

00
DECLASSIFIED

CONFIDENTIAL

DECLASSIFIED
EXEMPT R 5200.9

Gene - Retain
DECLASSIFIED

30 June 1946

BULLETIN OF ORDNANCE INFORMATION

No. 2-46



Issued Quarterly by the Bureau of Ordnance

A7-1(3)(PLb)

NAVY DEPARTMENT
BUREAU OF ORDNANCE
WASHINGTON 25, D. C.

30 June 1946

BULLETIN OF ORDNANCE INFORMATION NO. 2-46

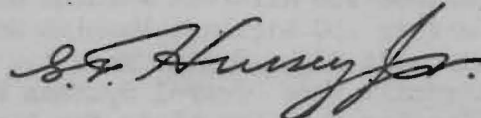
Bulletins of Ordnance Information are issued quarterly by the Bureau of Ordnance for the purpose of:

- (a) Keeping naval activities afloat and ashore informed of the progress of certain ordnance projects which are of special interest or urgency.
- (b) Giving wide dissemination to ordnance information likely to be of general interest, including new developments.
- (c) Indicating the Bureau's action on suggestions or recommendations which are likely to be of general interest.

The Bureau of Ordnance hopes that these Bulletins will eliminate much individual correspondence and duplication of recommendations, suggestions, and inquiries, and at the same time furnish a background of information which will be useful for general planning and direction of effort. Suggestions for furthering these ends through the medium of these Bulletins will be welcomed.

Since much of the information appearing in these Bulletins is not readily available elsewhere, commanding officers are urged to arrange for widespread routing of the publication, particularly among junior officers.

This publication is CONFIDENTIAL and shall be safeguarded in accordance with the security provisions of U.S. Navy Regulations, 1920, Article 76.



G. F. HUSSEY, Jr.

C O N F I D E N T I A L

TABLE OF CONTENTS

<u>Paragraph</u>	<u>GENERAL</u>	<u>Page</u>
1-11	Bureau of Ordnance Activities and Achievements During World War II.	4-9
12-14	Casualties Due to Unauthorized Modifications of Ordnance Equipment.. . . .	9-10
15-16	Cumulative Editions of Bureau of Ordnance Circular Letters.. .	10
17-18	Bureau of Ordnance Section of the Catalog of Navy Material.. .	10-13
<u>MAIN BATTERY</u>		
19-20	8"/55 Caliber Three-Gun Turret for CA139-Class Cruisers . . .	14-17
21	6"/47 DP Three-Gun Turret.	14
<u>ANTI-AIRCRAFT</u>		
22-25	Gun Fire Control System Mark 67.	18-19
26-27	Computers Mark 1 Mods 0 to 7, 9, 10, 13 (5"/38 Caliber DP Guns)	19-20
28-30	5"/54 DP Single Gun Mount Mark 42 Mod 0.	19
31-32	3"/50 Caliber Twin Mount Mark 27.. . . .	19-21
33	3"/70 Caliber Twin Mounts Mark 28 and Mark 29.	22
34	3"/70 Caliber Gun.	22
35-37	3" Hypervelocity Gun - Experimental.	22
38-41	20mm AA Guns - Double Loading Stop Plunger Hole.	22-23
42-43	Muzzle Blast of Worn Versus New Guns.. . . .	23
<u>RADAR</u>		
44-47	Radar Equipment Mark 47 Mods 1, 2, 3 and 4.. . . .	24
48-49	Jet Plane Tracking Tests with Radar Equipment Mark 25 Mod 2. .	24-25
50	Improvement in Radar Equipment Mark 22.. . . .	25-26
51-53	Fire Control Radar Training Films.	26-27
<u>AVIATION</u>		
54-57	20mm Automatic Gun M3.	28-29
58-61	Caliber .50 Aircraft Machine Gun M3 (T25E3) Basic.	30-32
62-66	Caliber .60 Aircraft Machine Gun T17E3.. . . .	32-33
67-70	Aircraft Sight System Mark 1.. . . .	33-34
71-74	Aircraft Fire Control Systems Mark 5 Mod 0 and Mark 6 Mod 0. .	34-35
75-76	Sighting Data Pamphlets for Aircraft.. . . .	35-36
77-78	Tests of Aircraft Engine Starter Cartridges.	36
79-81	Naval Aviation Ordnance Test Station, Chincoteague, Va.. . . .	37
82-89	Casualties and Malfunctions of Aviation Ordnance Equipment During World War II.. . . .	37-40

TABLE OF CONTENTS

<u>Paragraph</u>	<u>AMMUNITION</u>	<u>Page</u>
90-91	Shaped Charge Bomb Tests	41
92	Special Saluting Cartridges for Ships.	41
93-95	Percussion Misfires in 5"/38 Caliber Guns When Firing Salutes.	41-42
96	OP 1480 (1st Revision) - VT Fuzes for Projectiles and Spin-Stabilized Rockets.	42
97	Canned VT Fuzes and Aluminum Cavity Liners for Projectiles..	42
98-99	Mechanical Time Fuze Mark 57 Mod 1..	42-43
100-102	Fuze Mark 247 Mod O for Practice Bomb Signal Mark 7 Mod O. . .	43
103-105	Accident in Using Smoke Grenades..	43-44
106-120	Casualties and Malfunctions of Ammunition During World War II.	44-47

ROCKETS

121-124	Rocket Base Fuzes Mark 162 and Mark 166.	48
125-126	Strippable Protective Coating for 5#0 Spin Stabilized Rocket Motor Bourrelets..	48

UNDERWATER

127-137	Torpedo Mark 25.	49-53
138-140	Modifications of the Torpedo Mark 13..	54
141-142	Torpedo Exhaust Valves and Springs..	55
143	Torpedo Mark 15 Type Tail Bearing.	55-56
144-149	Mine Mark 19 Mod 2..	56-57
150-154	Exhibit at the Naval Academy to Demonstrate Mine Warfare.. . .	57-61
155-161	Underwater Ordnance Malfunctions During World War II.. . . .	61-62

GUIDED MISSILES

162-178	Bureau of Ordnance Policy for Guided Missiles.	63-67
179-190	Bureau Facility for Guided Missile Research at Daingerfield, Texas..	67-71
191-213	The Ram Jet.	71-76

MISCELLANEOUS

214-217	Central Station Fire Control System for Motor Torpedo Boats. .	77
218-223	Demolition Firing Devices.	77-78
224	Exterior Paint for Projectiles and Rockets..	78
225	Unusual Personnel Casualties..	79
226-232	Window Breakage from Explosions.	79-81

GENERAL

1. BUREAU OF ORDNANCE ACTIVITIES AND ACHIEVEMENTS DURING WORLD WAR II. Although it has been one of the major purposes of the Bulletin to keep naval activities informed of the progress of technical developments in ordnance, it has not been possible to include in the Bulletin any appreciable amount of information on naval ordnance activities in general. It is felt that a summary of some of the general developments, problems, and accomplishments of the war period may therefore be of interest.

2. Scope of the Program. The magnitude of the program of supplying the fleet with ordnance during the emergency and war years had, of course, been far greater than anything in previous naval history. Although this fact is generally recognized, actual comparisons with previous periods are still startling. The only comparable program was that for World War I, which was roughly a billion-dollar program. Expenditures for naval ordnance for the fiscal year 1945 alone were between four and one-half and five billion dollars - approximately twice the amount spent for naval ordnance during the 150-year period preceding 1940. For the World War II period, including the emergency years, 1940-1941, expenditures were roughly fifteen billion dollars. In terms of developments, of items of ordnance produced, of facilities established for production, of obtaining and training requisite personnel, and of solving the problems involved in establishing the machinery for wartime development and production, the accomplishments of the war period are no less striking than the recount of monies spent. The Bureau feels that it can be justifiably proud of these achievements without courting complacency.

3. Period of Emergency Expansion. Beginning in 1933, the U. S. policy of gradually building up to treaty limitations brought renewed life to naval ordnance activities and called for a yearly program approximately $2\frac{1}{2}$ times that of each of the annual programs from 1923 to 1932, but this expansion was orderly and normal and presented few of the problems of the later period. In the thirties, ordnance was manufactured in ordnance shore stations, of which four were in actual production, in Army arsenals which had an excess capacity, and in private manufacturing establishments. Army arsenals produced mechanical time fuzes and some projectiles and guns, while commercial plants produced armor, forgings, some fire control equipment, and considerable quantities of unassembled material; all other ordnance equipment was manufactured by the Naval Gun Factory and other naval ordnance establishments.

4. The emergency expansion program actually got underway in the spring of 1940 with the passage of the 11% and 70% Naval Increase Acts. These Acts authorized ordnance for a ship and plane building program far more extensive than any previous peacetime one, and the success which the Nazis were having in overrunning Europe necessitated the utmost haste in the execution of the program. While there were endless problems to be solved, including the improvement of existing and the development of new weapons, the basic problem was that of building a war production machine in peacetime. The availability of funds was no longer a problem, but the necessary facili-

ties and the requisite knowledge of ordnance manufacturing were almost hopelessly inadequate. The shortage of machine tools and the "flatness" of the machine-tool industry constituted the most serious feature of the facilities problem. Between early 1940 and the end of 1941, a two-pronged facilities expansion program was directed on the one hand toward the expansion of the Navy's own ordnance manufacturing establishment and on the other toward bringing U. S. industry into the ordnance manufacturing program. In most cases, private plants had to expand their facilities, either at their own or government expense. Prior to Pearl Harbor Day, six new naval ordnance plants were authorized and a seventh was being planned, while existing government manufacturing capacity was expanded, and the World War I plants at South Charleston, West Virginia, and at Alexandria, Virginia, were re-opened and enlarged. By the end of 1941, the Bureau had placed 112 contracts for facilities, eight of which were for government-owned plants and the remainder for private plants. The total amount of these contracts was nearly 2½ million dollars. The number of Bureau contractors increased from 243 in July 1939 to 2381 by the end of 1941. In addition, there were on the latter date approximately 5000 sub-contractors. The funds involved in these contracts in December 1941 totalled \$1,500,000,000, as compared to \$65,000,000 in July 1939.

5. Wartime Production. By 7 December 1941, the ordnance production machine was still in low gear but it was moving forward. Continued expansions in the directions already decided upon were necessary until the end of the war. The addition of new and the enlargement of old ordnance shore establishments of all types ultimately cost an estimated \$850,000,000. A peak number of more than 25,000 prime and sub-contractors produced naval ordnance. The expansion of commercial production facilities through government financing from 1 July 1940 to V-J Day totalled approximately \$390,000,000.

6. As the war progressed there were inevitable major shifts in production to meet the changing tactics of warfare as well as to include new developments. During the emergency period and the first two years of the war, greatest emphasis had to be placed upon the production of non-expendable items. By 1944 the procurement of non-expendables began to decline; by early 1945 there was a leveling off and even a reduction in a number of expendable items, but these reductions were offset by continued increases in requirements for other expendables such as high capacity ammunition and rockets. Late in the war there were increased requirements for underwater demolition equipment.

7. In addition to arming the Navy's ships, the Bureau supplied the ordnance for the arming of 6229 merchant ships, and the Army was furnished with certain fuzes, explosives, rockets, various aviation fire control equipments such as the Norden bombsight, and miscellaneous parts. In turn, the Bureau procured from the Army small arms and small arms ammunition, some bombs and fuzes, certain explosives and chemical warfare and ground equipment.

8. The over-all trends in the procurement of naval ordnance equipment may be seen from the following tables of yearly production of selected major items:

MAJOR ORDNANCE PROCUREMENT
(Calendar Year)

ITEMS	1940	1941	1942	1943	1944	To 11/45	TOTAL
<u>Antiaircraft Assemblies</u>							
20mm Singles	0	622	30,640	49,358	41,191	2,924	124,735
20mm Twins	0	0	0	0	0	7,562	7,562
40mm Singles	0	0	62	2,517	5,823	1,346	9,748
40mm Twins	0	0	503	1,738	3,747	3,427	9,415
40mm Quads	0	0	212	530	774	967	2,483
1 1/2 Quads	0	293	453	25	0	0	771
<u>Turrets and Mounts</u>							
16"/50 Three-Gun Turret (BB61 IOWA Class)	0	0	3	6	5	3	17
16"/45 Three-Gun Turret (BB55 NORTH CAROLINA Class)	3	3	12	0	4	0	22
12"/50 Three-Gun Turret (GB1 ALASKA Class)	0	0	0	0	6	4	10
8"/55 Three-Gun Turret (CA68 BALTIMORE Class)	0	0	4	10	39	9	62
6"/47 Three-Gun Turret (CL55 CLEVELAND Class)	0	0	38	32	57	21	148
5"/38 Merchant Type (Mark 37)	0	0	0	869	1,857	874	3,600
5"/38 Twins (Marks 28, 29, 32 and 38)	8	63	164	202	475	362	1,274
5"/38 Single Base Ring Mark 30 (DD Type)	56	71	618	604	729	90	2,168
3"/50 Dry Type (Mark 24, 20, and 22)	0	317	2,403	6,488	4,562	228	13,998
<u>Depth Charges (Loaded)</u>	0	26,450	140,886	158,564	241,189	55,039	622,128
<u>7 1/2 Projector Charges for Projectors Mark 10 and 11 (Loaded)</u>	0	0	144	337,418	214,003	0	551,565

CONFIDENTIAL

MAJOR ORDNANCE PROCUREMENT
(Calendar Year)

ITEMS	1940	1941	1942	1943	1944	To 11/45	TOTAL
<u>Torpedoes (Turned into Store)</u>							
Aircraft and PT Mark 13	149	521	1,800	6,762	6,463	645	16,340
Submarine Type Mark 14	6	554	2,368	6,610	7,046	3,475	20,059
Submarine Type Mark 18	0	0	0	1,160	3,733	3,204	8,097
Surface Type Mark 15	315	774	274	594	5,762	533	8,252
<u>Fire Control</u>							
Gun Director Mark 34	0	0	37	25	30	38	130
Gun Director Mark 38	0	4	10	8	6	3	31
Gun Director Mark 37	31	53	128	257	256	136	861
Gun Director Mark 52	0	0	0	0	290	449	739
Gun Director Mark 51	0	0	784	3,077	6,798	3,902	14,561
Gunsight Mark 14	0	0	1,439	23,917	41,886	17,550	84,792
<u>Fire Control Radar</u>							
Radar Equipment Mark 8	0	0	18	77	110	0	205
Radar Equipment Mark 12	0	0	0	8	412	280	700
Radar Equipment Mark 22	0	0	0	1	556	336	893
Radar Equipment Mark 26	0	0	0	0	421	357	778
<u>Aviation Fire Control</u>							
Bombsight Mark 15 Mods 5-7	506	1,458	4,967	11,696	20,264	(To 7/45) 3,376	42,267
Stabilized Bombing Approach Equip. Marks 1, 2 Mod 1	482	1,657	5,532	15,955	18,442	4,783	39,180
<u>Rockets (Complete Rounds)</u>							
2425 Aircraft (Sub.Cal.)	0	0	0	0	848,000	(To 11/45) 4,209,000	5,057,000
345 and 540 Aircraft (3425 Motor)	0	0	0	23,000	717,000	474,000	1,214,000
540 Aircraft (540 Motor)	0	0	0	0	60,000	1,004,000	1,064,000
11475 Aircraft	0	0	0	0	1,100	30,400	31,500
445 Barrage	0	0	0	158,000	1,019,000	480,000	1,657,000
540 Spin Stabilized (Barrage)	0	0	0	0	36,000	747,000	783,000

CONFIDENTIAL

MAJOR ORDNANCE PROCUREMENT
(Calendar Year)

ITEMS	2nd half 1940	1941	1942	1943	1944	To 9/1/45	TOTAL
<u>Ammunition</u> (Loaded and Fuzed Projectiles)							
16" HC (1900#)	0	0	0	9,296	40,884	35,886	86,066
16" AP (2700#)	0	0	10,325	4,481	6,962	3,097	24,865
14" HC (1275#)	0	0	29	12,475	49,284	67,808	129,596
14" AP (1140#)	0	0	4,543	7,437	6,474	1,125	19,579
12" AP (1140#)	0	0	0	0	7,057	3,733	10,790
12" HC (940# & 740#)	0	0	0	911	7,013	9,280	17,204
8" AP (335#)	0	0	0	7,342	45,300	10,367	63,009
8" AP (260#)	0	0	26,047	8,546	1,174	0	35,767
8" HC (260#)	0	0	5,168	28,379	89,699	128,345	251,591
6" HC (105#)	0	0	26,508	170,202	295,780	182,767	675,257
6" AP (130#)	0	0	27,785	73,601	167,439	48,318	317,143
5"/38 VT	0	0	0	108,000	482,000	716,000	1,306,000
5"/38 AAC	48,000	485,000	741,000	2,084,000	3,773,000	1,939,000	9,070,000
3"/50 AP, HC Com & Illum	0	0	380,000	973,000	1,461,000	307,000*	3,121,000
3"/50 AA	41,000	234,000	554,000	2,318,000	2,550,000	630,000	6,327,000
40mm AP & APT	0	0	0	2,813,000	5,109,000	3,805,000	11,727,000
40mm AA	0	0	9,365,000	30,788,000	88,364,000	51,315,000	179,832,000
20mm AA	0	4,406,000	153,095,000	468,039,000	374,959,000	153,150,000	1,153,639,000

*To 7/1/45

CONFIDENTIAL

9. Personnel. In the discharge of the Bureau's tremendously increased responsibilities, a constant problem was that of obtaining adequate personnel. On 30 June 1939 there were 29 officers and 236 civilians on duty in the Bureau. At the end of August 1945 personnel on duty in the Bureau included 1,335 officers, 614 enlisted men and women, and 1,475 civilians. There were, in addition, 3,312 officers, 33,414 enlisted, and 77,342 civilian employees in naval ordnance establishments. Reserve officers with the classification of O-V(S) numbered 6,299. Of this number, 942 were on duty in the Bureau, 3,496 on duty within the continental limits of the United States, and 1,861 on sea duty or attached to activities outside continental limits. Nearly all of the personnel included in this wartime increase had little or no previous naval ordnance experience. A Bureau request in 1941 for 40 additional regular naval officers with ordnance experience was granted, but the regular officers on the active list who were attached to the Bureau always numbered considerably under 100. The peak number of retired officers recalled to active duty with the Bureau was 25, but before V-J Day the number was reduced to less than 15.

10. Naval Ordnance Establishments. The expansion in naval ordnance establishments is significant both from the viewpoint of contributions made by these establishments during the war and from the long-range viewpoint. The establishment of a number of new naval ordnance plants not only added to the total productive capacity and gave a flexibility to the procurement program which would have been impossible of accomplishment with private contracts alone, but also added permanent sources of ordnance manufacturing to the naval establishment.

11. New Naval Ordnance Plants established in the period 1940-1945 include those at Center Line, Mich., Canton, Ohio, Louisville, Ky., Macon, Ga., Milledgeville, Ga., Indianapolis, Ind., Forest Park, Ill., St. Louis, Mo. (which is not to be retained), Pocatello, Idaho, and Shumaker, Ark. (which was subsequently designated a naval ammunition depot). The increasing magnitude of the problem of assembling, loading, storing, and issuing ammunition led to the establishment of three large Naval Ammunition Depots in the interior of the country - at Crane, Ind., McAlester, Okla., and Hastings, Nebr. Among the more important new coastal depots were the Naval Ammunition Depots at Earle, N. J., Charleston, S. C., New Orleans, La., and Fallbrook, Calif., and the Naval Magazine at Port Chicago, Calif., Indian Island, Wash., and Cohasset, Mass. Among the new stations of other types of permanent importance are the Naval Ordnance Test Station, Inyokern, Calif., and the Naval Mine Warfare Test Station at Solomons, Md. The new plant for the Naval Ordnance Laboratory at White Oak, Md., was also started during the war. At the end of the war there were 75 active shore stations under the cognizance of the Bureau of Ordnance.

12. CASUALTIES DUE TO UNAUTHORIZED MODIFICATIONS OF ORDNANCE EQUIPMENT. During the active progress of the war, officers of the forces afloat frequently received considerable encouragement, and occasional commendation, from their seniors for exercising initiative and ingenuity in modifying ordnance material in cases where apparently they acted without formal compliance with Article 972(8) of U. S. Navy Regulations, 1920, which

reads as follows:

"Changes, modifications in, or additions to ordnance material, or other material used in connection therewith, shall not be made without explicit authority from the bureaus concerned."

13. In general, the over-all results of such practices, at least insofar as is indicated by reports reaching this Bureau, were not bad and resulted in relatively few casualties; and while the war was being actively conducted, the Bureau did not feel it advisable to oppose or directly criticize such practices.

14. However, since the cessation of hostilities, the Bureau feels that the provisions of Article 972, USNR 1920, should be complied with and that in any investigation where it appears that the provisions of that article have not been complied with, the reasons, if any, for non-compliance should be explicitly covered.

15. CUMULATIVE EDITIONS OF BUREAU OF ORDNANCE CIRCULAR LETTERS.
The printing of NAVORD OCL CEL-45, Restricted and Unclassified Ordnance Circular Letters, and OCL CELa-45, Confidential Ordnance Circular Letters, has recently been completed, and distribution is now being made. These two publications comprise a two-volume cumulative edition of all Bureau of Ordnance Circular Letters in effect on 15 November 1945; and on receipt of these volumes, all individual copies of circular letters issued prior to that date may be destroyed.

16. New circular letters will continue to be printed and distributed separately, but it is anticipated that when the number of these warrants, they will be collected and reprinted as supplements to the cumulative editions.

17. BUREAU OF ORDNANCE SECTION OF THE CATALOG OF NAVY MATERIAL.
A complete list of all sections that have been published and distributed, as of the date of this Bulletin, is given below in the form of an alphabetical index. Each catalog should contain all of the sections listed below and the Bureau requests that each catalog user check the list carefully to be sure that every catalog is complete. If any sections of a catalog are missing, it is requested that a detailed list of the missing sections be submitted to the Bureau of Ordnance Catalog Section, Building 213, Naval Gun Factory, Washington 25, D. C., so that the missing sheets may be supplied.

18. The Bureau will appreciate receiving any comments, suggestions, or criticisms regarding the ordnance section of the catalog. It is also requested that the Bureau's Catalog Section be notified immediately if any errors are found in the catalog.

Alphabetical Index of the
Bureau of Ordnance Section of the Catalog of Navy Material

(Note: Effective immediately the designation sheet number
will be discontinued and the section number will
take its place)

	<u>Section Number</u>
ADAPTERS	
Aircraft Gun Mount . . . . .	.6315
AVIATION ORDNANCE SETS, KITS, TOOLS, Etc. . . . .	.6103
BOLTS	
Bolts . . . . .	.7410
Bolts, Trunnion Brackets, Trunnion . . . . .	.6327
BOMB AND AERIAL TORPEDO EQUIPMENT	
Bomb and Aerial Torpedo Equipment . . . . .	.6101
Bomb and Aerial Torpedo Handling Equipment . . . . .	.6102
Bomb Racks . . . . .	.6110
Bomb Releasing Gear . . . . .	.6140
Bomb Shackles . . . . .	.6115
CARBINES	
Caliber .30 Carbine M1 . . . . .	.9601
CHARGERS, GUN	
Chargers, Gun, Electric . . . . .	.6340
Chargers for 20mm Automatic Gun . . . . .	.6338
COMPOSITION RESISTORS . . . . .	.7860
COMPUTERS	
Marks 1 and 3 . . . . .	.4131
Marks 6, 10, 11, 12, and 13 . . . . .	.4132
Star Shell Mark 1 . . . . .	.4132
Torpedo Data, Mark 3 . . . . .	.4132
Computing Instruments . . . . .	.4130
DEPTH CHARGE PROJECTORS	
Depth Charge Projectors Mark 6 Mods 1 and 2 . . . . .	.3300
DIRECTORS AND FIRE CONTROL SYSTEMS	
Marks 51 and 52 . . . . .	.4111
Torpedo Director Mark 31 . . . . .	.4112
FEED MECHANISM, 20mm . . . . .	.6365
FUELS, LUBRICANTS, AND RELATED ITEMS . . . . .	.7230
GENERATORS, SMOKE SCREEN	
Mark 1 Mod 0, Mark 1 Mod 1, Mark 4 Mod 0, Mark 6 Mod 0 . . . . .	.3400
GUNS (MACHINE)	
Caliber .30 Browning Machine Gun (Aircraft) . . . . .	.6310
Caliber .30 Browning Machine Gun . . . . .	.5310
Caliber .45 Sub-Machine Gun M3 and M3 A1 . . . . .	.9712

Section Number

RIFLES (Continued)	
Caliber .30 Training Dummy Rifle . . . . .	.9688
Caliber .22 Mossberg Rifle Model 44 U.S. . . . .	.9680
RIVETS . . . . .	.7430
ROCKET LAUNCHERS and Control Equipment . . . . .	.5725
SCREWS . . . . .	.7440
SCREWDRIVERS . . . . .	.7150
SHOT GUNS	
Caliber .45 Line Throwing Gun . . . . .	.9611
12 Gauge Remington, Model 11A and 12 Gauge, Sportsman Riot Type, their Accessories, and Spare Parts . . . . .	.9701
12 Gauge Winchester (Riot Type) . . . . .	.9705
SIGHTS AND SIGHT AUXILIARIES . . . . .	.4120
SMOKE SCREEN EQUIPMENT (AVIATION) . . . . .	.6600
SPONGES, Bristle . . . . .	.8306
STABLE ELEMENTS . . . . .	.4140
TELESCOPES	
Antiaircraft Marks 21, 36, 37, 48, 49, 74, 78, and 82 . . . . .	.4312
Binocular Type Marks 30, 79, 86, 90, and 91 . . . . .	.4314
Fixed Prism, Not Otherwise Classified, Marks 13, 15, 16, 17, 20, 22, 42, 43, 44, 45, 53, 65, 66, 69, and 76 . . . . .	.4315
Movable Reflecting Element Marks 38, 50, 52, 57, 58, 59, 60, 61, 62, 63, 64, 67, 68, 70, 71, 72, 73, 80, 81, 83, 84, 85, 87, and 88 . . . . .	.4311
Straight Body Marks 8, 11, 12, 18, 23, 26, 27, 28, 29, 31, 33, 34, 39, 40, 41, 51, 56, 75, and 89 . . . . .	.4313
Lead Computing Sight . . . . .	.4317
TORPIONS . . . . .	.8350
TORPEDOES, Marks 13, 14, 15, and 18 . . . . .	.2600
TORPEDO LAUNCHING EQUIPMENT . . . . .	.3500
TORPEDO LAUNCHING RACK . . . . .	.3505
TRANSMITTER, Wind, Mark 4 Mod 0 . . . . .	.4150
TRAP SHOOTING EQUIPMENT . . . . .	.6550
VALVES, HYDRAULIC GUN CHARGING . . . . .	.6335
WASHERS . . . . .	.7450

MAIN BATTERY

19. 8"/55 CALIBER THREE-GUN TURRET FOR CAL39-CLASS CRUISERS. The design of the 8"/55 rapid fire three-gun turret for the CAL39-class heavy cruisers (see Bulletin 4-45, paragraphs 55-57) is now complete. Recent firing tests have indicated a firing rate of over 10 rounds per gun per minute. It is expected that extensive tests of the pilot turret will commence in August at the Naval Proving Ground, Dahlgren.

20. Supplementing the information contained in the previous Bulletin article on this turret, the illustrations and captions on pages 15-17 show the principle of ammunition handling from the top of the hoist to the slide and the transfer of ammunition on the slide.

21. 6"/47 DP THREE-GUN TURRET. A new 6"/47 dual purpose three-gun turret is being designed by the Bureau. This turret is expected to have a rate of fire in excess of 25 shots per gun per minute at all angles of elevation. Ammunition will probably be fed into each hoist on an endless chain. From the time the ammunition is in the chain until it is fired, its handling will be completely automatic. Ammunition handling from the top of the hoist to the slide and the transfer of ammunition on the slide will be similar in principle to that used in the 8"/55 caliber turrets of the CAL39-class cruisers. One-man control will replace the conventional pointer, trainer, and sight setter for antiaircraft fire in local control.

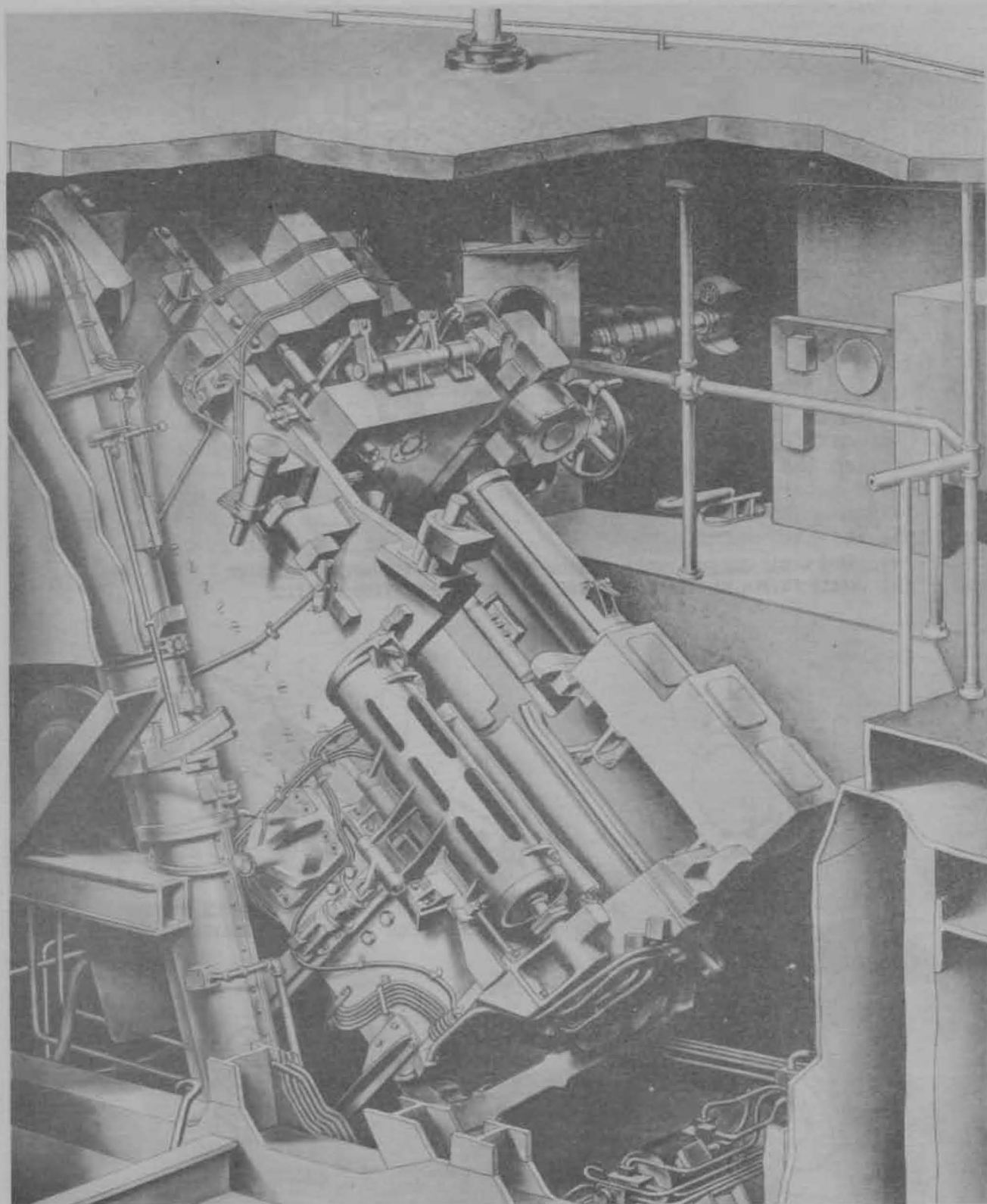


FIGURE 1 - RIGHT GUN POCKET OF CA139-CLASS 8"/55 TURRET
SLIDE AND POWDER HOIST GENERAL ARRANGEMENT - LEFT REAR VIEW

CONFIDENTIAL

OPERATION OF SLIDE - PROJECTILE AND POWDER LOADING SEQUENCE

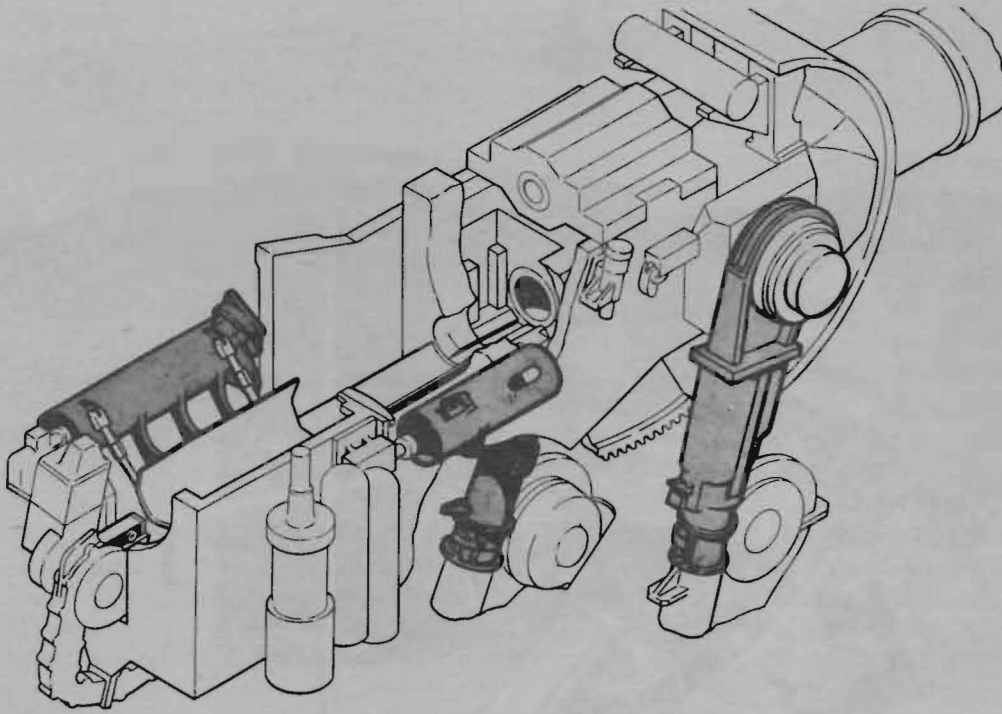


FIGURE 2 - GUN CHAMBER EMPTY, BREECH OPEN, RAMMER RETRACTED, TRANSFER TRAYS IN FIRING POSITION, HOIST CRADLES IN RECEIVING POSITION

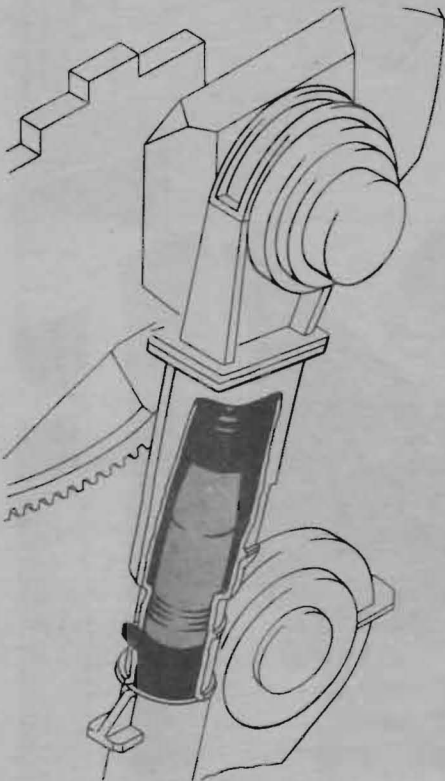


FIGURE 3 - PROJECTILE IN HOIST CRADLE, SPRING COMPRESSED AND RETAINED BY PAWL

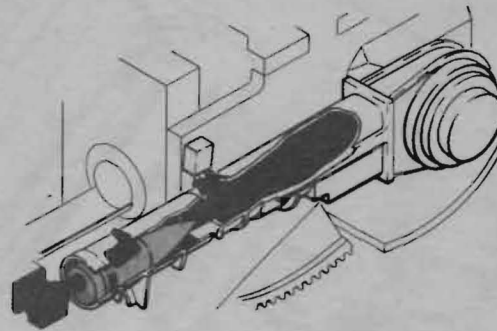


FIGURE 4 - PROJECTILE IN TRANSFER TRAY, HOIST CRADLE IN DISCHARGE POSITION

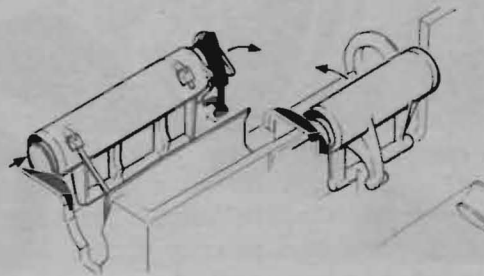


FIGURE 5
TRANSFER TRAYS IN MID-CYCLE POSITION

OPERATION OF SLIDE

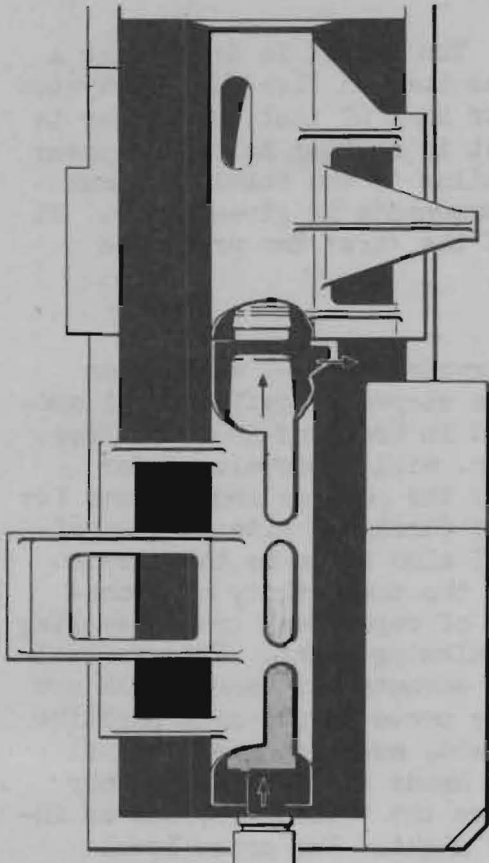


FIGURE 6
PROJECTILE AND POWDER LOADING SEQUENCE.
TRANSFER TRAYS IN TRANSFER POSITION,
RAMMER BEGINNING RAM STROKE

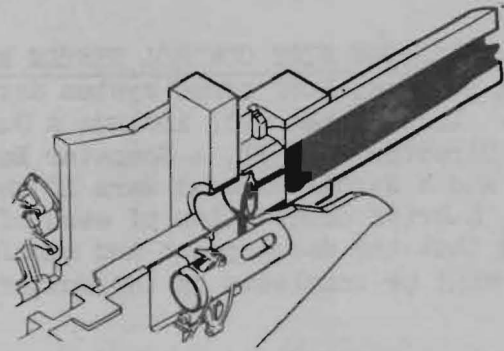


FIGURE 7 - PROJECTILE & POWDER LOADING SEQUENCE.
AMMUNITION IN CHAMBER, RAMMER RETRACTED, BREECH
CLOSED, TRANSFER TRAYS IN FIRING POSITION

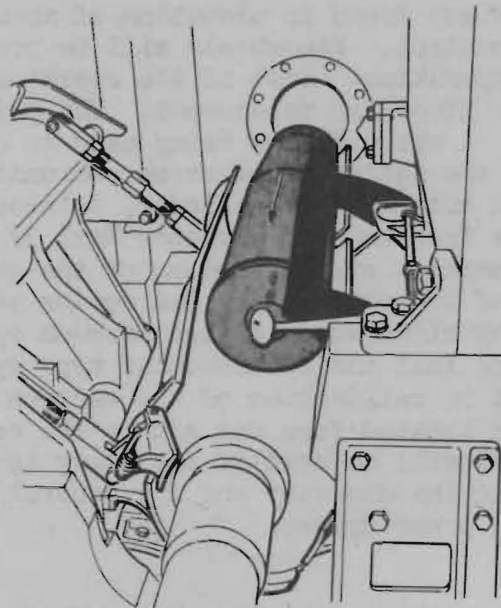


FIGURE 8 - EMPTY CASE EJECTION.
GUIDING ACTION OF EMPTY CASE LONGI-
TUDINAL GUIDE AND DEFLECTOR BRACKET

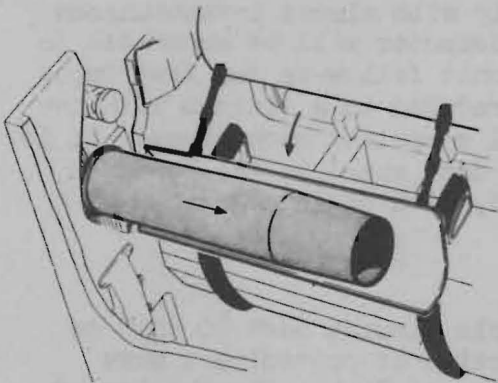


FIGURE 9 - EMPTY CASE EJECTION.
EMPTY POWDER CASE TRAY IN
MID-CYCLE POSITION

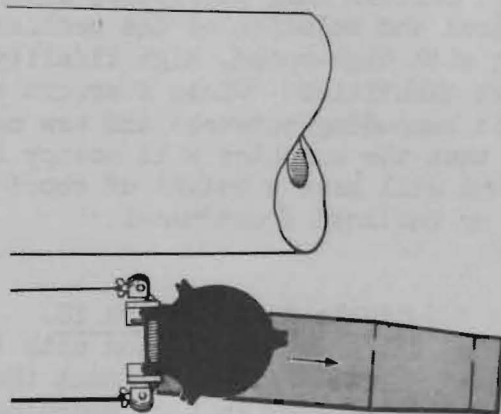


FIGURE 10 - EMPTY CASE EJECTION.
CASE EJECTOR TUBE COVER OPERATION.

CONFIDENTIAL

ANTI-AIRCRAFT

22. GUN FIRE CONTROL SYSTEM MARK 67. The Bureau is developing a new dual purpose, long range system designated as the Gun Fire Control System Mark 67. This system will include a Gun Director Mark 67 that is similar to the Gun Director Mark 37, a Computer Mark 47 that is similar to the Computer Mark 1, and a Stable Element Mark 10 that is similar to the Stable Element Mark 6. A brief description of each of these components is given below. It is hoped that the development and manufacture of the first two prototype systems will be completed by the summer of 1948.

23. Gun Director Mark 67. The Gun Director Mark 67 will be an automatic radar tracking director with a 15' base stereo rangefinder. A one-man tracking control station with a maximum speed in train of about 50°/sec. and a maximum speed in elevation of about 30°/sec. will be developed for optical control. Handwheels will be provided for the pointer and trainer for standby operation. Each of the operators will be furnished with dual magnification, binocular telescopes. The pointer will also serve as the one-man tracker. A study is now being made to determine the feasibility of cross-leveling the entire director as one unit instead of separately cross-leveling the radar antennas, rangefinder, telescopes and slewing sight. This radical departure from the Gun Director Mark 37 has many advantages, among which are the following: simplification of the gearing for cross-level, more positive sealing of the rangefinder and optics to the shield, much improved optical control by eliminating motion between operators' heads and bodies, thereby permitting full use of binocular type eyepieces on the telescopes, and an improvement in collimation of the various lines of sight. Two cross-level trunnions located fore and aft on the centerline of the director and outside the shield will be used if the study is approved. The Naval Gun Factory is developing the director and the General Electric Company is developing the amplidyne power drives.

24. Computer Mark 47. The Computer Mark 47, being developed by the Ford Instrument Company, will incorporate all of the advantages of the Computer Mark 1, but will eliminate all of the latter's disadvantages. The computer will deliver dual ballistics simultaneously with almost instantaneous rate control and solution of the problem. The computer will be automatic in operating with high-speed, high fidelity electronic follow-up for fast input and output quantities. Class B errors will be reduced to a minimum with new electronic computing networks and new mechanical computing mechanisms. It is expected that the computer will occupy the same deck space as the Computer Mark 1, but will have a height of about six feet, with dials and knobs on a vertical or inclined front panel.

25. Stable Element Mark 10. The Stable Element Mark 10 will be developed by the Arma Corporation with the objective of providing a more accurate and reliable stable element than the present Stable Element Mark 6 and with limits of $\pm 40^\circ$ in both coordinates. A new gyro will be incorporated

with a new electrical erecting system. New pick-ups and follow-ups will be included. Special provision will be incorporated for adding various corrections for accelerations, turns, latitudes, etc. The Stable Element Mark 10 will have synchro input of director train and synchro outputs of level and cross-level. This will permit its use in various types of fire control systems such as underwater, surface, and antiaircraft. Mechanical shafting outputs will be eliminated. Transmission to the Computer Mark 47 or other equipments will be by synchro circuits via the fire control switchboard.

26. COMPUTERS MARK 1 MODS 0 TO 7, 9, 10, 13 (5"/38 CALIBER DP GUNS).

A comparison of the latest 5"/38 caliber ballistic data, contained in OP 551A of 11 February 1946, with that given in Ordnance Sketches 61187 and 61188, upon which the design of the Computers Mark 1 Mods 0 to 7, 9, 10, and 13 was based, indicates differences in sight angle and time of flight for a few selected slant ranges and position angles as shown in the table on the following page.

27. The Bureau is investigating methods of modifying all Computers Mark 1 with 5"/38 ballistics to eliminate these differences. It appears that a new set of ballistic cams will be required for each computer if it is desired to have the computers conform exactly with the new ballistic data. However, this will require from one to two years to accomplish and may not be feasible from the standpoint of available funds. In the near future, the Bureau will issue a circular letter giving detailed instructions on how to re-set the Computers Mark 1 to approximate the data contained in OP 551A. This method will consist of adding spots in elevation, replacing the initial velocity dial, and altering the initial velocity stops. The circular letter will contain a paper I.V. dial for temporary use over the present I.V. dial. An Ordalt will be issued later to provide a new I.V. dial.

28. 5"/54 DP SINGLE GUN MOUNT MARK 42 MOD 0. A new 5"/54 dual purpose single gun mount is being designed. At present the design is in a very fluid state. Numerous new ideas and control systems are being considered for possible incorporation into this mount.

29. An increase in the acceleration rates of both elevation and train is contemplated. The rate of fire is expected to be in excess of 35 rounds per minute at all angles of elevation. Ammunition handling will be completely automatic from the fixed structure to the rotating structure and thence to the gun. The powder case and projectile will be separately but simultaneously loaded into a common hoist. The handling of the round, after it has been loaded into the hoist, will be similar to that of fixed ammunition. Two ammunition hoists per gun, one on each side of the gun, will be required.

30. It is expected that one-man control will eliminate the necessity for the pointer's, trainer's, and sight setter's stations.

31. 3"/50 CALIBER TWIN MOUNT MARK 27. As mentioned in Bulletins 2-45 (paragraph 21) and 4-45 (paragraphs 38-39), a 3"/50 rapid fire twin mount employing only VT-fuzed projectiles is under development for use where

5"/38 CALIBER AA GUN, I.V. 2550 F.S.
DIFFERENCES IN SIGHT ANGLE AND TIME OF FLIGHT
BETWEEN OLD AND NEW AA BALLISTIC DATA*

Slant Range Yards	Position Angle								
	0°			20°			40°		
	New	Old	Diff.	New	Old	Diff.	New	Old	Diff.

SIGHT ANGLE IN MINUTES

2,000	63	59	4	61	58	3	51	46	5
4,000	143	136	7	134	134	0	112	110	.2
6,000	251	244	7	237	246	-9	194	205	-11
8,000	411	396	15	382	402	-20	316	338	-22
10,000	623	610	13	589	620	-31	489	529	-40

60°

80°

2,000	34	28	6	14	10	4			
4,000	74	71	3	28	24	4			
6,000	128	133	-5	48	46	2			
8,000	208	221	-13	76	75	1			
10,000	328	347	-19	120	120	0			

TIME OF FLIGHT

	0°			20°			40°		
	New	Old	Diff.	New	Old	Diff.	New	Old	Diff.
2,000	2.60	2.62	-.02	2.60	2.64	-.04	2.62	2.65	-.03
4,000	5.84	5.84	0	5.87	5.98	-.11	5.89	6.05	-.16
6,000	9.99	9.91	.08	10.00	10.28	-.28	10.04	10.49	-.45
8,000	15.27	15.06	.21	15.31	15.69	-.38	15.42	16.13	-.71
10,000	21.52	21.22	.30	21.80	22.32	-.52	22.24	23.17	-.93

60°

80°

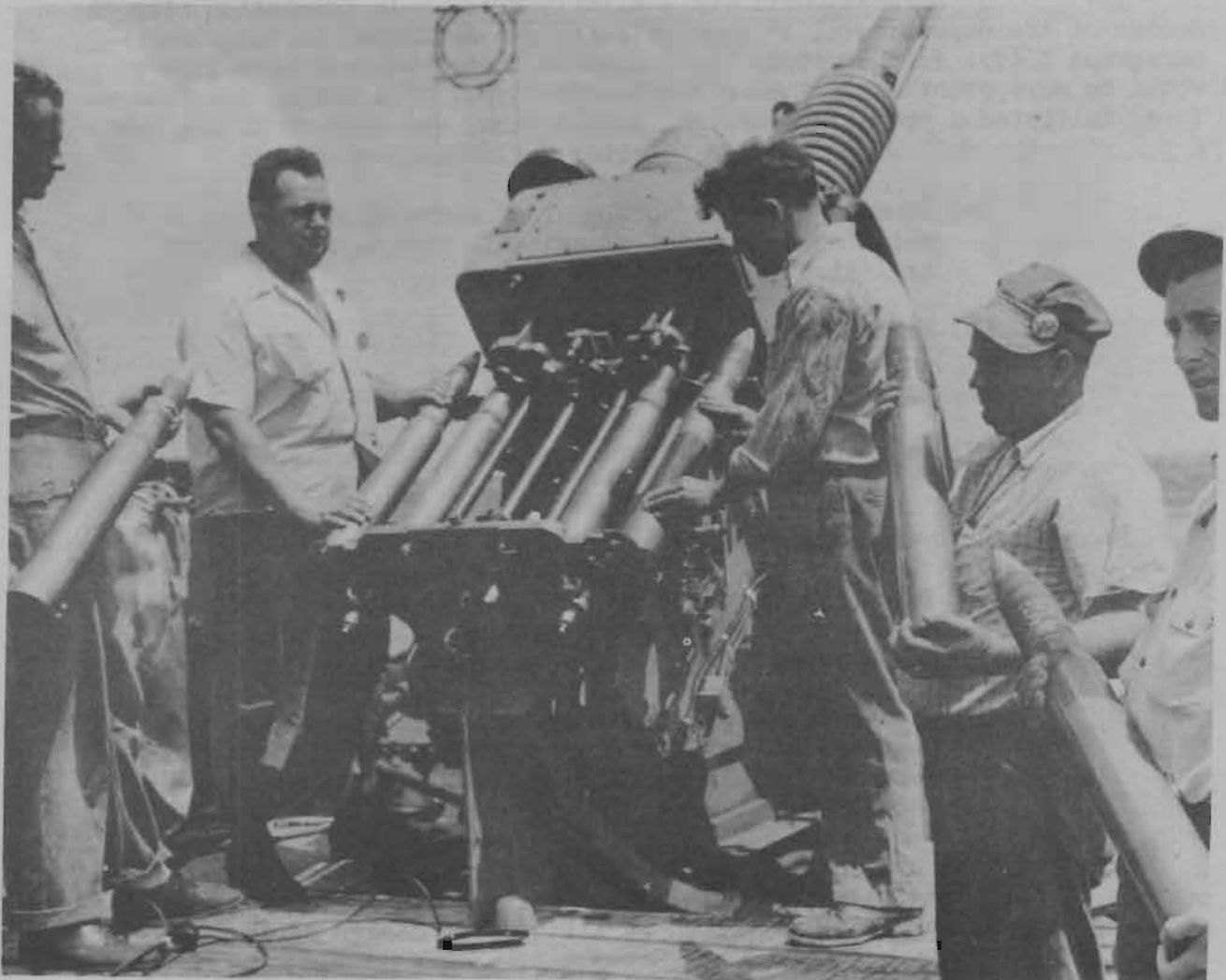
2,000	2.63	2.66	-.03	2.63	2.67	-.04			
4,000	5.92	6.11	-.19	5.92	6.05	-.13			
6,000	10.10	10.55	-.45	10.13	10.49	-.36			
8,000	15.56	16.27	-.71	15.64	16.14	-.50			
10,000	22.74	23.70	-.96	23.10	23.70	-.60			

*New refers to OP 551A

Old refers to BuOrd Sketches 61187 and 61188.

40mm quads are now used. Production of 490 of these mounts has been authorized for installation on CA139-class and CIL14-class vessels and various other CL's, CVB's, CV's, and DD's. It is now planned that this mount will not have the conventional pointer and trainer, but will have a one-man control station on each side, one for antiaircraft fire and one for surface fire. It is also planned that later Mods will be equipped with Gunar (on-mount radar).

32. A 200-round rapid fire burst and several less extended bursts fired with the first experimental loader (see photograph below) have indicated that a rate of fire slightly higher than 50 rounds per gun per minute can be attained. One pre-production developmental mount will be ready for test in about a month and a second one in the fall of 1946. It is expected that the first production mounts with power drives will be ready for test in the spring of 1947. The first 275 mounts will have amplidyne power drives.



3"/50 EXPERIMENTAL LOADER MARK 1

33. 3"/70 CALIBER TWIN MOUNTS MARK 28 AND MARK 29. Two general over-all designs and the detail design of several sub-assemblies for the 3"/70 machine gun (performance requirements for which were outlined in Bulletin 4-45, paragraph 41) have been approved. Manufacture of parts for pilot mounts and tests to determine strength, durability, and functional characteristics of various components are underway. It is expected that the first complete mount will be ready for test firing late in the summer of 1947.

34. 3"/70 CALIBER GUN. The first 3"/70 caliber gun barrel, to fire 15-lb. projectiles at 3400 f.s. muzzle velocity (see Bulletin 4-45, paragraph 15(a)) has been fired 168 ESR slow fire. The barrel appears to be satisfactory except for the experimental chrome plating (.006 thick). Plans for modified plating are underway. Tests are continuing on several designs of projectiles to determine the best projectile-gun combination.

35. 3" HYPERVELOCITY GUN - EXPERIMENTAL. In connection with the design of the experimental 3" hypervelocity gun mentioned in Bulletin 4-45, paragraph 15(d), further study has indicated that a squeeze-bore type of gun would be more practicable than a smooth-bore type. The Bureau has, therefore, initiated a project to design, manufacture, and conduct firing tests of a gun with the following proposed interior ballistic performance:

- (a) Squeeze-bore projectile of 3" emergent caliber, weighing 15 pounds, of suitable design to permit explosive loading and VT fuzing.
- (b) Muzzle velocity - 6000 f.s.
- (c) Maximum powder pressure - 34 tons/sq.in.
- (d) Gun barrel - 4"/3" squeeze-bore - 147 emergent calibers long.

36. The purposes of this project are:

- (a) To determine the practicability of obtaining 6000 f.s. with a projectile having general characteristics which would be acceptable for service use.
- (b) To obtain data on interior ballistic characteristics, heat transfer, gun wear, and exterior ballistic performance at high velocities, high pressures and high densities of loading.

37. This project is considered a purely experimental one for the purpose of obtaining technical data. No consideration is being given to adopting the gun as a service weapon in its present design stage.

38. 20MM AA GUNS - DOUBLE LOADING STOP PLUNGER HOLE. Since the issuance of Ordalt 2417, which eliminated the double loading stop on 20mm

machine gun mechanisms, suggestions have been received from the service that the Ordalt be revised to provide for plugging the double loading stop plunger hole in the breech casing. Plugging the hole was suggested to prevent the accumulation of dirt and to provide protection in the event that a barrel should be inserted inadvertently without the lower double loading stop plunger in place.

39. At the time Ordalt 2417 was issued, consideration was given to plugging the plunger hole in the breech casing. However, extensive firing tests were conducted on guns having the double loading stop parts removed from the breech casing without plugging the plunger hole, and no malfunction or abnormal operation resulted. It is considered that a malfunction caused by dirt from the upper plunger hole is highly improbable even with an excessive accumulation of dirt, and it appears that no difficulty will be encountered if normal gun maintenance procedure is followed.

40. Plugging of the hole by ships' forces is considered undesirable; if a gun should be fired without the lower plunger in place, the plug might be ejected at high velocity and thus be a serious hazard to personnel.

41. It is considered that no difficulty from dirt accumulation can occur if the gun is given a reasonable amount of maintenance and that casualties resulting from firing the gun without the lower plunger in place can be prevented by adequate inspection of each barrel before insertion. As gun barrels are no longer drilled for the lower double loading stop plunger, the possibility of loss of the lower plunger will eventually be eliminated.

42. MUZZLE BLAST OF WORN VERSUS NEW GUNS. When two badly worn 5"/38 caliber guns (each having about 8900 ESR) were fired at an antiaircraft training center to compare gun life with and without chromium plating, it was reported that blasts were unusually severe and caused temporary injury to the personnel operating the gun mounts.

43. This alleged effect appeared new and unexplainable and to investigate the matter further, these two worn guns and a new gun were fired at the Naval Proving Ground, Dahlgren. Observers in appropriate positions on the mounts did not notice any difference in intensity of muzzle blast, and approximately the same blast pressures were obtained with both the worn guns and the new gun. The Bureau, therefore, can offer no ready explanation for the reported excessive muzzle blasts at the training center.

RADAR

44. RADAR EQUIPMENT MARK 47 MODS 1, 2, 3 AND 4. Radar Equipment Mark 47 is an X-band, fire control radar equipment being developed for use in Gun Fire Control System Mark 61 instead of Radar Equipment Mark 43, which was previously planned for this system and reported in Bulletin 2-45, paragraphs 28-39. Its main components are two below-deck operating consoles. The main console is similar to the operating console of Radar Equipment Mark 39 Mod 3 (see Bulletin 1-46, paragraphs 43-45) which contains a power supply, the range unit, modulator, and cathode ray oscilloscope indicator and circuits appropriate for enabling an operator to range on targets out to 30,000 yards. The other console, which is to be mounted alongside the main console, consists of an automatic tracking unit, target acquisition unit, and servo amplifier.

45. Radar Equipment Mark 47 provides the Gun Fire Control System Mark 61 with automatic tracking in traverse and elevation and its target acquisition features permit a below-deck operator, by means of a joy-stick control, to acquire designated targets in the shortest possible time and to conduct organized search of assigned sectors when necessary. A Plan Position Indicator in the equipment repeats either ship's search or Radar Equipment Mark 47 information at the choice of the operator. Matched pointer dial groups are employed for utilizing train, elevation, and range designation of targets from CIC.

46. The antenna, a 30" parabolic reflector illuminated by a vertically polarized, nutating wave guide feed, will be mounted on the gun director.

47. Information on Radar Equipment Mark 47 will be included in OP 1562 on Gun Fire Control System Mark 61, which is under preparation.

48. JET PLANE TRACKING TESTS WITH RADAR EQUIPMENT MARK 25 MOD 2. Tracking tests with a developmental model of Radar Equipment Mark 25 Mod 2 (described in Bulletin 3-45, paragraphs 71-75) were conducted at the Bell Telephone Laboratories, Whippany, New Jersey, using a conventional aircraft (F4U-4) and a jet plane (P-59) as the targets in a total of fourteen runs. The results of these tests are summarized below:

Summary of Averages

<u>Aspect</u>	<u>Target</u>	<u>Auto-rad*</u>	<u>Man-rad**</u>
Nose	P-59	# 11,600-27,700 yds.	36,000 yds.
Nose	F4U-4	# 18,700-36,400 yds.	34,800 yds.
Tail	P-59	28,700 yds.	45,300 yds.
Tail	F4U-4	31,200 yds.	50,200 yds.

* Automatic tracking with the automatic tracking equipment which is a part of this radar.

** Manual tracking by watching the B and E scopes.

Auto-rad tracking started at the higher range but due to the fact that a greater signal strength is required for auto-rad than man-rad tracking, the auto-rad tracking was not consistent until the lower range was reached. In the tail view, auto-rad tracking was consistent all the way since rates had been established which allowed continuous tracking even through occasional signal fading.

49. The tail measurements can be dependably compared with each other but cannot be dependably compared with the nose measurements. Man-rad tracking on the tail view was carried out to extreme range by taking advantage of occasional glints which were visible only because the operators knew approximately where to look for them. Such glints were of little advantage in acquiring the incoming target. The differences between maximum man-rad ranges for the nose and tail aspects, therefore, cannot be attributed solely to differences in radar effective area.

50. IMPROVEMENT IN RADAR EQUIPMENT MARK 22. The advantages of Radar Equipment Mark 22 Mod 1 (see Bulletin 3-45, paragraphs 85-89) over the Mod 0 equipment are pointed out in the following quotation from a report by the Operational Development Force:

"Range capabilities of the Mark 22 Mod 1 radar are substantially improved; reliable range of detection for a single fighter is approximately 20,000 yards, fighter section 23,000 yards, and a medium size tanker 25,000 yards. Range, angular vertical, and bearing discrimination were found to be approximately 100 yards, 1 degree, and 9 degrees, respectively.

"The ability of the Radar Mark 22 to track aircraft in surroundings involving scope clutter has been greatly improved by Modification 1. No difficulty was experienced in tracking aircraft over ships or ship dispositions; and tracking over land was possible providing the angular position of the target was as much as one vertical beam width (1.2 degrees) above the land. Reliable tracking through window was possible with careful manipulation of the gain control in all but the most thickly infested areas. No tests involving electronic jamming were conducted. The ability of the radar to track the target through scope clutter resulting from shell burst has been materially improved by Modification 1, because of its superior range and bearing discrimination characteristics. The ability of Radar Mark 22 Mod 1 to spot surface fire was found to be superior to that of Radar Mark 12 because of its shorter pulse length and more expanded scale of presentation.

"The improved range capabilities of Radar Mark 22 Mod 1 are attributable to the different type of data presentation em-

ployed. A target indication on Radar Mark 22 Mod 0 consists of a bright spot superimposed on the already brightened indicator sweep trace; the lack of contrast to the 'no target' indicator scope appearance produced by a weak echo when employing this type presentation, often results in the operators overlooking small target indications. The change to 'type E presentation' effected by Modification 1 removes this limitation by initially presenting the target in a relatively clear area on the indicator cathode ray tube which results in a significantly greater contrast of target indication for a given strength of returning signal.

"The improvement in range and elevation discrimination is also attributable to the change to type E presentation which gives the operator a better and more expanded view of what is actually taking place.

"The ability of the Mark 22 Mod 1 Radar to range on targets is a particularly helpful indication to the pointer as to which target to follow in elevation as well as an excellent auxiliary means of obtaining target range in the event of a material failure in the Mark 4 or Mark 12 radar ranging circuits."

51. FIRE CONTROL RADAR TRAINING FILMS. As a part of the over-all program for the instruction of operators of fire control radar equipment, a number of training films have been produced. As these films were released, they were described in the Bulletin of Ordnance Information (No. 1-44 and No. 4-44) and in the Catalog of Training Films for the U. S. Navy, Marine Corps, and Coast Guard, NAVAER-PH-3022-11(Confidential).

52. Since the issuance of the above-mentioned publications, several new films have been released and nearly all films have been reclassified from confidential to restricted, thus simplifying procurement and permitting a much wider distribution of the films. Reference should be made to Catalog of Training Films for the U. S. Navy, Marine Corps, and Coast Guard, NAVAER-TF-22-10 (Restricted) for detailed information on procurement and audiences to which the films may be shown.

53. Following is a list of all films produced for the Bureau of Ordnance on fire control radar equipment, and a brief description of MN-5096 on Fire Control Radar Beacon Mark 2 which is not now included in the catalog and was not described in Bulletin 4-44:

<u>Catalog No.</u>	<u>Title</u>
MN-955c-d	Ship's Radar - Operation of Fire Control Radar Mark 3 and Mark 4, Parts 1 and 2 (Restricted).
MN-2867c-d	Radex Fire Control for Radar Equipment Mark 3 and Mark 4, Parts 1 and 2 (Confidential).
MN-3202a-b	Fire Control Radar Mark 8 Mod 1 at Sea, Parts 1 and 2 (Restricted).

Catalog No.

Title

MN-3221a Fire Control Radar Mark 12 Mod 0 (Restricted).

MN-3221b Fire Control Radar Mark 22 Mod 0 - Operation and Use (Restricted).

MN-3222 Fire Control Radar Mark 26 Mod 3 and Mod 4 (Restricted).

MN-3223 Fire Control Radar Mark 28 Mod 0 and Mod 3 (Restricted).

MN-4922a-b-c-d Main Battery Fire Control Radar, Parts 1, 2, 3, and 4 (Restricted).

MN-4925 Heavy Machine Gun Fire Control Radar (Restricted).

MN-5096 Fire Control Radar Beacon Mark 2 - Operation (Restricted). This film covers operation of Radar Beacon Mark 2 with Radar Equipments Marks 4, 12, and 28, and carries the audience through a complete shore bombardment operation illustrating coordination between the ship and the shore fire control party.

AVIATION

54. 20MM AUTOMATIC GUN M3. The 20mm Automatic Gun M3 (T31) Basic (see accompanying illustrations) has been briefly described in previous issues of the Bulletin (No. 3-45, paragraphs 172-174; No. 3-44, paragraphs 90-91; and No. 2-44, paragraphs 136-140). Both air and ground firing tests have been conducted by Navy testing facilities to improve the operation and reliability of this weapon under all conditions of flight.

55. Two hundred round continuous bursts have caused failures of the gas cylinder vent plug, and improved models of the plug are in the test stage of development. Failures of the Electric Heater T2 have been brought to the attention of the Bureau, and an improved model heater has been manufactured and is now under test.

56. The firing of dry ammunition has caused cartridge cases to rupture upon extraction, leaving the neck of the case in the chamber. The results of numerous tests at the Naval Proving Ground, Dahlgren, indicated that the application of a fine coat of ceresin wax on the ammunition corrected this malfunction. The following was found to be a satisfactory method of applying the ceresin wax:

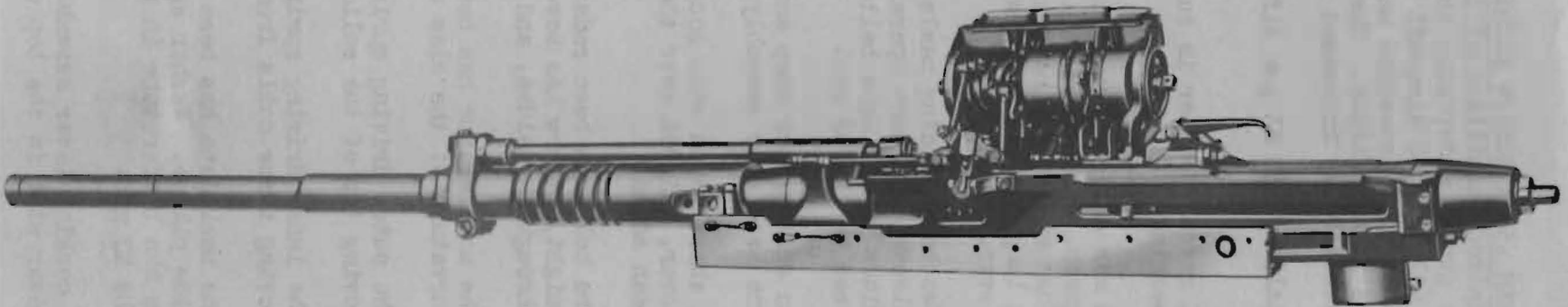
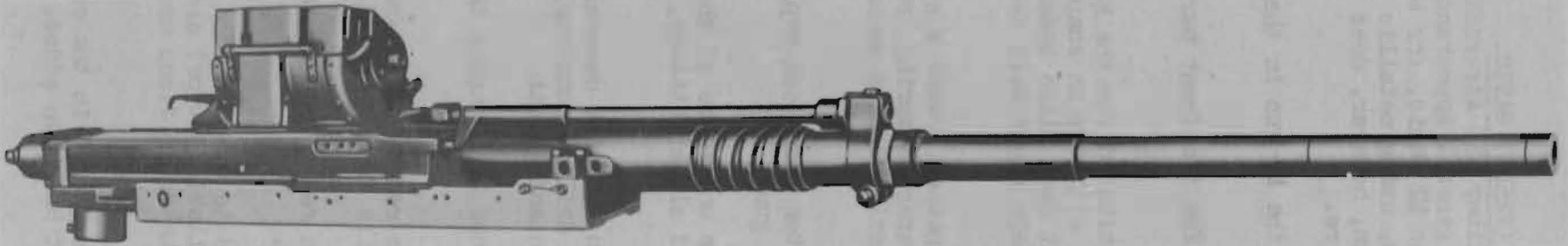
(a) Carbon tetrachloride was brought to ambient indoor temperature (about 72° F.). The wax was maintained at the same temperature.

(b) Wax was shaved in thin slices and added to carbon tetrachloride (one part wax to nineteen parts of carbon tetrachloride by weight).

(c) The mixture of carbon tetrachloride and shaved wax was placed in a covered container and the container placed in hot water. With occasional stirring, the wax dissolved in about one hour. Caution had to be exercised because of carbon tetrachloride fumes released by this heating.

(d) Belted ammunition was dipped in the mixture, removed and allowed to dry. The dipping process was done in one motion, immersion lasting from one to three seconds. Two to four hours were allowed for drying. (Note: It was found that if ammunition belts were much colder than the mixture, dipping resulted in the belt's being covered with blisters and bubbles of solution with precipitated wax that would not dry.)

57. An extensive program to improve the operation and the reliability of the 20mm Automatic Gun M3 is continuing. Particular emphasis is being concentrated upon improved cold weather and high altitude performance. It is expected that the improvements resulting from this program will be incorporated in all of these guns.



20MM AUTOMATIC GUN M3 (T31) BASIC

CONFIDENTIAL

58. CALIBER .50 AIRCRAFT MACHINE GUN M3 (T25E3) BASIC. The Navy is now receiving limited quantities of the new Caliber .50 Aircraft Machine Gun M3 Basic. This gun is materially the same in general appearance and functioning as the Caliber .50 Aircraft Machine Gun M2 Basic, for both are recoil operated, belt fed, air-cooled machine guns, using metallic links and disintegrating belts in all firing. The new M3 gun, however, does vary in detail and has a considerably increased rate of fire.

59. The caliber .50 M3 gun differs from the M2 gun in the following respects:

- (1) A recoil booster is substituted for the front barrel bearing.
- (2) A new design cover group is substituted for the M2 cover group. The cover, which differs slightly in shape from that of the M2, houses a new belt feed slide assembly, a longer belt feed pawl, and a more rigid belt feed lever.
- (3) Two belt-holding pawls nested together around a spacing sleeve, and each operated by a separate spring, replace the single belt-holding pawl and twin springs used on the M2 gun.
- (4) An accelerator stop and accelerator stop lock replace the sear stop assembly of the M2 gun.
- (5) A short round stop located on the underside of the cover, clipped over the belt feed slide retainer, has been added.
- (6) The bolt has been redesigned. In order to decrease its weight, it now has several holes drilled completely through the sides, and other lightening cuts.
- (7) The accelerator has been redesigned by changing the curvature of the claw end.
- (8) The outer driving spring has been redesigned by removing two of the solid wound coils from each end.
- (9) The inner driving spring has been redesigned by removing three coils from each end.
- (10) The backplate has been redesigned to clamp around the side plates. Washer springs (Belleville type) are used in the buffer tube in place of the fiber discs used in the M2 gun.
- (11) A cocking lever assembly which is housed in the cocking lever slot in the top of the bolt has been added.

- (12) The cocking lever has been redesigned to provide thicker cross sections and to eliminate sharp corners. In addition, a shoulder has been added to the lever to facilitate assembly.
- (13) The sear has been redesigned by making the top left side thicker and the tip stiffened with a rib. In addition, a larger fillet has been provided where the hook joins the main body of the sear.
- (14) The sear slide has been redesigned by eliminating the "V" shape cut on one end and by adding an elongated slot on the other end for retention in bolt.
- (15) A sear slide stop pin has been added to retain the sear slide in the bolt.
- (16) The bolt switch has been redesigned to provide an interlocking tongue on the underside.
- (17) The side plate switch has been redesigned and has been made slightly heavier.
- (18) The extractor cam has been modified by slightly changing its shape and making it much wider.
- (19) The cover extractor cam has been redesigned by forming a steeper cam having a concave camming surface.
- (20) The barrel extension has been changed by providing additional clearance cuts for the ejector. The depressor slots are milled across the entire side.
- (21) The extractor assembly has been redesigned so that the position of the ejector may be shifted to facilitate feeding from the left side of the gun.
- (22) A new air and washer spring type barrel buffer is used in place of an oil buffer assembly.
- (23) The breech lock depressors are securely fastened to the side plates. On the M2 gun the depressors are attached to the oil buffer body. The depressors have a curved camming surface formed on the front end.
- (24) The breech lock cam has been changed to add a radius at the top of the camming stop.

60. Further comparing the two guns, it is found that the M2 gun weighs 61 pounds, whereas the M3 gun is only one pound heavier. This is especially noteworthy in view of the fact that the M3 gun fires 1200 rounds per

minute, while the M2 gun fires 750-850 rounds per minute. Keeping the weight of the gun down while at the same time greatly increasing its rate of fire has been accomplished by sound engineering, eliminating all excess weight by drilling and lightening cuts, and redesigning and strengthening many parts in order to realize maximum performance with minimum weight.

61. The use of the Caliber .50 Basic Aircraft Machine Gun M3 is at present limited to test purposes. Reports from test centers are highly favorable and indicate that an even greater rate of fire can be obtained with a few modifications. It is not expected that this gun will be service-installed, except in experimental aircraft, for some time. The large stock of caliber .50 M2 guns and the results of the present 20mm automatic gun installations will be determining factors in a decision as to the eventual service installation of the M3 aircraft machine gun.

62. CALIBER .60 AIRCRAFT MACHINE GUN T17E3. The development and testing of the Caliber .60 Aircraft Machine Gun T17E3 has now progressed to the point where this gun is considered ready for testing in naval aircraft. At this time the Navy has available for experimentation, testing, and operational use, approximately 100 of these guns with the necessary replacement parts.

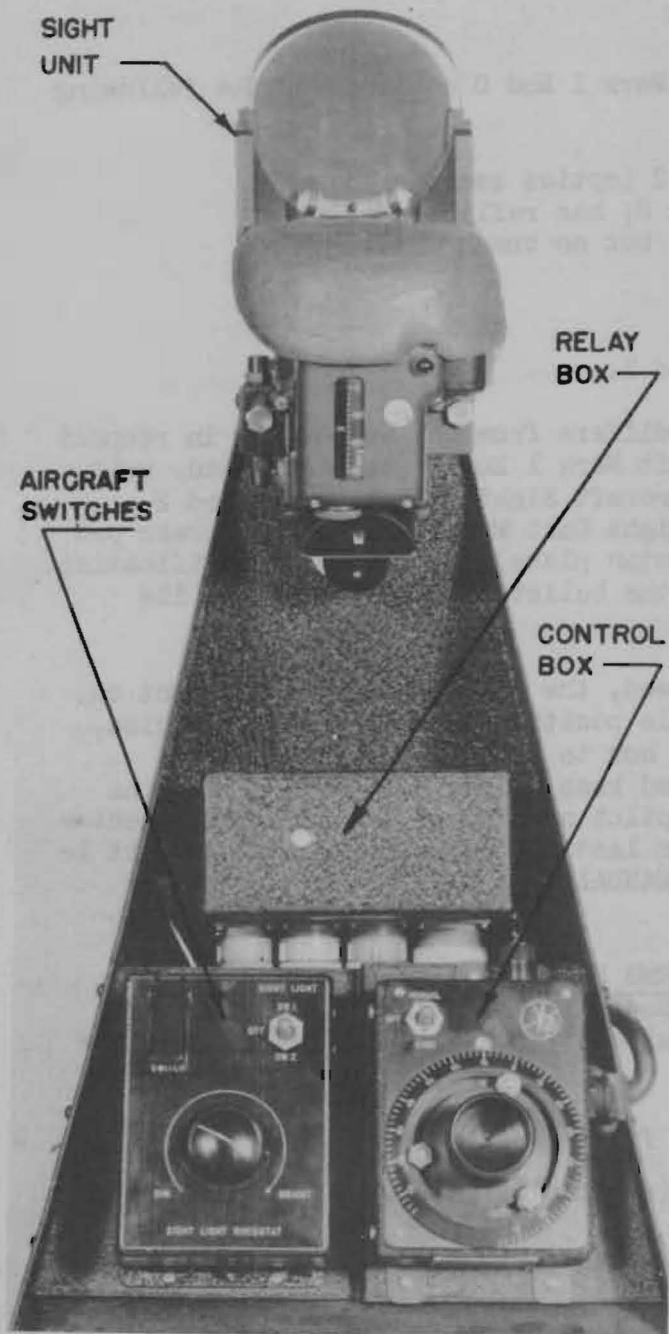
63. As described in Bulletin 3-44, paragraphs 95-96, the Caliber .60 Aircraft Machine Gun T17E3 has a muzzle velocity of approximately 3500 feet per second, a rate of fire of about 700 rounds per minute, is recoil operated, air cooled, and can be fed from either side by the belt which is of the disintegrating metallic link type. The gun, with accessories, weighs about 126 pounds and it has an over-all length of 91 $\frac{1}{2}$ ". In addition to ball ammunition, combat types of ammunition that have been developed are incendiary, armor-piercing incendiary, and armor-piercing incendiary tracer. These types of ammunition are expected to be approved for service issue following extensive tests by the Army Ordnance Department and the Naval Proving Ground, Dahlgren.

64. The Army Air Forces have made installations of the caliber .60 gun in the P-38, XP-83 and B-17 airplanes for the purpose of ground and air test firing. The Navy has initiated a similar program at the Naval Proving Ground. A temporary installation of a caliber .60 gun has been made in an F6F airplane to check space requirements and necessary structural modifications, as well as the feasibility of installing this gun in future design aircraft. The preliminary arrangement at Dahlgren was ground fired 1250 rounds with fairly satisfactory results. Another project has been set up at the Naval Air Modification Center, Philadelphia, Pa., to modify two additional F6F aircraft for a more permanent type of installation for air firing. Each of these two planes will be equipped with two caliber .60 guns and necessary accessories. Upon completion of these installations, which is expected in the very near future, an engineering evaluation of this gun in naval aircraft will be made.

65. The Army Ordnance Department expects to adopt the caliber .60 gun, in its present state of development, for operational use. This will be dependent upon the gun's being properly adjusted and upon the replacement of

components periodically in accordance with a replacement schedule established by Army Ordnance. The replacement schedule is based upon the number of rounds fired, varying from 2000 to 7000 rounds according to the part to be replaced; for example, firing pins must be replaced every 2000 rounds.

66. In Army and Navy tests of the caliber .60 aircraft gun to date, over a million rounds have been fired. The program to develop this gun further will continue under the close coordination of the Army and the Navy.



67. AIRCRAFT SIGHT SYSTEM MARK 1. The Aircraft Sight Systems Mark 1 Mods 0, 1 and 2 are entering the production stage at the Naval Ordnance Plant, Indianapolis, with the general objective of installation, both in new aircraft and retroactively, in naval aircraft fitted with the Bomb Director Mark 1 (AN/ASG-10) (see Bulletins 4-45, paragraph 172; 3-45, paragraphs 175-176; and 4-44, paragraphs 162-167). The equipment shown in the accompanying photograph is a pre-production prototype developed by Specialties, Inc., and differs in minor detail from the production equipment described in the following paragraphs.

68. The Aircraft Sight System Mark 1 is designed to provide the following facilities:

(a) To serve as a reflector-type gunsight for fixed guns in aircraft.

(b) To provide remote control of sight elevation (manual control by pilot). The manual control has a range of movement of 75 mils above or below the normal gunnery boresight position. Three adjustable detents are provided in the control knob. One of these is to be set at the sight elevation corresponding to the line of flight when in an average toss-bombing dive, usually 20 to 40 mils above the gunnery

boresight position; the latter position will normally utilize the second detent; while the third detent may be removed or may be used as squadron doctrine prescribes for the elevation offset needed for a standard rocket or dive-bombing release condition.

(c) To provide circuits for an automatic external device for controlling elevation that may be attached later. This provision was planned for plug-in of a "safe pull-out computer" which the Bureau of Aeronautics has under development and which will be that Bureau's item if adopted.

69. The Aircraft Sight System Mark 1 Mod 0 consists of the following components:

- (a) Sight Unit Mark 1 Mod 2 (optics same as those of Illuminated Sight Mark 8; has reflector plate and inclinometer vial, but no crash pad).
- (b) Relay Mark 4 Mod 1.
- (c) Control Box Mark 18 Mod 1.

The Aircraft Sight System Mark 1 Mod 1 differs from the Mod 0 only in respect to its sight unit, which is the Sight Unit Mark 1 Mod 3 (has crash pad, reflector plate and inclinometer). The Aircraft Sight System Mark 1 Mod 2 differs similarly, being supplied with Sight Unit Mark 1 Mod 4 (has crash pad and inclinometer only; no integral reflector plate). This latter modification of the system is for aircraft utilizing the bulletproof windshield as its sight reflector plate.

70. When the sight system is used, the pilot may turn the sight on, and having pre-computed the proper reticle position for the coming exercise, throw the selector switch on the control box to MANUAL, then pre-set his reticle position by means of the graduated knob on the control box. If the exercise includes gunnery runs, all the pilot need do is to throw the selector switch to GUNS; to return to the position last set manually by the knob, it is necessary only to return this switch to MANUAL position.

71. AIRCRAFT FIRE CONTROL SYSTEMS MARK 5 MOD 0 AND MARK 6 MOD 0.
The Aircraft Fire Control System Mark 5 Mod 0 is an interim system under development to provide lead-computing equipment in fighter or attack aircraft for the following:

- (a) Gun sighting for fixed guns.
- (b) Rocket sighting (surface targets).
- (c) Bomb directing.

72. The components of the Aircraft Fire Control System Mark 5 Mod 0 are as follows:

- (a) Sight Unit Mark 8 Mod 0 (this unit is externally similar to the sight head of Gunsight Mark 23, but incorporates circuit changes).
- (b) Control Box Mark 20 Mod 0 (this box is a modification of the selector dimmer unit of Gunsight Mark 23 Mod 0).
- (c) Switch Box Mark 3 Mod 0 (contains dive angle selector and weapon selector switches).
- (d) Relay Box Mark 7 Mod 0 (contains relays and circuits for remote control of the system by Switch Box Mark 3 Mod 0).
- (e) Voltage Regulator Mark 1 Mod 0.
- (f) Bomb Director Mark 1 Mod 2.
- (g) Gunsight Controller Aero 2 (this item is developed and furnished by the Bureau of Aeronautics; it functions as the stadiametric range drive from the pilot's twist action on the throttle to the Sight Unit Mark 8 Mod 0).

73. The Aircraft Fire Control System Mark 6 Mod 0 has the same components as Aircraft Fire Control System Mark 5 Mod 0 except that the Bomb Director Mark 1 Mod 2 is not included in the system, and the Switch Box Mark 3 Mod 1 is substituted for the Switch Box Mark 3 Mod 0, the former not having a "bombs" position of its weapon selector switch. When bombing, planes with Aircraft Fire Control System Mark 6 Mod 0 must, therefore, use conventional dive and glide bombing techniques; this system is for those planes whose bombing function is felt to be secondary and for which the additional weight of a bombing computer is not justified.

74. It is anticipated that production of the Aircraft Fire Control System Mark 6 Mod 0 will commence in the early fall of 1946 for installation in naval aircraft; at the present time only limited production of the Mark 5 Mod 0 system is planned for installation in a small number of Marine fighter planes. Ordnance Pamphlets (OP 1688 and OP 1688a), now under preparation, will contain detailed information on both of these aircraft fire control systems.

75. SIGHTING DATA PAMPHLETS FOR AIRCRAFT. Ordnance Pamphlets are being prepared for each type of aircraft to provide sighting data for use with fixed gunsights in fixed-gun strafing, rocket firing, and bombing. The purpose of these pamphlets is to eliminate separate publications for each type of attack and to incorporate in one publication for each type of aircraft all current ballistic data under the cognizance of the Bureau for strafing, rocket firing, and low-altitude bombing.

76. The first of these pamphlets, OP 1355(1st Revision), which contains sighting data for F6F-3 and F6F-5 aircraft, was distributed recently. In order to provide sighting data in the most convenient and useful form in future pamphlets, comments and suggestions in regard to the contents and form of OP 1355(1st Revision) will be appreciated by the Bureau.

77. TESTS OF AIRCRAFT ENGINE STARTER CARTRIDGES. Reports received in this Bureau indicated the presence of corrosion on the terminals of aircraft engine starter cartridges. On the basis of these reports, samples of mixed lots from various contractors were sent to the Naval Powder Factory, Indian Head, Maryland, with a request that the following tests be conducted:

(a) Measure the electrical resistance of 200 of the most corroded samples, using a contact point similar to the firing pin of a standard starter breech.

(b) Determine by actual trial whether the most corroded cartridges would fire satisfactorily.

(c) Determine the source and composition of the corrosion.

(d) Determine whether the corrosion would be a continuing reaction, and if so, whether it would be likely to proceed, within 5 years, to such a stage as to form an insulating film over the primer contact sufficient to render the cartridge incapable of satisfactory performance.

78. The above tests resulted in the following conclusions:

(a) A considerable number of cartridges from accepted lots failed to meet resistance specifications.

(b) Increased resistance resulting from corrosion did not cause firing failures at the specified current level of 10 volts.

(c) The corrosion noted was caused by the reaction of sulphur in the rubber impregnated asbestos disc in contact with the copper firing terminal, forming a film of copper sulphide.

(d) Accelerated aging produced increased corrosion and indicated that corrosion would be progressive, although all of the cartridges so aged fired.

(e) Some normally aged cartridges, almost four years old, highly corroded and failing resistance specifications, also fired.

(f) The presence of corrosion in itself, should not be considered a cause of unserviceability.

79. NAVAL AVIATION ORDNANCE TEST STATION, CHINCOTEAGUE, VA. The Naval Aviation Ordnance Test Station at Chincoteague, Va., which on 22 March 1945 was established by the Secretary of the Navy as a Fifth Naval District activity under the cognizance of the Bureau of Ordnance, was placed in commission on 15 April 1946.

80. The primary function of this station is the proving of aviation ordnance developed and manufactured by civilian contractors, the Naval Gun Factory, NDRC and the Bureau, and its duties include performing tests, experiments and modifications of aviation ordnance equipment and guided missiles in connection with experimental and developmental projects.

81. The Naval Aviation Ordnance Test Station at Chincoteague is well situated for its type of work; it is centrally located on the eastern seaboard, a short distance from the Navy Department and from naval establishments at Dahlgren, Va., Patuxent River, Md., Norfolk, Va., Cape May, N.J., Philadelphia, Pa., etc. On page 38 is an air view of the station and its immediate vicinity.

82. CASUALTIES AND MALFUNCTIONS OF AVIATION ORDNANCE EQUIPMENT DURING WORLD WAR II. The following extracts on the casualties and malfunctions of aviation ordnance equipment during World War II and the Bureau's corrective action are from the summary referred to in paragraph 4 of Bulletin 1-46 and are in addition to those contained in paragraphs 59-69 of that Bulletin.

83. Caliber .30 Guns. RUDACE's received on caliber .30 guns were few and varied. Most of the difficulties were occasioned by the use of guns with obsolete parts. When individual parts of the gun were changed or sufficiently modified to warrant declaring the replaced part obsolete, supply activities were advised to dispose of the obsolete items. However, it was impossible to assure that these obsolete parts were replaced in guns which were in the hands of operating activities until the guns were overhauled by an approved machine gun overhaul shop of the major air stations.

84. Mass production methods employed by aircraft machine gun manufacturers to meet the increased requirements for these weapons during the war occasionally permitted acceptance of guns with minor defects which were not revealed by the firing of a minimum of 220 rounds during the acceptance tests at the manufacturers' plants. Most of the RUDACE's received in this category proved to be isolated instances and were corrected locally.

85. Caliber .50 BAM M2.

(a) Retracting Slide Bracket. The first retracting slide brackets were improperly secured to the side plate of the gun and were light in construction. The redesigned bracket had additional holes tapped for securing screws and the forward end and area around the plunger hole strengthened to withstand charging.

(b) Barrels. The caliber .50 barrel has undergone no radical change in design but has kept pace with advances in metallurgy. The present

CONFIDENTIAL



AIR VIEW OF NAVAL AVIATION TEST STATION, CHINCOTEAGUE, VA., AND VICINITY

barrels will last longer, withstand longer firing bursts and need less cooling time between bursts. The latest barrel is a "threaded sleeve, banded, nitrided, plated bore with liner." The majority of RUDAOE's received by this Bureau covered barrels which were fired beyond their life expectancy, were fired with faulty ammunition, or were new and the bores found to be rusty or fouled with metal filings.

(c) Oil Buffer Assembly. The principal difficulty encountered in the oil buffer assembly was improper securing of the filler screw and careless assembly by the manufacturer. Springs, shipped as spares, were often found to be rusty, indicating improper preservation for shipment. The filler screw was redesigned, making it practically foolproof, and producers were cautioned as to the necessity for proper assembly, free of steel shavings, grit and other foreign matter.

(d) Link Strippers and Cartridge Stops. As a result of stepped-up production, inspection was lax and a number of guns were sent out with these items "fitted" by hammer. The result was a series of broken pawl-holding pins when any attempt was made to remove them. This matter was pointed out to the manufacturer and immediately corrected.

(e) Sear and Sear Slide. Guns from one manufacturer were received with the sear slide extending beyond the side of the bolt. When inserted, the sear slide partially depressed the sear, which then failed to hold the firing pin properly. Timing of the gun was impossible and firing was erratic. It was found that the sear slides were being checked on one side only, and these difficulties were eliminated by having both sides checked.

(f) Retracting Slide Bracket Bolt. The retracting slide bracket bolt was found to be weak at the threaded portion. A bolt with solid threaded ends was designed and an OMI was issued containing instructions for combining it with the retracting slide assembly.

(g) Cover Extracting Spring, Barrel Locking Spring, and Caliber .50 Switch. Reports received on each of the above indicated that the springs were weak, bent, and usually rusty, and the switch was found to be warped. All of these conditions were judged to have been the fault of poor inspection prior to shipping and a more careful inspection procedure was required.

(h) Breech Lock. The breech lock of one manufacturer was found to be binding on the first part of recoil, resulting in jerky operation. This item was within the tolerance allowed, but as a result of investigation it was decided to increase the length of the forward bevel, and smooth functioning resulted.

(i) Ejector Springs. A report of weak ejector springs resulted in the manufacture of a special test fixture for uniform measurements. It was further found necessary to add a straight extension, which prevented rotation and resultant sluggish operations.

(j) Latch Covers. One report was received of a loose latch cover which bore on only one side, thus permitting the cover to "roll" on

firing. This was corrected by having installed enlarged latches which would be hand fitted at the factory by grinding to size.

(k) Bolt. There were two instances of bolt slides breaking in the after position. In both instances, metallic tests showed brittleness to be the cause, and action was taken to scrap the specific lot. The enlargement of firing pin holes was found in two cases to be the result of gas action and/or bent firing pins. It was decided that pierced or extended primers had initiated the trouble. A broken bolt reported in a RUDAOE was found to have been the result of extreme over-all brittleness following a "bluing" process, and the practice of testing all bolts following "bluing" was inaugurated.

86. Bombsight Mark 15. A RUDAOE reported the receipt from a supply depot of bearings which had obviously been in previous use and which were entirely unsatisfactory for proper repair and operation of the bombsight, while three bearings received in plastic containers were in excellent condition. Since all new bombsight ball bearings being supplied at the time were individually packed in sealed lucite boxes, or sealed metal foil bags, often immersed in the proper operational lubricant, and a program had been initiated to have all bearings in stock inspected and repackaged in this type of container, the unsatisfactory bearings referred to in the report had evidently been from a group not yet inspected and repacked.

87. One RUDAOE reported the receipt of bearings which, although in new lucite containers, were defective because of corrosion. The boxes in which the bearings were received had not, however, been sealed with a neoprene gasket. A more careful inspection and closer adherence to new specifications were requested of the Inspector of Naval Material.

88. RUDAOE's reported the receipt of bombsight material in such a condition that extensive overhaul to put it back in service was required. Careless and faulty packing had resulted in much physical damage. Also, failure to give monthly warm-up runs had rendered sights unfit for use. An ordnance circular letter was issued emphasizing the delicate nature of bombsight material, the ease with which it could be harmed by rough or improper handling, and the expense and labor involved in repair. Monthly warm-up runs were made mandatory.

89. Aircraft Buffeting. The reported buffeting of aircraft flight surfaces was caused by the carrying of external stores on high-speed aircraft. Preliminary studies indicated that the cause was interference between the bombs and the aircraft surface air streams. A joint project of the Bureau of Ordnance, the Bureau of Aeronautics, and the National Advisory Committee for Aeronautics is underway to investigate the causes and methods of eliminating this difficulty.

AMMUNITION

90. SHAPED CHARGE BOMB TESTS. Static tests of shaped charge bombs on multiplate targets simulating a battleship with and without superstructure were reported in Bulletin No. 4-45. Further static tests have been conducted at the Naval Proving Ground, Dahlgren, on multiplate targets simulating a cruiser with and without superstructure. The bombs, with an AN-M103 fuze modified for static detonation and loaded with Composition B, were placed about four inches from the first mild steel plate. The plates were set at an angle of 45° to the axis of the bomb. Three 500-lb. GP bombs loaded with TNT were piled vertically on their sides in the section of the target representing the magazine space of a cruiser. Two tests of 1000-lb. bombs did not defeat the target with superstructure. One test of a 1000-lb. bomb defeated the target without superstructure, detonating the three 500-lb. GP bombs. None of the plates of this test were recovered. One 500-lb. shaped charge bomb did not defeat the target without superstructure. The results of these tests approximated the predicted performances.

91. In Bulletin 4-45, drop tests of 1000-lb. shaped charge bombs fuzed with an instantaneous fuze AN-M103 were also reported. In order to determine the effect of stand-off, the distance from the target to the base of cone, it is necessary to have the bombs detonate above the target. To accomplish this, other 1000-lb. shaped charge bombs were fitted with modified VT nose fuzes T702 or with nose fuze extensions having nose fuzes AN-M103 at the forward end. These bombs were dropped from an airplane onto an octagonal reinforced concrete target, 28" thick and 250' across, at a striking velocity of about 700' per second. Bombs with modified VT nose fuzes did not function at the expected height of 5'. Bombs with fuze extensions which were 16" long did function properly. Two hits of bombs with fuze extensions made craters 8' deep and 14' wide in soft earth and 11' 5" deep and 2' 8" wide in concrete. Three hits of bombs with fuze extensions made craters 6' 4", 9' 6", and 11' 1" deep, respectively, and, in all cases, 2' 6" wide in concrete. These results were comparable with those of the previous tests referred to above.

92. SPECIAL SALUTING CARTRIDGES FOR SHIPS. Bureau of Ordnance Circular Letter A8-46, "Special Saluting Cartridges for Ships", was issued in April and reprinted in the Navy Department Semimonthly Bulletin of 15 April 1946 (NDB 46-768). This letter contains instructions for the stowage and use of saluting cartridges for 3"/50, 5"/25, 5"/38, and 5"/54 caliber guns. Saluting cartridges are currently being stocked in certain continental depots, but they will be issued only on specific instructions from the Bureau.

93. PERCUSSION MISFIRES IN 5"/38 CALIBER GUNS WHEN FIRING SALUTES. Reports received from ships firing salutes with 5"/38 caliber guns revealed an unusually high rate of misfires when percussion fire was used. From a recent investigation of the causes of percussion misfires in 5"/38 caliber guns, it has been determined that in many instances the firing pin spring does not impart sufficient energy to the firing pins to cause all primers to fire. To overcome this deficiency in the percussion firing mechanism

of 5"/38 caliber guns, the Bureau has under preparation Ordalt 2594 entitled "5"/38 Caliber Single and Twin Mounts - 5" Housing Mark 1 - Installation of Heavier Firing Pin Spring".

94. Based on knowledge of the percussion sensitivity characteristics of the Primer (Combination) Mark 27 Mod 0 and as a result of actual measurements of firing pin striking energies taken aboard vessels of the Operational Development Force and considered as average for all 5"/38 guns, it can be stated that as high as 60% of the primers fired by percussion may be expected to misfire. This condition will, of course, be rectified as soon as Ordalt 2594 is issued and the firing pin springs are replaced.

95. Saluting cartridges now available for 5"/38 caliber guns are, as described in BuOrd Circular Letter A8-46 (see paragraph 92), assembled with the Combination Primer Mark 27 Mod 0. Therefore, in view of unreliable performance when percussion fire is used, it is recommended that electrical firing be used for firing salutes with 5"/38 guns. Some ships have reported the complete absence of misfires when using percussion and electrical firing simultaneously.

96. OP 1480 (1st REVISION) - VT FUZES FOR PROJECTILES AND SPIN-STABILIZED ROCKETS. Ordnance Pamphlet 1480 (1st Revision), superseding OP 1480 (Preliminary) and OP 1480A (Preliminary), is now in the hands of the printer and will be ready for distribution some time in July 1946. The revision brings together for the first time all of the information on VT fuzes for projectiles and spin-stabilized rockets which is of interest to those who use these types of ammunition. A detailed and well-illustrated chapter on "Theory" is included. The classification of the pamphlet is CONFIDENTIAL, but the possibility of downgrading to RESTRICTED is under consideration.

97. CANNED VT FUZES AND ALUMINUM CAVITY LINERS FOR PROJECTILES. VT projectile fuzes assembled with auxiliary detonating fuzes are now being sealed into individual hermetically-sealed tin cans at loading depots. Experience during the war with VT fuzes made for the Army has shown that the life expectancy of ammunition preserved in this manner is greatly extended. In order to make possible the exchange of fuzes on shipboard, 5"/38, 5"/54, and 6"/47 projectiles cavitized for VT fuzes are to be fitted with aluminum cavity liners. As improved types of VT fuzes become available, the exchange of fuzes will not require the removal of projectiles from the handling rooms. Issue of projectiles fitted with cavity liners probably will not start before the end of 1946.

98. MECHANICAL TIME FUZE MARK 57 MOD 1. The Mechanical Time Fuze Mark 57 Mod 1 has been adopted as standard for use with the 260-lb. projectiles fired from the 8"/55 caliber rapid fire gun turrets of CAL39-class ships. The Mark 57 Mod 0 fuze which was originally designed for this round was identical with the Mark 61 fuze in regard to internal mechanism and graduations, and was regulated to function at a spin of 9720 r.p.m. at

service velocity. It resembled the Mark 51 fuze in that setting slots were provided instead of lugs, although the contour was modified to conform to the shape of the projectile.

99. This original design was found to be deficient because of its inability to withstand the rapid operation of the Fuze Setter Mark 20. Therefore, the recently developed Fuze Mark 57 Mod 1 requires that the body be constructed of manganese bronze instead of brass, and incorporates comparatively deep setting slots in the lower cap and body. These slots have been reversed, as compared to other mechanical time fuzes, in order to prevent occasional unthreading of the fuze from the projectile during the setting operation. Because of essential considerations in the design of the fuze setter, it was believed impracticable to adopt the same ogival contour for both the Mechanical Time Fuze Mark 57 and the Point Detonating Fuze Mark 29. Accordingly, the range obtained with a time-fuzed projectile at service or reduced velocity will exceed that of an impact-fuzed projectile by approximately 1%.

100. FUZE MARK 247 MOD 0 FOR PRACTICE BOMB SIGNAL MARK 7 MOD 0. Practice Bomb Signal Fuze Mark 247 Mod 0 has been developed for use with Practice Bomb Signal Mark 7 Mod 0. This signal, which contains one pound of black powder, produces a smoke puff on ground impact. It will be provided for attachment to the 100-lb. Practice Bomb Mark 15 Mod 3. It is anticipated that the signal and fuze will be available for issue some time in the fall of 1946.

101. The fuze is a simple air arming type. It contains no explosive, but fits into the bomb signal in such a way that, in the armed condition, the firing pin drives forward on impact and fires a .38 caliber special blank cartridge contained in the signal. A creep spring holds the firing pin back until the impact of the bomb. In the unarmed condition, the firing pin is held back by the arming screw, which is in turn secured to the arming vane. Rotation of the vane during air travel unscrews the arming screw, arming the fuze. Provision is made for the use of the standard arming wire to lock the vane while the practice bomb is carried in bomb racks. The fuze firing pin is held by a safety pin during shipment and handling.

102. Information on both the Practice Bomb Signal Mark 7 Mod 0 and the Fuze Mark 247 Mod 0 will be included in a forthcoming change to OP 998, "Aircraft Pyrotechnics."

103. ACCIDENT IN USING SMOKE GRENADES. Attention is invited to the fact that the following two smoke grenades closely resemble each other in external appearance:

HC Smoke Grenade AN-M8 - primarily a ground-to-air signaling device (not a weapon), which burns for 2-2½ minutes.

WP Smoke Grenade M15 - a weapon, designed to burst after a 5-second delay, to cause casualties from burns when used against enemy concealments and flammable material.

These items are described in War Department Technical Manual TM3-300, and instructions accompany them in their shipping containers.

104. A recent accident occurred at a naval air station during an airplane crash drill when a WP Smoke Grenade M15 was used inadvertently instead of an HC Smoke Grenade AN-M8 in simulating a burning airplane. The grenade exploded after about 5 seconds, seriously burning a chief ordnanceman who, being unfamiliar with its characteristics, was too close to it.

105. Smoke grenades are very conspicuously marked on their exteriors; and before using them for drill, personnel should identify them and be familiar with their characteristics so that accidents of this sort will be avoided.

106. CASUALTIES AND MALFUNCTIONS OF AMMUNITION DURING WORLD WAR II. The following extracts on ammunition casualties and malfunctions during World War II and the Bureau's corrective action are from the summary referred to in paragraph 4 of Bulletin 1-46 and are in addition to those contained in paragraphs 102-114 of that Bulletin.

107. 3"/50 Cartridge Case Defects. Following a gun stoppage, attempts to extract the cartridge case usually resulted in the separation of the cartridge case from the projectile and the spilling of the propellant into the breech mechanism. As a corrective measure, the cartridge case was crimped to the projectile.

108. 3" and 5" Cartridge Case Defects. Circumferential cracks in the base of the cartridge case near the flange permitted leakage of propellant gases, with resultant damage to the breech mechanism. Ammunition showing this defect was withdrawn from service, and manufacturing processes were improved to control stress corrosion cracking tendencies.

109. 3", 5", and 6" Flashless Charges. Flashless charges were reported to be emitting a large amount of sparks and causing residue and an undesirable amount of smoke. The replacement of flashless pellets by flashless grains or flashless powders removed the cause of residue. The development of new propellant compositions to reduce smoke and flash is now underway.

110. 5" and 6" Tracer Deterioration. There occurred a high percentage of failures of Tracers Mark 9 (white and red) to ignite due to tracer deterioration resulting from exposure to moisture and high humidity. As a remedy, the tracer seal was improved by the use of a moisture-resistant coating.

111. 5" and 6" Cartridge Case Defects. Failure of the cartridge to seat properly prevented the breech from closing and resulted in a loading jam. Improved inspection to prevent oversized cases and oversized or undersized cork plugs eliminated some of these failures and the improvement of handling and loading procedures lessened the number of jams caused by cases which had been dented and crimped by improper handling.

112. 8", 12", 14" and 16" Casualties. Lead foil used for decoppering occasionally fused and fouled the mushroom and breech. As a preventive measure,

lead foil was omitted from bag charges and issued in separate packages for use as directed by gunnery officers. A series of accidental explosions of 14" and 16" reduced charges was experienced, the cause of which was finally attributed to electrostatic ignition. BuOrd Circular Letter A52-45 described these accidents and their causes, and Circular Letter A56-45 contained the necessary instructions for packing and handling charges to prevent electrostatic ignition. One of the corrective measures taken was the provision of spacers to prevent longitudinal movement and adapters to prevent lateral movement of bags in the tank; another measure of correction was the omission of the lead foil as mentioned above. Powder tanks to accommodate the diameter of reduced charge powder bags have been developed by the Bureau to replace standard powder tanks with adapters and deliveries of 16"/45 Mark 7 tanks and 16"/50 Mark 8 tanks are now being made (see Bulletin 1-46, page 9).

113. Variables in Major Caliber Reduced Charges. Variables in reduced charges were reported as being due to loading the wrong charge weights. Bulletin 4-45, paragraphs 124-132, describes the two major causes for these variables, viz., (1) errors inherent in the now obsolete "New Gun" method of powder proof, and (2) errors introduced because of failure to take into account the powder quickness effect in making the charge assignment. As stated in Bulletin 4-45, velocity loss curves have been corrected and the new reduced charges will in time replace the existing charges and thus eliminate the larger variables in reduced charges for major calibers.

114. Base Detonating Fuze Mark 13 (5"/25 AAC and 5"/38 AAC). Because it was not bore safe and a large number of prematures occurred, the Base Detonating Fuze Mark 13 was declared obsolete. The Bureau produced the Base Detonating Fuze Mark 28 by modifying the Base Detonating Fuze Mark 20 design and the Mark 28 and its subsequent modifications were used throughout the war wherever Mark 13 fuzes had previously been used.

115. Base Detonating Fuze Mark 28 (5"/25, 5"/38, 5"/54 AAC, 5"/51, 6"/47, 6"/53 HC; 6"/50, 6"/47, 7"/45 Common). A high percentage of duds with Base Detonating Fuzes Mark 28 was reported. The duds were caused primarily by deterioration of the primer mixture and the corrective measures taken were to make the fuze moistureproof and to include a desiccant element within the fuze. Duds were also caused by insufficient sensitivity on light impacts. Although this latter defect may be inherent in the design, defective manufacturing or inspection techniques were no doubt a contributing factor and steps were taken to improve the fuze by perfecting the manufacturing technique and by the use of improved inspection gages; particularly gages designed to limit eccentricities to acceptable values. Other improvements, less immediate in nature, include the development of a new primer mixture and the development of an improved, simplified fuze.

116. Moistureproofing Projectile Base Fuzes. In order to reduce the percentage of duds caused primarily by deterioration of the primer mixture in base fuzes that were not moistureproofed, all projectile base fuzes have been moistureproofed and a desiccant element within the fuze has been added. Also, the Bureau is now working on a project to develop a new primer mixture which will be less susceptible to deterioration than present mixtures.

117. Point Detonating Fuze Mark 29 (5"/51, 6"/47 (SP), 6"/53 - 16"/50 HC; 5"/25, 5"/38 AAC). The plastic ogives of early Point Detonating Fuzes Mark 29 were susceptible to chipping during handling and loading of projectiles into the gun trays. The early (no Mod) fuzes are now obsolete and in later modifications the ogives were made of a stronger fabric-filled plastic. The metal parts also were changed in the Mods 2 and 3 to provide a much more rigid structure. Also in the Mod 3 a thin aluminum disc was added between the interrupter and the relay detonator to assist in preventing the relay detonator from being set off in case the upper detonator is initiated when the fuze is in the unarmed condition.

118. Auxiliary Detonating Fuze Mark 46 (3"/23, 3"/50 AA; 5"/25, 5"/38 AAC; 4"/50, 5"/51, 6"/53, 6"/47 (SP) HC). A large number of duds were reported with the Auxiliary Detonating Fuze Mark 46, due to rapid deterioration of the primer mixture. The fuze was modified to make use of a stab type lead azide primer which has a much longer life. The Mark 46 fuze has been declared obsolete and replaced by Auxiliary Detonating Fuze Mark 54 with the lead azide primer.

119. VT Fuzes. The four major causes for the malfunctioning of VT fuzes in service use during the war were found to be:

- (a) The breaking of the nose section in hoisting and loading operations (Mark 32, early Mods).
- (b) Life failure due to the short shelf life of the dry battery (Mark 32, all Mods except Mod 40).
- (c) Excessive prematures (Mark 32, all Mods except Mod 40).
- (d) Excessive duds in VT Fuzes Mark 53 Mods 0, 1, 2, 3 and 4 due to moistureproofing failure.

120. To correct the above, the following remedial measures were taken in production and in the design of subsequent models:

(a) The mechanical strength of the nose section (antenna cap) was weak because of plastic molding techniques used in 1942. This was corrected by the molding of the antenna cap (metal insert) into the plastic nose, thus minimizing the possibility of breaking the antenna connection.

(b) The shelf life of the dry battery was estimated to be 8 to 12 months, hence a recharging program for replacing old batteries in fuzes was set up in forward areas. Later, however, in Mark 40 and Mark 53 type fuzes, the dry battery was replaced with the reserve battery (indefinite life) type (see Bulletin 4-45, paragraphs 108-110).

(c) To minimize prematures, complicated electrical circuits were developed and produced in the Mark 40 and Mark 53 type fuzes. Further, prematures due to the melting of the antenna connection were

eliminated by the development of a high-melting point solder connection to the antenna (Mark 40) and the development of the capless antenna type fuze (Mark 53).

(d) Duds in Fuzes Mark 53 Mods 0, 1, 2, 3 and 4 were caused by the entry of moisture into the fuze through the rear end. The development of Fuzes Mark 53 Mods 5 and 6 included the provision for compression gasket waterproofing of the auxiliary detonator (Mark 44 Mod 1) to the fuze assembly at loading depots, thus sealing the rear end against possible moisture entry. Future designs now in the engineering production stage provide for the manufacture of a completely hermetically-sealed VT fuze.

ROCKETS

121. ROCKET BASE FUZES MARK 162 AND MARK 166. Bulletin 2-45, paragraphs 214-216, described the development of Rocket Base Fuzes Mark 162 and Mark 166. Although range firing test results have indicated that these fuzes function satisfactorily, it has been found desirable to incorporate certain improvements in their design.

122. One of these improvements is a redesign of the fuzes to eliminate any unstable sensitivity features, as these fuzes have exhibited erratic sensitivity in drop sensitivity tests conducted by the fuze manufacturer.

123. Another improvement will be the inclusion of a set-back arming feature in addition to the pressure arming assembly, so as to prevent the fuzes from becoming a hazard in the event a rocket motor should accidentally ignite and burn in a ready stowage locker.

124. Other improvements to be investigated concern performance, safety, manufacture, loading, and a reduction in weight and size of these fuzes.

125. STRIPPABLE PROTECTIVE COATING FOR 540 SPIN STABILIZED ROCKET MOTOR BOURRELETS. The Naval Ordnance Laboratory, Silver Spring, Md., has developed a strippable coating which is suited for the corrosion protection of 5" spin stabilized rocket motor bourrelets. The material, which consists of a lacquer compounded from vinyl resin, plasticizers, solvents, oils, pigments, and stabilizers, may be applied either by spraying or by dipping, and dries to a tough elastomeric film. The adhesion of this film is sufficient to provide excellent corrosion prevention, as evidenced by its ability to withstand a 20% salt spray test for 150 hours at 95° ±2° F. and a 240-hour exposure to accelerated weathering. The coating was almost unaffected by this test and there were no visible signs of corrosion of the protected metal. The coating is readily removable without the use of solvents, as it may be stripped off and leaves no residue. This latter factor is of extreme importance in the above-mentioned application as a residue might impair the conductivity of the bourrelet.

126. In order that rocket bourrelets have adequate corrosion protection after removal of the strippable coating, Navy Specification 52C18 Gr II should be applied before the strippable coating. Tests at the Naval Research Laboratory, Anacostia, have shown that 52C18 Gr II will have no deleterious effects upon conductivity. Specifications for the new strippable coating have been prepared and are available under the designation 52L17(INT).

UNDERWATER

127. TORPEDO MARK 25. With the advent of the Grumman torpedo plane, the limitations of the Torpedo Mark 13 as to height and speed of release became so critical as to preclude the possibility of its future use. Realizing this adverse situation, the Bureau called upon the Office of Scientific Research and Development to aid in the development of a new aircraft torpedo which would be capable of withstanding water impact when launched at the then high speeds of the TBF airplane. The National Defense Research Committee, an organization within the framework of the OSRD, was given the task of designing a new torpedo, to be known as the Torpedo Mark 25, which it was hoped would supersede the Torpedo Mark 13 type.

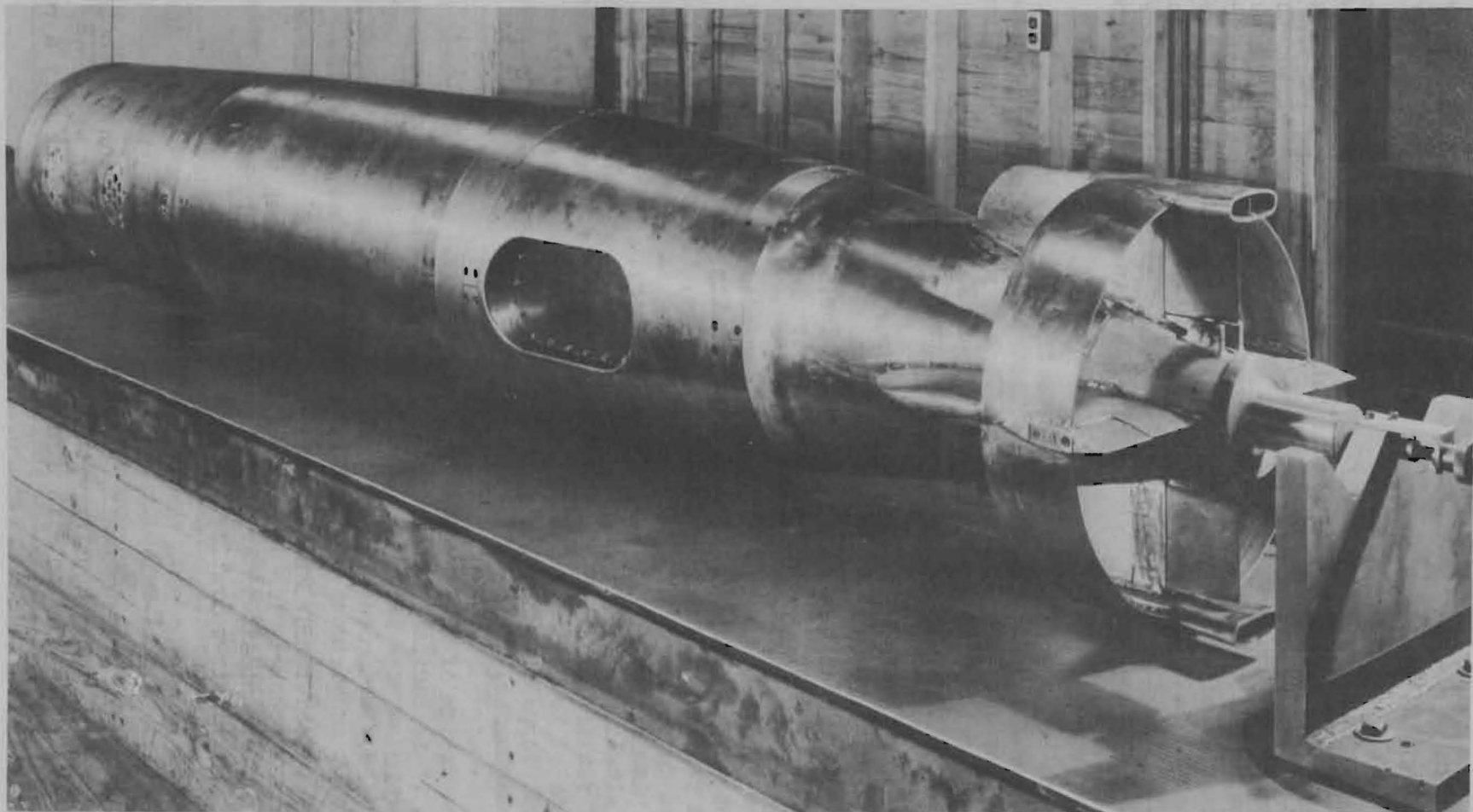
128. Since the aircraft torpedo had to fit into the bomb bays of aircraft then in service, it was necessary to set up limitations as to size and weight of the torpedo; hence, the Torpedo Mark 25 was to retain the same over-all length, diameter, and weight as the Torpedo Mark 13 type. Other specifications of the Torpedo Mark 25 are as follows:

Range	- 3000 yards.
Speed	- 40 knots
War head charge	- 600-800 lbs.
Launching speed	- 350 knots

129. The NDRC set up a program which proceeded along two general lines: the first was to study the Torpedo Mark 13 with the purpose of retaining its good features and correcting, if possible, its weak points; and the second called for research on problems concerning torpedo structure, controls, power plants, torpedo motion, and water entry. These two phases were carried on simultaneously by a number of activities established by NDRC. NDRC made use of facilities at the California Institute of Technology, Massachusetts Institute of Technology, Newark College of Engineering, American Can Company, the Naval Torpedo Station, Newport, and other educational institutions, industrial establishments, and naval stations.

130. The design of the Torpedo Mark 25 is similar to the Torpedo Mark 13 in shape, but it is radically different in structure and internal arrangement (see photograph on page 50). The Torpedo Mark 25 has the conventional war head for an aircraft torpedo. The air flask section has been reduced in length and the water compartment has been entirely eliminated since only alcohol is carried for fuel and coolant.

131. The reduction in air flask length and the elimination of water is accomplished by the design of a more efficient super-heater system and turbines. The combustion pot is constructed to allow circulation of the alcohol about the liner of the pot, thus cooling the pot and preheating the alcohol. An excess of alcohol is sprayed into the pot to cool the gases of combustion by its evaporation. The combustion pot of the Mark 13 is cooled by free circulation of sea water through the midship section of the torpedo. The control section of the Torpedo Mark 25 is a dry compartment intended to carry the course and depth controls and various recording instruments. The

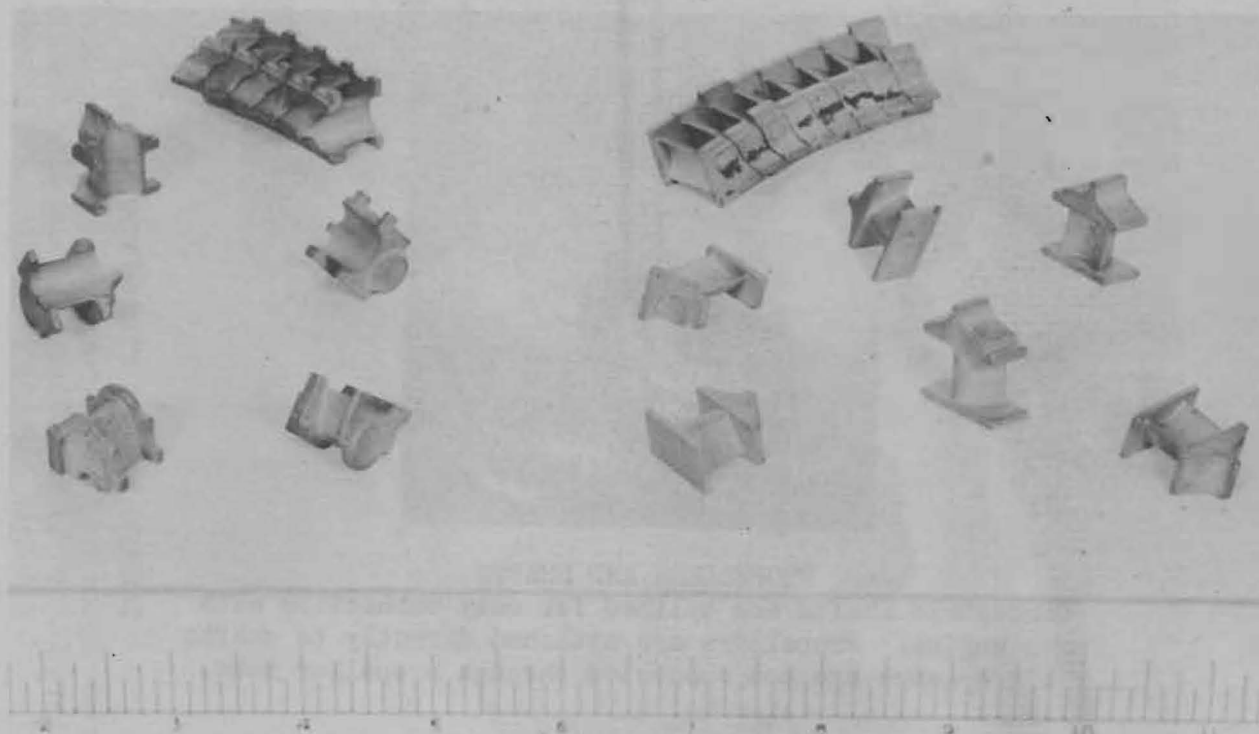
CONFIDENTIAL

TORPEDO MARK 25 TYPE - FIRST MODEL

**View of Torpedo Lying on its Starboard Side, Showing Modified Exercise
Head Mark 26 Mod 4, Air Flask, Midship Ring (not included
in later models), Control Section, and Afterbody**

construction of the combustion pot, therefore, was designed with the view to keeping it as cool as possible so as not to overheat the control section.

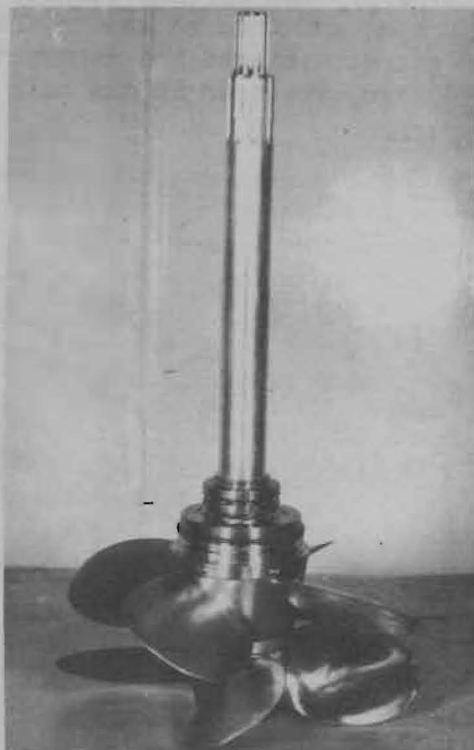
132. The turbines and gear train also differ radically from those of the Torpedo Mark 13. The turbines of the Mark 25 are arranged similarly to those in Torpedoes Marks 16 and 17. This arrangement is commonly referred to as the "H" or horizontal type engine. Two jack shafts are utilized to pass the turbine drive to the concentric, short, splined propeller shafts. The turbines are constructed in accordance with the latest design practices in designing turbo-superchargers. The turbine buckets are cast separately by the Austenal lost wax process and then welded to the turbine wheel (see photograph below). Ground gears, designed and manufactured in accordance with aircraft engine gear design, are used in the main engine of the Torpedo Mark 25.



CAST TURBINE BUCKETS, 1st and 2nd STAGE
Individual buckets (in lower part of picture) when welded
to turbine wheel, interlock to form completed turbine.
Turbine's operating speed is 18,000 r.p.m.

133. The turbines, gear train, and lube oil pump system are encased in an aluminum housing. This housing with all parts in it may be removed as a unit from the afterbody section with a minimum of effort since only a very

few bolts hold it in place. The propeller shafts (see photograph below) offer no trouble since they are splined and the engine may easily be pulled away from them. The casing also prevents exhaust gases from circulating throughout the interior of the afterbody. Conduits lead the gases to the hollow streamlined horizontal fins. The gases are then exhausted through the fins into ports which extend beyond the horizontal rudders. This system prevents the gases from enveloping the rudders and propellers, which would seriously reduce their effectiveness. This system of exhausting gases avoids overheating of the propeller bearings and simplifies their design.



PROPELLERS AND SHAFTS

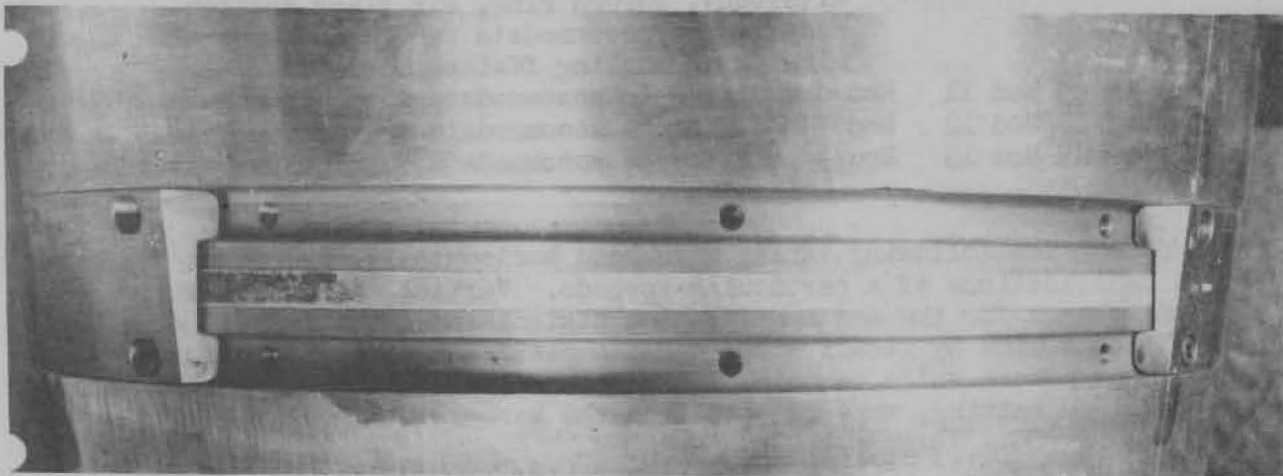
Concentric shafts are splined for easy connection with main engine. Propellers are attached directly to shafts since gases are not exhausted through propeller hubs.

134. The radical nature of the internal changes has resulted in a different system of compartmenting the torpedo. The sections of the torpedo are as follows: war head, air flask, control section, and afterbody. The control section, or buoyancy chamber, is a large dry chamber located between the air flask and the afterbody and contains, in addition to the course and depth control mechanisms, combustion pot, regulator valve, and other valves similar to those in the midship section of the Torpedo Mark 13, as well as instruments for recording torpedo data. Located in and on the afterbody are the turbine and turbine gears, propeller shafting, streamlined horizontal and vertical fins, rudders, shroud ring, and propellers.

135. Radical departures other than those mentioned above are the

use of cast aluminum exercise heads and war heads, cast aluminum afterbodies, waterproof wedge type joint rings (see photograph below), an air pick-off system to replace the pallet mechanism in the present gyro control system, an air-jet operated depth engine, and the employment of an evacuated bellows in the depth mechanism instead of an atmospheric chamber for obtaining reference pressure.

136. Ten models of the Torpedo Mark 25 have been constructed and are undergoing tests. Twenty-five additional models of the Torpedo Mark 25 are now under construction and will be used in an exhaustive study of this torpedo and its related mechanisms. It is believed that the many novel features of this torpedo merit continued testing to make a complete evaluation of them and their application to future torpedo design. Every effort has been and will continue to be made in the development of this torpedo to utilize commercial standards and products so that, if necessary, this, and all future torpedoes, may be put into production with a minimum loss of time due to the tooling up of factories supplying assemblies or sub-assemblies.



WEDGE TYPE JOINT

The four sections of the new ring draw the afterbody and control section together. An "O" ring seal makes the joint watertight.

137. With the advent of jet-propelled airplanes, and airplanes of conventional type which are capable of flying at speeds far in excess of the 350 knots for which the Mark 25 was originally designed, it is doubtful that the Torpedo Mark 25, as such, will be released for service use. Because of the many new and important features incorporated in this torpedo and their application to newer torpedoes, it is considered that the talent, energy, and money employed in developing this torpedo has considerably advanced the Navy's knowledge of aircraft torpedo design.

138. MODIFICATIONS OF THE TORPEDO MARK 13. The following table has been prepared as a guide to clarify the nature of the modifications of the Torpedo Mark 13. Only the principal, or easily recognizable, changes to the torpedo have been set forth.

<u>Mark and Mod</u>	<u>Principal Reason for Change in Mod Number</u>
Mark 13 Mod 0	Now obsolete.
Mark 13 Mod 1	Rudders moved forward of props.
Mark 13 Mod 2	Experimental - 40 knots - abandoned.
Mark 13 Mod 2A	Conversion of Mod 2 to 33.5 knots.
Mark 13 Mod 3	Addition of gyro angling feature.
Mark 13 Mod 4	50 models - experimental - expended - strengthened afterbody (internal).
Mark 13 Mod 5	Addition of water trip to Mod 1.
Mark 13 Mod 6	Addition of shroud ring to Mod 2A.
Mark 13 Mod 7	Addition of shroud ring to Mod 3.
Mark 13 Mod 8	Addition of shroud ring to Mod 4.
Mark 13 Mod 9	Addition of shroud ring to Mod 5.
Mark 13 Mod 10	Manufactured as such - internally strengthened afterbody, shroud ring, air flask section modified to accommodate suspension beam - minus gyro angling feature.
Mark 13 Mod 11	Mod 6 modified to accommodate suspension beam.
Mark 13 Mod 12	Mod 7 modified to accommodate suspension beam.
Mark 13 Mod 13	Mod 9 modified to accommodate suspension beam.

139. The following table, when read horizontally, indicates the successive modifications of a particular torpedo. Vertical columns indicate the principal reason for the new modification designation. The Torpedo Mark 13 Mod 10 is on a line by itself since certain new features were added at the time of manufacture while certain other features, notably provision for external gyro angle setting, were omitted from the Mark 13 Mod 10.

Modification Table

<u>Basic Design</u>	<u>Change in Rudder Location</u>	<u>Mfg. & Ordalts</u>	<u>Shroud Ring</u>	<u>New Mfg.</u>	<u>Suspension Beam Modification</u>
		13-2A	13-6		13-11
		13-3	13-7		13-12
		13-4	13-8		None
13-0	13-1	13-5	13-9		13-13
				13-10	

140. No distinction need be made among the higher modification numbers of this torpedo (Mods 6 through 13) for service use since they all have essentially the same speed and range, carry the same pay load and stand up under the tactical uses specified for aircraft torpedoes. Detailed information for each torpedo is given in the torpedo's record book.

141. TORPEDO EXHAUST VALVES AND SPRINGS. Correspondence from the fleet, particularly from submarine torpedo firing activities, indicates that excessive losses during practice firing can be attributed to leakage of sea water into the afterbody at the end of the run. An investigation of the reported losses indicates that they are the result of three principal conditions:

(a) Failure of the Exhaust Valve Springs. The physical characteristics of springs are such that they take a permanent set when stressed at elevated temperatures. The temperature of the exhaust gases approaches and frequently exceeds the critical point of the Inconel exhaust valve spring under many conditions of torpedo operation. Thus, the valves fail to close because the spring has simply lost its "oomph".

(b) "O" Ring Particles. There have been occasional reports that particles of the exhaust valve "O" ring failed to burn out during a run, and, consequently, the exhaust valve was prevented from seating at the end of the torpedo run.

(c) Exhaust Valve Warping. One activity has consistently reported that torpedoes have been retrieved with the exhaust valves so distorted that considerable leakage into the afterbody had taken place.

142. In an effort to counteract the above-mentioned difficulties, the following steps have been taken:

(a) Spring Failure. Ordalt 1685, which has been distributed, substitutes a spring with higher heat-resisting properties for the present Inconel spring in Torpedo Marks 13, 14, 15, and 23 types. The new spring (SP 31967) has 10 coils of #070 wire, instead of the 9 turns of #062 wire in the present spring (SP 18089). It is believed that the use of the new spring will not only eliminate losses caused by spring failures, but it will also materially reduce the losses attributed to warped exhaust valves.

(b) "O" Ring Particles. In NAVORD OCL T8-45 it was recommended that the "O" ring not be used in exercise firing of submarine torpedoes. The recommendation was not extended to other types of torpedoes inasmuch as it was understood that the "O" rings were not being used in exercise firing of those torpedoes. In connection with the removal of the "O" ring for exercise firing, it should be pointed out that all pertinent ordnance pamphlets call for lapping the exhaust valve to the after bulkhead during overhaul.

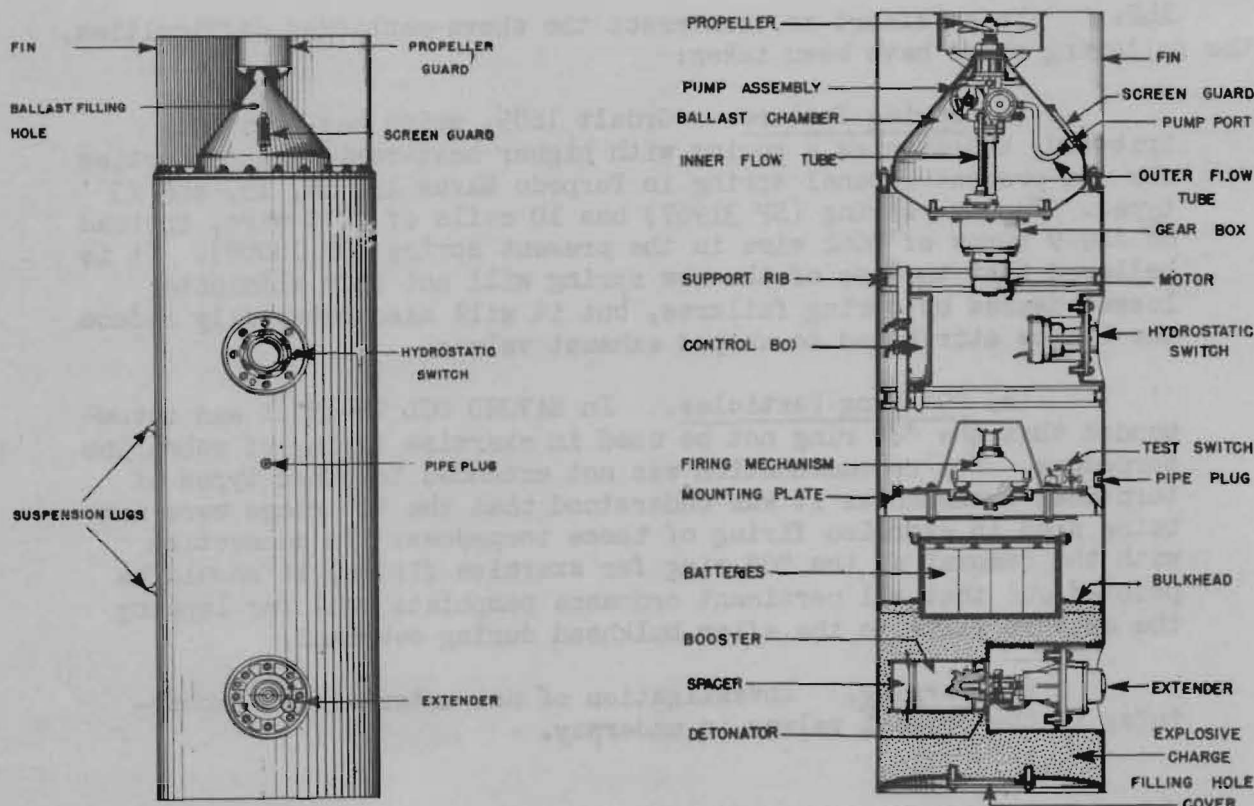
(c) Warping. Investigation of new materials as substitutes in the present valves is underway.

143. TORPEDO MARK 15 TYPE TAIL BEARING. An investigation of reports of seizure between the forward propeller sleeve and the tail bearing of the

Torpedo Mark 15 type, originally attributed to a flow of tin plating from the tail cone into the tail bearing, has indicated that the difficulty is caused by too close a fit between the tail bearing and the forward propeller sleeve. The remedy is to increase the diameter of the tail bearing (TP 18378) by .02, and an Ordalt, which will require no new parts, is under preparation.

144. MINE MARK 19 MOD 2. The Mine Mark 19 Mod 2 (see illustrations below) is a modification of a design originally produced by the Navy for the Army Air Forces. This aircraft-laid, drifting mine can be set to operate from 10' to 60' beneath the surface of the water. It contains an inertia firing mechanism which operates when the mine is struck. The Mine Mark 19 Mod 2 has the same length and maximum diameter as a 1000-lb. bomb, and may be loaded into aircraft with the same methods and equipment used to load a 1000-lb. bomb. The mine weighs 550 pounds, 190 pounds of which is explosive.

145. Prior to planting, the Mine Mark 19 Mod 2 is kept safe by a hydrostatically operated extender mechanism, which holds the detonator a safe distance from the booster charge. Other safety features are a switch on the extender mechanism and relays in the firing circuit which are designed to remain open until 12 seconds after the mine has sunk to its operating depth. Operation of the extender mechanism prior to planting is prevented by a safety pin, an arming wire, or a soluble washer.



MINE MARK 19 MOD 2

146. In the forward end of the cylindrical case of the Mine Mark 19 Mod 2 is the explosive charge; in the after end the depth control mechanism is housed. In the central buoyancy chamber are located the firing mechanism, batteries, and control box. Because the center of gravity of the mine is located well forward, the mine floats with its long axis vertical and its depth control mechanism up.

147. After the Mine Mark 19 Mod 2 has been planted, the depth mechanism keeps the mine near the pre-set depth. This is accomplished by a propeller, which drives the mine up or down in the water, and by a pump, which forces ballast in or out of the buoyancy chamber. A hydrostatic switch originates the signal which operates the depth mechanism.

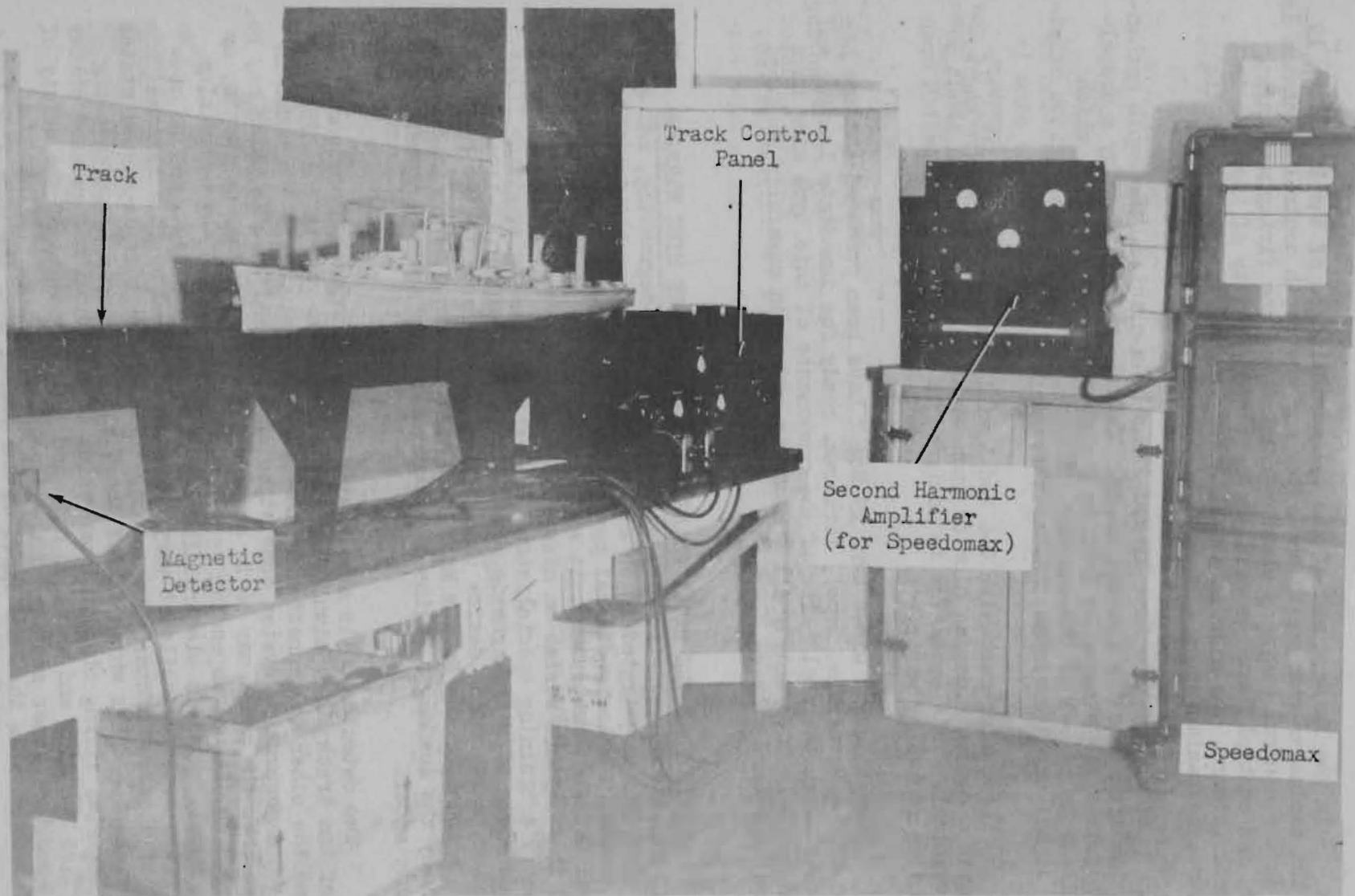
148. The firing mechanism C-4 Mod 1 will close a firing switch if the mine receives a sudden sidewise blow or push or is tilted more than about 50° from the vertical. This mechanism is designed to keep the firing switch open if the mine is rocked by waves.

149. One thousand Mines Mark 19 Mod 2 have been produced and are being stowed at the Naval Mine Depot, Yorktown, ready for immediate loading and assembly. Although the shelf life of the components of this type mine have not been definitely determined, all components have been carefully packaged for optimum long-term storage.

150. EXHIBIT AT THE NAVAL ACADEMY TO DEMONSTRATE MINE WARFARE. The three basic aspects of magnetic mine warfare - mining, degaussing, and sweeping - are clearly demonstrated in an elaborate exhibit recently installed at the Naval Academy for instructional purposes. Built by the Training Division of the Naval Ordnance Laboratory, it was used initially at the Academy as a visual aid in a lecture series on mine warfare given in March 1946 by one of the Laboratory's training specialists. The exhibit (see accompanying illustrations) consists of a 6' magnetic model of the USS JUNEAU (CL-119) mounted on a 25' track, a recording device (Speedomax), and a typical mine firing mechanism. A model of the Navy M Mark 5(b) magnetic sweep has been added to the exhibit by the Academy's Engineering Department to be used interchangeably with the ship model.

151. Two detector coils are located adjacent to each other under the mid-point of the track; one, simulating a mine, is connected to the mine firing circuit, and the other is connected to the Speedomax recorder. The model is equipped with a degaussing system consisting of M, F, and Q coils which may be energized so that the model may be in an undegaussed, partially degaussed, or well degaussed condition, depending upon the current used in the degaussing coils. The model, which is electrically driven along the track, may be made to pass over the detector coils at varying rates of speed up to a maximum scale speed of about 40 knots. The model's fields in various degaussed states are shown by the Speedomax which traces the field signatures produced along the keel. The mine firing circuit shows which of the model's degaussed states and fields fire the mine and which do not, and the dependence of the safety of the vessel upon the proper setting of the degaussing coils. Variation of model speed demonstrates that the speed of the vessel over the mine also has a

CONFIDENTIAL

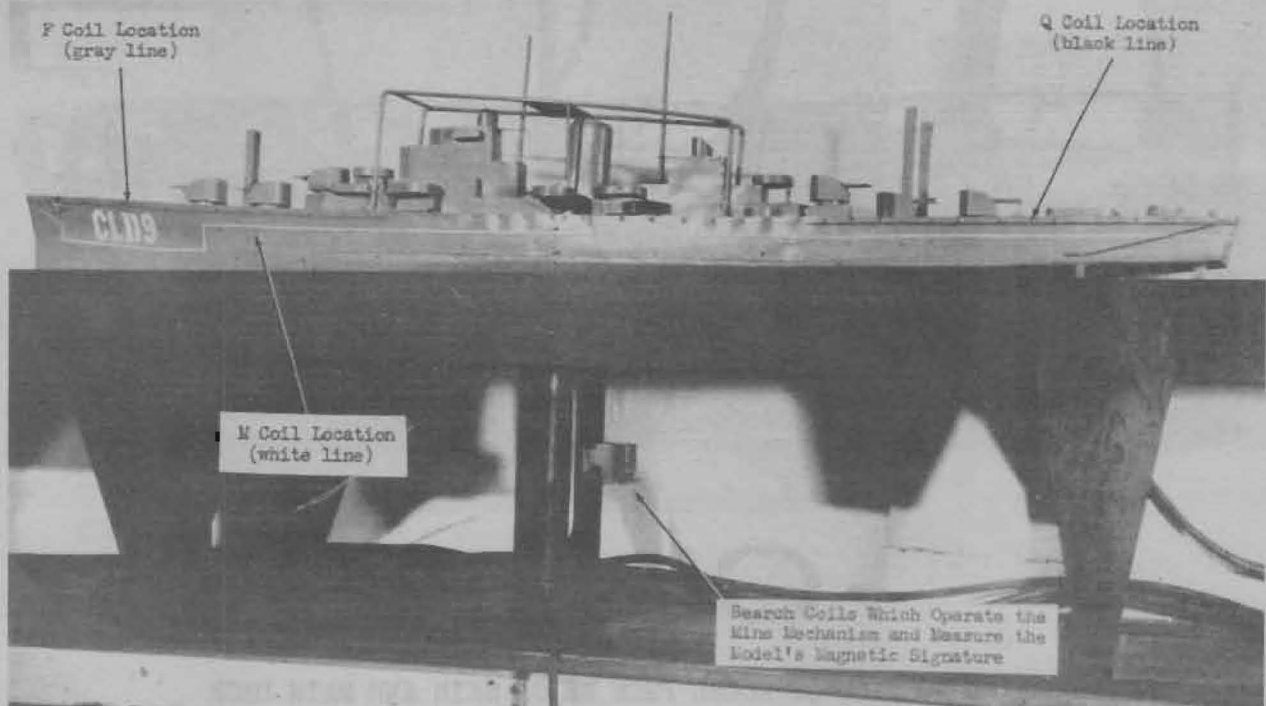


MAGNETIC MINE WARFARE EXHIBIT AT THE NAVAL ACADEMY

bearing on firing the mine because a field of a certain strength which will actuate the mine mechanism at a high or intermediate speed will not do so when the model is driven across the track slowly. Magnetic sweep effects are similarly demonstrated by mounting the sweep in place of the model.

152. The components of the mine firing mechanism in the exhibit are laid out in breadboard fashion so that control and operation may be easily observed. The detector leads are connected to the windings of a sensitive polar relay which operates when a small current (on the order of 3 micro-amperes) flows through the windings. The initial operation arms the mine firing mechanism and automatically resets the relay to the neutral position. As long as the signals transmitted to the relay are of the same direction as the first signal, the relay will operate to the same contact and the mine is merely continuously armed. When the signal direction is reversed, however, the relay operates to the other contact closing the detonator circuit and exploding the mine. This is dramatically shown by the flashing of a red light in the exhibit.

153. Controls for adjusting the sensitivity of the mine firing mechanism have been incorporated into the device to show how the different degaussed states of the vessel explode mines of various sensitivities. The ship-counting mechanism, designed to prevent the mine from firing until it has been actuated a predetermined number of times, is also included to show that the vessel may apparently be safe for several passes over a mine but may fire it on some succeeding pass.



CLOSE-UP OF THE MAGNETIC SHIP MODEL ON THE
TRACK OVER THE MAGNETIC PICK-UP



ASSEMBLED MAGNETIC SHIP MODEL SHOWING LEADS FROM EXPERIMENTAL
COILS PROTRUDING THROUGH MAIN DECK



CL-119

FORWARD PORTION OF MODEL FROM WHICH SKIN AND MAIN DECK
HAVE BEEN REMOVED TO SHOW DETAILS OF
CONSTRUCTION AND EXPERIMENTAL DEGAUSSING COILS

154. The magnetic ship model of the USS JUNEAU was constructed early in the war to aid in designing a satisfactory degaussing coil system for the JUNEAU-class of cruisers. By the method of model design, coils may be permanently installed on ships under construction, thereby saving appreciable time and materials that would be required if the system were to be installed on completed vessels. The model must be constructed so that it is a magnetic replica of the ship, producing magnetic fields which are reasonable facsimiles of the ship's fields. As much as possible of the ship's magnetic masses are reproduced in the model with such small items as piping, minor machinery, and various fittings smoothed into decks or hull. Such deviations have negligible effect. Additional non-magnetic components are used for bracing and handling. The model is constructed so that it may be easily taken apart and reassembled to facilitate the installation of the experimental coils required to determine the coil system for the class. The assembled model and the forward portion of the model from which the skin and main deck have been removed to exhibit the details of construction and installation of the test coils are shown in the photograph on page 60. To save time all coils are installed before testing and all coil connections are made by the leads extending through the main deck. Magnetic models of each class of naval vessel and of many classes of merchant vessels were built and degaussing coils for each class were designed at the Naval Ordnance Laboratory during 1941 and 1942 and were used as the basis for all U.S. degaussing coil designs.

155. UNDERWATER ORDNANCE MALFUNCTIONS DURING WORLD WAR II. The following information has been extracted from the analysis of casualties and malfunctions of underwater ordnance during World War II and the corrective action taken by the Bureau (see Bulletin 1-46, paragraph 4); information on this subject was also included in paragraphs 160-173 of Bulletin 1-46.

156. Torpedo Directors Mark 27. During the war it was demonstrated that the Torpedo Director Mark 27 was obsolete in the light of present standards for fire control equipment. One of its inadequacies was that it was not built to readily utilize radar data. This was corrected during the war by Ordalt 2107, which added a target bearing receiver to the director (see Bulletin 1-44, paragraphs 232-233). This receiver, though not automatic, made it possible to train the director on the correct target bearing by matching pointers.

157. One minor defect of the Torpedo Director Mark 27 was corrected by Ordalt 1255, which provided for the installation of a centering device for the follow-up control of the sight angle motor. The device, by damping the action of the sight angle motor follow-up control, makes it possible to decrease the contact gaps with a consequent reduction in the error of placement of the telescope without producing oscillation of the motor.

158. No further Ordalts on this equipment are being considered in view of the proposed redesign of the torpedo fire control system for destroyers.

159. Gun Train Indicator Mark 52. The Gun Train Indicator Mark 52, used in conjunction with the Target Designation Transmitter Mark 8, was de-

signed to control the Projector Mark 10. After a short period of service, many of the instruments required overhaul or replacement of the gyro roll indicator. Damage and wear of the gyro unit was attributed to the shock of firing and the practice of running the gyro continuously. Reduced breakage and improved anti-shock characteristics were accomplished by Ordalt 2000. Continuous operation had been adopted to avoid delay due to the slow starting characteristics of the gyro. A condenser and push button mounted in the I.C. Room, near the 400-cycle gyro supply, reduced the gyro starting time (see Bulletin 1-45, paragraphs 302-306). The improved starting characteristic reduced gyro wear as it was no longer necessary to keep the unit running continuously. Later models of the gun train indicator used gyros with better starting characteristics.

160. Target Bearing Transmitter Mark 9. The early models of the Target Bearing Transmitter Mark 9 proved somewhat unsatisfactory due to a tendency to retain water above the cover glass. This condition was eliminated by Ordalt 2421, which provided for the drilling of drainage holes in the bezel casting (see Bulletin 4-45, paragraph 194). It was also found that glare from the cover glass tended to interfere with the operator's ability to read the dials. A triangular prism mounted in a hinged brass casting on the top of the target bearing transmitter proved successful as a "viewer" in eliminating this condition (see Bulletin 4-45, paragraph 195). Ordalt 2422 has been issued to cover the installation of this viewer.

161. Attack Plotter Mark 1 Mod 2. The Attack Plotter Mark 1 Mod 2 was designed primarily for the fire control of antisubmarine ahead-throwing weapons. The principal feature of the instrument is the plot of own ship and target traced on the viewing surface of a cathode ray tube. Since the first shipboard installation of the plotter, twenty-two field changes have been authorized. Many of these changes were of a minor nature, such as changing the size of the resistors and substituting a different type of tube. Changes of this nature were usually made to stabilize a portion of the electrical circuit or to overcome recurrent electrical failure of a circuit component. One of the more important changes concerned the installation of a potential barrier ring. The ring is intended to neutralize leakage effects present with some cathode ray tubes. This leakage is through the surface of the tube and is most pronounced in humid atmosphere and disappears when the atmosphere is dry. The defect is observed as a change in the scale of the plot on the screen, a condition which may develop slowly as the surface of tube and the rubber mounting gasket collect moisture. When the condition is present, the scale length changes as the intensity or brightness is changed. The potential barrier ring is a single loop of bare wire placed around the cathode ray tube beyond the edge of the screen and under the rubber mounting cushion. This wire is connected directly to the high voltage cap of the cathode ray tube. The potential present on the screen is highly positive due to secondary emission. By holding the edge of the screen at positive potential, leakage through the glass is reduced.

GUIDED MISSILES

162. BUREAU OF ORDNANCE POLICY FOR GUIDED MISSILES. Since the end of World War II, agencies and committees that were actively engaged in research and development of guided missiles have been studying the field with a view to establishing a five-year program.

163. In surveying the guided missiles field, the major problem appears to be that of guiding the component systems and the missiles through their various stages of research and development, and adjusting the tempo at each stage to conform to the existing general situation. One extreme approach would be to neglect basic research and concentrate on the remaining stages of the missiles now under development. The result would be a workable weapon in the shortest time. Actually this is what happened to some extent during the recent war, but it is not generally recommended. The other extreme would be to discontinue work on the missiles now underway, except basic research, and to put all the available effort, time, and money into the development of new principles which will serve as the basis for an advanced form of missile in the future. Obviously there must be a compromise. The best practical solution is to maintain, for a few years, an overlap between the development of the conventional weapon and that of the new age, and this has been accepted as a part of the Bureau's guided missile policy.

164. One of several joint Army-Navy committees under the Joint Chiefs of Staff, the Guided Missiles Committee of the Joint Committee on New Weapons and Equipment, in its report entitled "A National Program on Guided Missiles", states:

"The enemy will have faster, more accurate, and more destructive missiles. Countermeasures and counter-countermeasures must be developed. Guided missiles must be evaluated against a background of the probable aircraft and aerial warfare of the future. But above all, guided missiles must evolve along lines dictated by the probable future development of atomic energy both in the war head and, more remotely in the future, as a probable propellant."

165. A resume of this committee's recommendations includes the following:

(a) That the national program be based on these missiles as ultimate objectives:

- (1) Missiles for area attack in ranges up to thousands of miles and guided with precision.
- (2) Accurate missiles for precision attack at short, medium, and long ranges, the accuracy and lethal range being adapted to targets of pin-point size.
- (3) Missiles for the destruction of high-speed, high-flying aircraft and missiles of the future.

(4) Coast defense and shipborne weapons to repel naval and amphibious attacks.

(b) That the program be based on the following concepts with respect to research and development:

- (1) Emphasis on the need for further basic information in both fundamental and applied science for all phases of guided missiles.
- (2) Practical development must not be pushed ahead of sound knowledge.
- (3) Rules of cognizance between the various bureaus of the Army and Navy should be modified as new knowledge of basic problems is obtained.

(c) That a joint Army-Navy board be set up with a trained secretariat and that it be instructed to activate such suitable advisory committee as it deems advisable.

(d) That, pending action on the above recommendation, the present Guided Missiles Committee continue in existence.

(e) That full liaison be established between guided missiles and atomic power development agencies.

(f) That guided missiles be procured only in quantities needed for testing, organizational and training purposes.

(g) That countermeasures and counter-countermeasures be studied and developed from all viewpoints.

(h) That groups be established for constant staff study of the strategical and tactical operational role of guided missiles.

(i) That inter-service organization be established for disseminating guided missiles information, including a museum, a library, and a liaison office.

(j) That an efficiently staffed, organized, and operated intelligence system be established to collect, evaluate and disseminate data on guided missiles research and development conducted by potentially hostile countries.

166. The conclusions reached by these recommendations are that:

- (a) Future work with present day guided missiles should be limited to that necessary to test and perfect mechanisms and principles which will be of use to the long-range program.

- (b) A maximum of emphasis should be placed upon fundamental research in fields of guidance, propulsion, aerodynamics, launching systems and atomic energy which must be integrated in the guided missile of the future.
- (c) Countermeasures against guided missiles must be studied from all possible viewpoints.
- (d) Groups should be established for the study of the strategical and tactical operational role of guided missiles.

167. On 1 November 1945 the Assistant Chiefs of the Bureaus of Ordnance and Aeronautics held a conference in regard to the coordination of the guided missiles and pilotless aircraft programs. It was agreed that a Joint Technical Committee, consisting of two members from each of these Bureaus, be established for the purpose of "continually reviewing both programs and advising the Chiefs of the two Bureaus regarding the status of these programs and of the coordination necessary for the best employment of their effort along technical lines."

168. The Bureau of Ordnance program for research and development in guided missiles includes two major phases, viz.:

- (a) Applied Research - A critical and exhaustive investigation or experimentation, having for its aim the practical application of new and revised conclusions, and enlarging, in a specific direction, the fields of measurements, analysis and experimentation established by basic research.
- (b) Development - The application of the results of basic and applied research to the creation of a practical embodiment of the principle under consideration, in a device which will serve a specific purpose or perform a specific function.

169. The Bureau plans to build a sufficient number of units of each practical design to permit evaluation of production, fleet training, and fleet tactical problems. This will, therefore, involve the eventual introduction of a limited number aboard several representative ship or aircraft types for extensive service tests and for training purposes.

170. The subject of guided missiles is such a new one that no standard classification system of types of missiles has been accepted. However, the general classes of guided missiles that the Bureau is stressing at the present may be listed as follows:

- (a) The antiaircraft guided missile.
- (b) The bombardment guided missile.
- (c) The aircraft-to-ship guided missile.

171. Of these three, there are active projects in the first and third classes. In the second class, the bombardment missile, the major effort is being made by Army Ordnance, through General Electric and California Institute

of Technology. It is believed that their research program will be adequate to provide a satisfactory basis for starting development of ship-launched bombardment missiles in a few years. This method of dividing major effort with Army Ordnance is believed to be the most practical way of utilizing presently restricted personnel and funds. The chief aim of the Guided Missiles Section of the Bureau's Research and Development Division is to produce an anti-aircraft missile first, stressing research at present. It is believed that without extensive measures for anti-aircraft protection the fleet may not be able to operate within range of enemy land-based planes. The use of anti-aircraft guided missiles is one method of improving fleet defense. It now appears that it may be several years before service trials of an anti-aircraft missile will be possible. The two active projects, now in the research stage, being developed to satisfy this aim are the BUMBLEBEE and the METEOR. The BUMBLEBEE is a ship-to-air, supersonic missile with ram jet propulsion (see paragraphs 191-213) and beam guidance, and is being developed by the Applied Physics Laboratory of Johns Hopkins University, Silver Spring, Md. These anti-aircraft missiles projects emphasize guidance problems, but if those problems can be solved, the transition to bombardment missiles should not be very difficult.

172. The third general class of missiles, launched from aircraft, offers an effective transition weapon since it can combine the long range and high payload of an aircraft with a freedom from anti-aircraft gunfire from the target. The Bureau's current project in this field is the KINGFISHER, which is being developed by the Bureau of Standards. This is a glider missile (eventually to be rocket-assisted), carrying a torpedo or other underwater payload for attacking enemy ships. This type is a logical evolution of the BAT which the Bureau developed and which actually was used in service during the last few months of the war (see Bulletin 4-45, paragraphs 146-166). The BAT is a glider carrying a 1000-lb. bomb and a self-contained automatic radar homing unit, making it virtually an automatic Kamikaze. The aircraft-carried missile problem is considerably simpler from a technical standpoint than the anti-aircraft missile, but developments in this field may be slow in the next few years due to lack of personnel and concentration on the anti-aircraft missile.

173. The Bureau's policy on guided missiles calls for a continuance of research on countermeasures against all types of guided missiles. For every new principle determined to be applicable to our own guided missiles, similar discovery and development by foreign nations must be assumed, and parallel development of countermeasures for the weapons must be carried out.

174. Countermeasures for guided missiles can be divided into two broad classes - offensive and defensive. The offensive class covers attacks on enemy bases and launching points, using all types of weapons but probably emphasizing supersonic guided missiles since no effective countermeasures for the latter, except passive types, are in sight. It is believed that this will be by far the most effective class of countermeasures and therefore should receive our major effort.

175. Defensive countermeasures may be divided into:

- (a) Local striking systems such as anti-aircraft guns and anti-missile missiles.

- (b) Passive measures such as dispersion of units, and armoring, or tunneling into the ground, or radar jamming.

The local striking systems are by far the most difficult technically and at present little progress is being made because the effort is small. Passive measures are believed to be fairly effective but present concepts will probably require many radical changes. At present, however, little is being done in this direction.

176. Due to the fact that guided missiles are in an embryonic state, the Navy would be taking considerable risk during the next decade if it stopped other developments at this time and put major dependence on guided missiles. The timing of guided missile developments and the degree of emphasis on them during the transition period are the most urgent problems we have. Nevertheless, there is considerable possibility that by major emphasis and mass scientific attack, some other country could develop radically advanced types of guided missiles in much less time than we now anticipate.

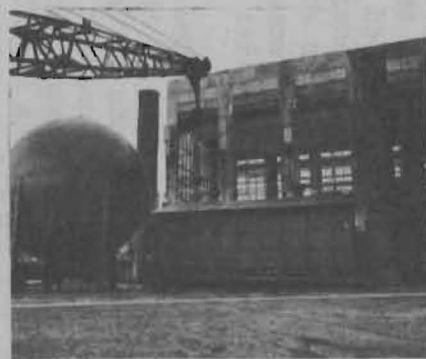
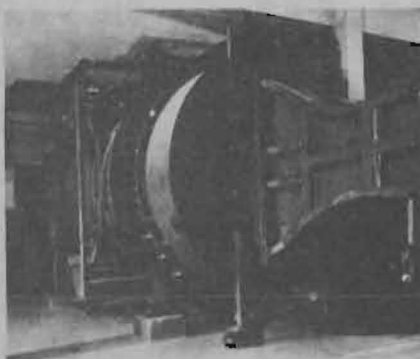
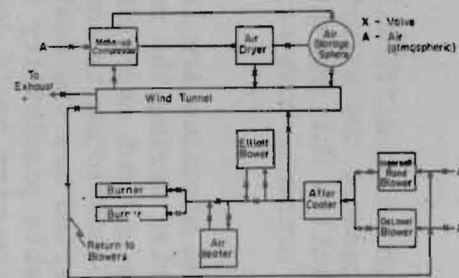
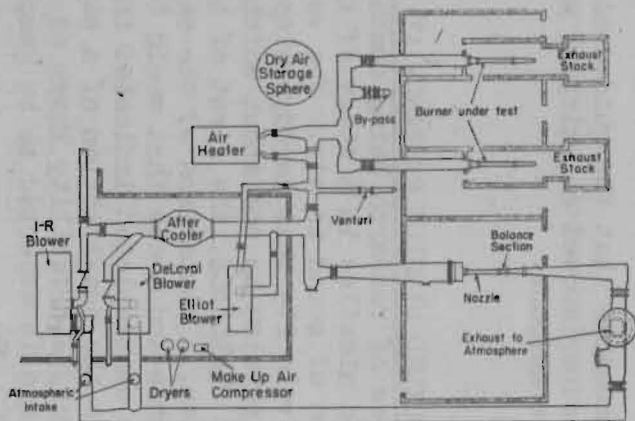
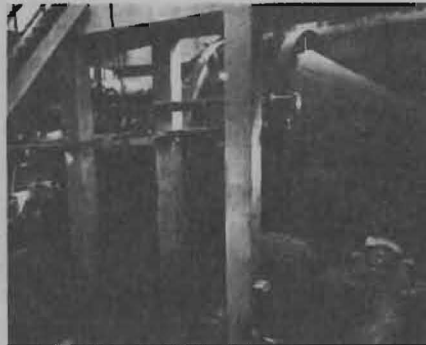
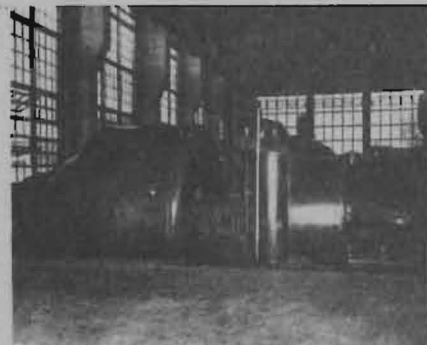
177. It should be noted in summarizing that our prime limitations are in personnel ceilings both in the Bureau and in field stations. Also limited are material installations for research and development and range facilities for flight testing. At present all major guided missile projects of the Bureau of Ordnance are being handled by civilian agencies (Johns Hopkins University, Massachusetts Institute of Technology, and Bureau of Standards). Existing Bureau of Ordnance laboratories and stations have inherent limitations and are well occupied with other Bureau work.

178. It now appears most probable that the guided missile will be another complex scientific weapon superimposed on existing weapons such as aircraft were superimposed on other weapons.

179. BUREAU FACILITY FOR GUIDED MISSILE RESEARCH AT DAINGERFIELD, TEXAS. One of the important phases of research being conducted by the Bureau in the development of guided missiles is a study of the aerodynamics of flight at speeds above the speed of sound in air. The velocity of sound is critical because it is at this velocity that aerodynamics changes from a fairly well established branch of physics to one about which little is known. During the early stages of project BUMBLEBEE, the first of the supersonic missiles being evolved by the Bureau, a comparison of the supersonic wind tunnel facilities that were available and those that would be required considering the scope of the research contemplated indicated the necessity for the Bureau of Ordnance to undertake the construction of a supersonic wind tunnel. Construction of the Daingerfield facility known as the Lone Star Laboratory was begun in June 1945 and is expected to be completed in October 1946 at a total cost of about \$2,000,000.

180. The site selected was at Daingerfield, Texas, where a new plant, operated by the Lone Star Steel Company, had been built by the Defense Plant Corporation as part of an emergency steel program. The plant, however, had been used only for the production of coke on a small scale and for the genera-

CONFIDENTIAL



VIEWS OF LONE STAR LABORATORY, DAINGERFIELD, TEXAS

Left to right: (Top row) Ingersoll-Rand blower; DeLaval blower; After-cooler; Interior of main laboratory building. (Center) Schematic laboratory plan; Air flow block diagram. (Bottom row) Office building and fuel storage tanks; Diffuser showing test section on right; Dry air storage sphere and air heater; Aerial view of laboratory buildings.

tion of electrical power that was sold to a local utility company, which activities utilized only a part of the power available in the steam turbines at this plant. It was the large supply of unused power, coupled with the fact that the plant had an Ingersoll-Rand low pressure blower of sufficient capacity to be useful in supersonic wind tunnel work, that accounted for the selection of the Daingerfield site. A DeLaval low pressure blower similar to the blower already at Daingerfield was obtained from the Pittsburgh Steel Company, dismantled, and shipped to Daingerfield for installation. A third blower of the high pressure type is under construction at the Elliot Company in Jeannette, Pa. On page 68 are some interior and exterior views of the Lone Star Laboratory, as well as a schematic laboratory plan and an air flow block diagram.

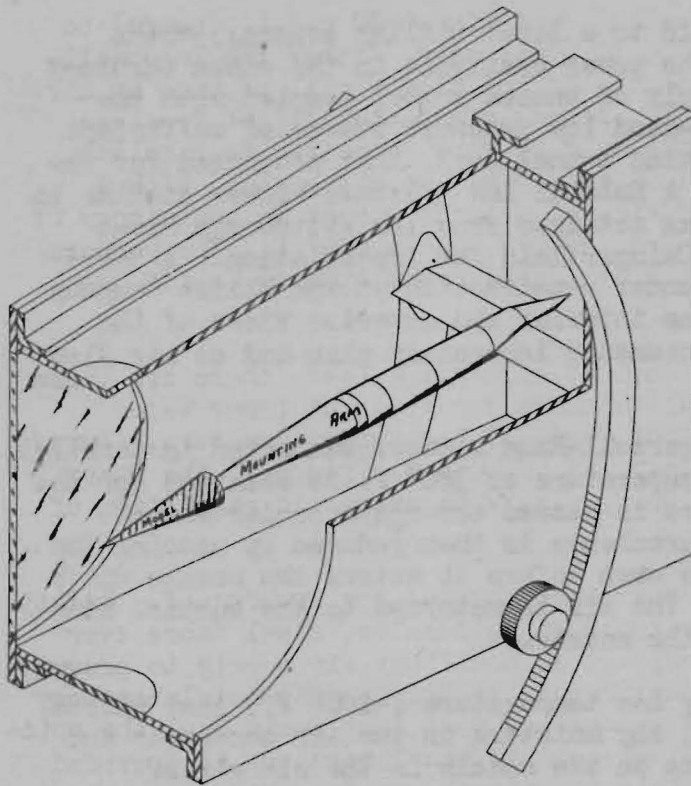
181. With the DeLaval and Ingersoll-Rand blowers connected in parallel, an air flow of 200,000 c.f.m. at a temperature of 380° F. is obtained for the wind tunnel. The air from the blowers is passed through a cooler which lowers its temperature to 150° F. Turbulence is then reduced by passing the air through a honeycomb and fine wire mesh before it enters the nozzle which produces the supersonic air stream. The air is returned to the suction side of the blower after it goes through the nozzle.

182. Because of the extremely low temperature (-200° F.) that exists in the working section of the nozzle, any moisture in the air condenses and interferes with the force measurements on the models in the air stream. Therefore, an air dryer and a large storage sphere containing 10,000 cubic feet of dry air at 75 p.s.i. are located in the line. Availability of the stored dry air makes possible the use of a small dryer with a capacity of 500 c.f.m. of air dried to a dew point of -30° F.

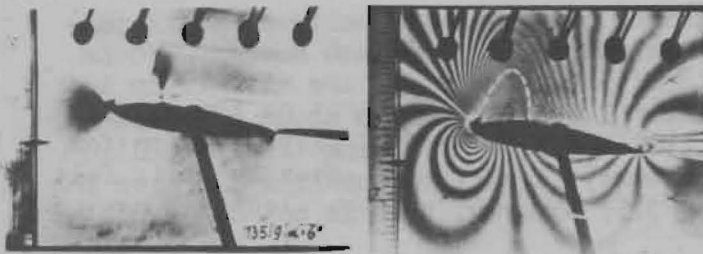
183. By using nozzles of different sizes, the velocity of the supersonic air stream can be varied from Mach number 1.25 to Mach number 2.50 in steps of .25 (Mach number is the ratio of the velocity of the air stream to the velocity of sound in air; Mach number 1 corresponds to about 600 m.p.h., Mach number 2.5 corresponds to about 1500 m.p.h.). By connecting the Elliot blower in series with the other two blowers, it will be possible to raise the maximum tunnel velocity to Mach number 3.5; however, this is not contemplated in the near future.

184. With a working section area of 19" x 27½", the supersonic wind tunnel at Daingerfield is one of the larger ones in the country. The missile model to be tested is mounted in the working section on an arm projecting upstream (see illustration on next page). Air forces of lift, drag, etc., produce minute strains or deflections in the mounting arm and also in electrical strain gauges fixed to the arm, thus varying the resistance of the gauges. The resulting changes in current flow through the gauges are indicated graphically and interpreted as changes in the moments imposed on the mounting arm. Forces are computed from the moments. This unusual method of measuring forces acting on a wind tunnel model was developed during the design of the Daingerfield wind tunnel and is now being considered for use in other tunnels.

185. Data obtained from wind tunnel tests at Daingerfield is teletyped to the Cornell University Aeronautical Laboratory, where calculations are



A MODEL MOUNTED IN THE TUNNEL



PHOTOGRAPHIC STUDIES OF THE AIR FLOW
AROUND A WING SECTION

The Photograph on the Left Was Made by
Using a Schlieren Apparatus. On the
Right is an Interferometer Photograph.

made by IBM machine. Results can be teletyped from Cornell to various activities concerned about 30 minutes after transmittal of data from Daingerfield.

186. The wind tunnel is equipped with instruments for measuring pressure distribution on models, and with instruments for recording pressure and temperature ahead of the nozzle to determine air density. Further insight into the nature of the air flow around a model is obtained through the optical accessories of the tunnel. One of these is a "Schlieren" apparatus which shows the variations in density about the model through the refraction these variations produce in a parallel beam of light. The accompanying illustration is a Schlieren photograph of the air flow around a wing section; variations in light intensity indicate air density gradients. Schlieren photographs also show shock waves in the flow. The sensitivity of a Schlieren photograph makes possible the photographing of weak shock waves that could not be detected in the shadow method of photography formerly used.

187. Utilizing the same power plant and blowers, a testing laboratory for missile jet engines (a "burner" laboratory) is operated as part of the Daingerfield facility. Here measurements are made of the pressures and temperatures at points within the missile and the thrust exerted by its engine. Ignition is also studied in the burner laboratory. Two burner rooms are provided in which full-scale missile engines

can be mounted in an air stream and set in operation. Combustion chamber conditions in flight up to altitudes of 30,000' can be simulated by varying combinations of blowers supplying the air stream. It is necessary that air be provided at a fixed mass flow, temperature, and pressure for any particular test. Using the Ingersoll-Rand or DeLaval blower, it is possible to supply

either burner room with 100,000 c.f.m. of free air at 30 p.s.i. (gauge) to simulate flight at altitudes of 8,000'-30,000'; using either the Ingersoll-Rand or DeLaval blower in series with the Elliot blower will provide an air supply of 100,000 c.f.m. at 120 p.s.i. (gauge) simulating flight from sea level to 8,000'. With the two low pressure blowers connected in parallel, both burner rooms can be operated simultaneously. An air heater, with a capacity of 75,000,000 BTU/hour operating on natural gas at an efficiency of 50%, heats the air from the blowers from 380° F. up to 600° F. The burners can be either air cooled or water cooled. Burner room exhaust is led out through a stack.

188. To supply fuel to jet engines undergoing test, there are three 10,000-gallon tanks and two 2,000-gallon tanks for fuels of lower vapor pressure, and one 2,500-gallon tank for fuels of high vapor pressure. Pumps have a maximum capacity up to 200 g.p.m. at 500 p.s.i. (gauge). The pumps can be operated at 50, 100, 150, or 200 g.p.m. with automatic regulation of the pressure at discharge.

189. Both the tunnel and burner laboratories are soundproof. Safety precautions in the burner laboratory include fog nozzles, steel doors over observation ports in the burner rooms, and an auxiliary air supply to prevent accumulation of noxious fumes. The air supply to the wind tunnel laboratory passes through a precipitron for the removal of dust that would foul the optical equipment. A small machine shop adjacent to the laboratory is provided for minor repairs on wind tunnel models and missile engines undergoing tests in the burner laboratory.

190. The Lone Star Laboratory will be used for fundamental studies of supersonic air flow and the principles of combustion, as well as for performance testing of specific guided missiles.

191. THE RAM JET. The Navy's first press releases on the development of successful working models of the ram jet, a means of propulsion for flight at supersonic speeds, were made on 8-9 June 1946. Because it is felt that the press releases will be of interest to those in the fleet who may not have seen them, they are reprinted below.

192. Operating under special research contracts with the Bureau of Ordnance, the Applied Physics Laboratory of Johns Hopkins University, Silver Spring, Maryland, and 20 associated industrial organizations and universities have during the past year proved conclusively that the ram jet is a practical method of achieving high-speed flight at high altitudes. The first successful flight was made June 13, 1945, at Island Beach, New Jersey.

193. The ram jet, tested by the Bureau of Ordnance as a means of propulsion for guided missiles, is the first step beyond the turbo jet which is now used to propel high-speed aircraft. It consists essentially of an open pipe. Oxygen is scooped into the front opening from the air during flight and compressed by the speed of the jet; fuel is injected and burned and the exhaust streams out the rear opening.

194. At comparatively low speeds the conventional engine and propeller are the best form of propulsion. As speed increases, the propeller becomes less efficient and it is preferable to use a turbo-jet engine. At still higher speeds at which air is compressed by its own speed, it is possible to omit the complicated turbine and compressor. The resulting engine is the ram jet which draws air through the front, heats it to a high temperature in the combustion chamber, and exhausts it to the rear. The impulse thus produced by the escaping hot gases thrusts the jet through the air at a velocity of from 800 to 1500 miles per hour.

195. The ram jet is frequently called the "flying stovepipe" because of its form and the fact that it has no moving parts. Actually, the first test jet was made from the exhaust pipe of a Thunderbolt plane. This modified exhaust produced 3000 horsepower, more than the horsepower of the conventional reciprocating engine from which it was detached.

196. The complete ram jet weighs only 70 pounds. Since it has no moving parts, no precision machine work is required and it can be produced rapidly and cheaply. The low cost feature is especially important for use in missiles which are expendable.

197. The idea for the ram jet was first set forth by a French scientist named Lorin in 1913. Subsequent discoveries in the field of supersonic aerodynamics enabled modern scientists to see in his theory the fast engine of the future. The Applied Physics Laboratory of Johns Hopkins University undertook the development of the ram jet in January 1945 at the request of the Bureau of Ordnance. Six weeks later the first models were launched "cold" for drag measurements and by June ram jets were delivering thrust. Development work is continuing to improve performance and reliability.

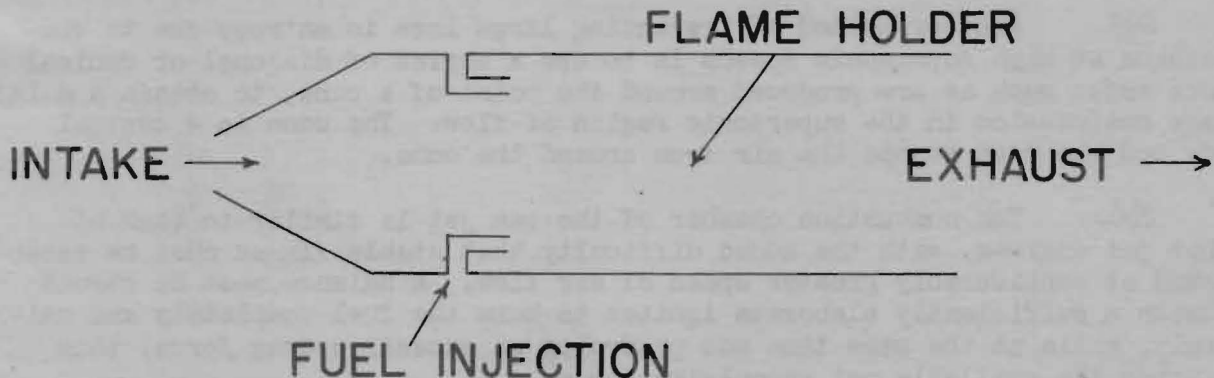
198. In announcing development of the ram jet by scientists of the Applied Physics Laboratory, Vice Admiral George F. Hussey, Jr., USN, Chief of the Bureau of Ordnance, stated, "The postwar collaboration of Johns Hopkins University with the Bureau of Ordnance provides a pattern for maintenance of democratic principles in providing for the defense of the nation. Here is no dictatorship of the military over the scientists, but a smooth working partnership in which a civilian university takes the lead in assuming postwar responsibilities."

199. The pulse motor or intermittent jet used on the German V-1 buzz bomb is the closest approach previously made to the ram jet. Its speed was too low to develop a sufficient "ram" pressure. Therefore, a valve arrangement was used on the air intake to prevent the explosions from blowing out the front. At higher speeds, the valves, which gave the V-1 its buzzing sound, are no longer necessary and continuous operation as a ram jet becomes possible.

200. As compared to rocket power, the ram jet has a great advantage in that it takes its oxygen from the air. For example, the German V-2 carried five and one-half tons of liquid oxygen and four tons of fuel. If the V-2 had been powered by a ram jet, the liquid oxygen could have been replaced by explosives, or by more fuel to give it longer range.

201. One disadvantage of the ram jet is that it must be brought up to a high speed before it operates efficiently. This must be done by catapults or auxiliary rockets. It is possible that in the future ram jets may be used for high-speed cruising on aircraft which are equipped with other forms of propulsion for launching to a speed at which the jet would be operable.

202. Description of the Supersonic Ram Jet. The ram jet is composed of three principal sections; the forward part is known as the diffuser, the middle part is a combustion chamber, and the latter part is the exhaust nozzle. The arrangement of these parts is shown in the illustration below. The function of the diffuser is to receive air at atmospheric pressure, and by subsonic expansion increase its pressure to the highest value practicable. The combustion chamber furnishes a flame front which increases the momentum of the air, thus creating a back pressure supporting that developed in the diffuser. It is essentially from this phenomenon that the ram jet gets its thrust. The pressure of the air in the diffuser exerts a forward thrust on the diffuser inner walls, and the reaction is against the exhaust gases. Exhaust nozzles are variously simple constrictors, straight ducts with no constriction, or a combination of constriction and expansion. The matching of the three sections of the ram jet involves some thermodynamic balancing, but certain aspects are easily understood.



203. There are three types of diffusers that can be used to obtain desired recovery pressure. The simplest is a conical frustum with the small end used as the intake. Since the speed of the duct is supersonic relative to the intake air, and the speed of the air in the diffuser exit is subsonic and of the order of a few hundred feet per second, the air must somewhere pass through the sonic speed while slowing down. The laws of conservation of energy, momentum, and mass flow require the formation of what is known as a normal shock wave for the change-over through the transonic region. Amazingly abrupt changes in pressure and velocity occur in this shock region which is only a small fraction of an inch in thickness; for example, air moving at 1800 ft/sec and at atmospheric pressure changes across this thin boundary to air at 900 ft/sec and nearly three times atmospheric pressure. Now, it can be shown that maximum thrust will be obtained when this normal shock wave is located at the nose or entrance of the diffuser. If the burner pressure is higher than the design value, this shock wave will be detached and a certain

amount of air will spill around the nose, resulting in an effectively reduced intake area. If combustion pressure is too low, the shock wave will enter the diffuser but the mass flow of air will continue to be the same as when the shock was on the nose.

204. The normal shock wave is characterized by a loss of entropy. This means that some of the energy of the gas has gone into heat irreversibly and the maximum pressure that can be recovered by the diffuser is somewhat reduced. Up to supersonic speeds, less than twice the velocity of sound, this loss is not large. At the higher speeds, however, some means of approximating isentropic compression in supersonic speeds is imperative. The simplest method that suggests itself is the use of the so-called reversed DeLaval nozzle. In this arrangement the supersonic air stream is taken into a contracting duct and pressure is increased isentropically until sonic speed is reached at the minimum section, called the throat. From this point on, the duct expands as a normal diffuser, velocity subsonic and decreasing, and pressure increasing. This system, is, however, unstable in certain ways. If the speed of the air past the duct is sufficiently increased to attach the shock to the nose, it will suddenly jump inside to the expanding part of the diffuser. Then, as the speed is decreased, the shock wave will move up the diffuser and tend to disappear at the throat. A slight further decrease in speed will cause the shock to jump to a detached position. Some scheme has to be devised to permit controlling of shock wave position if isentropic compression is to be obtained.

205. Another method of preventing large loss in entropy due to compression at high supersonic speeds is to use a series of diagonal or conical shock waves such as are produced around the point of a cone, to obtain a multi-stage compression in the supersonic region of flow. The cone is a central body and the duct scoops the air from around the cone.

206. The combustion chamber of the ram jet is similar to that of other jet engines, with the added difficulty that stable flames must be established at considerably greater speed of air flow. A balance must be struck between a sufficiently elaborate igniter to burn the fuel completely and uniformly, while at the same time not producing an excessive drag force, thus reducing the available net propulsive force.

207. Expanding or converging-diverging exhaust nozzles produce little gain in thrust until velocities greater than twice the velocity of sound are reached. It can be easily shown that the speed of the exhaust gases at the minimum section will be the speed of sound for the local conditions of temperature and pressure, and that the pressure at this point is about half the combustion chamber pressure. If one is operating at high speeds, the combustion pressure will be high and consequently the exhaust pressure may be sufficiently above atmospheric pressure to warrant an expansion section from which additional forward thrust would be obtained.

208. Experimental Techniques. The basic difficulty in research work on ram jets is that they cannot be tested statically - either the ram jet must be moved through the air as in free flight or the air must be moved past the

ram jet as in a wind tunnel. Since the most promising region for operation is at velocities in excess of that of sound, either of the above two tasks poses formidable technical problems. The cost and immensity of the installations required for supplying air at the proper temperature and pressure have been a deterrent to this line of attack. It required the pressure of wartime needs to initiate such a program.

209. There are several different ways of assaying the performance of ram-jet engines once such facilities are available. We are interested here principally in the internal thermodynamics. One can attach the intake of a ram jet directly to the source of air, and by appropriate adjustments of temperature and pressure reasonably simulate flight intake conditions. By making pressure surveys along the duct, certain conclusions about thrust can be evaluated. The addition of a direct thrust measurement of some sort is, however, essential for good quantitative data. There is also a method which more nearly simulates flight conditions by placing the ram-jet intake in a supersonic air stream, the so-called free jet. Size considerations at the present time preclude the use of supersonic wind tunnels on flight models.

210. In free flight tests, both internal thrust and external drag are evaluated. The duct is first flown cold with a tail constriction, to simulate the flow conditions produced by a burner. Internal drag can be calculated from the flow condition and total drag is obtained from the deceleration rate shown from the velocity time curve. The unit is then flown with the burner operating, and the thrust of the unit calculated from the excess of thrust over drag.

211. It is immediately seen that the total internal thrust, which is the integral of all the forces from the internal surface of the duct, is simply the difference between the momentum of the exhaust gases and the intake air. The intake momentum is a function of atmospheric conditions, geometry, and speed, while the exhaust momentum depends principally on temperature and the mass flow of air.

212. On the ground, instrumentation is rather complete and it is accomplished without great difficulty. In flight, however, it is necessary to employ the methods of telemetering. Pressures, accelerations, temperatures, fuel flows, etc., must all be converted into a radio signal which is broadcast from an antenna integral with the ram jet, and then picked up and analyzed by field equipment at the test site. It has been necessary to develop equipment so small and compact that a four-channel system complete with power supplies, measuring instruments, and broadcasting equipment could be contained in a space only slightly larger than a man's two hands. This could not have been done without the components developed for the proximity fuze. The successful development of this telemetering technique has greatly augmented the intelligent analysis of individual flight tests and thereby speeded up the development program in general.

213. Performance. Using the techniques described above, it has been possible to demonstrate both in combustion tests in the laboratory and in free flight, the attainment of thrusts commensurate with those predicted by theory.

Thrust alone, however, is not the most striking performance criterion, as is easily realized when one compares the total weight of certain of the test missiles launched to the horsepower they develop, and arrives at a figure of less than $\frac{1}{2}$ oz/h.p. as compared to roughly 1 lb/h.p. for the standard internal combustion engine.

MISCELLANEOUS

214. CENTRAL STATION FIRE CONTROL SYSTEM FOR MOTOR TORPEDO BOATS.

The motor torpedo boat, primarily designed as a fast torpedo carrier, requires armament for defense against aircraft and for offense against small surface targets. This secondary importance of armament, combined with the stringent weight requirements, greatly augments the fire control design problem of this boat. Because this problem parallels, to a large degree, that of aircraft fire control, it is felt that airborne equipment is more adaptable than shipborne equipment and the former has therefore been selected for tests to be made in connection with the study of the fire control problem of the motor torpedo boat.

215. A General Electric central station fire control system, designed for the B-29, is being installed in PT-620. The installation consists of two caliber .50 quad mounts and one 40mm Mount Mark 3 Mod 4 controlled from a Sperry A18A stabilized ball-top turret redesigned for use as the main director. Divided control is possible by utilizing a regular B-29 ring sight station (unstabilized) as a secondary director.

216. The experimental installation weighs 6800 pounds and has a power drain of 21 kilowatts. The caliber .50 quad mounts are amplidyne driven, carry 1000 rounds of ammunition per barrel, and have automatically-charged guns. Both directors mount General Electric rectiflector sights which transmit stadiametric or radar range, and elevation and train orders and gyro rates, to the central fire control computers.

217. The extensive tests to be conducted with this system within the next month will form a basis for the design of an ultimate fire control system to be installed aboard the new developmental motor torpedo boats.

218. DEMOLITION FIRING DEVICES. Because information on demolition firing devices has been relatively limited in previous issues of the Bulletin, it is believed that the following description of some of these devices and their development will be of interest.

219. In the assault clearance of both land and water obstacles, large demolition charges had to be placed under difficult combat conditions, thus making impractical the use of electric firing systems actuated from a safe distance. Various methods of time delay were tried, including the use of blasting time fuse of the proper length attached to a non-electric cap, delayed release of a spring-loaded striker by means of acid eating through a retaining wire or the dissolving of a plastic retainer of the striker by acetone, and clockwork mechanisms. In all methods, excepting the mechanical clockwork time delay, accuracy depended entirely on the chemical composition of the components, and the speed of the reaction was greatly influenced by changes in ambient temperature. Emphasis was, therefore, placed on the development of mechanical clockwork devices. In order to obtain the necessary accuracy, the project was divided into time ranges of seconds, minutes, and hours, and a device was developed for each range.

220. The Demolition Firing Device Mark 12 (4 to 92 seconds) utilized the movement and firing system of the Army M11A3 Flare Fuze in a waterproof case. Since the movement is built up of laminated plates and contains a weighted balance or "flutter" type of escapement, it is extremely rugged and yet can be regulated to within $\pm 1\%$ of the running time. In order to use existing tooling, a die cast aluminum case of the same general outline as that of the Army fuzes was decided on and watertightness was obtained by the use of round rubber gaskets, known as Army-Navy "O" Ring Hydraulic Packing, which were developed at Wright Field for aeronautical use at pressures up to 1500 p.s.i. The Demolition Firing Device Mark 12 will function accurately, allowing an error within \pm the sum of 1 second and 1% of the set time, has no water leakage at 50 p.s.i. for 14 hours, will function satisfactorily after severe vibration and jolting, or after a 12-foot drop on concrete, and is not damaged by explosion of a $2\frac{1}{2}$ -pound tetrytol block at a distance of 15 feet.

221. The need for a firing device having a 1 to 15-minute delay led to the development of the Mark 13, which used parts of a number of different movements for which tooling existed at the time. The escapement from the Army "Butterfly Bomb," a weighted balance of the same general type as the Mark 12, was used along with Mark 12 and commercial clock parts. Samples of the first production lots of the Mark 13 firing device showed timing errors as great as 35% and after a small number were produced, the contract was cancelled.

222. The Demolition Firing Device Mark 15 was designed with a balance wheel (watch type) escapement for greater accuracy using the same type cast aluminum case as was used in the Marks 12 and 13. The time may be set from 15 minutes to 11 hours and an error within \pm the sum of 4 minutes and 4% of the set time is allowed. The ruggedness and waterproofness of the device is comparable with that of the Mark 12.

223. A program is now underway to design three new firing devices, one each in the seconds, minutes, and hours ranges, having characteristics similar to those of the Mark 15 but also incorporating several new ideas. This will result in a series basically the same, but with minor variations for the different time ranges. With this standardization of design, tooling and production costs will be reduced.

224. EXTERIOR PAINT FOR PROJECTILES AND ROCKETS. A new lacquer enamel, to be designated Spec. 52L19(Ord), has been developed for use as an alternative finish to Enamel Rust Inhibiting Spec. NAVORD O.S. 1590 on projectiles and rockets. The new lacquer enamel has a very short drying period and produces a high-grade semi-gloss finish of any desired navy color. On small caliber ammunition, one coat of Spec. 52L19(Ord) will serve as an alternative to one coat of NAVORD O.S. 1590 enamel. However, on larger projectiles and items which are not so well packaged, it is recommended that a coat of Primer, Synthetic, Lacquer Resisting, JAN P-72 (Navy No. 52P76) be used under the lacquer enamel, the two forming an alternative paint system to one coat of NAVORD O.S. 1590 enamel.

225. UNUSUAL PERSONNEL CASUALTIES. The following typical cases of personnel casualties caused by disregard of U.S. Navy Regulations, 1920, Article 972(82), have been extracted from a letter of warning distributed in one of the fleet forces and they are brought to further attention in this Bulletin since they represent a relatively new type of accident:

"Case 1 - A man was sent to the magazines from the third deck via the bomb elevator because condition Able was set. There was no one in the magazine. The operator heard a groan and investigation revealed the man at the bottom of the pit. It is surmised that he was caught when partly off the elevator when a sticky control contact reversed the elevator direction as it reached the magazine level. Result - Death.

"Case 2 - Three men were sent up a bomb elevator with a load of mail. Part way up one man was caught between the elevator and the side of the shaft. Investigation revealed that the mail sack on which he was reclining caught on the side of the shaft and he was pulled with it. Result - Death.

"Case 3 - One man intended to ride from the flight deck to hangar deck in an elevator that went as far as the third deck. The switches were set for the third deck. Arriving at the third deck he emerged, set the selector switch for hangar deck, wedged the flame proof door switch so that the elevator would operate with the door open, then he pressed the 'up' switch and dove onto the moving platform. Result - Loss of one foot.

"Case 4 - A man attempted to ride a 40mm hoist big enough for one can of 40mm ammunition. Result - Broken leg."

226. WINDOW BREAKAGE FROM EXPLOSIONS. The following data from an Army-Navy Explosives Safety Board report is given as a matter of general interest.

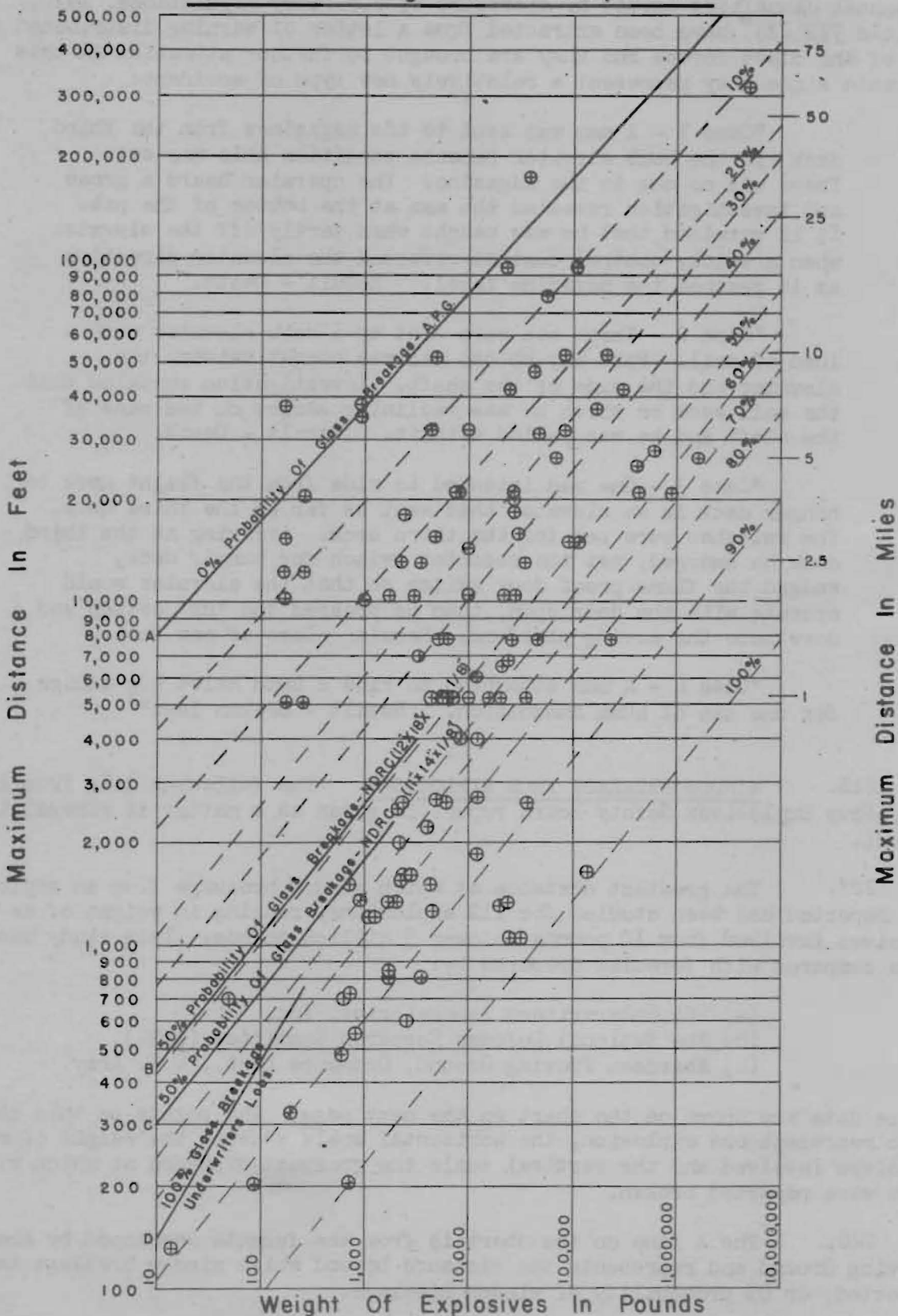
227. The greatest distance at which window breakage from an explosion was reported has been studied for 112 explosions, ranging in weight of explosives involved from 10 pounds to over 5 million pounds. This study has been compared with formulas prepared by:

- (a) The Underwriters Laboratories, Inc.
- (b) The National Defense Research Committee (NDRG).
- (c) Aberdeen Proving Ground, Ordnance Dept., U.S. Army.

These data are shown on the chart on the next page. The points on this chart each represent one explosion, the horizontal scale showing the weight of explosives involved and the vertical scale the greatest distance at which windows were reported broken.

228. The A line on the chart is from the formula developed by Aberdeen Proving Ground and represents the distance beyond which window breakage is not expected, or 0% probability of window breakage.

Window Breakage • From Explosions



229. The B line is from NDRC and represents 50% probability of window breakage for window panes 12" x 18" x 1/8" thick, face-on to the explosion and unprotected. The C line is similar except that it is for panes 11" x 14" x 1/8" thick.

230. The D line represents the Underwriters Laboratories, Inc., formula for the limiting distance for 100% probability of window breakage.

231. One hundred ten of these points have been divided into 10 groups of 11 each by lines drawn approximately parallel to lines A, B and C, each line thus representing 10% of the points, using line A to represent 0%. It is seen that the 50% line is nearly the same as line B. The table below was made from the chart.

Weight of Explosive in Pounds	Probability of Window Breakage			
	Distance in Feet, for Face-on Exposure			
	0%	50%	100%	U.L. Inc. 100%
10	8,000	400	50	140
100	17,500	1,000	100	460
1,000	37,500	2,500	250	1,500
10,000	81,000	6,000	550	
100,000	200,000	14,000	1,350	
1,000,000	370,000	34,000	3,250	
10,000,000	780,000	82,000	7,800	

232. Thus the detonation of one million pounds of explosives would have an even chance (50% probability) of breaking windows as far away as 34,000 feet or 6½ miles, and buildings to be entirely safe would have to be 370,000 feet or 70 miles away, depending on the variations of local topography.

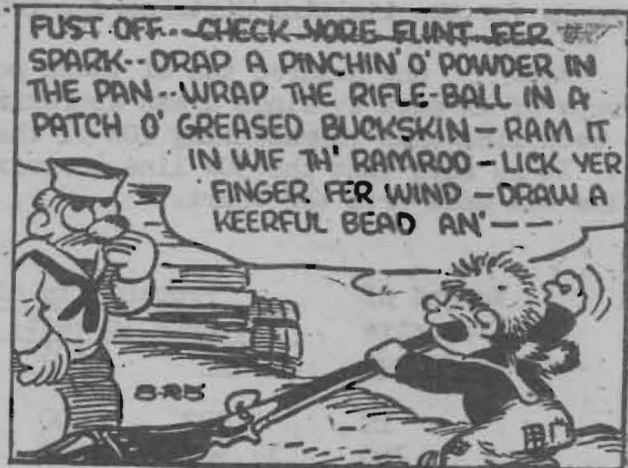
ON THE LIGHTER SIDE

MISSILE MUSINGS

The trajectory of a missile
Is observed to have much grace,
But is it grace or gristle
A rose or thorny thistle
That we want in such a missile
To win the atom race?

An apostle of the missile,
In a rather long epistle,
Conjectures that a whistle
Of the long, low sort
Could guide a guided missile,
Or an anti-missile missile;
Experiments with this'll
Be explained in his report.

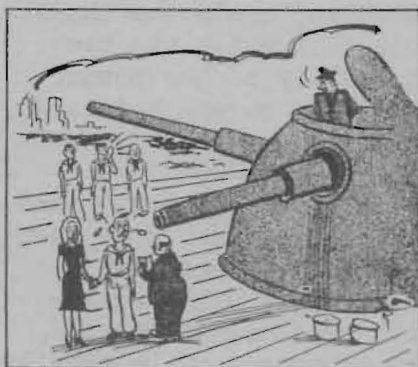
But whether hiss or whistle
Can home a guided missile,
Or an anti-missile missile,
As described by the apostle
In his rather long epistle;
Or whether it can not. -
And will only be a fizzle -
I DO NOT GIVE A GREAT BIG DAMN!



Reprinted by Special Permission of
KING FEATURES SYNDICATE

* * * * *

EXTRACT FROM WAR REPORT



"4. A trick learned from the USS _____ for furnishing ice cream to the small craft is worth noting. Ice cream is run off into sterilized five inch cartridge tanks and hardened thoroughly in the meat room. A reserve of several cans can be built up and kept indefinitely, ready for transfer on suitable occasions. Each can holds about 4 gallons and one will serve an LCS crew, though two makes it more worth while. The ice cream is easily handled in this form and there is no worry about getting the containers back, as the LCS can turn in the 'empties' later. Ice cream was furnished to LCS's on two occasions, and seemed to be greatly appreciated."

(CAUTION: Use only ALUMINUM tanks)

ON THE LIGHTER SIDE

1844 - 1946? The following letter was written by the first Chief of the Bureau of Ordnance and Hydrography to the Secretary of the Navy:

BUREAU OF ORDNANCE AND HYDROGRAPHY

November 21, 1844

SIR:

I have the honor to inform you, that the proviso in the act making appropriations for the naval service for the year ending June 30, 1844, which requires that all materials for the navy be furnished by contract, operates greatly to the prejudice of this bureau and to the public interest, and does not sufficiently guard the interests of the United States, or provide for the security of our ships and seamen.

Efforts to procure good cannon and powder under this proviso, which forces the acceptance of the lowest bidder, be he a jobber in contracts, or a bona fide manufacturer of the article bid for, have resulted in frequent and inconvenient disappointments.

The contract for cannon dated December, 1842, failed on the part of the contractor, by the bursting and rejection of the guns delivered for proof; another contract, for the same guns, dated 13th August, 1843, failed, in consequence of the inability of the contractor to comply with his engagements.

On the 20th August last, the same guns were awarded to the lowest bidder who thereupon refused to comply with his own bid; and, after a delay of nearly two years, have been let now (for the fourth time) to a responsible person, who, it is believed, will complete a delivery of the guns in June, 1845, which were to have been delivered by the 1st December, 1843.

The lowest bidder for the supply of powder did not appear when the contract was declared, (12th November, 1843) - nor the next - and again the third; and when let to the fourth, who was the first responsible contractor who came forward, nearly the whole contract failed, from the bad quality of the powder delivered; and at a late period, under absolute necessity, the bureau had to go into the market and procure the supply.

It is my conviction that so important a matter as the supply of cannon and powder for the naval service should not be suffered to depend so much upon the ability of a contractor to meet the forfeit of non-compliance, as upon the known ability of the bidder to furnish a good article; to secure which advantage to the country, I would respectfully recommend, with great earnestness, that, so far as ordnance and ammunition for the navy are affected by the proviso above referred to, it be so modified as to except them from its action.

I have the honor to be, with great respect, your obedient servant,

W. M. CRANE

Hon. J. Y. MASON
Secretary of the Navy.

CONFIDENTIAL

ON THE LIGHTER SIDE

LOST - ONE CRUISER. A Scouting Squadron in the Pacific sent the following to the Bureau, with the statement that it had been related "by a fellow 'Fly-Fly' from a heavy cruiser":

It was just after sunset and the Gun Boss had been on the bridge only a few minutes looking over the side, first from one wing and then the other, as the ship moved along in formation. He stopped at the PPI, squatted and squinted, straightened up and peered somewhere off the port beam, squatted and squinted again, and pointing to the scope, said in a puzzled voice to the operator: "Which one is us?"

* * * * *



ON THE LIGHTER SIDE

ATTRITION. During the recent war the following survey report was received from an escort carrier:

"CONDITION: Barrel, 20mm AA Gun Mark 4 Mod. 1 lost overboard during action.

CAUSE: The above 20mm AA gun barrel was lost overboard during an evening action (aircraft attack. Crew of 20mm AA Gun #9 starboard side were steward's mates. On being ordered to place hot barrel in water (dunking tub) one crew member removed the hot barrel and threw it into the sea. This was done under the stress of action.

RESPONSIBILITY: None. Incident to stress under fire.

RECOMMENDATION: Expend from books and replace in accordance with allowance.

* * * * *



"Hey! Easy wit' those things! They cost plenty dough!!" JAY IRVING

(From Collier's Weekly)