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U. S. NAVAL TECHNICAL MISSION TO JAPAN
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9 February 1946

RESTRICTED

From: Chief, Naval Technical Mission to Japan.
To : Chief of Naval Operations.

Subject: Target Report - Japanese Demolition Methods.

Reference: (a)"Intelligence Targets Japan" (DNI) of 4 Sept. 1945.

1. Subject report, covering Target O-35 of Fascicle O-1 of reference (a), is submitted herewith.

2. The investigation of the target and target report were accomplished by Lieut. H. L. Blackwell, Jr., USNR, assisted by Lieut. A. Wilkinson, RNVR, as interpreter and translator.

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Captain, USN

JAPANESE DEMOLITION METHODS

"INTELLIGENCE TARGETS JAPAN" (DNI) OF 4 SEPT. 1945

FASCICLE O-1, TARGET O-35

FEBRUARY 1946

U.S. NAVAL TECHNICAL MISSION TO JAPAN

SUMMARY

ORDNANCE TARGETS

JAPANESE DEMOLITION METHODS

Japanese Army and Navy demolition stores are in general of the simplest standard kind, drawn from or closely resembling civilian demolition supplies.

The Navy had done almost no research or development of specialized demolition items. The Army had done little more. Neither branch did any work comparable to that done by such agencies as the U.S. Army Engineer Board, the U.S. Navy Demolition Research Unit, the Janet Board, the U.S. Navy Bomb and Mine Disposal Schools, or to the work of the British Combined Ops. Experimental Establishment and the Obstacle Assault Center.

What little research done by the Japanese was devoted to purely defensive projects; American and British efforts were primarily offensive -- obstacle-demolition and special attack work. The only interesting demolition research done by the Japanese was on shaped charges especially as applied to anti-invasion defense; the only interesting training at all like U.S. assault demolition courses was that of the FUKURYU suicide groups, whose mission was destruction of Allied landing craft.

The little research work done was rendered almost valueless by (a) the incompleteness (or virtual absence) of exchange of information between Japan and Germany, (b) the similar lack of free exchange between the Japanese Army and the Navy, and (c) the failure of the higher officers in both branches to appreciate, until the end of the war, the importance of the subject.

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LIST OF ENCLOSURES

LIST OF ILLUSTRATIONS

REFERENCES

Location of Target:

Ordnance Experimental Department, Kure Navy Yard.
Second Naval Powder Arsenal, Hiratsuka, TOKYO.
Third Military Technical Laboratory, Kogachi Machi, TOKYO.
Yamashiro Arsenal, UJI, KYOTO Prefecture.

Japanese Personnel Interviewed:

M. MITSUI, Captain, ex-IJN, Head of Ordnance Experimental Department, Kure Navy Yard. (Graduate of Japanese Naval Academy, served in Gunnery Department of HARUNA (BB) and other ships; doctorate in explosives chemistry, Tokyo Imperial University; speaks English; capable and extremely cooperative.)

Y. KOHZU, Lt. Comdr. ex-IJN, Head of Ammunition Section of Ordnance Experimental Department, Kure Navy Yard. (Graduate of Naval Academy; served in BB YAMATO in Gunnery Department before war; graduate work Tokyo Imperial University; speaks a little English; capable, cooperative.)

K. NISHIDA, Tech. Lieut., ex-IJN, Fuse Designer of Ordnance Experimental Department, Kure Navy Yard. (11 years training as nuclear physicist, at Third Tech. High School (equals U.S. college) in KYOTO and doctorate at Tokyo Imperial University under SAGANI; speaks and writes good English and German; brilliant and highly cooperative.)

H. KITAMURA, Major, ex-Japanese Army. Head of Research on close combat weapons (including mines and demolitions) at Third Military Technical Laboratory, located at Kagane Machi, TOKYO. (Seemingly very intelligent; speaks very little English, but writes it a little.)

Pertinent Reports of Other Agencies:

References to other technical intelligence reports are included in the text of this report, under the appropriate subject headings.

INTRODUCTION

At the time of preparation of this report, representatives of other U.S. technical intelligence agencies operating in Japan had already investigated many aspects of the subject of demolition. The present report sets forth additional information obtained and, in order to avoid duplicating the reports of other agencies, such reports are simply referenced.

THE REPORT

Part I
DEMOLITIONS

A. Use of Shaped Charges for Penetration, Cutting, etc.

Shaped charges, exlusively for demolition purposes, did not exist in the Japanese Army or Navy. However, as the cutting or penetrating process is the same whether used in a demolition charge, or in a land mine or rocket, a discussion of Japanese research and experimentation of shaped charges is presented in Part II of this report.

B. Use of Mechanical and Chemical Time Delay Firing Devices

Questioning revealed no information on the use of time-delay firing devices, other than the obvious fact that they were employed with demolition charges and land mines during retreats. There is nothing to add to the discussion of these devices in the Handbook of Japanese Explosive Ordnance published by OPNAV 30-3M on 15 August 1945. Research and development personnel stated that they never received service evaluations concerning the performance of their products; they were unable to give information on the operational use of such materials.

C. Initiators for use with Detonating Cord

In the Japanese Navy, only civil-type blasting caps, standard electric or percussion, were used.

D. Security Demolition Charge Installations in Japanese Radar, Aircraft, and Ship Installations

No such charges existed in Japanese Naval equipment, according to categorical statements from the best available sources. Certain Japanese submarines, described as "operating near Pearl Harbor early in the war," requested scuttling charges, but none were ever issued them. The only existing Japanese naval doctrine for security destruction of classified material concerned code books, etc. At first, these were to be burned with a welding torch, but this method often resulted in imperfect destruction. Thereafter, documents threatened with compromise were to be placed in an airtight locker, the locker was to be evacuated by a simple air pump, and finally sulphuric acid was to be introduced.

E. Special Ammunition in Use As Decoys for Allied Weapons

No information was uncovered on this subject.

F. Yamashiro KAYAKU SEIZO KK, (Yamashiro Powder Manufacturing Co.) Miyamagimura, KYOTO-Fu

The Yamashiro Powder Manufacturing Company was investigated. Its principal products were:

1. Yamashiro Kayaku. (Yamashiro is ancient name for KYOTO Prefecture, Kayaku is Japanese for "powder".) This is a kind of substitute civil demolition explosive, made by pulverization of smokeless powders purchased from Army and Navy arsenals. About 200 tons were produced annually.

2. Carlite. (another name for Navy explosive Type 88). This was produced from dynamite and ammonium perchlorate obtained from other concerns. 400 tons were produced annually.

3. Starting cartridges for internal combustion engines. They consisted mainly of aluminum powder and barium nitrate; annual production unknown.

Part II
DEMOLITION TRAINING AND EQUIPMENT

A. Training

1. Navy. The Japanese Navy had no specialized demolition training programs comparable to those of the U.S. Navy Underwater Demolition Teams (UDT) or the British Landing Craft Obstruction Clearance Units (LCOCU), nor even such general instruction as was given to U.S.N. Construction Battalion personnel at Camp Perry.

However, the organization and training of the Japanese Navy FUKURYU are of interest, in connection with the reference to the U.S. Navy's UDT and the British LCOCU.

FUKURYU personnel were a sort of underwater KAMIKAZE Corps. Their suicide mission was to blow up by use of pole charges Allied landing craft attempting an invasion. They were to wait beneath the surface of the water, clad in two-piece rubber diving suits (not "swim-suits") and equipped with a self-contained, pure-oxygen breathing set, said to be good for fifteen hours, and with a container of liquid food, until Allied landing craft passed overhead. Each would then detonate his pole charge (Type 5 Attack Mine) against the bottom of a boat.

The FUKURYU demolition training consisted soley of learning to use the Type 5 Attack Mine (see Figure 1). This was a simple 10 kg charge with a crushable, horn-type exploder, mounted on the end of a 3-meter stick and fitted with an air chamber to reduce negative buoyancy to a very slight figure. It was also intended to have the FUKURYU manhandle naval mines and small torpedoes on the sea bottom in the same way, the mines to be fired after the sweepers had passed, and the torpedoes to be aimed by hand at some of the larger craft.

The organization, training, and equipment of the FUKURYU have been covered in detail in NavTechJap Report, "Special Underwater Attack Units (FUKURYU) and Harbor Defense Measures", Index No. S-91 (N). This report also includes Japanese doctrine concerning safe distances for underwater explosions, and some interesting ideas on protection from such explosions for men underwater.

The only other naval personnel given demolition training, as far as is known, were some members of the RIKUSENTAI (roughly equivalent to the USN Marine Corps). They were given elementary instruction in the use of standard civil demolition stores, in the same course given to Army personnel, at the TATEYAMA Naval Gunnery School.

A pamphlet, for use in giving elementary training in the use of demolition explosives and certain land-warfare weapons to naval personnel in the field, was prepared in July 1945 by members of the Kure Naval Ordnance Experimental Department, but distribution was never effected because of the war's end. The only extant copy has been forwarded to the Washington Document Center as NavTechJap Document No. ND 50-3232 (see Enclosure E). It contains an elementary explanation of the theory of detonation and initiation, and directions for the use of various naval land-warfare weapons such as the 8, 10, and 20cm. A/T rockets, the hemi-spherical hollow charge A/T mine, etc.

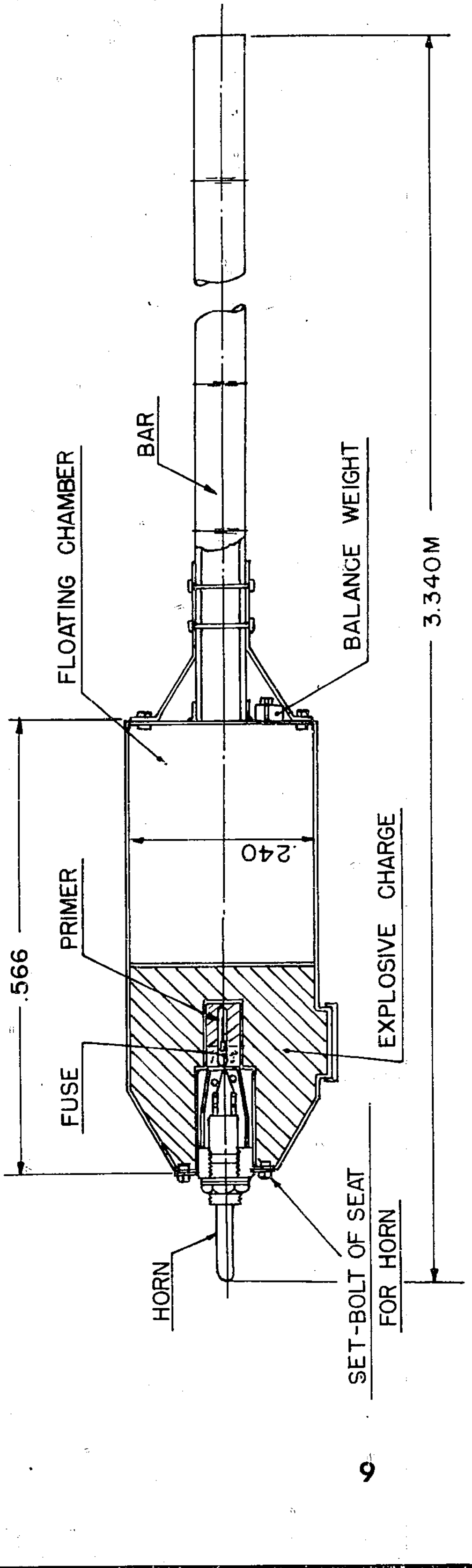

Figure 1
ATTACK MINE TYPE 5
FUKURYU OR SUICIDE UNDERWATER UNIT

2. Army. Some Japanese Army troops were trained in demolition. In addition to the engineer units, there was a special group called the SEMPAKU KO HEI (roughly translated Marine Engineers). Their mission, like that of the FUKURYU, was the destruction of Allied landing craft by the use of a charge on a stick. The mission generally involved the suicide of the attacker, blown up by the force of his own demolition charge. (The Marine Engineers, however, operated in the water but not submerged.) Training was conducted at UJINA near HIROSHIMA. It involved nothing so specialized as underwater swimming, and little work on explosives; it was mainly concerned with amphibious warfare in general. Major KITAMURA, source of this information, believed that as many as 5,000 SEMPAKU KO HEI personnel had been trained by the end of the war. He stated that members of these units were used to repel landings in the defense of Okinawa and Manila.

B. Equipment

1. Standard items. Japanese naval demolition equipment consisted mainly of standard civil-demolition items: caps (electric and non-electric), safety fuze, detonating cord, and charges. They Navy also frequently drew on the Army, or engaged in joint procurement with the Army. Since the early days of the war standard stores of both branches have been recovered and reported by many technical intelligence agencies. Demolition equipment, land mines, and booby traps are fully described in the below-listed publication (among many others):

HANDBOOK OF JAPANESE EXPLOSIVE ORDNANCE,
prepared by OPNAV 30-3M, 15 August, 1945

JAPANESE LAND MINES, BEACH MINES, AND IGNITERS,
published by U.S. Navy Bomb Disposal School, Sept. 1944

Reports of Mobile Explosives Investigation Unit #1
Reports of Mobile Explosives Investigation Unit #4
Reports of the Enemy Land Warfare Section of JICPOA,
(Joint Intelligence Center, Pacific Ocean Areas,
CINCPAC-CINCPOA).

2. Specialized equipment, including research and development. The problems of defense provided the only impetus of the whole war to the study of specialized demolitions. As has been seen, it was the need for a defense against invasion that was responsible for the organization of the FUKURYU. It was the need for a defense against the American tank that lay behind the development at KURE of the assorted sizes of hollow charge anti-tank rockets (see Figure 2), the hemispherical hollow charge land mine, and the experiments with German-type "Faustpatrone". Defense against invasion motivated Japanese Air Force work on a hollow charge warhead for the BAKU Kamikaze bomb. The theoretical background of this hollow charge work at KURE is rather thoroughly presented in Enclosure (A). All records of experimental data were destroyed, some accidentally and some purposely before the Americans arrived.

The extensive work done on shaped charges by the various Japanese Army Laboratories has been investigated and reported by the Ordnance Technical Intelligence Section of SCAP. OTI Report No. 11 -- "Japanese Hollow Charge Research and Development" will be available in the U.S. through G-2, War Department, Washington, D. C.

Theoretical mathematical work, done on behalf of the Japanese air forces, for the development of the hollow charge warhead of the SAKURA or BAKU suicide bomb, is contained in ATIG Report No. 158. Appendix B of that report - "Mathematical and Experimental Studies of the Hollow Charge" is based on studies by Prof. N. NASU, Earthquake Recording Institute, Tokyo

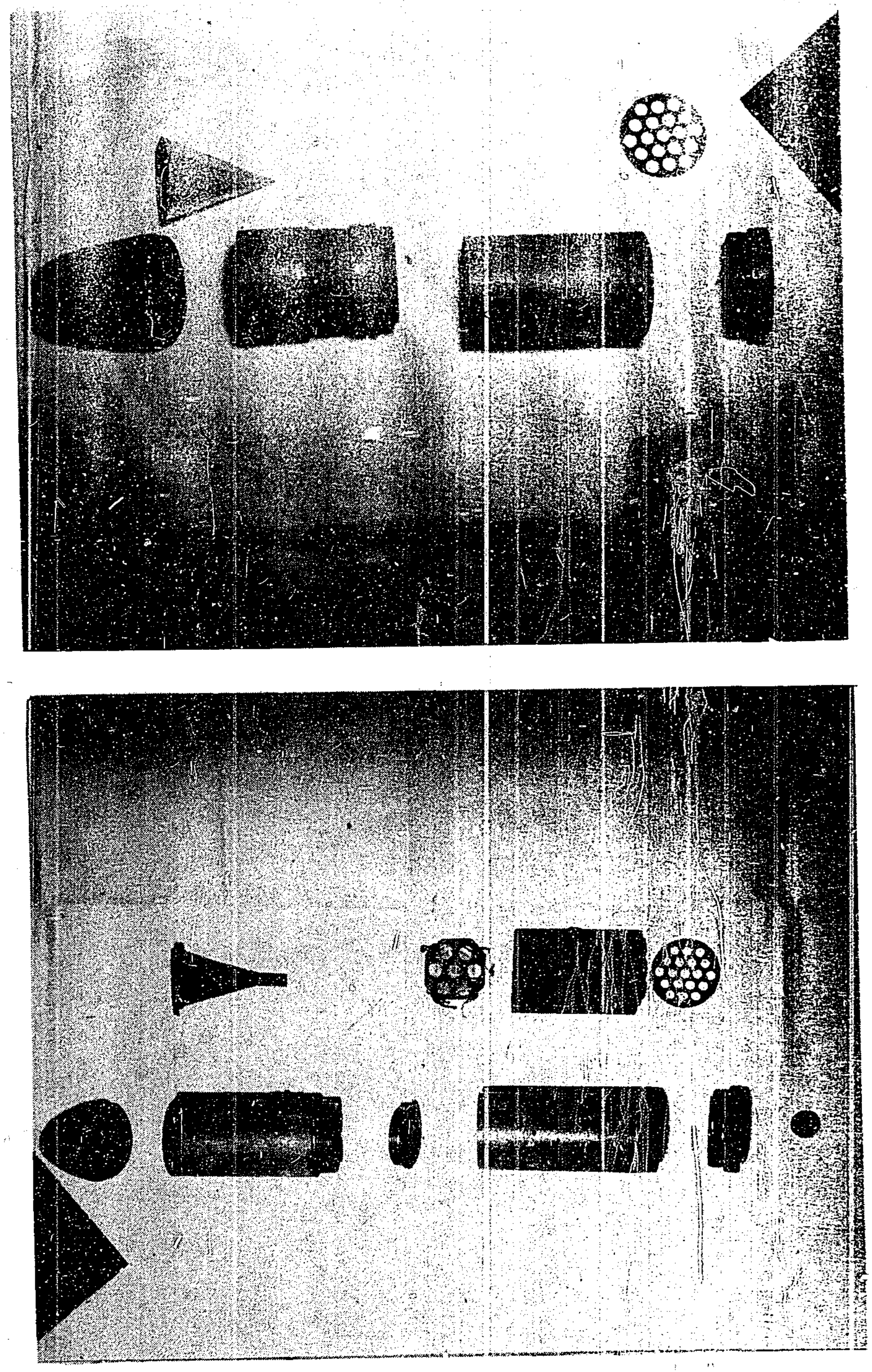

Figure 2

JAPANESE NAVAL 8cm AND 10cm HOLLOW CHARGES

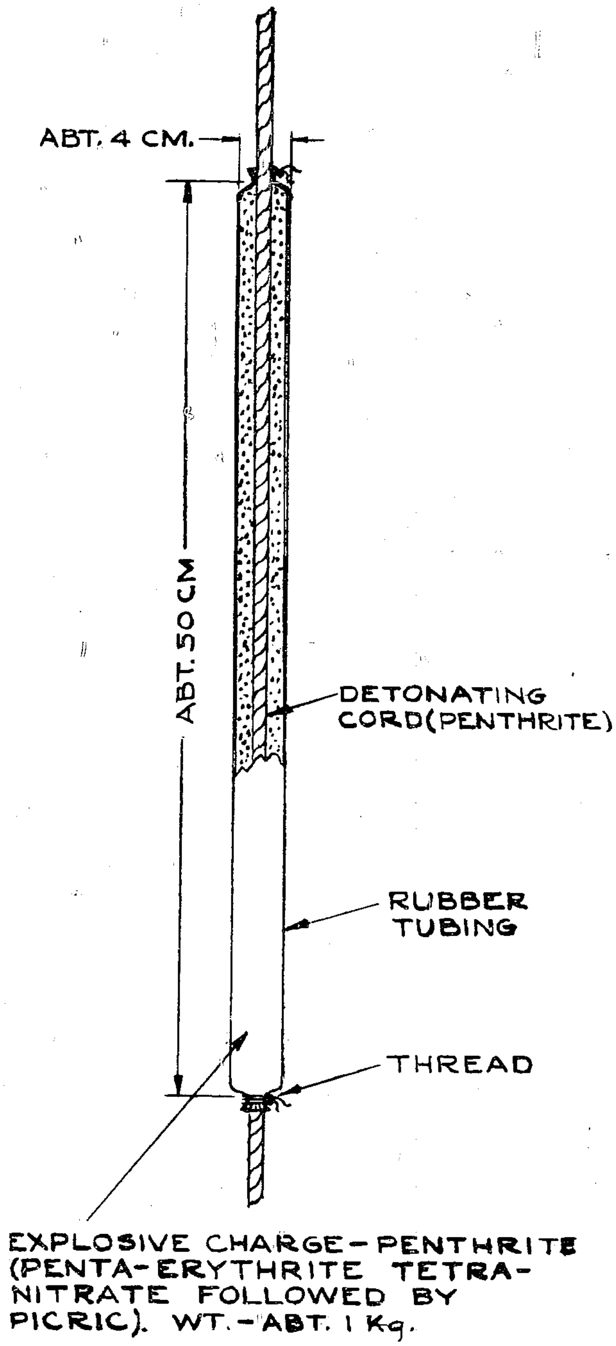

Figure 3

NAVY BAKUSAKU ROPE CHARGE

Imperial University.

Theoretical studies on the Vee warhead for the Type 95 torpedo are partially covered by Enclosure (B) of NavTechJap Report "Characteristics of Japanese Naval Vessels - Article 9, Underwater Protection", Index No. S-01-9.

In addition to the previously mentioned items the Japanese Navy had several specialized charges either in service or under experimentation. Service items included:

a. The BAKASAKU Rope Charge consisted of a quantity of P.E.T.N. in a cylindrical rubber container and was used for cutting timbers, girders, and for improvised demolition of aircraft. (see Figure 3) (A very imperfect step towards the U.S. Navy "Hagensen Pack" charge.)

b. The SENKO KAGU was a "hasty-cratering" charge consisting of 30 grams of Type 88 carlite and used in combat for quick digging of protective holes. It was manufactured by Kanfo Denki Kogyo Company and procured through Sagami Arsenal. (see Figure 4)

c. A "temporary explosive wheel" was a 120-kg depth charge, with delay firing by safety fuze which was intended to be dropped from cliffs. (Lieut. NISHIDA stated that about 300 of these charges were used at Iwo Jima.)

d. ETSUKI SAKUDAN (Hand Placed Charge) Model II was a SHIMOSE charge of one kilogram, fitted with a suction cup and a handle and was for use in sneak attacks on parked aircraft. It was developed at Sagami Arsenal.

e. A thermite grenade for bomb disposal, while not precisely a demolition charge, deserves mention. Samples have been forwarded to the Ordnance Investigation Laboratory (see Enclosure D). Object of the grenade was to produce low-order detonation of unexploded bombs; but in about 70% of the cases in which it was used, according to Lieut. NISHIDA's information, high order detonation resulted. Statements made by officers at Sagami Arsenal, where the grenade was produced, indicated better performance but NISHIDA is considered a very reliable source.

3. Experimental items

a. The BAKURIN (explosive wheel) was a sort of rocket-propelled cart. A large charge was mounted on a 4-wheeled cart which was propelled by three special rocket motors. The charge was delay-fired by a safety fuze ignited simultaneously with the rocket motors. Directional accuracy was so poor that development was abandoned. (It is believed that certain similar developments tried by the British Admiralty, although more "streamlined", were abandoned for the same reason.) (see Figures 5a and 5b).

b. The "Explosive Wheel, Remote Controlled" was a small, wireless-controlled automobile, carrying a large charge. It was designed at the Yokosuka Naval Technical Research establishment, but abandoned because of its complexity. (Not unlike the unsuccessful German "Goliath" tank.)

4. Special charges and mines. The Japanese Army had numerous special charges and mines. Most of these are already familiar to U.S. technical intelligence, and will be found in the publications already listed for standard stores. They had also two new land mines:

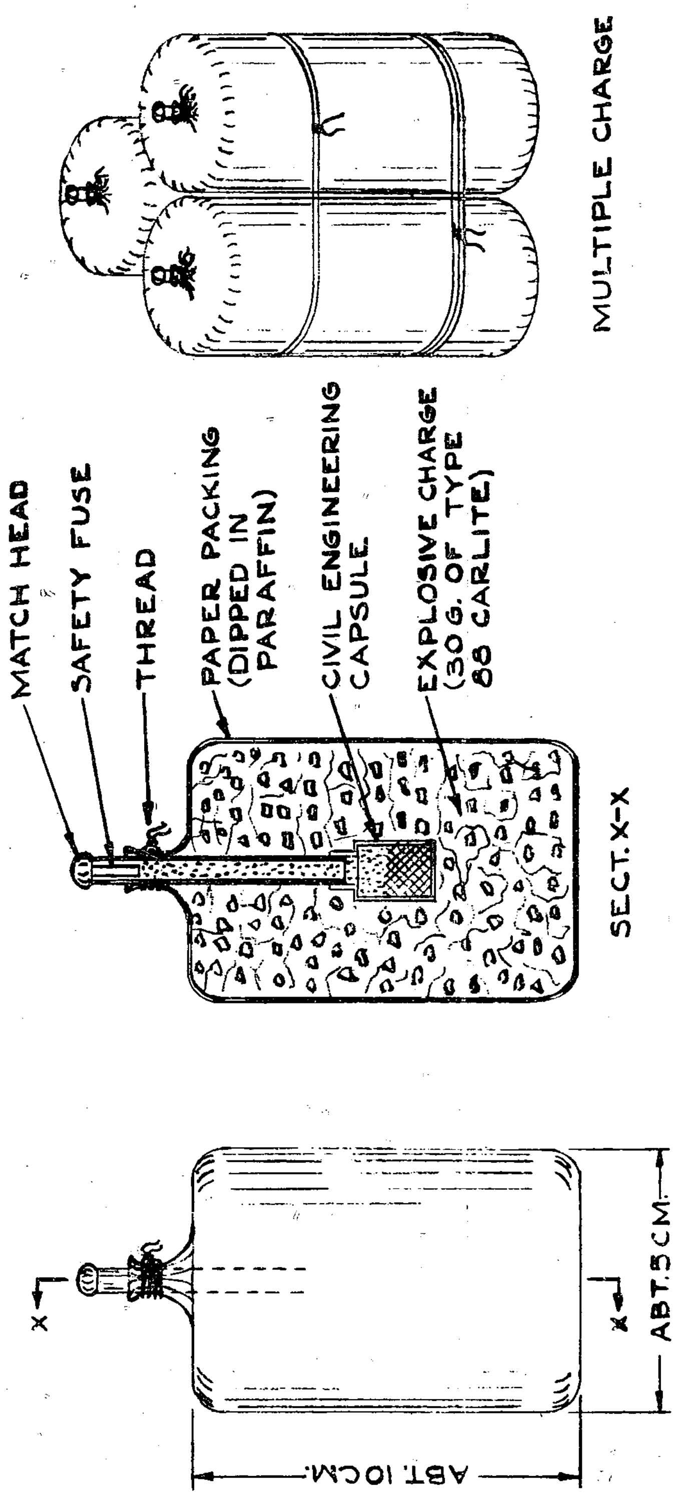

Figure 4
NAVY SENKO KAGU HASTY CRATERING CHARGE

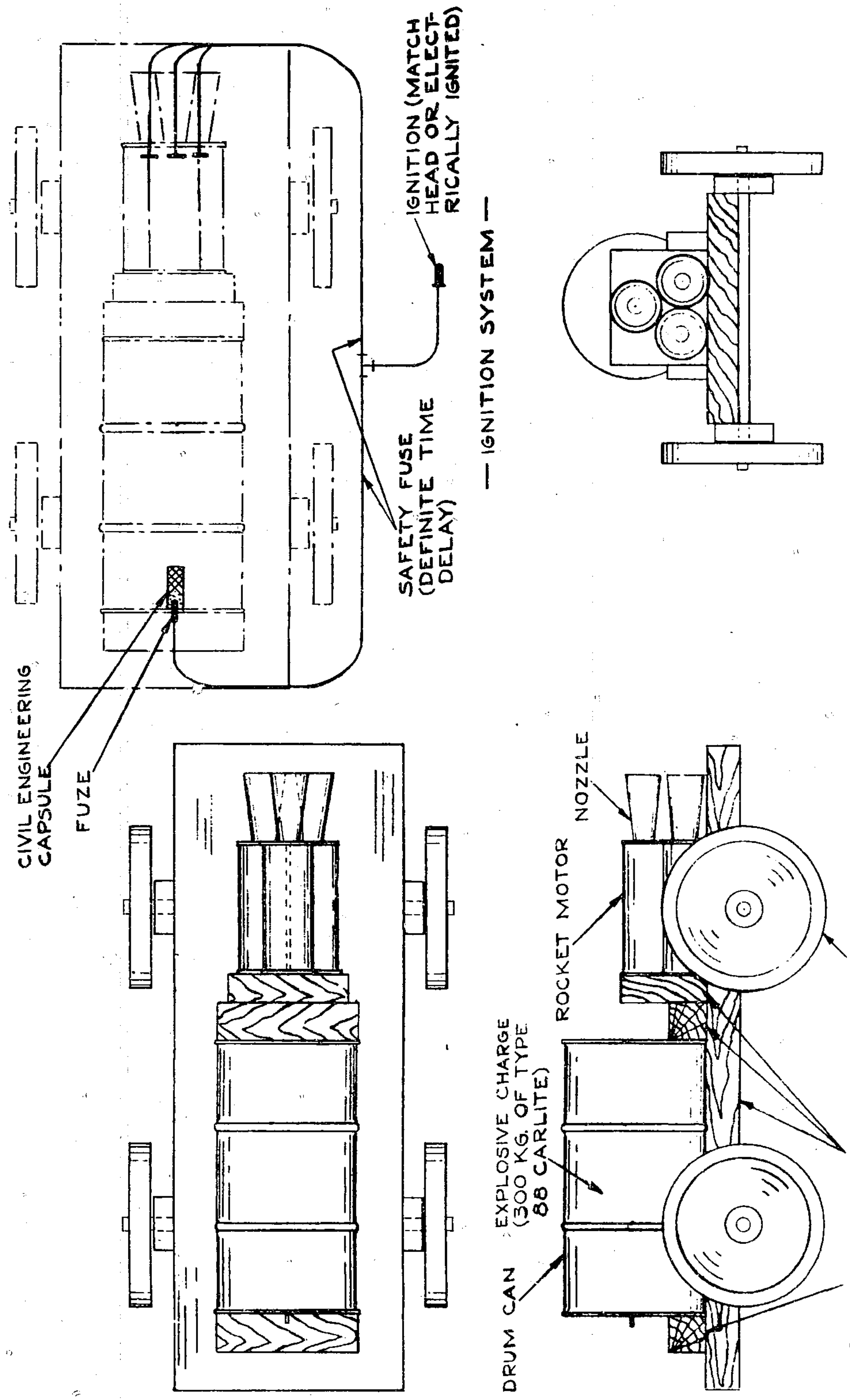

Figure 5-a
BAKURIN (EXPLOSIVE WHEEL)

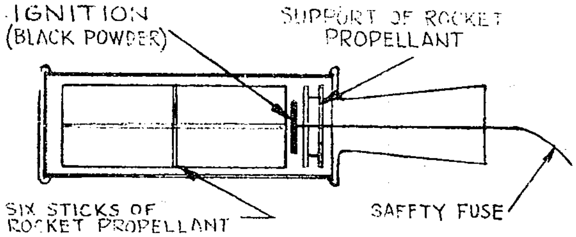

Figure 5-6
BAKURIN (EXPLOSIVE WHEEL) ROCKET

a. Amphibious Mine, Mark 4; which mine consisted of two standard ceramic mines, Mark 3, encased in a buoyant container. It did not get into production before the end of the war.

b. Ceramic Jumping Land Mine, Mark 3 was a development to increase the anti-personnel effect of the Ceramic Mine, Mark 3. It was never produced in quantity. Samples of this mine were shipped to the Engineer Board, Fort Belvoir, Va.

c. A floating, rocket-propelled, anti-boat mine which carried a charge of 100 kg was designed but abandoned for lack of directional control.

d. The SEN SUI BAKU was a hollow charge, anti-boat mine used by the SEMPAKU KO HEI. It consisted of 5 kg of Army explosive "L" loaded into a hemisphere 23cm outside diameter, 20cm inside diameter, and having a steel liner 1.5mm thick. The mine was on the end of a pole. A booster of 100 grams in the form of a rectangular block, was sunk halfway into the dome. Initiation was secured through a percussion igniter actuated by the man carrying the mine. These items and others were studied and developed by Major H. KITAMURA at the Third Military Technical Laboratory in TOKYO. The mines themselves are described in: "Japanese Military Land Mines, Demolition Explosives, and Accessories", prepared by Lieut. John Ward, Corps of Engineers, AUS, dated 11 January 1946, for the Chief Engineer, GHQ, AFPAC, and is available through the Office of the Chief of Engineers. Other research work on subjects related to Japanese Army demolition is described in the following Ordnance Technical Intelligence (OTI) reports:

- OTI Report No. 6, Part I - "Japanese Explosives and Powder Industry"
- OTI Report No. 6, Part II - "Japanese Ammunition Loading"
- OTI Report No. 6, Part III - "Japanese Explosives Research and Development"
- OTI Report No. 5 - "Research, Development, and Production of Japanese Army Ammunition and Components, Bombs, Mines, and Grenades"

These reports were prepared for the Chief Ordnance Officer, GHQ, AFPAC; distribution will be effected by G-2, War Department Intelligence Section, and includes copies to G-2, War Department, Washington, D.C. and to the Office of the Chief of Ordnance, War Department, Washington, D.C.

ENCLOSURE (A)

REPORTS ON THE JAPANESE NAVAL DEMOLITION

By former Lt. Comdr. Y. KOHZU and Lt. K. NISHIDA
(Members of the Ordnance Experimental
Department at the Kure Navy Yard)

(Paraphrased)

31 January 1946

Note: This report is compiled as our reply to the requests stated in the request dated 24 January 1946 of the U.S. Naval Technical Mission to Japan.

1. DESCRIPTION IN GENERAL

a. In the Japanese Navy, demolition was rarely used except for secondary purposes - to destroy some obstacles in civil engineering, to break captured or wasted gun barrels into scraps for re-collection of material, or to make an opening on sunken ships for salvage purposes.

In those cases no special demolition stores but only those of civilian use were used. Therefore, we will glance over these familiar articles easily obtainable as commodities of powder-factories in our country. There were no standard naval demolition stores worth mentioning.

b. Those groups trained and instructed in the technique of demolition were members of Naval Brigades. They were educated in the Tateyama Naval Gunnery School, not as special demolition squads but only for personal acquirements. Army personnel were trained there also.

The course of instruction, text books of training, and operational experiments were for Army use, and were unsuitable for naval purposes.

c. When land-warfare was getting more serious for our Navy, it lacked fundamental knowledge of demolition as well as that of pyrotechnics. This would have been indispensable in utilizing any explosives obtainable at the front for temporary applications in face of some unexpected circumstances.

2. INVESTIGATION ON HOLLOW CHARGE

a. The idea of the hollow charge was imparted by Germany to the Japanese Army for the first time in 1943, as a finished weapon without information about anything theoretical, then transferred to our Navy. We found some documents about a conical hollow charge without cone-lining in the library of our laboratory. They concerned experiments with a Type 95 torpedo warhead more than ten years ago, though it was also nothing but a practical application of "Neumann Effect" discovered about 30 years ago.

b. The seriousness of conditions in those days of the war obliged us to finish its application on some weapons only by means of 'trial and error' instead of a systematic method. So it was not before the last several months of the war that we started studying the fundamental problems of the hollow charge principle. However, as most of the actual weapons had been already issued with some degree of success on an unreliable basis, they were subjected to criticism a posteriori, being assumed to be something effective a priori.

ENCLOSURE (A), continued

c. Experiences already acquired up to then had revealed that the critical factors in hollow charge effect consisted of the following:

(1) Degree of detonation in whole charge .... e
(2) Stand-off distance (between lip of cone and object to be penetrated) .... d
(3) Angle of cone .... a
(4) Thickness of cone-lining .... t
(5) Material of cone-lining .... m
(6) Type of explosion .... s
(7) Amount of charge .... w
(8) Shape of charge .... k
(9) Angle of attack c

Then we assumed the following function:

$$H = f\,(d,t,a,c,ekw)$$

where H meant the depth of penetration, and at the same time it was convenient to adopt the following symbols, (which are shown in Figure 1(A): T, D, A_1, A_2, L.

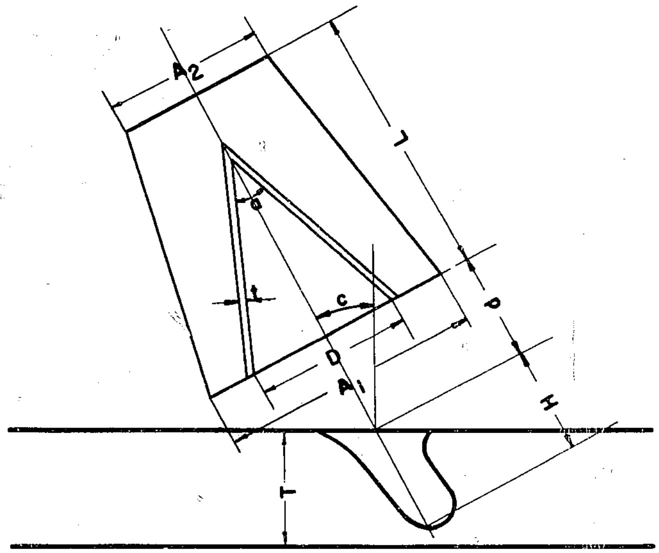

Figure 1(A)
THEORY OF HOLLOW CHARGES

As a result of the general demonstrative proof of all anti-tank weapons which was held at the end of June 1945, we had to re-examine all our knowledge, and investigations were accomplished to establish the above function. However, the function was not definitely established.

d. At first we wished to arrange all data collected from available reports of naval or Army laboratories. Most of these were merely an accumulation of experiments, except the one ontological investigation of the second Naval Powder Arsenal, which made clear the process of detonation in hollow charges and penetration into armor by photographing those phe-

ENCLOSURE (A), continued

nomena with an ultra-high speed camera.

Its conclusion was that the agents responsible for penetration were pulverized grains of the metallic cone-lining which were projected out of the lining and which rushed in a cloud against the armor plate. These grains had nearly the same order of velocity as the detonation itself, and they were followed by the blast of the explosion which assisted in enlarging the diameter of hole.

In those days, the lining was considered to fly as a whole against the plate, because of the remainder of deformed lining in the hole in the armor. But in that experiment it was proved that the total weight of the lining was considerably reduced after the explosion.

However, it remained unrevealed whether the function of the lining was as a reservoir of bombardment or a regulator for focusing the blast itself.

e. Through numerous tests they decided phenomenologically the optimum shape of a conical hollow charge to be as follows:

(1) $a = 40^o$.
(2) $D/A = 0.85$, $L/A = 1.9$, $t = D/34$ (where $A = A_1 = A_2$).
(3) m = mild steel.
(4) $f = 0.72$ (where $f = d/D$).

under the condition that:

s = Type 94: $c = 0^o$

These data were satisfactory for small scale testing.

For hemi-spherical hollow charges, it was decided that $f = 2.35$ was a satisfactory value and this type was better than the former for variable d.

f. <u>Relation between a and f.</u> This point had been a principal theme of argument for a long time and we could not establish it definitely. Values used were:

for $a = 30^o$ $f = 1$ or $f = 0.3 - 0.4$ (Army)
for $a = 40^o$ $f = 0.72$
for $a = 180^o$ (hemi-spherical)

$f = 0.5 - 1.5$ (s = TNT) }
$f = 2.4$ (s = Type 98) } Army
$f = 2 - 4$ (s - Type 94) }

However, we could not always agree with these conclusions, because reality was by no means so simple and plain. The actual weapons adopted unreasonably before then had the following values:

Name of Weapons	s*	D(mm)	a (deg.)	f	Hmax. (cm)
Hollow Charge Rifle Grenade	98	40	30	0.38	7.5
Hollow Charge Trench Mortar I	98	50	30	0.3	-
Hollow Charge Trench Mortar II	98	50	(hemi-sph.)	2.4	-
Conical Hand Grenade	94	60	30	0.33	15
10cm A/T/rocket	94	90	30	0.39	-
Hemi-spherical Mine	94	100	(hemi-sph.)	2-4	16

*Type

ENCLOSURE (A), continued

g. Relation between d and H (See Figure 2(A).) We could estimate the d-H characteristics assuming a as a parameter, and the value of d corresponding to maximum H became larger with a of cone. The general tendency of the curves was that a conical hollow charge had a sharp maximum; on the other hand, a hemi-spherical charge had a flat convex.

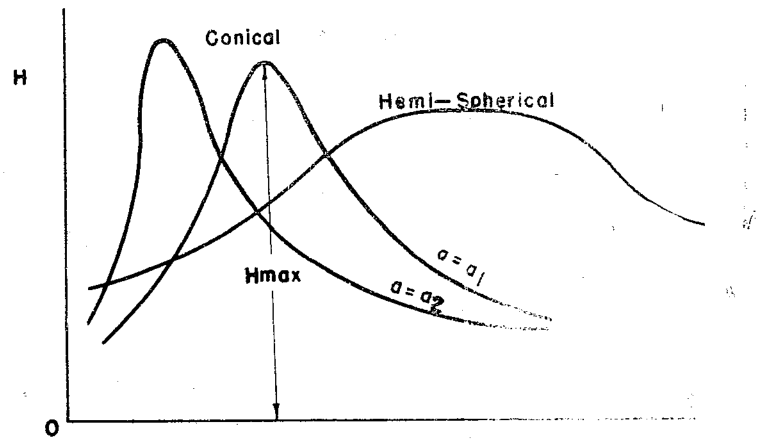

Figure 2(A)
THEORY OF HOLLOW CHARGES

It must be noticed that these curves were obtained by intentional elimination of the complicated effects of e, w, and k, which required separate, careful study.

h. Relation between w and Hmax. The first problem to be faced at the beginning of the design of a new hollow charge weapon is to determine the necessary quantity of charge for the required power. To make an estimate, we arranged in a diagram available data of various w's, from 5 kg to 0.1 kg for various kinds of explosives. To our surprise, Hmax was found to increase in linear proportion to w, and we developed the empirical formula:

$$\underset{(mm)}{H_{max}} = 100 + \underset{(kg)}{28w}$$

Of course, it became meaningless near w = o, but for any type of hollow charge, conical or hemi-spherical, this formula was valid within experimental error and useful for approximate estimation.

i. On the basis of the above mentioned facts, we hoped to establish design by positive methods and to clear away dogmatical conceptions, but it was not long before we had to abandon this schedule on account of the great catastrophe in August 1945.

j. Research on t and m. We studied the conical hand grenade with various kinds of cone-lining, especially for determination of the necessary conditions for manufacture. We found unexpectedly that frequent variation of its penetration power did not depend upon the casual variation of the lining but on the essential unstability of the detonation process in the cone-lining of 30°. (From this point of view 40° or 60° seemed much better.)

ENCLOSURE (A), continued

k. Research on k. On this subject we intended to find the most efficient form for a certain amount of charge, but could only establish whether cracks in shaped charges occurring at the impact on armor would effect its power. The conclusion was negative.

l. Research on detonation transmission from fuze to booster. If it is true that d must be known exactly for the purpose of getting maximum H, accordingly a certain value of d, the delay time between a nose fuze and a booster, should be determined exactly.

We used a Type 5, Model 2 percussion fuze which was situated 30cm from booster. The booster had a fine tin-foil and lead azide beneath. Of course, between the fuze and the booster was a funnel-form iron lining. With a high-speed camera the delay was found to be about 3×10^{-5} sec.

m. A most interesting and perplexing problem is the investigation on e, which still remains ambiguous. It is closely concerned with s, k, amount and shape of relay charge, initiating method and point of detonation. We could establish only the following facts:

(1) A certain amount of relay charge is necessary and sufficient independently of the amount of main charge.
(2) k and w are limited by s for high degree of e.
(3) e cannot be defined exactly.
(4) Primary initiation can hold its influence till the ultimate state of whole detonation in the main charge. (Owing to this fact, we adopted a hollow charge booster for the fuze itself.)

n. As for the influence of c, facts established a negative conclusion.

3. CUTTING GUN BARRELS

a. As already mentioned, our purpose of cutting gun barrels captured or wasted was only to salvage them, so we never developed a regular method. We made it a rule to determine approximately the amount of charge and method of ignition in accordance with the strength and structure of the barrels in question. Moreover, the blowing-up had to be such as to permit collecting the fragments easily. The principle of the hollow charge was unsuccessfully applied to this work.

b. To break barrels into adequate pieces, they put a series of charges in a barrel, the charges being separated by soil from each other, and both ends were packed tightly with clay. Every detonator in the charge was connected in a series to a main electrical circuit.

c. Japanese troops were never provided with gun-barrel cutting-charges for their retreat, because before this war they had no word for 'retreat' in their dictionary. Even in case of being annihilated, the last man was ordered to injure only the breech mechanism.

4. INCENDIARY GRENADE FOR BOMB DISPOSAL

a. We have no information on this problem, because this grenade was made in the Sagami Navy Arsenal and no intelligence about it has been given to our circles. We can only add that the percentage of successful low-order detonations was about 30%.

ENCLOSURE (A), continued

5. ON U.S. DEMOLITIONS SQUADS

We have nothing to describe here, because no sailor escaping from the fighting fronts has ever reported on this subject. We only heard of powerful machines as destroyers of artificial obstacles.

If any information had been obtainable, it would have been told to us by officers in charge at the ex-Navy Technical Department in TOKYO.

ENCLOSURE (B)

COMPOSITION AND MANUFACTURE OF JAPANESE INCENDIARY GUM (RUBBER)

By Tech. Comdr. Y. NOSE, ex-IJN

1. COMPOSITION AND USES OF INCENDIARY GUM

According to the weapon applied, the composition of incendiary gum is modified. Against airplanes, the combustion velocity of gum is required to be very rapid and efficient to ignite gasoline vapor. Against ship and ground targets, the composition is determined so as to be effective for igniting fuel oil and other combustibles.

TABLE I(B)
(All data are percent)

	Thiokol	Natural Rubber	Sulphur	Stearic Acid	Carbon Black	KNO_3	$Ba(NO_3)_2$	Electron Metal Fragments	Fe_3O_4	Al Particles
Ignitor (D)	13	68	10	0.2	5	65	—	—	—	—
Second Ignitor (S)	9.3	5	0.5	0.2	—	—	55	30	—	—
Incendiary Gum(F)*	9.3	5	0.5	0.2	—	—	40	45	—	—
Incendiary Gum(T)**	9.3	5	0.5	0.2	—	—	30	10	25	20

Note: Data reproduced from memory.

* 12.7cm, 15.5cm, 20cm, 36cm and 40cm against airplanes.
** 14cm incendiary shell for submarine gun used against ship and ground targets. 60 and 250 kg incendiary bombs against ship and ground targets.

Ignitor (D) is, so to speak, a rubber-bound black powder. Ignitor (S) is to ignite from (D) to (Z) or (T). Incendiary (Z) burns very rapidly and gives off voluminous gas and burning electron metal fragments which ignite gasoline vapor. This incendiary material is efficient for igniting gasoline vapor only. The combustion velocity is changed by the composition, especially by varying the percentage of the barium nitrate and electron metal fragments. Incendiary gum (T) is a rubber-bound thermite mixture. For 12.7, 15.5, 20, 36 and 40cm AA incendiary shells (D), (S) and (F) are used.

Against airplanes, the incendiary piece must rupture the gasoline tank and cause gasoline leakage. For this purpose the gum is loaded in small steel pieces. (See Figure 1(B).)

For 14cm shells, 60 and 250 kg bombs, (D), (S) and (T) are used.

For these applications the gum is used in the shape of gum black or loaded in pieces of steel pipe. (See Figures 1(B), 2(B) and 3(B).)

ENCLOSURE (B), continued

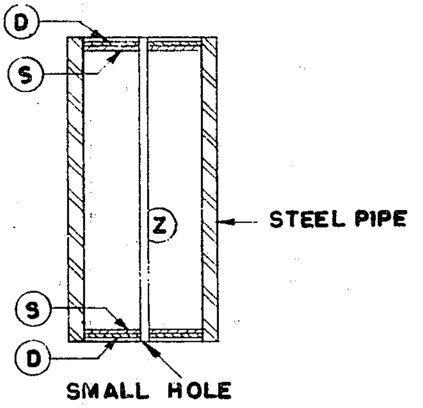

Figure 1(B)
INCENDIARY PIECES FOR AA INCENDIARY SHELL

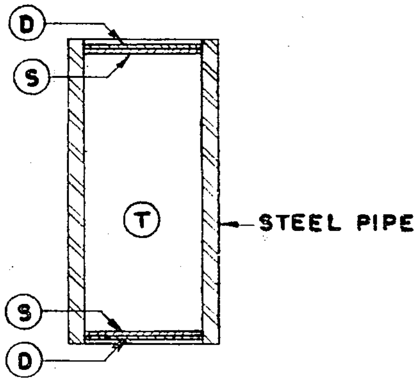

Figure 2(B)
INCENDIARY PIECES FOR 14cm SHELL AND INCENDIARY BOMBS

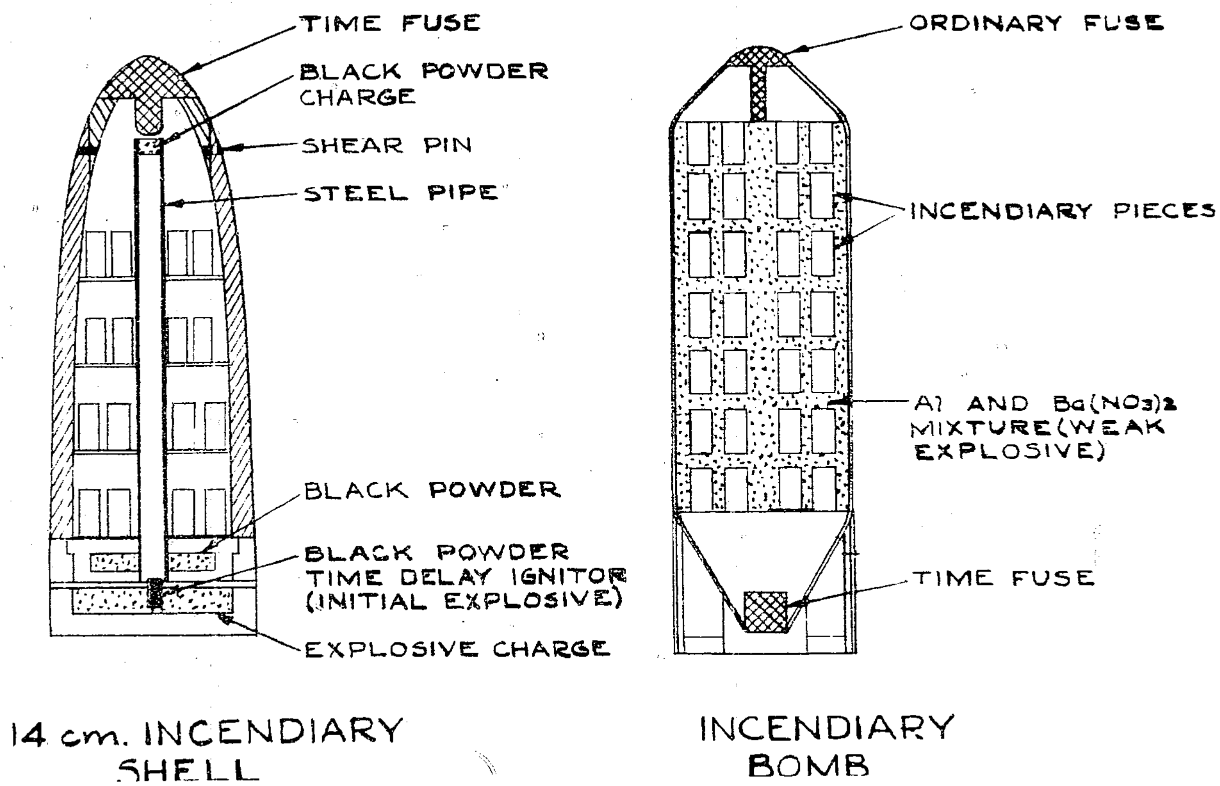

Figure 3(B)
14cm INCENDIARY SHELL AND INCENDIARY BOMB

ENCLOSURE (B), continued

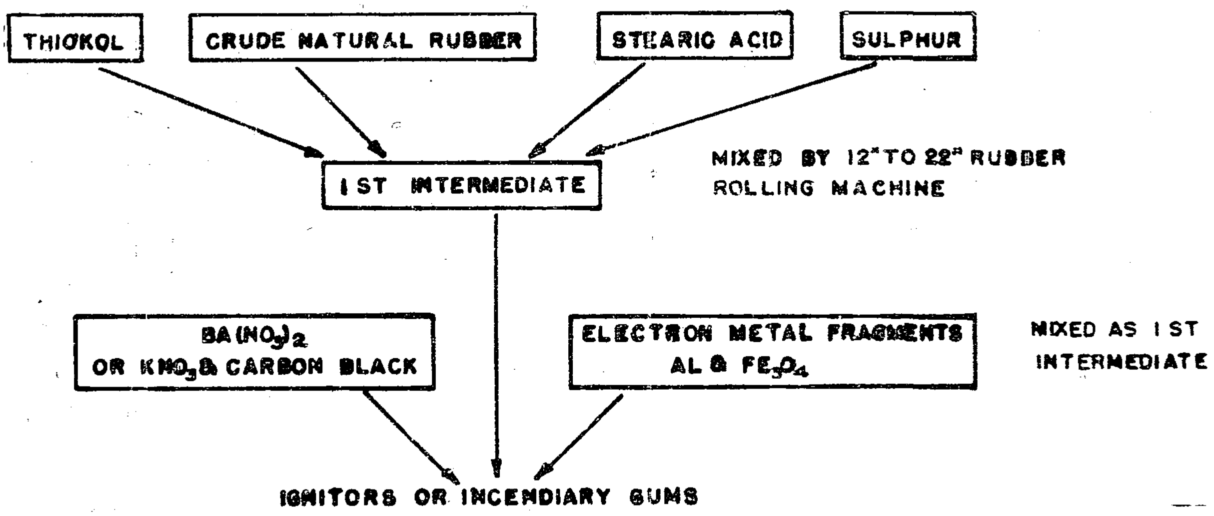

Figure 4(B)
IGNITORS OR INCENDIARY GUMS

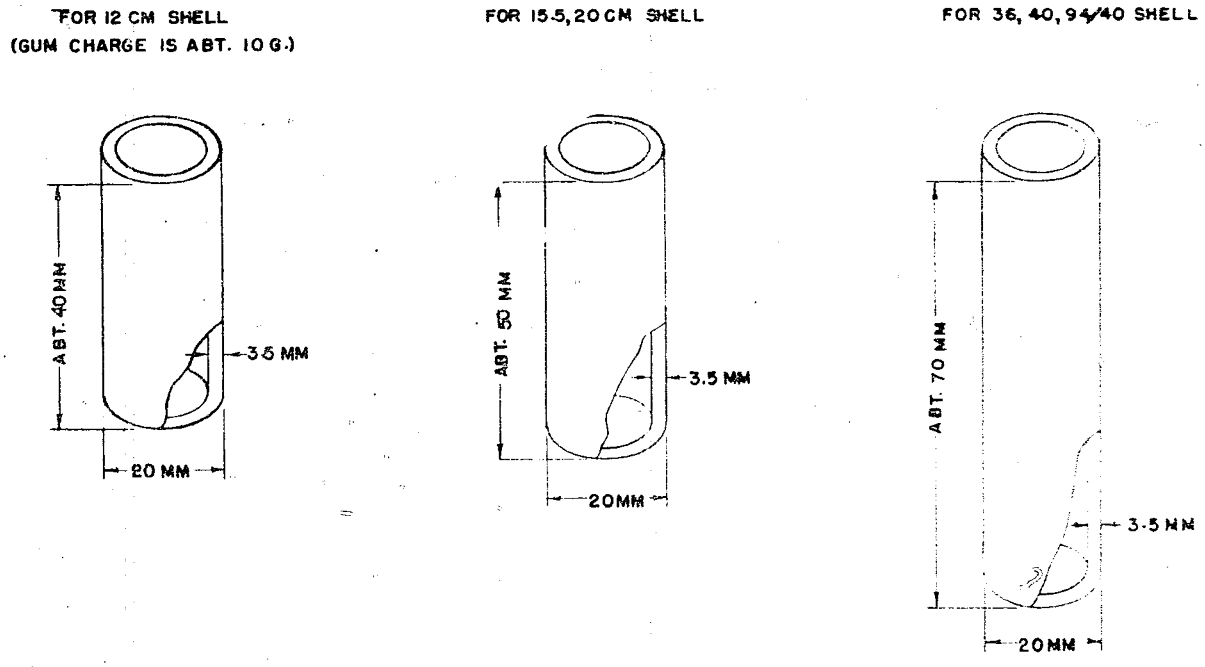

Figure 5(B)
TYPES OF INCENDIARY GUM CONTAINERS

ENCLOSURE (B), continued

The special requirements of incendiary rubber are as follows:

a. Ease of igniting by the flame of the black powder charge or other aluminum mixed explosive charge.
b. Must break into small pieces when bomb or shell explodes.
c. Combustibility.
d. Incendiary effect.

Smoke and illuminating agents are also mixed with the rubber. Zn, C_2Cl_6, or aluminum powder and $BaNO_3$ are mixed with natural rubber and thiokol for this purpose.

2. METHODS OF MANUFACTURE AND LOADING

(D) and (S) are made in 1-2mm sheets. (Z) and (T) are made in about 3mm sheets. (Z) and (T) are cut and rolled by hand and loaded or shaped by a hand pressing machine. Then (D) and (S) are stamped and combined by a hand pressing machine.

3. USES AND EFFECTIVENESS IN ACTUAL OPERATIONS

Type 3 shell (incendiary shrapnel shell) is expected to be effective against ordinary airplane gasoline tanks but not against rubber-covered, shell-proof types.

The 14cm incendiary shell has some effect against oil tanks of ship or ground targets. 60 kg and 250 kg incendiary bombs are also useful for the same purpose.

ENCLOSURE (C)

LIST OF EQUIPMENT SHIPPED TO ORDNANCE INVESTIGATION LABORATORY, INDIAN HEAD, MD.

Equipment No.	Description of Item	Quantity
JE 10-4100 (1-10)	Wooden Box Land Mines	10
JE 10-4106	Tape Measure Land Mines	1 box
JE 10-4015 (1-5)	Terra Cotta (Small Type Land Mines)	5 crates
JE 10-4023 (1-5)	Yardstick anti-tank Mines	5 crates
JE 10-4033 (1-5)	*Attack Mines (not the Lunge Mine)	5 crates
JE 21-4042	*Type 5 Strike Mine	1
JE 21-4041	Type 3 Seashore Land Mine	1
JE 21-4081 (1-2)	Large Hemispherical Land Mine	2
JE 21-4413	Bag Mine	1
JE 21-4090	Wooden Bos Mines	4
JE 21-4410	Type 93 Non-Magnetic Land Mine (with holes)	1
JE 21-4088	Type 93 Non-Magnetic Land Mine	1

* May be same as item shown in Figure 1 of this report.

ENCLOSURE (D)

LIST OF DOCUMENTS FORWARDED TO WDC VIA ATIS

NavTechJap No.	Name	ATIS No.
ND50-3232	Japanese Ground Warfare Weapons Manual	4093