on target" the battery commander gives the command "START". At this command, No 1 stops tracking, and observes the target as it flies from the crosshairs towards the edge of the reticle. No. 2 starts his stop-watch on the battery commander's command. Sketch No. 2 shows the reticle of the tracking telescope. The two concentric ellipses are graduated in mils. The reason for the ellipse will be treated under theory. In the actual firing, No. 1 observes the target as it moves across the reticle, and shouts the course angle (in mils) at which it cuts the large ellipse.

Sketch No. 2



As soon as No. 1 shouts the course angle, No. 2 stops his stop-watch. At this point, then, the observed speed of the target in seconds, and its course angle in mils has been introduced into the calculator.

No. 2 now must correct the observed course angle to the actual angle of approach in mils. This is accomplished by reading the value of the curve which is nearest to the observed course angle graduation, on the sliding index (fig 3-4). Note: The curves on the plate are numbered from zero to 6400 mils, and the sliding index is evenly graduated in hundreds of mils between the same limits. No. 2 calls the corrected course angle to the battery commander, who relays it to the guns.

No. 3 must correct the observed speed in seconds, to the actual number of seconds it takes the target to fly 500 metres. The height finder crew No. 1 calls the altitude in metres to No. 3. He sets this into the system by holding the upper section of the drum, and rotating the lower until the right hand arrow (as he faces the instrument) on the lower section of the drum, is set to the required altitude graduation inscribed on the upper section. The proper arrow is marked as shown in sketch No. 3. The other arrow refers to altitudes used with the small ellipse for practice purposes only. When the altitude has been set in, he rotates the entire drum by means of the rotating knob, (fig 1-5) until the "observed course angle" curve, inscribed on the lower half of the drum, is set opposite the "observed course angle" graduation on the second sliding

Sketch No. 3

"Outer Ring"

scale. (Fig 1-3). The true target speed may now be read from the "target speed curve" on the upper section of the drum which falls opposite the "observed target speed" graduation on the fixed index scale (fig 1-4). It will be remembered that the "observed target speed", in seconds, was received from No. 2, who timed the flight from cross-hairs to ellipse with his stop watch. The corrected speed is called to the battery commander, who relays the information to the guns.

3. THEORY:

A. Course Angle: The angle of approach, or course angle of a target, is determined in the following manner:

(1) Flight of the target is observed as it moves from the cross-hairs of the reticle of a telescope, to an ellipse inscribed on the reticle in such a manner that the cross-hairs form its major and minor axes.

(2) The reason for the ellipse will be discussed under target speed calculation.

(3) The periphery of the ellipse is inscribed with cross-graduations as shown in sketch No. 2. The graduations are in mils, from zero at the bottom of the minor axis, in a clockwise direction to 6400, again on the bottom of the minor axis.

(4) At 90 degrees elevation, the path of the target will be observed truly in the reticle. That is, if the target moves from the cross-hairs and cuts the ellipse at 800 mils; then its true course angle is 800 mils.

(5) At any elevation other than 90 degrees, however, the target will cut the ellipse at a mil value which is not its true course angle. This discrepancy is due to the fact that the path of the target in the horizontal plane is being observed from an oblique angle.

(6) The correction of the observed course angle to the true course angle is accomplished on the inscribed plate (5) and sliding scale (4) in fig. 3.

(a) The plate is inscribed with curves, plotted in rectangular co-ordinates, for true course angles, with angles of elevation as ordinates and observed course angles as abscissas.

(b) The sliding scale (4) is graduated in mils from 0 at the left-hand side, to 6400 at the right.

(c) The plate is graduated from zero degrees elevation at the bottom, to 90 degrees elevation at the top on the left side.

(d) The sliding scale moves vertically from 0 degrees to 90 degrees as the telescope elevates.

(e) At any instant then, the true course angle curve may be read opposite the apparent course angle graduation on the sliding scale.

B. Target Speed.

(1) Unit Speed: The velocity of a moving target in this prediction system is not measured in any of the conventional units, such as "miles per hour", or "metres per second". The unit of speed is SECONDS. A velocity of X seconds indicates that a basic distance of 500 metres was travelled in that time.

It is not known definitely if this method of measuring speed is in use in all the Japanese prediction mechanisms. Interrogation of a prisoner of war brought forth the opinion that such a method is considered more efficient, in Japan, than any of the "distance per unit of time" systems.

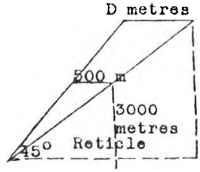
The above opinion was apparently based on the theory that it is easier to visualise 500 metres being traversed in a given number of seconds than it is to conceive of two or three hundred miles being covered in an hour.

(2) Measurement of speed: The speed of the target is computed by first measuring the distance travelled in a given length of time, then converting this to "seconds required to fly 500 metres". The distance measurement is accomplished by solving similar triangles.

A point in space is selected at some given range and altitude. Consider an imaginary circle with a radius of 500 metres drawn about that point in the horizontal plane. When observed through the telescope of the computor, the circle appears elliptical, as its horizontal plane cuts the cone of vision at an oblique angle. If the imaginary ellipse is inscribed on the reticle of the telescope with the major and minor axes as cross-hairs, then, at the given conditions of range and altitude, a target moving from the centre of the reticle to the periphery of the ellipse, in any direction, moves 500 metres.

On the instrument being treated, the selected point in space was located at an angle of elevation of 45 degrees and an altitude of 3000 metres. Thus a target flying at 3000 metres which appears to move from the cross-hairs of the reticle to the ellipse, when the telescope is at 45 degrees elevation, travels 500 metres.

Sketch No. 4



The speed of the target under these conditions is equal to the number of seconds required for it to move to the ellipse.

At any altitude other than 3000 metres, the similar triangles, (sketch No. 3), must be solved to find the distance travelled by the target. The speed in seconds may then be computed from the Distance D and the observed time in seconds.

At any angle of elevation other than 45 degrees, the ellipse is not a true representation of the circle of 500 metres radius in the horizontal plane. Therefore a correction from the apparent distance travelled to the true distance must be applied.

There is a third correction which must be applied due to the difference between the observed and the true course angles, which would introduce an error into the time required to move from the cross-hairs to the ellipse.

The mathematics of the above corrections will not be treated here. The mechanical solving for the corrected velocity in seconds is accomplished on the left side of the computor (looking from the telescope eyepiece), (fig. 1). The variables are introduced mechanically by setting indices to curves inscribed on the drum. The values are multiplied and divided logarithmically by rotation of the complete drum with respect to the fixed indices, and by rotation of the bottom half of the drum with respect to the top. The corrected speed is read from the curve on the upper half of the drum which lies on or nearest the observed target speed in seconds on the fixed index scale 4, in Fig. 1.

C. Summary of the theory of operation:

(1) Course angle.

(a) At 90 degrees elevation, the course angle in mils as read in the reticle of the telescope, is the true course angle of the target.

(b) At all other elevations, the apparent course angle must be corrected to compensate for the error introduced by the fact that the target course is being observed from an oblique angle.

(c) This is accomplished on the right side of the calculator (see fig 3)

(2) Target Speed.

(a) At 45 degrees elevation, and 3000 metres altitude, the speed of a target, as observed in the telescope, is its true speed.

(b) At any other angle of elevation, and/or altitude, the apparent speed of the target must be corrected for the following errors:

(i) The error introduced by the fact that the ellipse is incorrect at angles of elevation other than 45 degrees.

(ii)The fact that a change in altitude causes a change in slant range, which makes the distance travelled by the target something other than 500 metres.

(c) These corrections are accomplished on the left side of the calculator, which, is, in effect, a slide rule designed to solve the required equations.

ORIENTATION

Fig 3-6 shows the movable azimuth ring which is graduated from zero to 6400 mils in a clockwise direction from an index in the rear of the calculator. All the instruments and guns in the battery are oriented to true north.

5. TRAVERSING.

Fig 2-3 shows the clutch lever which engages or disengages the traversing worm gear as desired. The lever is forward and horizontal for hand-wheel traverse, and vertical when it is desired to slew the instrument rapidly through large azimuth angles.

(REPORT BY C.O.O. USAFFE)

NOTE

Translation of markings on the breech ring are as follows:

"OSAKA ARMY ARSENAL TYPE 88 7 CM.

FIELD A/A GUN 1940".

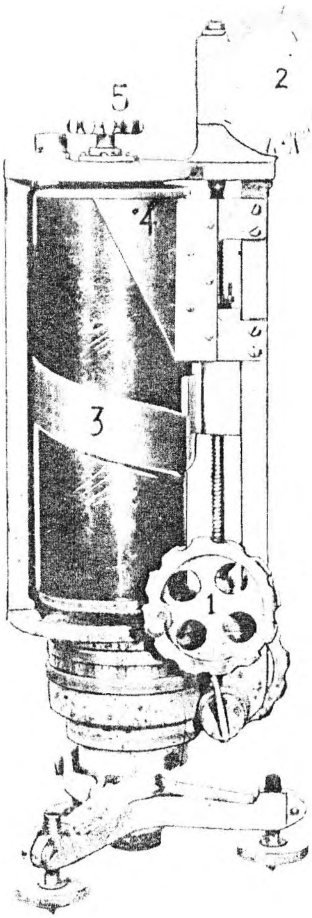
It should be noted that all references to the 7 cm. Field A/A Gun refer to this weapon, although the actual calibre is 75 mm.

This also applies to the following reports:

2 Metre Range-Height Finder

Computing Disc.

Target Speed and Course Angle Calculator.



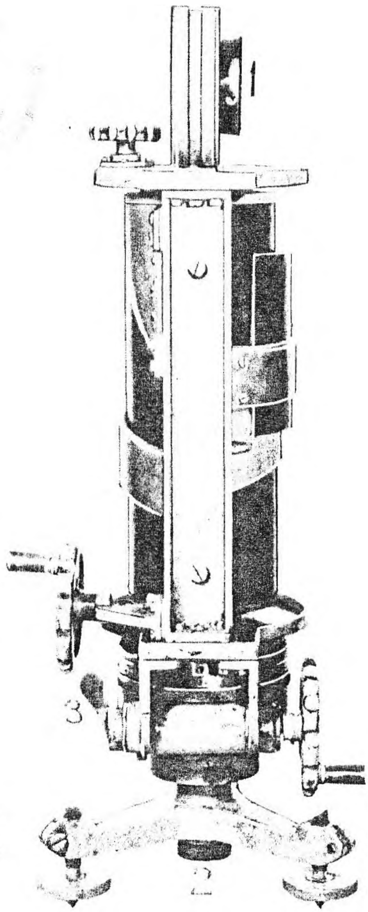


Fig. 1. Fig. 2.

JAPANESE TARGET SPEED AND COURSE ANGLE CALCULATOR

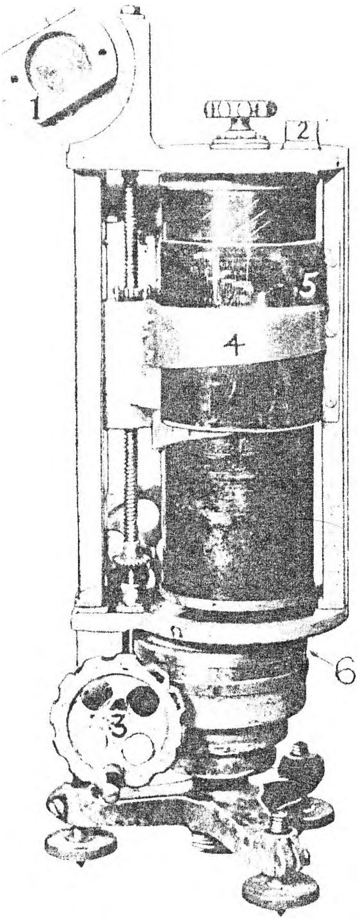


FIG. 3.

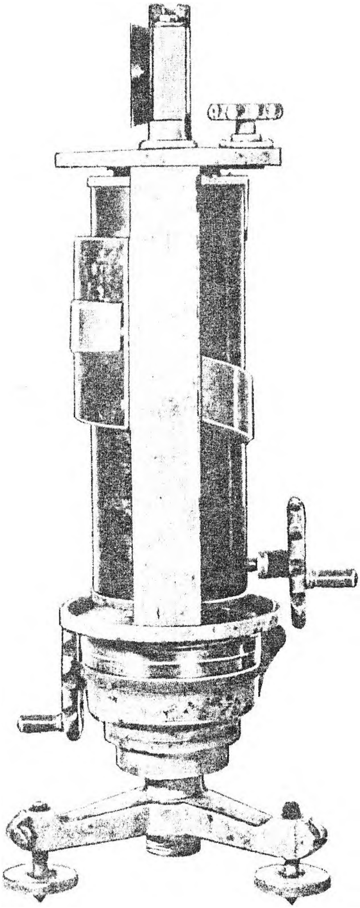


FIG. 4.

JAPANESE TARGET SPEED AND COURSE ANGLE CALCULATOR.

JAPANESE 50 MM FLARE DISCHARGER

1. Description.

The Japanese 50 mm flare discharger is a small, light, smooth bore mortar with a trigger-operated firing mechanism. The discharger is also equipped with an adjustable gas escapement port at the base of the barrel for controlling the range of the flare. The weapon is fired with the curved base resting on the ground. In the accompanying photographs, figure 1 shows the flare discharger ready for use but with the range regulator missing. The pedestal and base portion of the flare discharger may be assembled within the barrel for compactness while carrying as shown in figure 2. The type 97 fragmentation grenade may be launched from this weapon. The bore of the weapon is smooth and well polished.

2. General Data.

Serial number of piece examined	2594
Weight	5.5 lbs
Diameter of bore	1.97 in (50 mm)
Length of bore (large diameter)	8.81 inches
Length of bore (including propellant container chamber)	9.81 inches
Overall length in firing position ..	20.88 inches
Overall length in carrying position	12.63 inches
Estimated range	40 to 200 metres
Length of base	6.5 inches
Width of base	1.88 inches

3. Construction: (Refer to Fig 3).

The barrel (1) is of the smooth bore type. The lower portion of the bore is of a smaller diameter than the bore itself, and accomodates the propellant container attached to the projectiles fired from the weapon. At the base of the barrel is a slot or gas port (2) opening into the barrel. A gas regulator or screwed cap attaches to the threaded portion of the barrel (3). The gas regulator cap was missing from the piece examined. The pedestal adapter (17) is attached to the pedestal (21) by the pedestal coupling (15). The base of the barrel is bored and threaded to receive the pedestal adapter, thus attaching the barrel to the pedestal. The barrel is locked to the pedestal adapter by means of the spring loaded adapter latch (16) fitting into a recess in the base of the barrel. The pedestal has a hollow recess for housing the firing mechanism, and has a rounded end with a spring loaded base plate latch (19) for purposes of attaching and locking the muzzle cover or cap (18), and the curved base plate (20) to the pedestal. Permanently pinned to extensions on an open slot on the pedestal is the sear (14). The trigger (11) is pinned and locked to the pedestal by the trigger axis pin (12), and the axis pin retaining ring (13). A pin between two of the lugs on the trigger arm engages a notch in the sear, and operates it on the last movement of the trigger. The firing mechanism consists of a firing pin (7), on which is assembled a firing spring follower (8), the firing pin spring (6) the firing spring guide (4); and finally the striker (5) is screwed to the firing pin (7), holding the spring (6) in place. A sear spring (9) is riveted to the firing pin. The firing mechanism assembles into the cavity in the pedestal and a split stop and guide bushing (10) assembles over the smaller diameter of the striker body, and is held in place by the pedestal adapter. Thus the movement of the firing mechanism is limited by the stop and guide bushing.

4. Operation and Use.

Operating the gas regulator port cover (missing from the weapon examined) regulates the range of the missile fired from the weapon.

Pulling the trigger downward, causes a compression of the firing pin spring by the lugs on the trigger pushing the firing pin spring follower and firing pin spring upward. The sear holds the firing pin to the rear by a cam engaging the sear spring. Upon completion of the maximum travel of the trigger, the sear is cammed over the spring-positioned bent of the firing pin, thus allowing the firing pin to fly forward into the barrel, firing the propellant primer of the projectile. As soon as the trigger is released, the firing spring reasserts itself and withdraws the firing pin from the barrel, and places the weapon in the ready position.

The weapon is fired with the base on the ground, the operator holding the piece with his left hand and loading and firing with his right hand. The curved base plate facilitates firing on soft ground and eliminates slipping of the weapon. A sighting line on the barrel enables the operator to aim the weapon.

The discharger may be assembled to the carrying position shown in figure 2, by unscrewing the pedestal adapter from the barrel and inserting the pedestal. The threaded section of the adapter screws into the base of the barrel from the inside; and the barrel cover screws into the barrel, completely enclosing the interior and protecting it from foreign material. The weapon is then in a compact assembly for carrying.

5. Disassembly procedure.

1. Release latch on pedestal adapter and unscrew barrel.
2. Unscrew gas regulator from barrel.
3. Unscrew pedestal adapter coupling and remove pedestal adapter and split bushing.
4. Remove axis pin retaining lock, pin, and lift out trigger.
5. Turn firing pin one half turn, slip forward until it engages shoulders in pedestal; and turn pin one half turn and remove.
6. Compress firing pin spring and unscrew striker from pin and remove spring, guide, and spring follower.
7. Depress base plate spring latch, and remove base plate and muzzle cover from pedestal.

6. Index to Fig 3.

1. Barrel.
2. Gas port.
3. Threaded portion of barrel for gas regulator.

4. Firing spring guide.
5. Striker.
6. Firing spring.
7. Firing pin.
8. Firing spring follower.
9. Sear spring.
10. Split striker stop and guide bushing.
11. Trigger.
12. Trigger axis pin.
13. Trigger axis pin retaining ring.
14. Sear.
15. Pedestal coupling.
16. Pedestal adapter latch.
17. Pedestal adapter.
18. Muzzle cap.
19. Base plate latch.
20. Base plate.
21. Pedestal.

(REPORT BY C.O.O. USAFFE.)

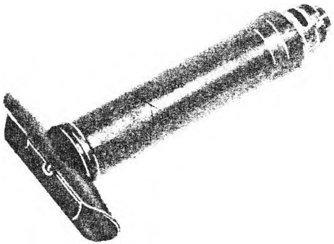


FIG.1. JAPANESE FLARE DISCHARGER.

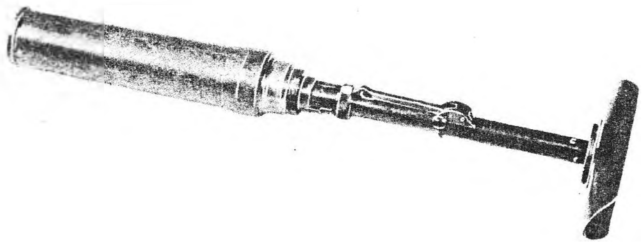


FIG. 2. JAPANESE FLARE DISCHARGER.

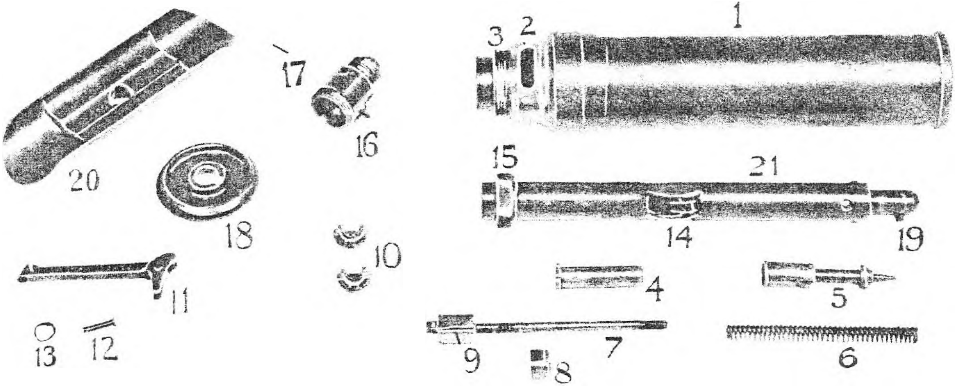


FIG. 3. JAPANESE FLARE DISCHARGER.

JAPANESE FRANGIBLE SMOKE GRENADE

1. GENERAL.

A Japanese Frangible Smoke Grenade captured by naval forces on Guadalcanal consists of a spherical glass flask (Fig. 1), packed in sawdust in a tin cylindrical container (Fig. 2). The outer metal container was painted a brown colour and had a badly damaged label attached to its side.

2. TRANSLATION.

A translation of the decipherable portions of the label reads:-

Experimental Trench Smoke Candle --------------
Tokyo 2nd Army Arsenal
Made 1942

Instructions

----

2. If this chemical gets on clothing or skin, wash it off with alcohol or water. Don't inhale the smoke which ---------------(if it is for a short time, no harm)------------

What is left in ---------------, can be used again, --------------- keep them as much as possible ---------------.

3. DESCRIPTION.

(a) The metal container is 10 cm. high and 8.5 cm. in diameter. The lid is removed by turning the top 2 mm. in a counter clockwise direction and lifting. The locking device consists of two diametrically opposite indentations in the lid fitting into L-shaped grooves in the side of the container.

(b) The flask has a flat bottom and a short neck with a 1.6 cm. opening. The flask is sealed with a rubber stopper held in by a double crown top as shown in [illegible]

(c) The complete frangible grenade (as pictured in Fig. 1), weighed 354.8 gms. and contained 188.0 gms. of a clear, light yellow liquid having a specific gravity of 1.52 at about 27° C., the composition of which is given in Table I, below. The total volume of the flask was 150 cc. and it contained 123.5 cc. of the smoke mixture.

4. FILLING.

TABLE I

The filling of the grenade is:-

Titanium Tetrachloride or FM	59.2%
Silicon Tetrachloride (by diff.)	40.8%

Both of these chemicals are recognised smoke agents which in their liquid state are fairly corrosive to metals and irritating to the skin. In ordinary field concentrations the smoke would not be sufficiently irritating to the respiratory system to cause coughing. Titanium tetrachloride is more expensive but not superior to ordinary FS - smoke.

Although no grenades were on hand for functional tests, experiments with similar grenades containing FS have shown that they would probably be fairly effective in screening a gun port of a pill-box or tank.

(REPORT BY 42ND CHEM. LAB. COY.)

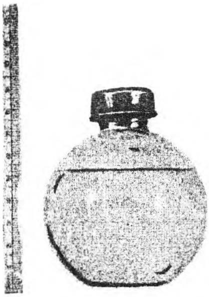


Fig. 1.

Fig. 2.

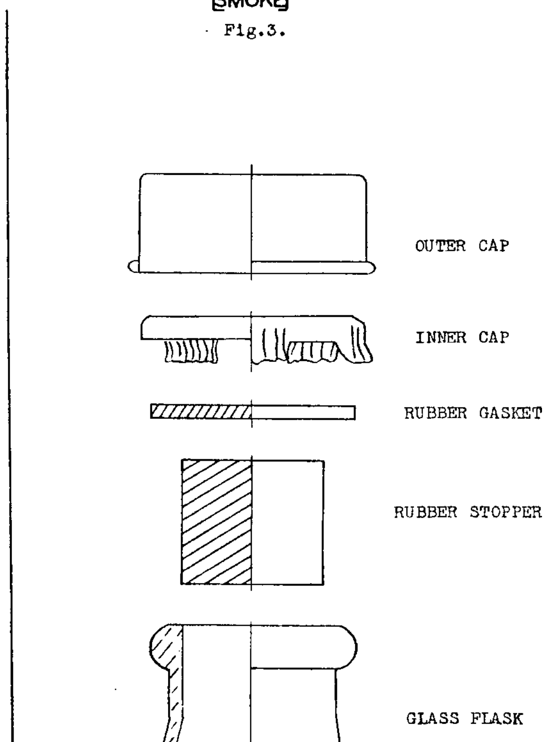
CORRECTION

HYDROCYANIC ACID (HCN)

L.H.Q. Technical Intelligence Summary No. 3: Page 75, para. 1: General. Delete from "The appended diagram......" to end of paragraph.

JAPANESE FRANGIBLE GRENADE
(SMOKE)

Fig.3.



JAPANESE ARMOUR PIERCING MINE (MAGNETIZED)

1. DESCRIPTION.

The Japanese armour piercing mine (magnetized) is issued to certain infantry units and is carried by the individual soldier. The mine described herein is known as "Hakobakurai". It is also known as a magnetized anti-tank bomb and as a magnetized armour piercing hand grenade. The mine has been identified as the Type 99 Experimental Armour Piercing Mine.

The Japanese armour piercing mine (magnetized) shown in figure 1 of the accompanying photographs contains eight separate wax paper wrapped sections of cast TNT (2), held together in a khaki coloured canvas cloth bag (3). It is circular in shape with two flat surfaces. Four equally spaced permanent magnets (7) are attached by Khaki webbing to the outer edge of the body. The mine is carried in a stiff canvas pouch which attaches to the soldier's belt. Fitted to the inside of the pouch is a metal cylindrical container (1), holding the fuse (4), which must be inserted into the mine prior to using. A wooden plug (5), is carried in the fuse cavity (6), in the mine when the mine is carried in the pouch. This is removed to permit fitting of the fuse which is secured to the mine container by the fuse retaining nipple (8) and held by a threaded brass collar, Fig 2 (12).

2. GENERAL DATA.

The following dimensions and weights were obtained:

Mine diameter	$4\frac{3}{4}$"
Mine thickness	$1\frac{1}{2}$"
Length of wooden plug	$3\frac{3}{4}$"
Length of fuse	$5\frac{1}{4}$"
Fuse weight	4 oz.
Mine weight with fuse	2 lbs. 11 oz.
Weight of high explosive	1 lb . 8 oz.
Size of magnets	$1\frac{1}{8}$" x 1-3/16" x $\frac{3}{4}$"
Size of carrying pouch	$7\frac{1}{4}$" x $6\frac{1}{2}$" x $1\frac{3}{4}$"

3. FUSE.

A complete disassembly of the sensitive delayed action percussion type fuse is shown in Figure 2. The obtruding end of the fuse consists of a plunger (1), attached to the fuse body (9) by a set screw (8) through the plunger set screw slot (2). The firing pin assembly (11) is spring loaded by the firing pin spring (10) and is held in the loaded position by four steel balls (7) fitting into the circular groove in the firing pin assembly (11) and the holes provided in the fuse body. A firing pin spring locking plug (5) limits the spring at the upper end of the fuse body. The steel balls are held in place by the plunger (1) which has a continually increasing internal diameter from the open end, and as the plunger is depressed against the plunger spring (3), the steel balls are forced from their position by pressure of the firing pin spring on the firing pin assembly, thus allowing the firing pin to go forward. The plunger is prevented from being depressed by a safety pin (4) positioned in the safety pin hole (6) in the fuse body and to which is attached a length of cord for withdrawing purposes. The primer and delay element (13) screws into the fuse body (9). The detonator element (14) screws onto the delay element. The primer is the percussion type and the delay element is the pressed black powder type with a burning time of approximately 4-5 seconds. The fuse body is provided with a fusible plug to allow escape of the gases from the delay element (15).

4. OPERATION AND USE.

This type of mine is intended for direct use against armoured vehicles, armour shields on gun mounts, doors of pill boxes, etc. The mine is placed in contact with the iron or steel object and adheres to it by action of the magnets. The safety pin is withdrawn and the plunger is depressed actuating the fuse and exploding the mine in approximately four to five seconds during which time the attacker must make his escape. Mobile Explosive Investigating Unit tested one sample and obtained a time of 10 seconds. Owing to lack of samples this has not been checked.

While it has been claimed that the mine may be thrown by hand, it is considered, from the shape and design of the mine and fuse, that it is not suitable for this purpose and must be brought by hand and placed in direct contact with any metallic part of the objective. The use of the mine and fuse in a booby-trap arrangement is highly doubtful because of the delay element in the fuse and the general design of the fuse and mine, although cases of the use of the mines in traps have been reported.

Mines may be used singly for $\frac{3}{4}$" armour plate or with another mine for penetration of $1\frac{1}{4}$" armour plate. Two mines are considered the normal method of use, placing opposing magnetic poles together. A gradual reduction in magnetic strength takes place on long storage.

(REPORT BY C.O.O. USAFFE)

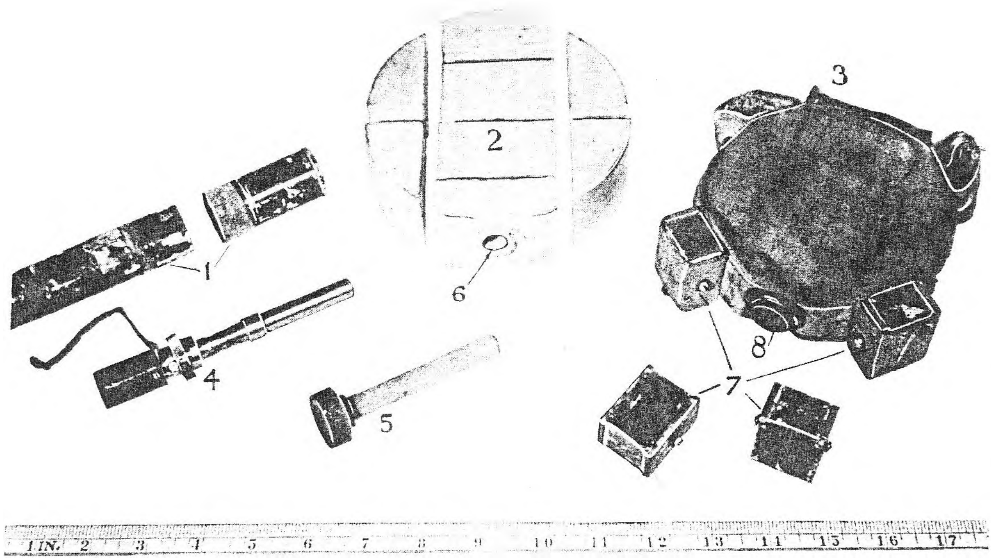


FIG. 1. JAPANESE A.P. MINE (MAGNETISED).

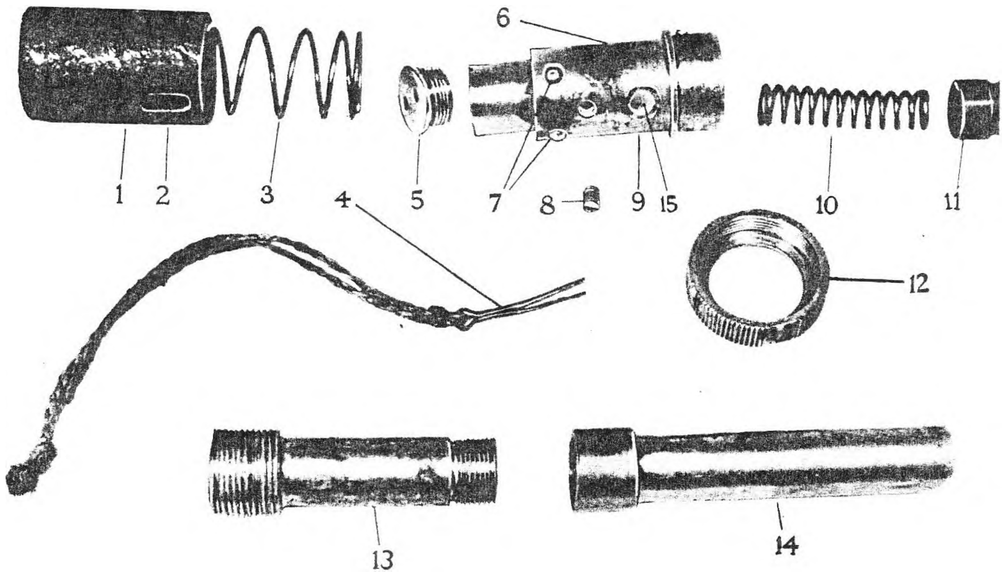


FIG. 2. JAPANESE A.P. MINE (MAGNETISED) - COMPONENT PARTS OF FUSE.

DUTCH "MUSHROOM-TOP" LAND MINE.
(Believed used by Japanese)

1. General.

During February 1943, several Dutch Land mines (see Fig. 1) were recovered at Guadalcanal by the U.S.N. Bomb Disposal Unit there. Although, at the time, the mines were not believed to be of Japanese manufacture, it was not until some Dutch 75 mm. projectiles were recovered that the mines were definitely known to be Dutch. Markings on the projectile fuses confirmed that fact that they were of Dutch Manufacture. The inscription "P.W. 2-41" on the base of the projectile booster container was also found on the mine in three places; namely, on the mushroom-shaped top, on the mine body, and on the mine fuse head. The nationality of both the mine and the projectile was later substantiated by a Royal Netherlands Forces Artillery Officer.

2. Construction.

Referring to the accompanying drawing, (Fig 2.), the fuse screws into the mine body, and consists of a spring-loaded striker which is held off the detonator by a 1/16 inch diameter copper shear wire. The mine cover, suspended over the mine body by a helical spring, is held in position by four (4) screws located in the body. The movement of the mine cover is regulated by the size and position of the slots in the mine cover. However, pressure in any direction on the cover will be transferred directly from the brass plug in the centre of the cover to the striker head.

Mine Data:

Nationality	:	Dutch.
Size	:	9.47 lbs. Land Mine.
Use	:	Anti-tank and Anti Personnel.
Information date	:	April, 1943.
Fuse	:	Mechanical Impact.

Data:

(a)	Diameter of cover	8 1/4 inches.
(b)	Diameter of mine body	7 7/8 "
(c)	Height of mine .. .. (through brass plug to base)	3 1/2 "
(d)	Height of mine body	2 7/8 "
(e)	Wall thickness of mine cover.	1/16 "
(f)	Wall thickness of mine body .	5/32 "
(g)	Dimensions of the four slots of mine cover	13/16 inch high 5/16 " wide.
(h)	Length of four cover-retaining screws	1/2 inch.
(i)	Thickness of helical spring .	1/8 "

(j) Largest diameter of helical spring .. .. 3 3/4 inches.

(k) Diameter of fuse head .. .. 1 1/8 "

(l) Length of fuse complete with gaine .. .. 2 3/4 "

(m) Length of striker spring extended .. .. 9/16 "

(n) Diameter of striker spring .. 13/32 "

(o) Length of striker block .. 11/16 "

(p) Length of striker point .. 5/32 "

(q) Weight of mine complete less fuse .. .. 9.25 lbs.

(r) Weight of mine complete less fuse and filler .. .. 4.0 "

(s) Weight of filler .. .. .. 5.25 "

(t) Charge/weight ratio .. .. 55.4 %

(u) Weight of fuse and gaine .. 100 grams.

(v) Color and markings .. .. .. Mine case and cover olive drab with "P.W. 2-41" printed in red paint across the face of both the cover and mine body. "P.W. 2-41" inscribed on fuse head.

(w) Material of mine components . Mine case, cover and helical spring-steel. Plug in mine cover - Brass.

(x) Material of fuse components . Striker point and striker spring - steel. Remainder of the fuse - Brass. Shear wire - soft copper.

(y) Construction of body .. .. Base of mine crimped over on dome.

(z) Type of filling .. .. .. Main charge - Cast TNT. Booster - TNT

Remarks:

(i) The inscription "P.W. 2-41" stands for "Pyrotechniche Werk-plaats", Army Pyrotechnical Work Shop, Bandoeng, Java.

(ii)This mine must be handled with great care since a weight of approximately 50 lbs., is sufficient to part the shear wire. When probing for this mine with a bayonet or other such device, the probe should enter the ground as near the horizontal as possible to avoid any downward pressure on the domed cover.

(iii) The analysis of the main charge by the 42nd Chemical Lab. Coy, U.S.A., APO 923, shows it to be a fairly pure grade of TNT. The booster is of a like grade of TNT.

(REPORT BY M.E.I.U. USAFFE)

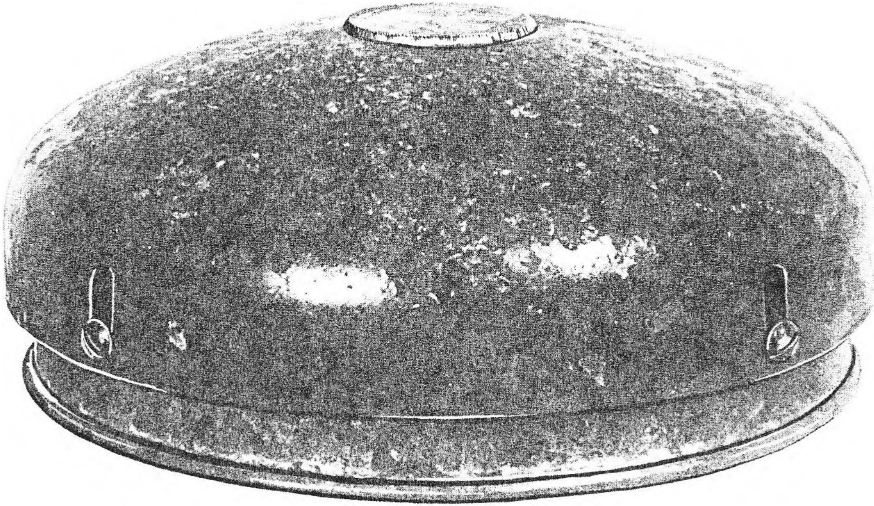
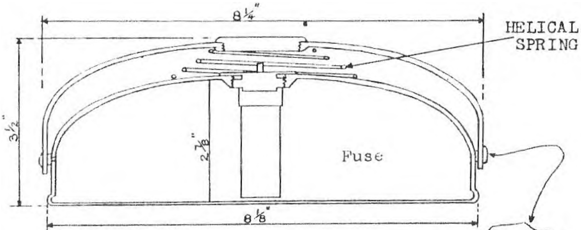
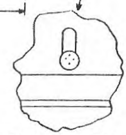


Fig. 1.
DUTCH "MUSHROOM TOP" LAND MINE.
(Used by Japanese)

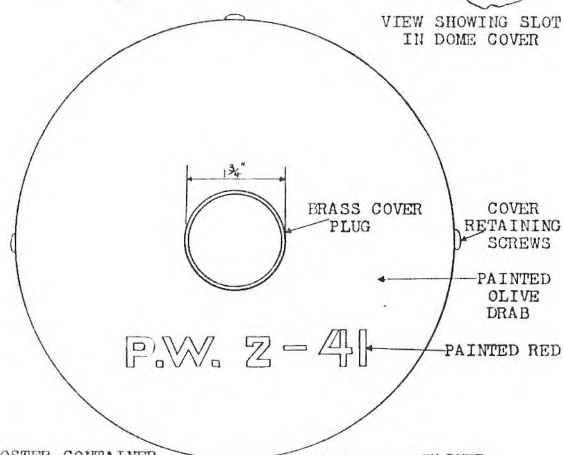
DUTCH LAND MINE USED BY JAPANESE
(FIG. 2)

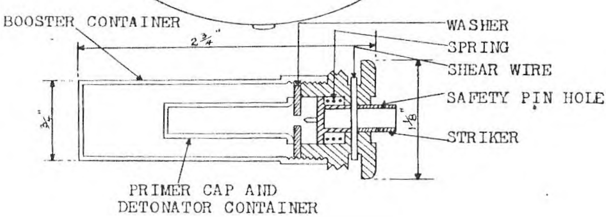


CROSS SECTION OF MINE



VIEW SHOWING SLOT IN DOME COVER





CROSS SECTION OF FUZE

GRENADE AND MINE TESTS AGAINST JAPANESE LIGHT TANK

A trial has been carried out to determine the effect of various Tank attack stores against Japanese Light Tank tracks.

The Japanese light tank (captured at Milne Bay) was towed on to the following by means of a tow-rope from a transporter:-

(a) Grenade No. 75, (U.K. manufacture) filled Nobels No. 704 B with 4 Victor Powder exploders, with Detonators No. 27 as supplied.

(b) Mine contact Tank Attack, Mk.IV (U.K. manufacture) filled K.F. 2/42 T.N.T.

Conditions:-

Soil : Wet and extremely muddy.

Method : The grenade and mine were laid as in service, flush with the ground and the Japanese track towed on to the grenade and mine in a reverse direction.

Results:-

Store	Result
Grenade T/A No. 75	The grenade was placed lengthways to the right hand track. The track passed over the grenade and failed to detonate it.
- do -	Grenade placed at right angles to the right hand track. Detonated correctly. Right hand track fractured and flange of bogey damaged. Crater 36" x 36" x 12". Tank out of action.
Mine T/A Mk. IV.	Mine placed in front of right track. Detonated correctly. Rear suspension arm and assembly sheared. Turret blown off to 5^x from tank. Large crater. Tank out of action and apparently too crippled to re-cover by transporter.

Comments:

(1) Only one tank was available and tests with Mine Contact Mk.V could not therefore be carried out.

(2) Photographs attached. (See Figs 1 - 9).

(REPORT BY - INSPECTION DIVISION M.G.O)

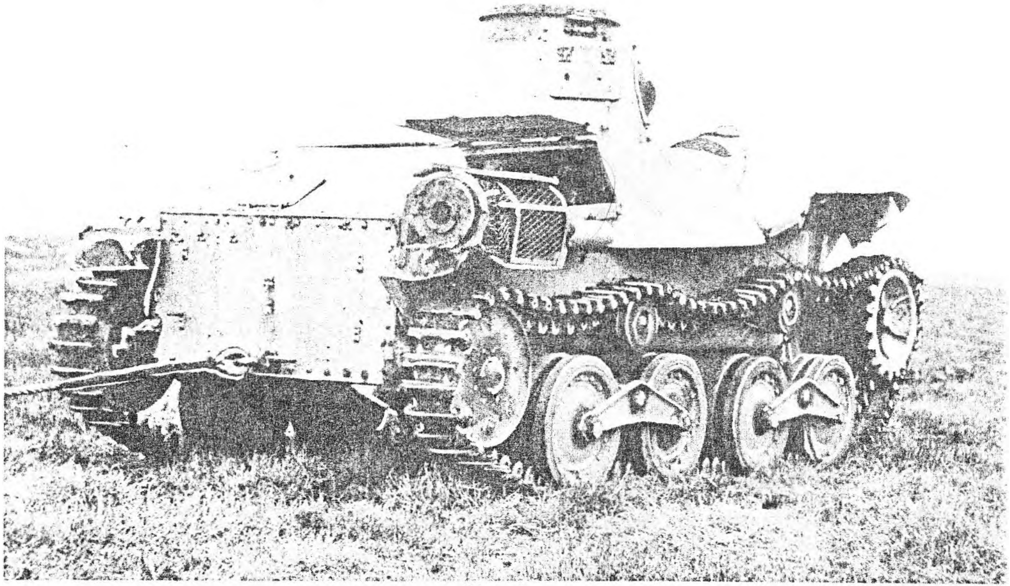


Fig. 1.

JAPANESE LIGHT TANK PRIOR TO TRIALS
(Showing Tow)

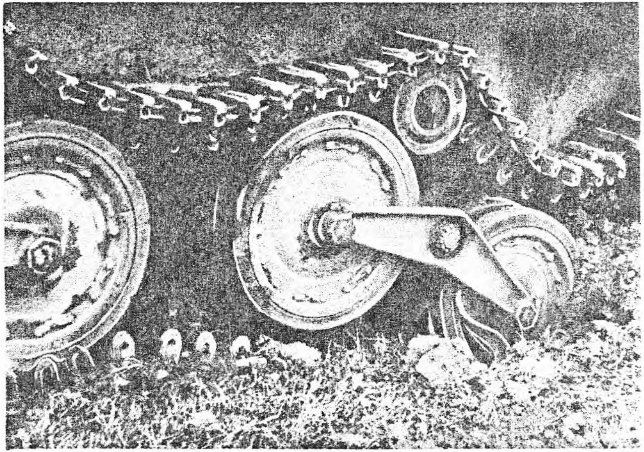


Fig. 2.
JAPANESE LIGHT TANK
(RIGHT HAND TRACK)
DAMAGE TO BOGEY, AFTER ATTACK BY GRENADE NO. 75.

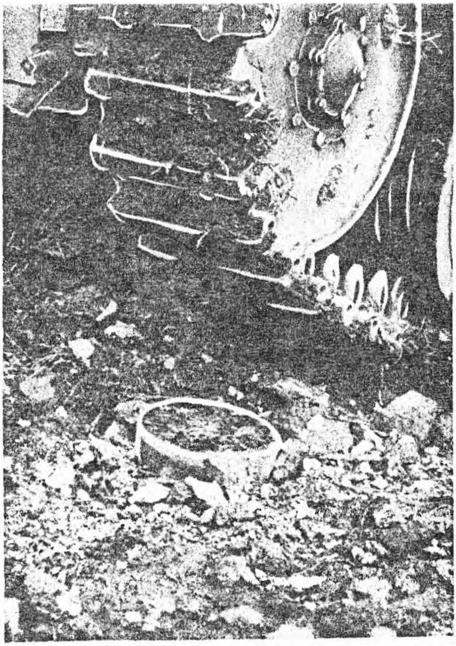


Fig. 3.
JAPANESE LIGHT TANK
MINE, CONTACT MK.IV - METHOD
RIGHT HAND TRACK)

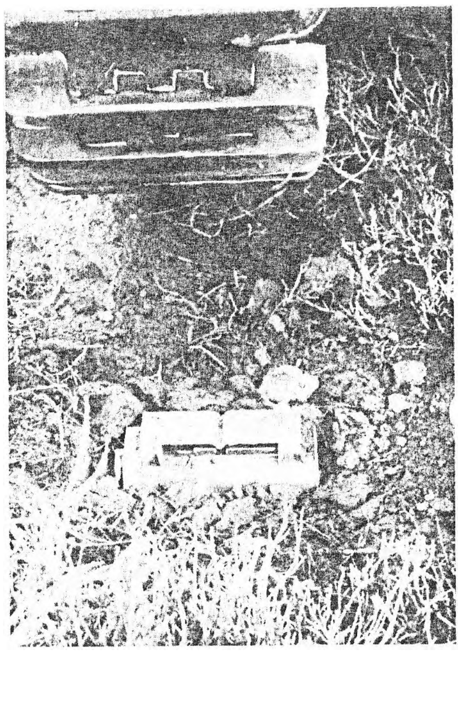


Fig. 4.

JAPANESE LIGHT TANK
(RIGHT HAND TRACK)
GRENADE TANK ATTACK NO. 75

METHOD.

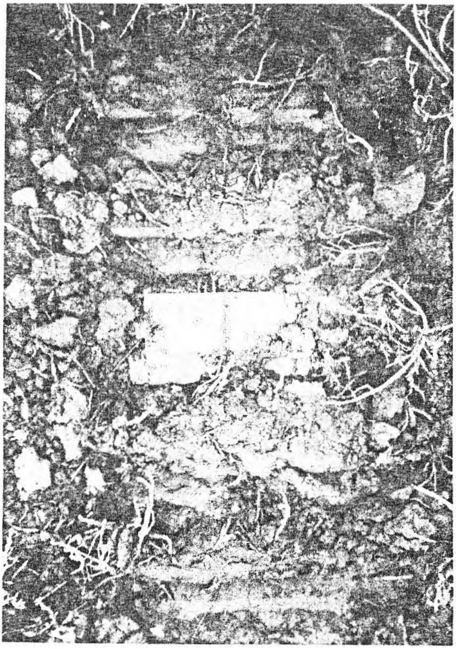


Fig. 5.
JAPANESE LIGHT TANK
GRENADE TANK ATTACK NO. 75.

FAILURE TO DETONATE

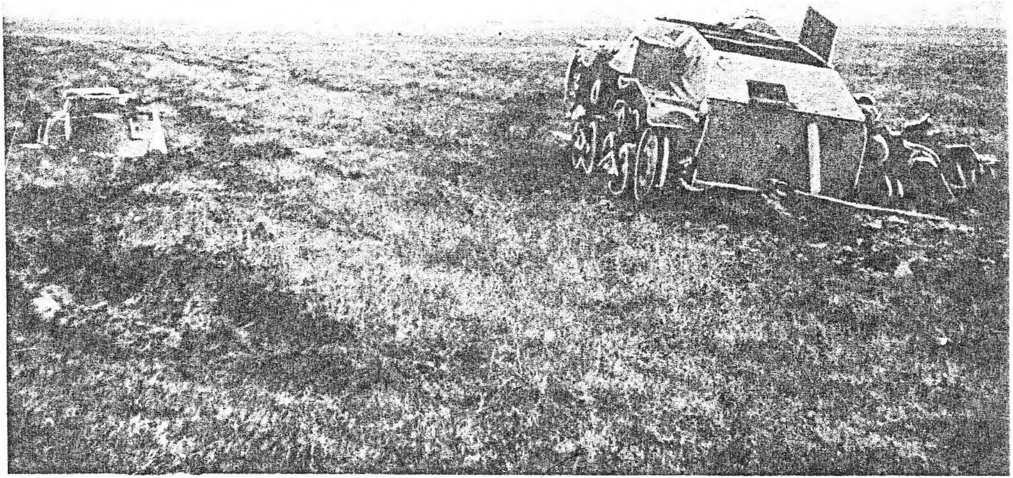


Fig. 6.
JAPANESE LIGHT TANK AFTER ATTACK BY MINE CONTACT T/A MK.IV.
TURRET 5 YARDS FROM TANK.
RIGHT HAND TRACK)

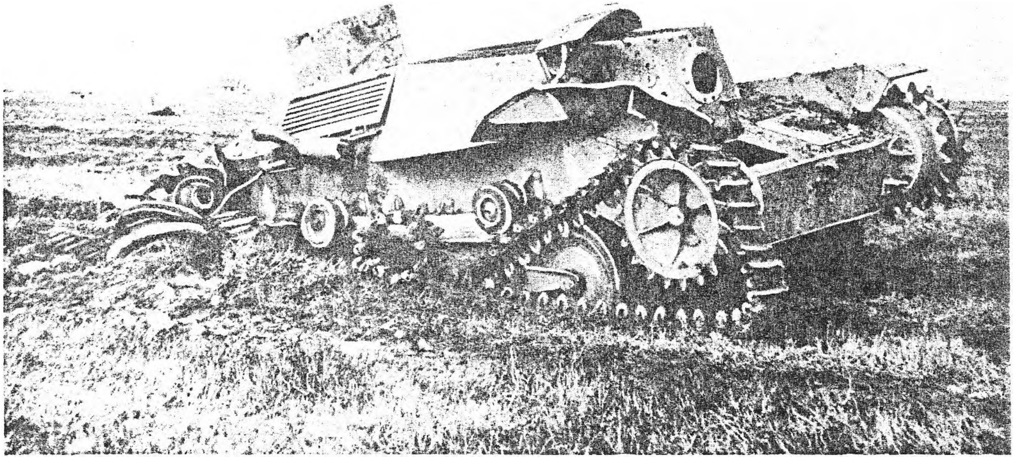


Fig. 7.
RIGHT HAND TRACK (JAPANESE LIGHT TANK) AFTER
ATTACK BY MINE - MK.IV.

Fig. 8.
REAR SUSPENSION ASSEMBLY (JAPANESE LIGHT TANK) AFTER ATTACK BY MINE, CONTACT TANK/ATTACK MARK IV
RIGHT HAND TRACK)

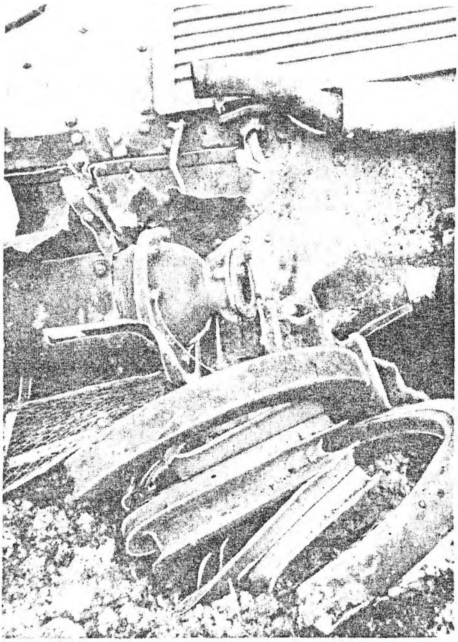


Fig. 9.
REAR SUSPENSION ASSEMBLY (JAPAN-
ESE LIGHT TANK) AFTER ATTACK BY
MINE, CONTACT TANK/ATTACK.
MARK IV
RIGHT HAND TRACK)

JAPANESE 20 MM. H.E. AND A.P. AMMUNITION USED WITH OERLIKON TYPE DUAL PURPOSE GUN

1. H.E. Ammunition.

(a) Identification points.

(i) Abnormally large brass cartridge case.
(ii) Black projectile body.
(iii) Yellow and green bands together around the middle of the projectile body.
(iv) Red band just below bourrelet.
(v) Brass, point-detonating fuze.
(vi) Markings (See Figs 3 and 4).

(b) Colours and Markings.

(i) Side of cartridge case-Blue lacquer.
Characters meaning 98 Ki; (Probably indicates that ammunition is used with Type 98 automatic gun)

(ii) Opposite side of cartridge case-Blue lacquer.
16.10C (Oct.1941 C) (Character for To)
(Probably abbreviation for Tokyo)

(iii) Projectile body.
Above green and yellow band-white lacquer.
Characters and Arabic 100. Translation.
Type 100 TEST.

Projectile body.
Below green and yellow band-white lacquer.
Arabic Numerals 16-10 (Oct. 1941) and TO

(c) Dimensions: See drawings (Figs 3 and 4)

(d) Weights.

a.	Complete round	14.5 oz.
b.	Complete projectile	5.0 oz.
c.	Fuze	1.3 oz.
d.	Projectile body	3.5 oz.
e.	Cartridge case	8.0 oz.
f.	H.E. Filler	63.9 grains
g.	Tracer compound	35.0 grains
h.	Propellant	908.0 grains

(e) Chemical Analysis.

(i) Fuze:
Detonator: lead azide

(ii) Filler: Hexogen (cyclonite) Hexahydro 1,3,5 Trinitrotriazene.

(iii) Tracer composition:

Strontium carbonate	53.6%
Sodium nitrate	30.9%
Antimony, metallic	11.6%
Sodium Chlorate	3.6%
Sulphur	trace
	99.7%

(iv) Propellant:

Nitro cellulose	92.2%
Diphenylamine	2.3%
DNT (dinitro toluene)	5.5%
Moisture content	1.9%

Note: A piece of metal foil 3½" x 1" has been removed from each cartridge case to date. Its chemical composition is :-

Tin	60%
Lead	40%

(f) Fuse Operation. (See diagrams: Figs 3 and 4)

The fuse is a point detonating, bore safe, self-arming, super-sensitive fuse. Upon firing, the arming fork stays in the unarmed position due to inertia. Upon leaving the muzzle, however, centrifugal force causes the safety fork to move toward the outside of the fuze body, against the compression force of the arming spring. This movement cams the firing pin toward the nose of the fuze slightly, to allow the lips on the safety fork to slide under the aluminium body of the striker. As soon as the safety fork is clear of the striker body, the striker moves toward the rear again, due to the retardation forces acting on the projectile, and rests upon the primer cap. The shell is now completely armed. Upon impact the wooden plunger is driven to the rear, either by the shearing of the sealing disc or crumpling of the nose. The firing pin penetrates the primer, setting off the detonator and the filler.

2. Tracer.

This tracer is not self destroying. The chemical analysis and weight has been given. All the ammunition found to date has contained tracer composition.

Propellant.

This is a very heavily graphite-coated single base Nitrocellulose non-hygroscopic powder containing a large percentage of diphenylamine which serves the function of a stabilizer. The DPA is present in sufficient quantity to act as a flash reducing agent. The grains are a single perforated type with an outside diameter of approximately 1/16" and vary in irregularly cut lengths from 1/16" to 3/16".

3. A.P.Ammunition.

(a) This ammunition differs from the H.E. in the projectile only. It is a solid, pointed, hardened steel body, with the same type and amount of tracer composition contained.

(b) Identification points: Black pointed body with white and green band midway between the bourrelet and rotating band.

(c)

Weight of projectile	5.5 oz.
Length of projectile	3⅛ in.

NOTE: (1) The H.E. Ammunition was packed in the cardboard containers shown in the photograph of the A.P. Round.

(ii) Base markings: Character "shi" stamped on both cases.

(REPORT BY C.I.S. USAFFE)

NOTE

JAPANESE BODY ARMOUR

Reference Figs 3,4,5 and 6 on page 110-113 incl., of L.H.Q. Tech. Int. Summary No 4. As reported in the text, in last para. on page 107, the penetration tests were carried out with .303 amn. at 100^{x} and 9 mm. amn. at 20^{x}.

CORRECTIONS

1. 37 MM. TK/A GUN.

This weapon, reported in L.H.Q. Tech. Int. Summary No. 3, was described as the 1935 model. Later information, however, indicates that this is the 1934 model.

2. JAPANESE 13 MM A/A - TK/A DUAL MOUNTED MACHINE GUNS.

On page 3 L.H.Q. Tech.Int.Summary No 2. ("Types of Ammunition and Markings on Caps") white markings were attributed to Ball ammunition and black to A.P. Subsequent information shows that these cap markings should be reversed. i.e., Ball (black): A.P. (white)

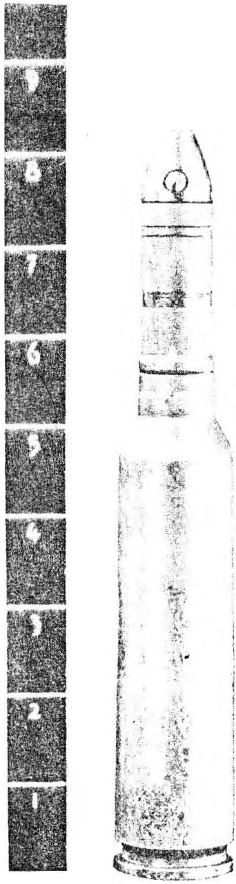


FIG. 1.

JAPANESE 20 mm. H.E. AMMUNITION.

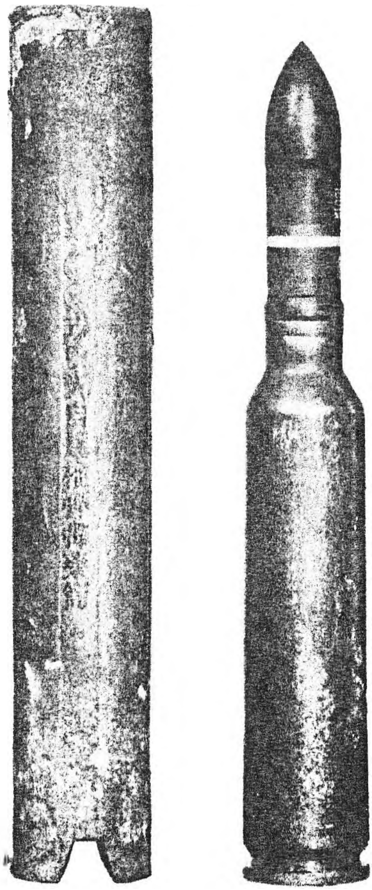


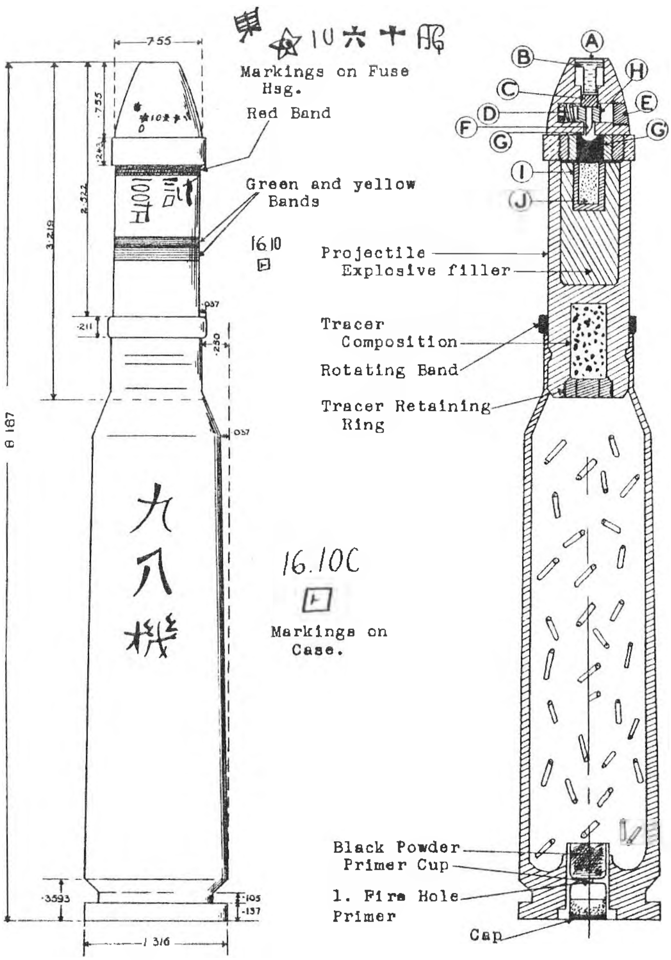
FIG. 2.

JAPANESE 20 mm. A.P. AMMUNITION.

JAPANESE 20MM H.E-TRACER

[POINT DETONATING]

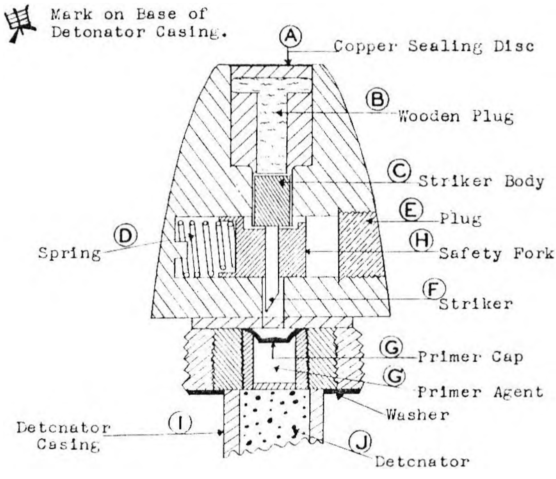
Fig. 3.



JAPANESE 20MM H.E.-TRACER

[POINT DETONATING]

Fig. 4.



JAPANESE TYPE 91 FRAGMENTATION GRENADE

1. Description.

The Japanese type 91 fragmentation grenade shown in the accompanying photographs is used as a mortar grenade and is fired from the model 89 grenade discharger. (See L.H.Q. Tech. Int. Sum. No 1. pp. 36 - 40). The explosive train is initiated by setback action and a delay pellet with a burning time of approximately eight to nine seconds is interposed between the primer and the detonator. The type 91 grenade can be modified for use as a rifle grenade by replacement of the propellant assembly (Fig 3 - 15) with a tubular tail fin assembly. Included in the photographs is a radiograph showing the component parts in their exact positions in the assembled grenade. (Fig 2).

2. Dimensions and Weight.

Overall length with propellant container ...	4.95 in.
Overall length without propellant container.	3.75 in.
Diameter	1.97 in.
Weight	18.8 oz.

3. Construction: (Refer Fig 3).

(a) Grenade Body. The cast grenade body (14) has fifty serrated segments. A filling plug (13) screws into the upper end of the body and screwed through this plug is a brass cylinder (6) containing a percussion cap, an arming spring (4) a brass nose body (3), and a steel firing pin (2).

(b) Propellant Container. Into the base of the grenade body is screwed a steel propellant container (15) which has six perforations drilled in its walls. A perforated plug (17) screws into the base of this container and in a cavity in this plug is a small brass percussion cap pressed into a brass holder (16). A Berdan type anvil formed in the holder bears against a small quantity of primer composition in the percussion cap and two flash holes lead through the holder to a small quantity of black powder. A perforated steel disc (12) let in to the inside face of the plug covers holder and black powder. Inside the steel container is a copper cup (11) containing 1.1 grams of nitrocellulose propellant powder in small, greenish-black flake shaped grains.

(c) Firing Assembly. The firing pin (2) in the bursting charge explosive train is a steel pin secured into a brass body (3) and is held away from the percussion cap by a light steel arming spring (4). The firing pin is held into the brass cylinder by a light brass cap (1) which is firmly tied into a cannelure (5), formed in the brass percussion cap holder (6) by many turns of a thin cord. The firing pin (2) is set in the brass nose body (3), and when so placed its point will not protrude below the base of the brass body. Before using the grenade, it is then necessary to insert a screw driver and screw the firing pin into the brass body thus allowing the firing pin to protrude beneath the brass body. In addition, a double brass safety pin (9), with cord for withdrawal, fits through to brass cap (1), through holes in the brass percussion cap holder (6) and into recesses in the base of the brass body (3), and further prevents the firing pin (2) from approaching the percussion cap.

(d) Delay Pellet. Screwing into the base of the percussion cap holder (6) is a brass tube (7) containing a black powder delay train with an enlargement in the internal diameter of the tube, at its base housing a pellet of highly compressed black powder. A small quantity of granular black powder is present between the top of the delay train and the percussion cap holder. A hole drilled in the side of the percussion cap holder (6) contains a fusible plug which melts as soon as the black powder is ignited, allowing the escape of the gases formed on combustion of the delay train.

(e) Detonator. A copper tube (8) extends from the bottom of the bursting charge inside the grenade body to the base of the percussion cap holder (6), and houses the delay tube (7), and, at its lower end, the detonator. Beneath the detonator is a thick felt disc, to protect the detonator from the shock of discharge, and also to keep the detonator pressed against the end of the delay tube.

4. Operation: (Refer Fig 3).

(a) As a Mortar Grenade. The safety pin is removed, and the grenade is dropped base downwards into the mortar. A central striker pin in the grenade discharger strikes the percussion cap in the base of the grenade, when the trigger mechanism of the grenade discharger is operated. The flash from the percussion cap ignites the black powder and then the propellant powder. The gases generated blow through the perforations in the wall of the container (15), and expel the grenade from the discharger. During acceleration of the grenade in the barrel of the discharger, the firing pin sets back, overcoming the resistance of the arming spring, and strikes the percussion cap. The flash from this ignites the loose black powder above the delay train, and this in turn ignites the delay. After this has burned through, the perforated black powder pellet is ignited and this initiates the detonator element, which then detonates the main bursting charge.

(b) As a Hand Grenade. The safety pin is withdrawn, and, before throwing, the firing pin is struck on some object such as on the shoe of the thrower. This strikes the firing pin on to the percussion cap, and the action proceeds as described for the mortar grenade. The propellant cylinder (15) is not needed when this grenade is used as a hand grenade, and can be removed by unscrewing it from the grenade body prior to throwing.

5. Explosive Fillings.

(a) Detonator. This consists of a long copper shell into which is pressed 1.06 grams of tetryl. Into a perforated copper cup lined with tin foil is pressed 0.7 gram of mercury fulminate. This cup is inverted and pressed into the shell so as to bring the tetryl and mercury fulminate surfaces into contact. The mouth of the outer shell is then rolled over the base of the cup. The copper shell containing the detonator composite filling may be seen in the accompanying X-ray photograph.

(b) Bursting Charge. The bursting charge consists of 65 grams of powdered, crystalline, low-grade TNT, lightly pressed in around the central copper tube. A cardboard washer (Fig 3 - 10) covers the upper surface of the charge.

6. Index to Fig 3.

1. Light brass cap
2. Steel striker pin
3. Brass nose body
4. Arming spring
5. Cannelure in cylinder
6. Percussion cap in brass holder
7. Brass delay tube
8. Copper tube
9. Safety pin
10. Fiber washer
11. Copper cup, containing propellant
12. Perforated steel disc
13. Filling plug
14. Grenade body
15. Perforated steel container for propellant
16. Percussion cap in brass holder
17. Screwed plug

(REPORT BY C.O.O. USAFFE AND MUNITIONS SUPPLY LABORATORIES)

CORRECTION

NEW TYPE H.E. AND INCENDIARY BOMB

L.H.Q. Technical Intelligence Summary No. 3. Page 93, para. 4(a), line 9. Delete "para. 7" and insert "para.6."

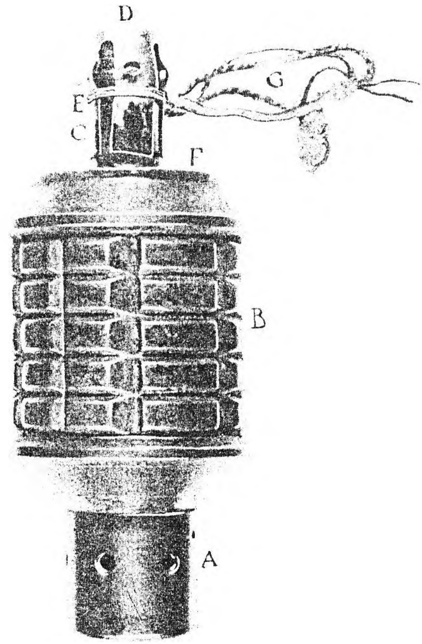


FIG.1. GENERAL VIEW OF JAPANESE GRENADE

a. Perforated steel propellant container.
b. Body of grenade.
c. Cylinder containing firing mechanism.
d. Light brass cap.
e. Cord holding cap (d) over cylinder (c).
f. Filling plug.
g. Cord for withdrawal of safety pin.

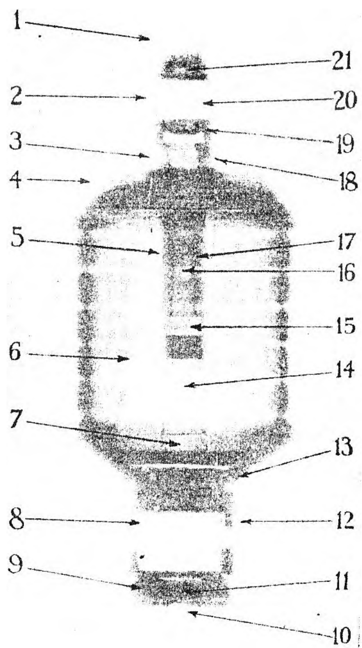


FIG.2. PRINT OF RADIOGRAPH
OF JAPANESE GRENADE.

(1) Light brass cap. (2) Cannelure in cylinder. (3) Fusible Plug. (4) Filling plug. (5) Copper tube. (6) H.E. Bursting charge. (7) Felt disc. (8) Copper cup containing propellant. (9) Screwed plug. (10) Cavity to take firing pin of mortar. (11) Percussion cap in brass holder. (12) Perforated steel container for propellant. (13) Propellant containers screwed into body. (14) Detonator. (15) Perforated gun powder pellet. (16) Delay composition. (17) Delay tube. (18) Brass cylinder. (19) Percussion cap in brass holder. (20) Arming spring. (21) Steel striker pin in brass body.

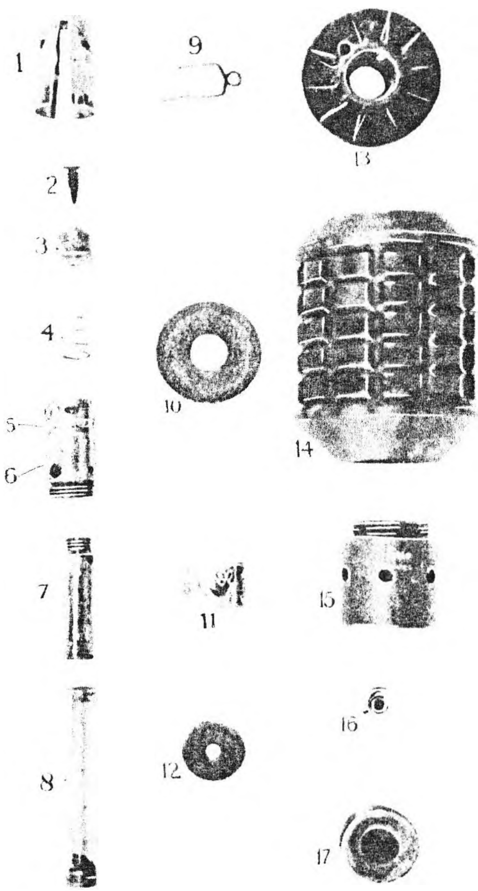


FIG. 3. TYPE 91 FRAGMENTATION GRENADE.

"USE AND EFFECTIVENESS OF FLAME-THROWERS"

(Translation of Captured Japanese Document)

NOTE: This pamphlet was captured from a Japanese probational officer at Buna. It gives the Japanese viewpoint as to the value and tactical use of their flame throwers. It also gives some details on oil mixtures to be used and a table of comparison with flame throwers of other countries.

An illustrated description of "Japanese Flame Thrower - Portable" appeared in L.H.Q. Technical Intelligence Summary No. 1, pages 69-77.

CHARACTERISTICS OF FLAME-THROWERS

1. Functions.

To kill the enemy troops or to cause fire or explosion on objectives. To build up the morale of our own forces by striking fear into the enemy, thus to expedite fighting.

As the flame-throwers are operated under a constant danger and risk only a few yards in front of the enemy, operators must be daring, cool, self-sacrificing, alert and strong. They must co-operate with other troops.

2. Uses.

In general, flame-throwers are used to support the function of flank defence at the time of a charge, or during mopping up operations. They also are used to capture strong points, or to attack tanks at close range. Flame-throwers help the destruction and capture of obstacles and key positions. Again, they support our charge, or employed on a broad scale, can break up the enemy's charge. It is necessary, therefore, to pay particular attention to these factors at the time of training.

3. Object of Training.

The chief object of training is to achieve efficiency of flame-thrower operation through proper leadership. Correct flame manipulation and quick action are essential in this respect.

4. Essential Points in Training.

Economy and replenishment of fuel are indispensable factors in efficiency of flame-thrower operation, as are treatment and maintenance of equipment. Instructors and their subordinates should have a thorough knowledge of the construction and operation of the weapon, and should become proficient by examination, training and experience.

Because of the dangers accompanying training with flame-throwers, discipline must be strictly observed. Thorough attention should be given to the handling of fuel, and particularly to the actual flame. In training, use water instead of fuel, but act as if it were real fuel.

EFFECT OF FLAMES AGAINST SPECIAL OBJECTIVES AND MACHINE GUN EMPLACEMENTS.

In attacking special positions (such as flank defences) temporary neutralization is achieved through causing casualties among the defenders and rendering ammunition temporarily unfit for use. To insure success, follow up an attack with explosives.

Because of the black smoke and poisonous gases emitted it is impossible for the enemy to post fresh guards for about 5 to 10 minutes.

In attacking machine gun nests if the flame is directed through the loop hole it will strike the side wall, refract and reach every part of the interior. If it is directed from the side at an angle of say 45° the flaming oil will hit the wall of the loop-hole, refract and penetrate the interior.

If the flame is discharged in bursts, even if directed blindly, it will reach the side wall (interior?) effectively.

In attacking tanks the flame-thrower can achieve the effect of temporary neutralization by causing casualties among the crew and by stopping the engines. Complete destruction is possible if followed by attacks with explosives. However, the best results are obtained by setting fire to the combustible parts of the tank's interior.

In experiments against a PT type tank it was found that if the flame was directed straight at the turret only, the gunner and crew would be injured by the flame and the interior filled with black smoke making movement difficult for the time being; but the engine would still be running. If the flame were directed at the turret loop-holes the gunners and driver would be burned to death or injured and the engine stopped because of insufficient air or setting fire to the spark plug cables.

SAFETY OF FLAME-THROWER'S CONSTRUCTION

1. Safety in attack.

With fuel and gas pressure ready for use, the flame-thrower can be dropped from a height of from 1 to 2 metres without affecting the container, air-pressure, or air-tight seal.

2. Safety against Small Arms Fire.

With the flame-thrower charged, ready for use, a direct hit on the air container by a 7.7 mm steel-jacketed bullet from a distance of 100 metres will not cause it to explode or burst. If the same test is applied to the lower part of the oil container, fuel will spread over a radius of 7½ metres. If the upper part of the oil container is hit, gas only will escape. It will not burst or explode.

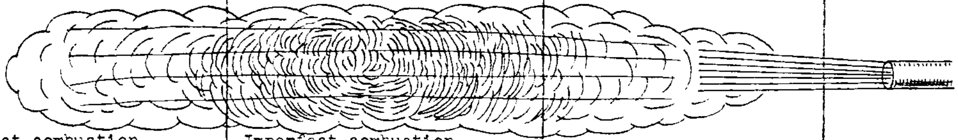
Comment: Vulnerability to snipers.

Although the container may not explode, a direct hit would render it useless; a hit with an incendiary bullet on the lower part of the container would ignite the contents.

PROPORTIONS OF INGREDIENTS IN FLAME-THROWER MIXTURE

Kind of Fuel	Gasoline	Crude Oil	Kerosene
Characteristics	Sudden rise in heat. Rapid combustion.	Great heat, constant ignition. Prolonged combustion. Very heavy.	Easy combustion, great heat
Notes regarding mixture	Decrease during dry days or Summer. Increase during rainy and snowy days or Winter.	Prolongs combustion. Increases distance.	Vary according to the proportions of gasoline and crude oil.
As directed in manual	1	2	5
Summer extreme heat	1	3	6
Winter cold	1.5	2	6
Rain & snow	2	2	6
Increase in distance	1	3.5	5
Great penetration (attacking tanks)	1	3.5	5
For use in an emergency	1	1	-
When no kerosene is available	1	1	-
When no gasoline is available	-	2	4
For burning out objectives	1	4	5

Metres
25 20 15 10 5 0



Perfect combustion 1. Although the fuel is dense, it is extinguished after penetrating objective. 2. As speed decreases, penetration is less.	Imperfect combustion. 1. If combustion is not quite complete, it will continue to burn after penetrating objective. 2. Emits black smoke and poisonous gas. 3. Because of great speed, penetration is good.	Fuel loses density immediately after igniting.	Non-burning for about 2 or 3 metres (discharged as a liquid)
Use for temporary neutralisation	For attacks on particular positions or MG nests, direct this part of the flame into the interior. Especially good for attacking tanks.	Affected by mixture. (Translator's note: Proportions of ingredients therein)	
	Range of discharge - about 15 metres		

BASIS FOR SELECTING POSITIONS (DISTANCE) FOR USE OF FLAME-THROWER.

Of the three types of discharge (non burning, imperfect combustion and perfect combustion), a partially consumed discharge directed on the objective attains maximum results. However, for momentary neutralisation, such as initial subjugation of flank defences, a perfectly burning discharge will achieve the purpose.

CAPABILITIES OF FLAME-THROWERS OF VARIOUS COUNTRIES

Country	Type of Flame-Thrower	Max. Projection (metres)	No. of Shots	Duration of flame (seconds)	Capacity of tanks (in litres) Fuel	Pressure
JAPAN	No. 1	28	6-8	10	14	15
	No. 2	45	6-8	12	40	10
	Type 95 -) small) Type SS)	- - - will be given verbally				
	Fixed	Underground - operated from behind 15 metre earthworks				
GERMANY	Portable GIII	30-50 20-25 35-50		 10 10-17		 10
FRANCE	LT-Heavy LZ-Heavy Flame- thrower	60 45 25-28 60-85	 30	 22-25 30	 13 50	 20-54
ENGLAND	Large Small	80 20	7-8 2	40	71	10
RUSSIA	Land mine Flame- thrower	 20-25 150 30-50		 50 60 60		

Comment:-

The data in this table has been printed as received except for omitting a final column of figures, meaning of which is not clear. There was no heading for column 4 but "number of shots" is obviously meant and was inserted. The meaning of the second row of figures under "France LZ" is not clear.

JAPANESE FUSE, SAFETY: AND FUSE, INSTANTANEOUS DETONATING

1. FUSE, SAFETY.

The fuse (recovered in New Guinea) is white in colour and is made up of a central core of gunpowder surrounded by five spirally wound protective layers. Fig. 1 shows a portion of the fuse unwound to reveal its structure. Running through the centre of the fuse are three thin hemp threads (A) around which is the gunpowder train. After comparison with British types of safety fuse, it is considered that the gunpowder may have been attached to the hemp threads with gum. Wrapped round the core of gunpowder are thirteen lengths of hemp thread (B). The second protective layer consists of eight hemp threads (C) wound in the opposite direction to (B), and following this are two thin layers of paper, (D) and (E), built up of spirally wound strips $\frac{1}{2}$" in width. Each turn of paper overlaps the previous one for about $\frac{1}{4}$ of its width. The paper is made from cotton and other unidentified cellulose fibres. The two lengths of paper strip, in addition to being wound in opposite direction, are also wound from opposite ends of the fuse, so that it is impossible to unwind both from the same end. The final outer covering (F) consists of ten threads of short staple unmercerised cotton. The unevennesses on the outer surface are filled with a white filling consisting mainly of powdered Silica.

The diameter of the complete fuse is 0.21". It was found impossible to obtain a burning rate for the fuse. This fact, coupled with the presence of Potassium Nitrate in all the protective layers, suggested that some leaching by water had occurred. It was subsequently learned that this sample of fuse had been exposed to the weather for some time. Under such conditions leaching would occur as the fuse is not waterproofed. This would also explain the lack of any granular structure in the "gunpowder" in the core. The presence of Potassium Nitrate in the protective layers, and of charcoal and sulphur in the central core, suggest that a normal type of gunpowder was originally present.

2. FUSE, INSTANTANEOUS DETONATING.

The detonating fuse consists of a lead tube approximately 0.23" in external diameter and approximately 0.17" in internal diameter, and filled with Trinitrotoluene. A certain amount of interaction had taken place between the lead and the T.N.T. giving some dark brown products at the interface. Some corrosion of the exterior of the lead tube had also occurred in isolated patches (Fig. 3).

The fuse is packed in a circular lacquered galvanised iron container $9\frac{1}{8}$" in diameter and $1\frac{3}{8}$" high. This consists of a circular base with upturned edges to which is soldered a cylindrical wall. A galvanised iron cover slips over the top of the container and is secured by a gummed paper tape. Fig. 2 shows the upper surface of the cover with the descriptive label attached.

The translation of the label is:-

"Date of manufacture - September 1940
Detonating fuse. 10 metres
Karitto Joint Stock Coy. Asano."

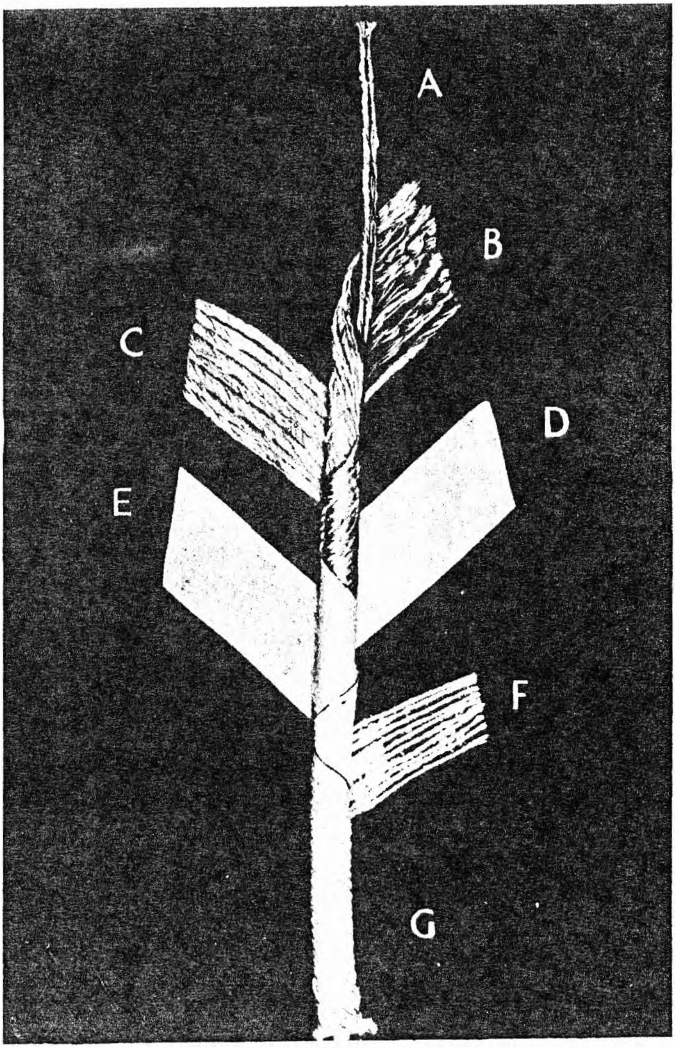


Fig. 1.
<u>JAPANESE SAFETY FUSE.</u>

Covering unwound to show construction.

A naval anchor and an inspection stamp are also present.

Fig. 3 shows the wooden frame which is contained in the metal container and on which the detonating fuse is coiled. The frame consists of two wooden discs $8\frac{7}{8}$" in diameter and $\frac{1}{4}$" thick nailed onto a smaller disc $5\frac{1}{2}$" in diameter and $\frac{3}{4}$" thick. The fuse is coiled in the groove so formed. A central 1-1/16" diameter hole drilled through the frame facilitates withdrawal from the container and also the coiling operation.

(REPORT BY MUNITIONS SUPPLY LABORATORIES, AUST.)

Figure 2. - Top Cover of Detonating Fuse Container.

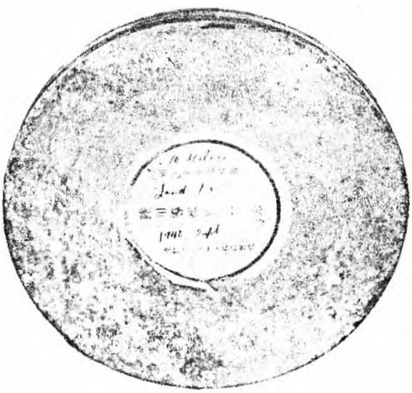
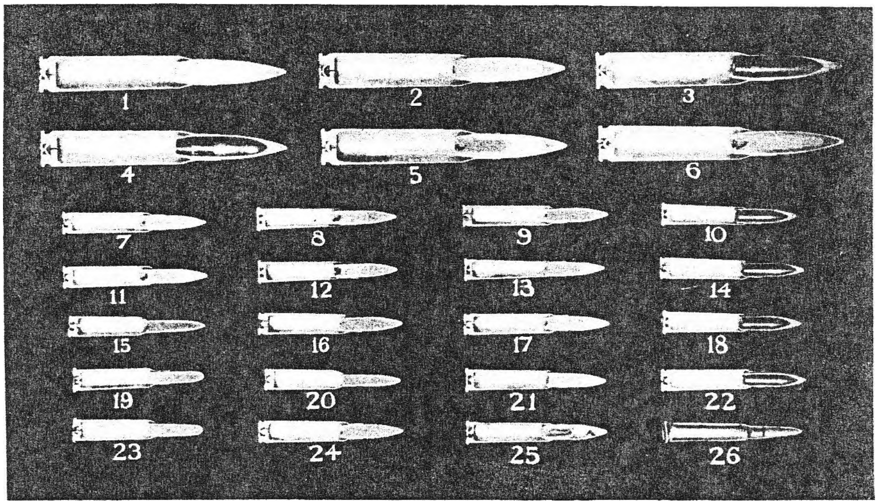


Figure 3. - Wooden Frame and Detonating Fuse.

TYPES OF AMMUNITION (JAPANESE)

Sample.	Type	colour
1.	13 M/M Ball S.L.	Black
2.	13 M/M Ball S.L.	Black
3.	13 M/M A.P. S.L.	White
4.	13 M/M A.P. S.L.	White
5.	13 M/M Tracer S.L.	Red
6.	13 M/M Tracer S.L.	Red
7.	7.7 Semi-Rimmed Tracer	Green
8.	7.7 Rimmed Tracer	Green
9.	7.7 Semi-Rimmed Ball	Red
1C.	7.7 Rimmed A.P.	Black
11.	7.7 Semi-Rimmed Tracer	Green
12.	7.7 Semi-Rimmed Tracer	Green
13.	7.7 Rimmed Ball	Black
14.	7.7 Rimmed-Semi A.P.	Black
15.	.256 Semi-Rimmed Ball	Red.
16.	7.7 Semi-Rimmed Ball	Red
17.	7.7 Rimless Ball	Red
18.	7.7 Rimmed A.P.	Black
19.	.256 Rimmed Ball	Red
20.	.256 Semi-Rimmed Ball	Red
21.	7.7 Rimmed Ball	Black
22.	7.7 Semi-Rimmed A.P.	Black
23.	.256 Rimmed Ball	White
24.	7.7 Rimless Ball	Red
25.	7.7 Rimmed Tracer Incendiary	Red
26.	7.7 Rimmed A.P.	Black

(REPORT BY M.G.O.)



TYPES OF AMMUNITION (JAPANESE)
(See Table Page 127)