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JAPANESE AMMUNITION

C.I. AMM. TECHNICAL REPORT

No. 5 (SECOND ISSUE)

(This Supersedes the *First Issue* which should now be destroyed)

GRENADE, HAND, OR DISCHARGER, H. E., TYPE '91 AND GRENADE, HAND, H.E., TYPE '97

JAPANESE AMMUNITIONC.I. AMM. TECHNICAL REPORTSREPORT NO. 5 (SECOND ISSUE)MAY 1945GRENADA, HAND OR DISCHARGER, H.E., TYPE '91ANDGRENADA, HAND, H.E., TYPE '97G E N E R A L

Before presenting a factual report on critical examinations carried out at Kirkee on Type '91 and Type '97 Japanese H.E. grenades it will be useful to make some general remarks on their development and use, based on an examination of large numbers of these grenades both at Kirkee and in the Burma Theatre.

The Type '91 grenade was evolved in 1931 and appears to have been intended as a hand or Discharger grenade. The firing of a grenade from a rifle was generally regarded as something of a makeshift and the trend then of Japanese Service opinion was probably that grenades should be fired from a Discharger. The Type '91 grenade could be projected, with its propelling attachment, from the Type Taisho 10 (1922) 50-mm. smooth bore Discharger and also from the Type '89 (1929) 50-mm. rifled Discharger. There is also believed to be another smooth bore Discharger known as the "1927 Model" which is very similar to the Taisho 10 in appearance and action. The 50-mm. smooth bore Discharger was probably designed initially as a flare Discharger while the 50-mm. rifled Discharger was designed to throw H.E. or smoke shell (spin stabilized) about 600 yards. The range from the Discharger with the Type '91 grenade is of the order of about 175 yards. The time of delay in the grenade being 7 to 9 seconds, it could be used equally well as a hand grenade, although the delay is a little too long. A somewhat similar position existed in the British Army before the present war. The No. 36 grenade was used as a hand and rifle grenade and the long delay time 7 to 9.4 seconds accepted. The 2-in. mortar (equivalent role to the Japanese 50-mm. Discharger) was introduced later.

2. Although the Type '91 grenade appears to be designed primarily for projection from a Discharger it is also fired (not very widely) from a spigot type launcher attached to a rifle. To effect this a tail unit is screwed into the base of the grenade replacing the propellant attachment and a bulletted blank round used as a rifle grenade cartridge. The grenade is heavy and with the rifle grenade cartridge used, the range must be short. No figures are available but, it is thought, it cannot be much more than 100 yards.

3. Subsequently, it is presumed, the Type '89 rifled Discharger with its long range and more efficient ammunition became available in adequate quantities and the need for projecting grenades from a Discharger declined. During operations in Assam and Burma in 1942-45 comparatively few Type '91 grenades were found and it is thought that they must now be largely obsolescent, if not obsolete, in that theatre at any rate.

4. About 1937 a modified version of the Type '91 grenade was introduced as the Type '97 hand grenade. The screwed cavity in the base of the grenade for the propellant attachment was omitted.

and the delay was reduced to 4 to 5 seconds. The grenade appears to have been intended only as a hand grenade, because no instances have been reported of an igniter set being fitted with a longer delay than 4 to 5 seconds. There is no reason, however, why this grenade could not be fitted with the standard long delay igniter similar to that used in the Type '91 grenade and used for projection from a rifle. Actually cup type launchers (discharger cups) have been captured in Burma which fit the Japanese Service rifle (6.5-mm.) and it is very probable that the Type '97 grenade is fired from rifles this way using a rifle grenade cartridge. See para. 16.

5. The Type '91 and Type '97 grenades have been frequently used by the Japanese as booby traps although the igniter mechanism which is similar to the old Adam's Type is not very suitable for this purpose.

6. Although each grenade is described separately below only one assembly sequence is shown for the Type '97 grenade on Plate B. This, however, applies equally to the Type '91 grenade, the components of which except for the delay tube are identical. In describing the Type '91 grenade on Plate A reference will be necessary to Plate B for details and assembly sequence of components.

D E S C R I P T I O N

GRENADE, HAND OR DISCHARGER, H.E., TYPE '91

7. The drawing in Plate A shows the general appearance and construction of the grenade. Plate B gives a detailed description and assembly sequence of internal components which are identical (except for the delay tube) in both types of grenade. For convenience of description the grenade can be divided into three main components:-

- (i) Body.
- (ii) Igniter assembly.
- (iii) Propelling attachment.

Body

8. The body is made of cast iron serrated externally to improve fragmentation effect and to facilitate holding by the thrower. The body is closed at the head by a flat screwed cast iron plug which is also serrated externally and has two key-holes diametrically opposite to facilitate screwing in. This plug is screw-threaded centrally to take the igniter assembly complete (fuze or igniter, delay tube and detonator). The details are shown clearly in the Plates. The body at the base is recessed* and screw-threaded internally to take the propelling attachment.

The filling is 2.2-oz. stemmed crystalline T.N.T. Following usual Japanese practice the top of the grenade is painted red to indicate that it is filled.

*NOTE:- Some grenades have been reported in which this recess is not screw-threaded and the propelling attachment was stated to be a push-fit in the base.

Igniter Assembly

9. This may be divided into two main parts:-

- (i) Igniter (or fuze) mechanism.
- (ii) Igniter assembly tube, holding delay tube and detonator.

10. Igniter Mechanism. This is of the percussion type consisting of a tubular brass body (5) screw-threaded internally at the lower end to take the delay tube (7) and externally to screw into the grenade closing plug (6). Details of this mechanism are clearly shown in Plates A and B. Note that the percussion cap is very similar to an ordinary S.A.A. cap (Berdan Type) and fits over an anvil formed in the cap-holder (4). The inertia pellet (2) with its screw striker is held off the cap by a light steel spring (3). The striker screws into the inertia pellet (2) and the grenade is issued with the striker withdrawn until the point is flush or below the surface of the inertia pellet (2) giving added safety during storage and transport. The striker has to be screwed down by the user and for this purpose small screw-drivers are issued on a fairly wide scale. A drawing of this screw-driver is given in Plate C.

It should be noticed that once the safety fork (1-A) is withdrawn the inertia pellet is held in position only by the brass ferrule which is a spring fit over the fuze body. If this gets distorted during transport and handling it may fall off, together with the inertia pellet (2) when safety fork (1-A) is withdrawn.

11. Igniter Assembly Tube. The igniter assembly tube (10) is made of copper and contains the delay tube (7) below which is a steel washer (8) separating the delay tube from the detonator (9). The detonator (9) rests on the felt pad. This arrangement will be clear from the Plates. The difference between the delay tube in the Type '91 grenade and the delay tube in the Type '97 grenade should be noted. All long delay tubes (7 to 9 seconds) examined were without any marking, while the short delay tube (4 to 5 seconds) has the time of delay stamped in Japanese characters as shown in Plate B. A relatively small number only of the long delay tubes have been examined and it is possible that some may be marked if of recent manufacture.

Propelling Attachment

12. The propelling attachment (11) is shown in Plate A. The construction of this component will be clear from the drawing. The propellant charge consists of about 15 grs. of flake N.C. The holder (15) and percussion cap in the propelling attachment appears identical with that used in the fuze and they are considered to be interchangeable.

Safety Devices

13. The safety of the grenade is ensured in three ways:-

- (i) During storage and transport to user troops the striker is withdrawn into the body of the inertia pellet (2) and even with accidental withdrawal of the safety fork (1-A) firing of the grenade is impossible.
- (ii) A safety fork (1-A) which passes through holes in the

brass ferrule (1) and fuze body (5) seats under the inertia pellet (2) positively preventing it from moving in the direction of the cap.

- (111) A striker spring (3) which after removal of the safety fork holds the inertia pellet (2) clear of the percussion cap until the fuze receives a blow sufficiently powerful to overcome the spring (3) or a sufficiently strong set-back force on firing.

Preparation for use and action

14. The grenades on receipt by the user are presumably examined and the striker screwed fully home. This can be done without removing the safety fork (1-A) or the brass ferrule (1).

(a) Action when thrown by hand. The grenade is held in the hand as shown in Plate C and the fuze is struck against a hard surface such as the heel of the boot and at once thrown. The sketch in Plate C has been taken from an actual Japanese instruction sheet packed with grenades. A point to watch is the hand or exposed portion of body must be clear of the vent hole to prevent being burnt by the escaping gases.

(b) Action when fired from a 50-mm. Discharger. The grenade is loaded in the Discharger from the muzzle after removing the safety fork similar to the loading of a British 2-in. mortar bomb. The Discharger is fired and the striker strikes the cap in the propelling attachment, causing the propellant to ignite. The propellant gases escaping through the six gas escape holes propel the grenade forward. The range is controlled according to the type of Discharger in use. Set-back forces cause the inertia pellet (2) to set back and fire the cap of the igniter set. The grenade then functions 7 to 9 seconds after leaving the Discharger.

(c) Action when fired from a rifle. The action here is similar to that employed for firing the American M9A1 H.E. Anti-Tank rifle grenade. The grenade by means of a tail unit is loaded on the spigot type launcher of the rifle, and the safety fork withdrawn. It is then fired in the usual way but a bulletted blank cartridge is used for this purpose. Again, set-back forces cause the inertia pellet to set back and the striker to fire the cap.

GRENADE, HAND, H.E., TYPE '97

15. The construction, and components of the Type '97 grenade, is generally identical with the Type '91 except that:-

(a) There is no screwed recess in the base to take the propelling attachment.

(b) The delay channel in the delay tube (7) is of a reduced length to give a short delay of 4 to 5 seconds.

Safety devices and action are identical with those of the Type '91 grenade and no further description is necessary.

16. As a result of examination of a large number of grenades the following observations are made, not as statement of actual facts but as suggestions for further study. Remarks are invited.

50-mm. cup type launchers (rifle discharger cup) which fit the Japanese Service 6.5-mm. rifle are known to be used and it is thought that the Type '97 grenades may be fired from rifles, using the normal rifle grenade cartridge. It would seem that:-

- (a) Some Type '97 grenades (4 to 5 seconds delay) were made from Type '91 grenade bodies, i.e. with the recess in the base. These grenades are naturally weak in the base and are not suitable for firing from a discharger cup. A number of those examined had the base portion painted white and studs of solder round the flanges, presumably to prevent accidental loading in a discharger cup. The usual label indicating 4-5 seconds delay fuze is pasted in the recess in the base which is not screw-threaded.
- (b) Certain Type '97 grenades are made to the same external dimensions as the Type '91 and are suitable for firing from a discharger cup. Those with defective bases, e.g. blow holes, have studs of solder also on the flanges to prevent accidental loading in a discharger cup.
- (c) Other Type '97 grenades have been manufactured as hand grenades only i.e. the flanges are approximately 53-mm. in diameter and the grenades cannot therefore be loaded in the discharger cup.
- (d) Certain grenades manufactured as at (c) above have had the flanges machined down to just under 50-mm. in diameter so that they can be loaded in the discharger cup.
- (e) Igniter assemblies are issued separately and can be fitted in the field by screwing in or out of the grenade. The copper igniter assembly tube (10) which seals the fuze hole and extends down the length of the filling facilitates interchange. It is possible that long delay igniter sets are fitted if necessary in Type '97 grenades. So far as is known, however, none has been found.

M A R K I N G S

TYPE '91 GRENADA

17. The body of the grenade and the propelling attachment are painted black. The brass ferrule of the igniter set is lacquered with a colourless lacquer. The igniter body (5) is stamped with Japanese characters indicating date of manufacture and inspection mark. This stamping is just above the closing plug (6) of the grenade and just below the lower edge of the ferrule (1). The closing plug (6) is painted red to indicate that the grenade is filled.

That this grenade has a long delay igniter set can be detected only by

- (a) the presence of the propelling attachment or the screwed recess in the base;
- (b) that the ferrule (1) is not coated with coloured varnish i.e. has a normal brass colour.

18. The conical base of this grenade is believed to be stencilled with characters indicating the monogram of the filling factory and date of filling. Grenades examined here, however, were very old and markings were very indistinct.

TYPE '97 GRENADE

19. The body of this grenade is painted black and the closing plug (6) painted red as in the case of the Type '91 grenade above. The ferrule (1) of the igniter set is, however, invariably lacquered with a purple lacquer. On the base of the grenade is pasted a paper label on which is printed 4 to 5 seconds time delay, see Plate B. In the case of grenades which have apparently been converted from Type '91 grenade bodies this label is pasted in the recess. Such grenades have also the conical base of the flange painted white, see para. 16 (a) above. The conical portion of the base is invariably stencilled on white paint with fillers' monogram and the date of filling, in this instance Nagoya Arsenal Branch Depot, October 41. 4 to 5 seconds delay tube (7) has been found invariably stamped with characters indicating this delay, see Plate B.

P A C K I N GTYPE '91 GRENADE

20. No grenades in original packing have been examined but reports indicate that 20 grenades are packed in a wooden box weighing about 50-lb., stowage dimensions being 30" x 13" x 6 $\frac{1}{2}$ ". It is assumed that these boxes are somewhat similar to the box described below for packing Type '97 grenades.

TYPE '97 GRENADE

21. Details of packing of this grenade are shown in Plate C. Two methods of packing have been examined here:-

- (a) Wooden box holding 20 grenades.
- (b) Waxed cardboard container containing five grenades. This container after being closed is hermetically sealed by dipping in wax. No details of the outer package are available but this is probably an ordinary wooden packing case holding two containers. The details and dimensions of this package will be clear from Plate C. The increased length of the tape used on the wooden blocks suggests that this may be a method of transporting grenades ready for use.

METALLURGICAL ANALYSIS

(Inspector of Metal and Steel, Ishapore)

TYPE '97 GRENADE

22. Body. This was a close grained cast iron of 20 Brinell hardness containing 3.7% total carbon; 2.1% silicon; 0.25% phosphorus and 0.57% manganese; which, apart from the phosphorus being somewhat lower than would normally be used for the purpose, shows no special features.

23. Inertia pellet (2) and fuze body (5). Had been machined from ordinary 60/40 brass bar of 160 V.P. hardness containing 59/60% copper with 0.25% lead and shows no special features excepting that a freer cutting material containing a higher lead content would normally be used for similar purpose.

24. Striker. Was a 0.7% approx. carbon steel which had been hardened and tempered to 470 V.P. hardness and showed no special features.

25. Striker spring (3). Was a tinned steel piano wire. No special features.
26. Ferrule (1). Was a 70/30 brass pressing made from sheet and showed 126 V.P. hardness. No special features.
27. Delay tube (7). Had been machined from a 60/40 type brass bar of 101 hardness which analysed at 58.5% copper with no lead. Shows no special features excepting the use of non-free machining material indicated by the absence of lead and low hardness.

CHEMICAL ANALYSIS

(Chief Inspector of Military Explosives, Kirkee)

These details apply to both types of grenade.

28. H.E. filling .. T.N.T. Crystalline, Grade I,
M.P. 80° C.

29. Fuze

Composition in percussion

cap ..	Mercury Fulminate	32%
	Potassium Chlorate	36%
	Antimony Sulphide	32%

Priming composition below percussion cap ..

* Gunpowder.

Delay composition in delay tube ..

* Mealed gunpowder

Booster charge in delay tube ..

* Gunpowder

Detonator ..

Mercury Fulminate and C.E.

* Quantity insufficient for quantitative examination.

30. Propelling attachment of Type '91 Grenades

Propellant charge
(Two natures have been examined)

Colour, size and shape

Composition

I About 15 grs. Black, shining, thin square flakes
(.05" x .05" x .004")

N.C., N.G., diphenylamine and graphite

II About 18 grs. Square flakes
(.025" x .025" x .006")

Graphited N.C. with diphenylamine as stabilizer

Priming composition)
above percussion)
cap)

Gunpowder mealed consisting of:-
Sulphur .. 9.0%
Potassium Nitrate .. 76.1%
Charcoal .. 14.9%
Volatile matter .. 1.2%

(There was no binding agent)

Composition in percussion)	Mercury Fulminate ..	32.0%
cap)	Potassium Chlorate ..	36.0%
	Antimony Sulphide ..	32.0%

A P P R E C I A T I O N

(Economic, manufacture and development aspects)

31. The Type '97 grenade appears to be the most commonly used grenade and is thought to be the Japanese standard hand grenade and counterpart of our No.36. The igniter mechanism is a slight modification of the old Adam's mechanism as used in a number of earlier British grenades e.g. the No.34 and No.37 Hand or Rifle Grenades. It has, however, obvious disadvantages and was abandoned by us in favour of the fly-off lever type as used in the No.36 grenade. As mentioned in para. 16 (e) the igniter sets are interchangeable either to change the delay or in case of deterioration.

32. It will be noticed from the metallurgical analysis that lead-free components are used generally which is probably connected with the fact that picric acid is a filling commonly used by the Japanese. Actually, however, no records can be traced of these grenades being filled with picric acid.

The general standard of workmanship and finish of the grenades is good.

F U N C T I O N I N G A N D P E R F O R M A N C E

Fragmentation Recovery Trial

33. As a standard for comparison, fragments recovered from a Japanese Type '97 grenade and a British No.36M grenade is shown on Plate D. Although it is stated that more small fragments were recovered from the Type '97 grenade, owing to the fragmentation being carried out under better controlled conditions, there is little doubt but that the body of the Type '97 grenade breaks up into infinitely more small fragments than the body of the No.36 grenade and that its incapacitating effect, except within a small range from point of burst is much less than in the No.36 grenade. It should be noticed that in this trial fragments above 1/25 of an ounce number 181 for the No.36, against 127 for the Type '97.

Fragment Effect Trials

34. Trials were also carried out to arrive at some idea of the lethal effect of the Type '97 grenade.

35. Dealwood targets 6-ft. high x 2-ft. wide and 1-in. thick were placed in a rectangular formation measuring 18-ft. square. A Type '97 grenade was placed in the centre at ground level in an upright position. Results are tabulated below.

Grenade No.	Functioning	No. of Throughs	No. of deep lodges	No. of Strikes	Delay
1	Complete detonation	131	60	118	4.37 secs.
2	"	245	99	132	3.73 secs.

36. Another trial with a Type '97 grenade was arranged by placing similar targets in a circular formation having a radius

of 30-ft. and the grenade detonated in the centre. Results are tabulated below. In this latter trial approx. 95% of hits on the target were 3-ft. and more above ground level.

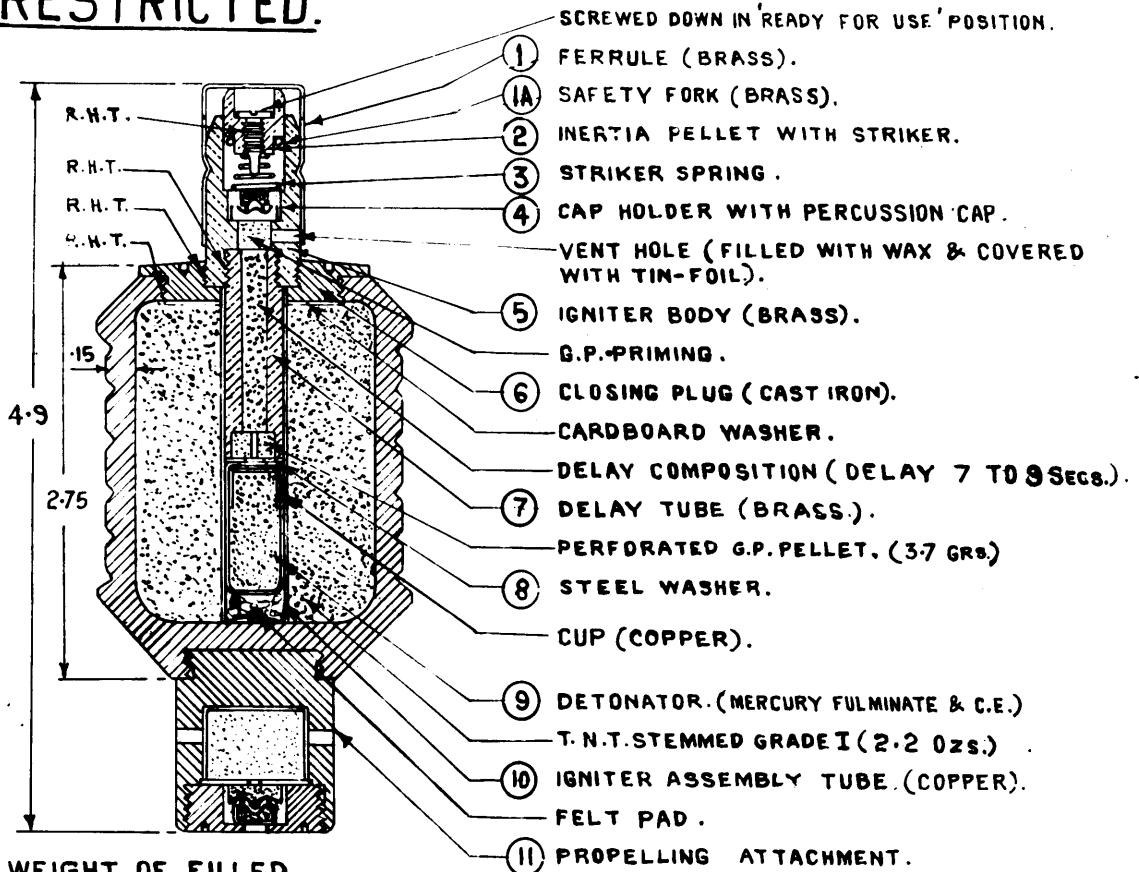
Grenade No.	Functioning.	No. of Throughs	No. of deep lodges	No. of Strikes.	Delay
3 Placed horizontally at ground level	Complete detonation	7	17	8	4 secs.
4 Placed upright 4-ins. above ground level	"	39	20	9	Not recorded

37. No trials with the Type '91 grenade were carried out since fragmentation is generally the same as for the Type '97. The propelling attachment is invariably blown off and is not fragmented.

SUMMARY OF DATA

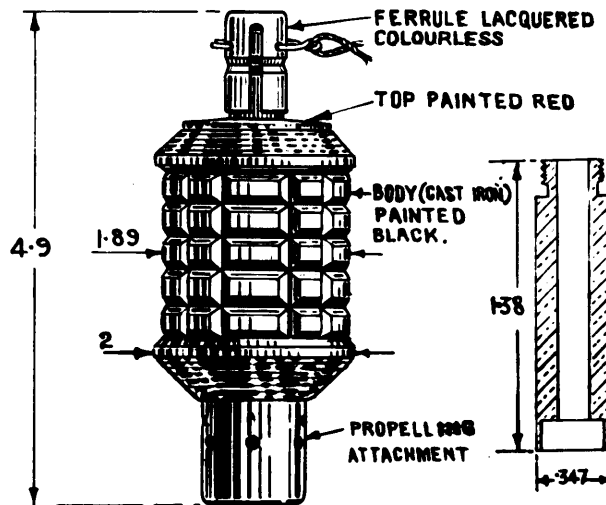
38.	Type '91	Type '97
Length overall (including igniter) ..	4.9"	3.9"
Weight filled ..	18.6-oz.	16.51-oz.
Length of body ..	2.75"	2.75"
Length of body with propelling attachment ..	3.7"	-
Maximum diameter (over flange) ..	1.985"	2.08" (but see para 16)
Maximum diameter over body ..	1.9"	1.9"
Nature and weight of H.E. filling ..	T.N.T. 2.2-oz. to 2.3-oz.	T.N.T. 2.2-oz. to 2.3-oz.
Weight of delay composition ..	10.16-grs.	6.16-grs.
Weight of perforated G.P. pellet (booster charge) ..	3.7-grs.	18.9-grs.
Time of delay ..	7 to 9 secs.	4 to 5 secs.
<u>Propelling attachment (11)</u>		
Length ..	1.2"	
Diameter ..	1.02"	
Weight filled ..	3.1-oz.	
Weight of propellant charge ..	I 15-grs. II 18-grs.	
(Two natures have been examined)		

RESTRICTED.

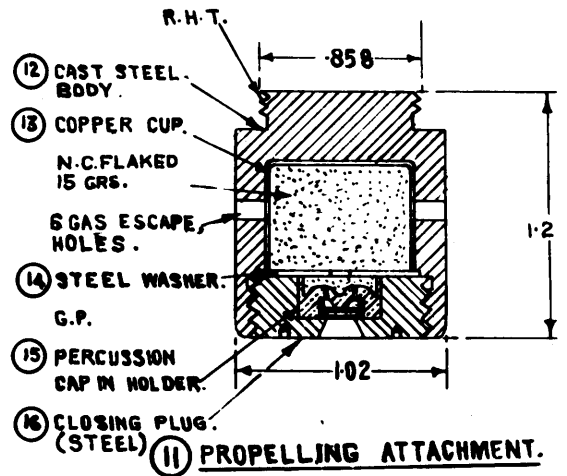


WEIGHT OF FILLED GRENADE :- 19.6 OZs.

NOTE:- FOR SEQUENCE OF ASSEMBLY OF COMPONENTS SEE PLATE 'B'



ENLARGED DETAILS.



⑦ DELAY TUBE.

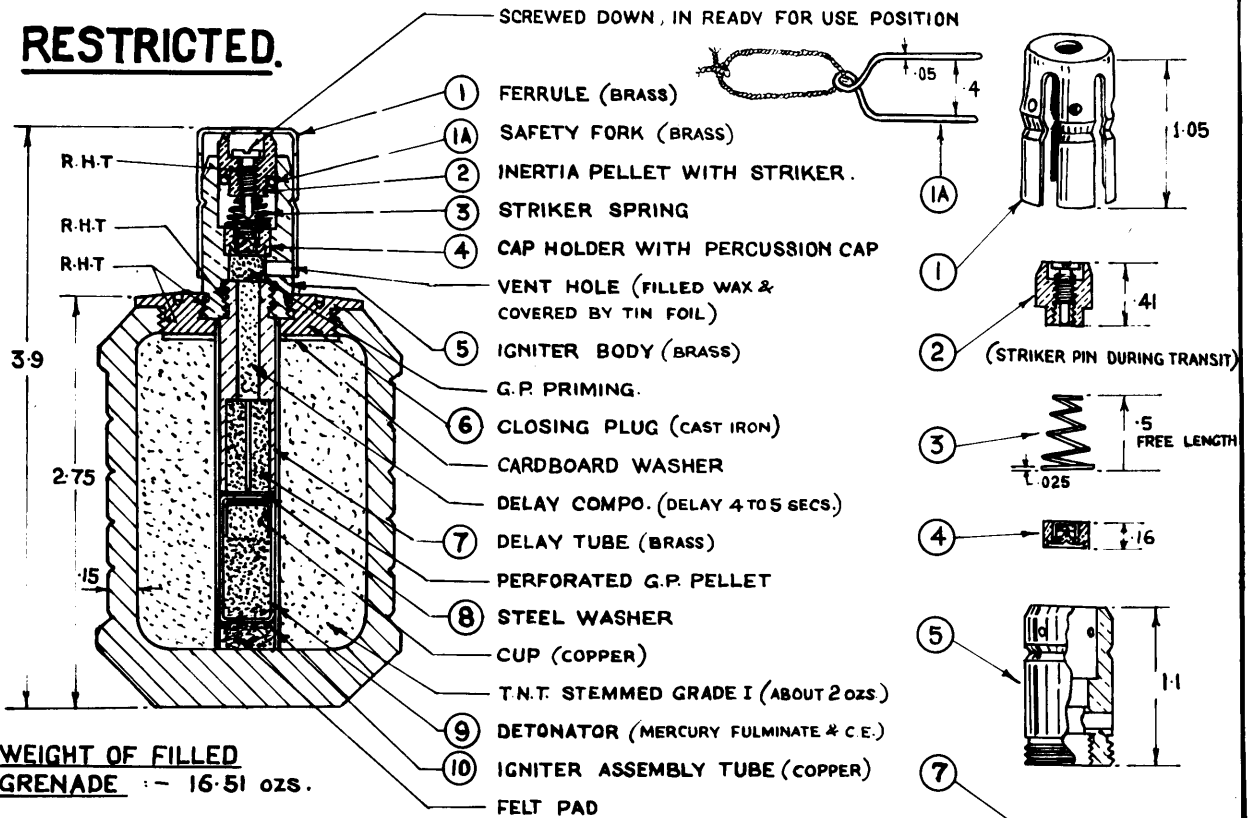
JAPANESE
GRENADE, HAND OR DISCHARGER, H.E., TYPE '91.

GENERAL ARRANGEMENT.

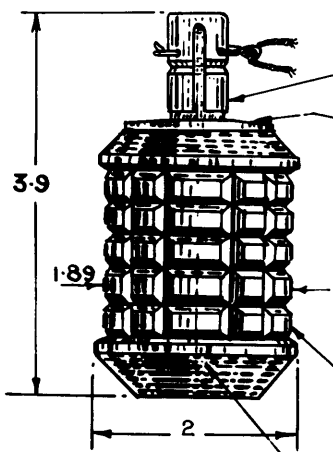
DIMENSIONS IN INCHES.

C.I.A.M.M. 5/1104.
 KIRKEE, MAY 45

RESTRICTED.



WEIGHT OF FILLED GRENADE - 16.51 ozs.



PAINTED IN WHITE



PAPER LABEL ON BASE OF GRENADE.

FERRULE LACQUERED PURPLE

TOP PAINTED RED

BODY (CAST IRON) PAINTED BLACK

STAMPED

四 4
1 1
延 5
時 SECS.

TYPICAL CHARACTERS STAMPED ON IGNITER BODY

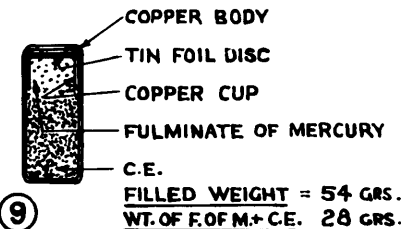
美 ☆ 4 三十 昭

TOKYO INSPECTION APRIL 1938 MARK

ENLARGED VIEW OF ITEM ④



DETONATOR



DIMENSIONS IN INCHES

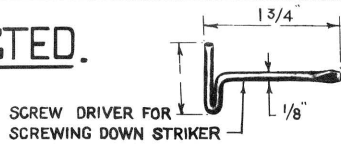
JAPANESE

GRENADE, HAND, H.E. TYPE '97

GENERAL ARRANGEMENT AND ASSEMBLY SEQUENCE.

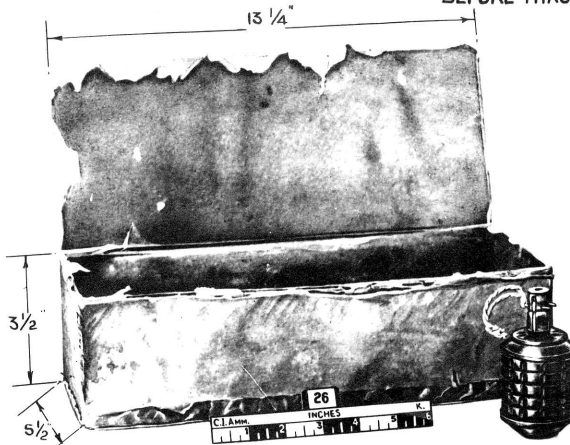
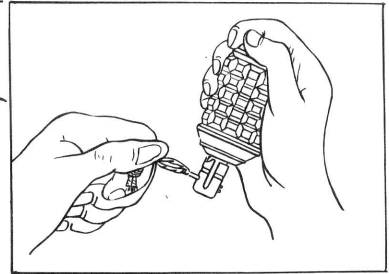
C.I.A.M.M.S./1103
KIRKKE, MAY '45

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SCREW DRIVER FOR SCREWING DOWN STRIKER

EXTRACT FROM JAPANESE INSTRUCTION SHEET ILLUSTRATING METHOD OF HOLDING GRENADE BEFORE THROWING.

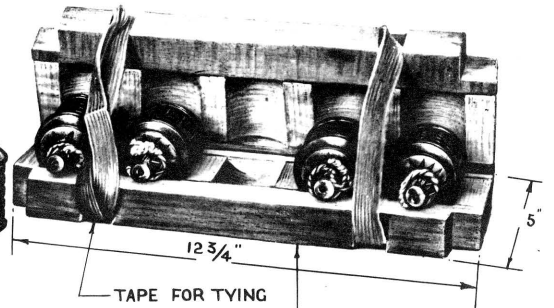


WEIGHT OF FILLED CONTAINER :-

7 LBS. 7 OZS.

WAXED CARDBOARD CONTAINER

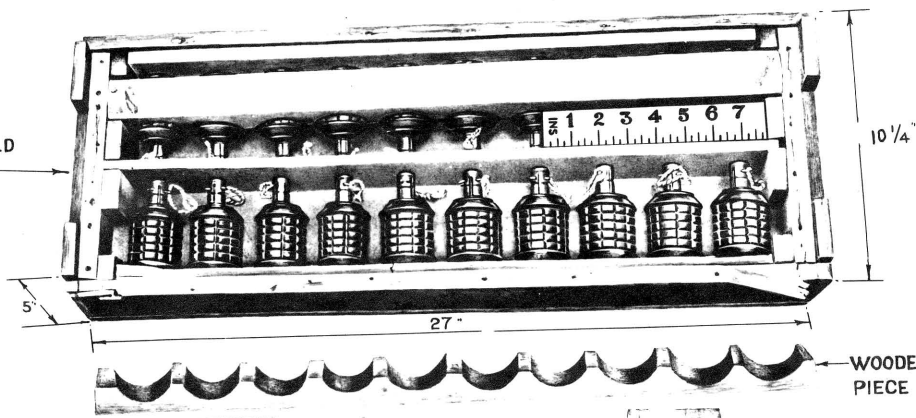
HOLDING FIVE GRENADES IN WOODEN PACKING PIECES; HERMETICALLY SEALED BY DIPPING IN WAX.



TAPE FOR TYING PACKING PIECES

WOODEN PACKING PIECES

WOODEN BOX TO HOLD TWENTY GRENADES

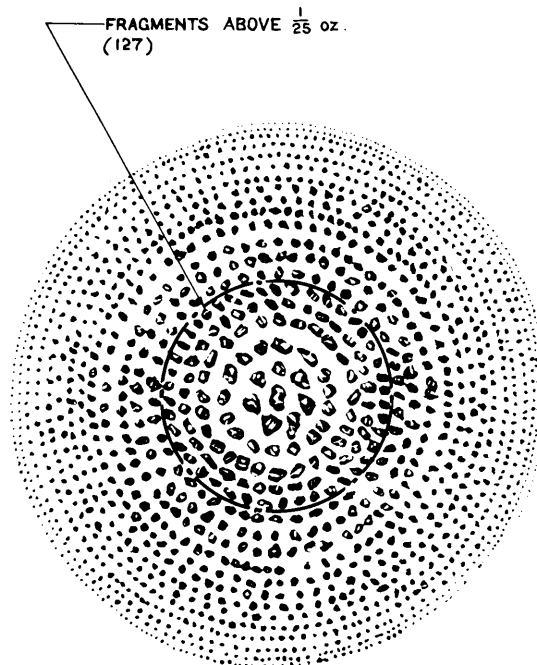
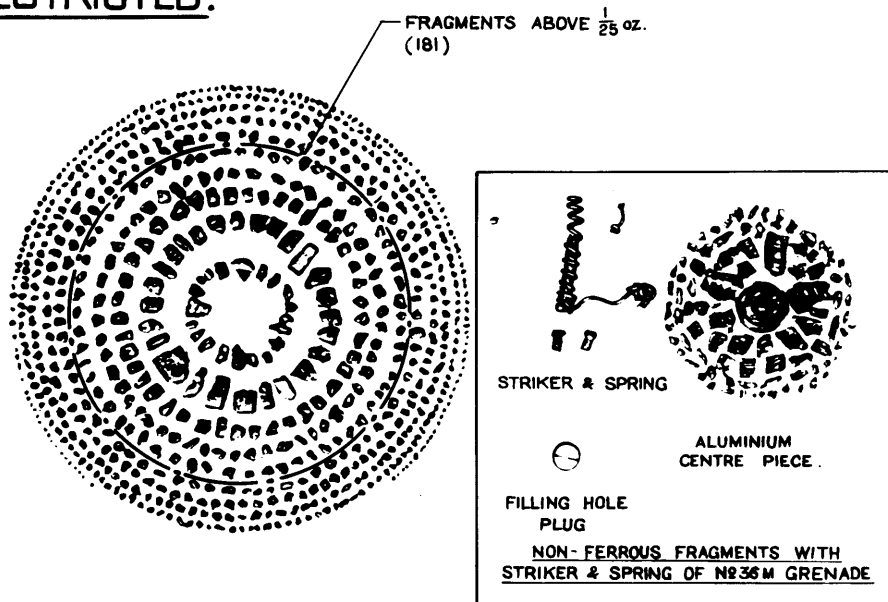


WOODEN PACKING PIECE

WEIGHT OF FILLED BOX :- 31 LBS.

**METHOD OF PACKING
JAPANESE GRENADES, HAND, H.E., TYPE '97**

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GRENADE, HAND, NO 36M (BRITISH)
FILLED T.N.T., K.F., 3-39



NOTES :

THE FRAGMENTATION OF THE NO 36 GRENADE WAS CARRIED OUT IN 1940 WHILE THAT OF THE TYPE '97 GRENADE WAS DONE IN 1943 UNDER MORE CAREFULLY CONTROLLED CONDITIONS. TO AVOID DELAY TRIALS WERE NOT CARRIED OUT SPECIALLY FOR THIS REPORT, OLD RECORDS BEING USED. EXTREMELY SMALL FRAGMENTS, SUCH AS WERE RECOVERED IN THE CASE OF THE TYPE '97 GRENADE, WERE IGNORED WHEN THE RECOVERY OF FRAGMENTS FROM THE NO 36 GRENADE WAS MADE; SUCH FRAGMENTS BEING CONSIDERED TO HAVE LITTLE IMMEDIATE INCAPACITATING EFFECT

DETAILS GIVEN, HOWEVER, SHOW CLEARLY THE BETTER FRAGMENTATION EFFECT OF THE NO 36 GRENADE.

GRENADE, HAND, H.E. TYPE '97 (JAPANESE)
FILLED T.N.T. GRADE I TOKYO 4-38
(EXCLUDING NON-FERROUS FRAGMENTS)

GRENADE	TOTAL WT. FILLED			WT OF EMPTY IRON BODY			PERCENTAGE RECOVERY.
	LBS.	OZS.	DRS.	LBS.	OZS.	DRS.	
NO 36	1	12	0	1	3	6	76
TYPE '97	1	0	8	0	14	8	85.6

COMPARATIVE FRAGMENTATION

— OF —

BRITISH SERVICE NO 36M GRENADE & JAPANESE TYPE '97 GRENADE.

CI AMM S 102
KIRKEE, MA