INDEX NO. A-39

AERONAUTICS TARGETS

JAPANESE NAVAL PHOTOGRAPHY

U.S. NAVAL TECHNICAL MISSION TO JAPAN

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U. S. NAVAL TECHNICAL MISSION TO JAPAN
CARE OF FLEET POST OFFICE
SAN FRANCISCO, CALIFORNIA

20 December 1945

RESTRICTED

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

Subject: Target Report - Japanese Naval Photography.

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

1. Subject report, covering the manufacture, use, quantity and control of Japanese photographic equipment, as outlined by Target A-39 of Fascicle A-1 of reference (a), is submitted herewith.

2. The investigation of the target and the report were accomplished by Lieut. W.D. Hedden, USNR, assisted by Lt. Comdr. G.Z. Dimitroff, USNR, as technical adviser, and Lt.(jg) W.A. Seymour, USNR, as interpreter and translator.

C. G. GRIMES
Captain, USN

30605

JAPANESE NAVAL PHOTOGRAPHY

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

FACICLE A-1, TARGET A-39

DECEMBER 1945

U.S. NAVAL TECHNICAL MISSION TO JAPAN

SUMMARY

AERONAUTICS TARGETS

JAPANESE NAVAL PHOTOGRAPHY

Investigation of Japanese naval photography, which was under the cognizance of the Naval Department of Aeronautics, indicated that the most important phase of photography was aerial applications for photo-reconnaissance. For general aerial photographic reconnaissance, the carrier-based aircraft, MYRT, equipped with aerial cameras, was generally used at high altitudes. During the war, developments in aircraft camera design, particularly toward the use of telephoto oblique cameras, indicated that emphasis was being placed on high altitude oblique, rather than vertical, coverage for reconnaissance purposes.

Four principal types of aircraft cameras were in general naval use. Three of these four cameras were direct copies and the fourth a modification of older types of U. S. cameras. Training type aerial cameras were used successfully for torpedo attack training. Gun cameras, however, particularly in the last two years of the war, were not used extensively.

Two photographic film emulsions, aerial panchromatic and infra-red sensitive, were in general naval use. However, the aero-panchromatic film was used almost exclusively while the infra-red found only limited use, owing primarily to its poor stability.

Photographic research to develop new techniques and materials was conducted throughout the war by the Navy and the leading commercial photographic manufacturers. Investigations were made into infra-red sensitization and stability, production of a two-color film for photo-reconnaissance, high temperature development techniques, camera and equipment design improvements, and other fields. However, no outstanding new product or significant improvements of existing equipment or material were reported or observed during the war.

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REFERENCES

(A) Locations Visited to Obtain Data and Equipment:

1. Sasebo Naval Base, SASEBO, Kyushu
2. Sasebo Naval Air Station, SASEBO, Kyushu
3. Omura Naval Air Station, OMURA, Kyushu
4. Yokosuka Naval Base, YOKOSUKA, Kanagawa Ken
5. Yokosuka Naval Air Station, YOKOSUKA, Kanagawa Ken
6. Branch, First Technical Air Arsenal, YOKOSUKA, Kanagawa Ken
7. Ikego Air Arsenal, ZUSHI, Kanagawa Ken
8. Tokyo Optical Co., TOKYO Fu (Lenses)
9. Nippon Optical Co., Oimachi, TOKYO Fu (Lenses)
10. Fuji Photo Film Co., Ltd.
    a. Odawara Plant, ODAWARA, Kanagawa Ken (Chemicals)
    b. Ashigara Plant, ASHIGARA KAMI Gun, Kanagawa Ken
11. R. Konishi Photo Co., Ltd.
    a. Tokyo Office, TOKYO (Statistics)
    b. Yodobashi Plant, YODOBASHI, TOKYO Fu (Cameras)
    c. Hinno Plant, HINNO, TOKYO Fu (Film)

(B) Japanese Personnel Who Assisted in Locating Equipment and/or Documents:

1. K. EZUMI, Director, Optics Branch, First Naval Technical Air Arsenal
2. R. HOTTA, Head Photographic Engineer, Branch, First Naval Technical Air Arsenal
3. S. MORITA, Managing Director, Fuji Photo Film Co.
4. S. FUJISAWA, Head Engineer and Research Director, Fuji Photo Film Co.
5. EGUI, Chief Engineer, Fuji Photo Film Co., ODAWARA plant.
6. R. SUGIURA, President, R. Konishi Photo Company
7. R. NISHIMURA, Head Engineer and Research Director, R. Konishi Photo Company
8. H. MORI, Head Engineer and Camera Design Specialist, YODOBASHI plant R. Konishi Photo Co.
9. Y. SHIKANO, Paper Engineer, YODOBASHI plant of R. Konishi Photo Co.
10. NAGAOKA, Head Engineer, Nippon Optical Co.

LIST OF ENCLOSURES

(A) List of Photographic Equipment Collected and Shipped to the U.S.

(B) Fuji Film Company Sensitometric Data

(C) Fuji Film Company, ASHIGARA Plant, Production Data

(D) Report on Chemical Production at ODAWARA Plant prepared by Fuji Photo Film Co. for U.S. Naval Technical Mission to Japan.

(E) Japanese Naval Photographic Organization

(F) Photographs of Japanese Aerial Photographic Equipment

(G) R. Konishi Co. Sensitometric Data (forwarded under separate cover to: Director, Photo Science Laboratory, Anacostia, Washington, D. C.)

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INTRODUCTION

In the evaluation of Japanese naval photography it was necessary first to determine what equipment, material and techniques were being used by the Japanese Navy. After determining what photographic equipment had been operational, what obsolete, and what in development, and the reasons for such trends, analysis of the military application and evaluation of naval photographic equipment and techniques were possible.

Much evidence indicated that although the Japanese Navy employed technicians engaged in photographic research and in the development of new techniques, the largest phase of photographic research was undertaken by Japanese commercial photographic manufacturers. Inspections of the large manufacturing concerns were then made with particular emphasis placed upon the products which could have been manufactured, production methods and facilities, and especially upon research which was in progress during the war.

Although investigation was concerned primarily with naval photography, it was considered both necessary and convenient to make similar observations of Japanese Army photographic activity. This comparison was considered necessary to obtain a true picture of general Japanese military photography for proper relative evaluation of the naval position, and convenient because commercial research usually did not differentiate between branches of the service.

After a detailed examination of naval photographic equipment, investigation of operational uses and techniques, and a detailed examination of commercial photographic products, research, and production facilities, the observations and conclusions on the application and use of photography by the Japanese Navy are submitted.

THE REPORT

PART I - PHOTOGRAPHIC EQUIPMENT

A. CAMERAS

1. Summary

Although both surface and aerial type cameras were used by the Japanese Navy, observations generally indicate that reconnaissance and mapping aerial cameras were the principal types developed for naval use. Operationally speaking, the Japanese Navy appeared to have standardized production on four aircraft camera models for general mapping and reconnaissance. Experimentation was undertaken on various aerial camera designs, with particular emphasis on lenses of long focal length. However, very little success was reported and none of the cameras developed were considered suitable for extended operational use.

Training cameras for torpedo attack and gunnery training were also used during the war. Of the two types of torpedo camera used, one was in general use throughout the war, while the second was not in general use after 1943. The camera generally used for gunnery training at the start of the war was also discontinued in 1943 and no other gun camera replaced it. However, experimentation on both 16mm free and fixed-gun cameras was in progress in the later years of the war.

It is interesting to note that in the first years of the war both the Japanese Army and Navy were primarily using Fairchild Cameras purchased from the United States prior to the war. These cameras were used for aerial reconnaissance and as a basis for Japanese camera design.

Still cameras, generally using glass plates, were the only type of ground cameras observed.

2. General Types of Naval Cameras

a. General Naval Use

K-8, 50cm mapping camera
K- , 25cm mapping camera
F , oblique reconnaissance camera
Ty) 99, hand-held oblique camera

b. Experimental or Test Use

Type IV, 70cm oblique reconnaissance camera
100cm telephoto, vertical or oblique experimental reconnaissance camera

c. Limited Use or Obsolete

70cm telephoto, oblique reconnaissance camera
Rb 75, German vertical mapping camera
Rb 50, German vertical mapping camera
25cm hand-held oblique camera

d. Training Type

Attack type torpedo camera
Deck type torpedo camera
Flack spotting camera
Type 89 gun camera (35mm)
W-7 type gun camera (16mm)
Cine No.2 gun camera (16mm)

3. Naval Camera Production

The principal producers of both surface and aerial cameras for the Japanese Navy were: R. Konishi and Co., Ltd., TOKYO, and Fuji Camera Co., OSAKA and TOKYO.

As the Fuji Camera Co. produced only the Type 99 aerial camera, and all torpedo training cameras were produced at TAKACHIHO and ASAHIDENKI, practically the entire production of cameras for the Japanese Navy was undertaken by the R. Konishi Co. at their YODOBASHI and HANNO plants in the TOKYO area. Production figures of the R. Konishi C., Ltd., showing all types, sizes, and quantities of cameras ordered by and delivered to the Japanese Navy annually from 1941 to 1945, inclusive, are given in Table I

TABLE I

JAPANESE NAVY CAMERA PRODUCTION

Type	Focal Length	Lens Aperture	Picture Size	Roll Size	1941		1942		1943		1944		1945		Total	
					Ord.	Del.	Ord.	Del.	Ord.	Del.	Ord.	Del.	Ord.	Del.	Ord.	Del.
K-8	50cm	f5	18x24cm	24cm x 24m	0	0	30	0	100	108	500	378	600	89		575
K-8	25cm	f4.5	18x24cm	24cm x 24m	10	10	10	10	25	15	383	202	480	79		316
F-8	25cm	f4.5	13x18cm	18cm x 3.7m	400	286	500	403	640	698	1044	787	1080	142		2316
Type 99	15cm	f3.5	6x10cm	9cm x 2.3m			50	50	700	600	1416	1231	1440	65		1946
Field Camera	21cm	f4.5	12x16.5cm				150	127	150	28	300	293	300	20		468
Field Camera	36cm	f4.5	12x16.5cm				80	55	100	124	120	3	120	0		182
Folding Camera	13.5cm	f4.5	8x10.5cm				50	40	50	50	100	150	100	0		240
Folding Camera	18cm	f4.5	12x16.5cm				120	116	70	0	500	407	500	65		588
Gun Camera Type 89	7.5cm	f4.5	35mm	35mm x 2.5m	1320	941	1500	1506	600	0						2447
Cine #2	7.5cm	f3.5	10x10mm	16mm x 5.6m					1500	0		?		?		?
Cine	5.0cm 7.5cm 15.0cm	f3.5 f3.5 f4.5	35mm						150	0	500	0				0
Projector	35mm		35mm				20	0	150	88	250	119	50	0		207

4. Army Cameras

Although a detailed survey of Japanese army photographic equipment was not undertaken, observations of army aerial equipment and production figures from the R. Konishi Co., which was the largest camera producer for the army, indicate that the army aerial cameras principally used for aerial mapping were the No. 1, Model 2, 50cm and 25cm. Except for operating voltage these cameras are practically identical to the Japanese Navy K-8 type.

Production figures of the R. Konishi Co. showing all types, sizes, and quantities of cameras ordered by and delivered to the Japanese Army annually from 1941 to 1945, inclusive, are given in Table II.

TABLE II

CAMERA PRODUCTION FOR JAPANESE ARMY

Type	Focal Length	Lens Aperture	Picture Size	Roll Size	1941		1942		1943		1944		1945		Total	
					Ord.	Del.	Ord.	Del.	Ord.	Del.	Ord.	Del.	Ord.	Del.	Ord.	Del.
No. 1 Model 2	50cm & 25cm	f5 f4.5	18x24cm	24cm x 24m	11	11	30	0	200	75	1000	608	1200	337		1026
Type 100	40cm & 20cm	f6.3 f3.5	24x16.5m	18cm x 6.0m	233	30	400	306	2500	1456	1400	2212	1600	265		4269
Night Camera	25cm	f2	18x24cm	24cm x 60m							3	1	50	0		1
1 Meter Camera	100cm	f8	12x16.5cm	12cm x 2m			5	5	2	0	210	62	200	0		67
Smallest Aerial Camera	7.5cm	f3.5	6x6cm	6.2cm x 850mm	900	900	500	477	500	0	0	361	0	144		1882
Fixed Gun Camera	7.5cm	f3.5	25cm x 25mm	35mm x 1.6m	200	0	1180	218	800	1120	0	430	0	211		1979
Flexible Gun Camera	18cm	f11	4x6cm	6.2cm x 850mm	320	308	450	382	0	68						758
Folding Camera	13.5cm	f4.5	8x10.5cm		100	80	50	50	50	0	50	100				230
Type B Field Camera	21cm	f4.5	12x16.5cm		75	50	125	100	50	0	50	100				250
Flexible Aerial Camera	2.5cm	f4.5	16mm	16mm x 5m					0	500	0	37	0	78		615

5. Camera Research and Development

Most of the research and development on the design of Japanese aerial cameras was undertaken by Mr. H. MORI, of the R. Konishi Co., working in conjuction with Mr. R. HOTTA, of the First Naval Technical Air Arsenal, YOKOSUKA. Designs of the K-8 and F-8, the basic Japanese naval aerial camera types, were admittedly direct copies of the United States Fairchild camera of the same type. With the exception of the Type IV 70cm aerial camera (and a 100cm similar army experimental model), no new designs of aerial cameras were found to be in experimental or trial operational use by the Japanese Navy at the end of the war.

6. Description of Japanese Naval Aerial Cameras

a. K-8, 50cm Type Aerial Camera

The K-8 50cm focal length aerial camera was the principal one used for vertical mapping and reconnaissance. It was equipped with two magazines, two intervalometers, view finder, and repair kit, and was used entirely as a vertical mapping camera mounted in a reconnaissance plane. The K-8 was reported to be copied directly from the Fairchild design, and some Fairchilds were actually used at the start of the war. This camera was generally used operationally from altitudes of 20,000 to 30,000 feet in the MYRT (Saiun) reconnaissance plane. Although a view finder was supplied, the camera was usually sighted and used with the drift meter installed on the plane. Infra-red film was reported to have been used in this type camera; however, no means of correcting the focal length of the lens to focus for infra-red correction was provided.

Descriptive Data:

Lens focal length 50cm
Lens aperture f5
Picture size 18x24cm
Roll size ..... 24cm x 24m
Shutter ..... leaf type
Shutter speeds ..... 1/50-1/100 sec.
Operating voltage ..... 12 volts

b. K-8, 25cm Type Aerial Camera

The K-8 25cm focal length aerial camera is identical to the 50cm K-8, except for the use of a 25cm focal length lens. This camera was reported secondary to the 50cm K-8 type for mapping and reconnaissance work, and was used in the MYRT at altitudes from 13,000 to 23,000 feet.

Experiments were made with three of these cameras mounted in a trimetrigon type installation utilizing one vertical camera and two oblique cameras set at angles of 24° from the vertical. This installation did not progress beyond the test stage and no record was found of its operational use.

Descriptive Data:

Lens focal length	25cm
Lens aperture	f4.5
Picture size	18x24cm
Roll size	24cm x 24m
Shutter	leaf type
Shutter speeds	1/50-1/150 sec.
Operating voltage	12 volts

c. F-8 Type, Oblique Aerial Camera

The F-8 type oblique aerial camera is almost a direct copy of the U.S. Navy Type F-8 aerial camera. This camera was reported to have been employed extensively as an oblique camera for scouting purposes. Glass plates, in a six septum magazine, were used before and at the start of the war; however, a change to roll film was made early in the war and used exclusively thereafter.

Attempts were made early in the war to employ the F-8 as a vertical camera and approximately 25 mounts were made for use in the MYRT. This vertical arrangement did not prove satisfactory and subsequently the F-8 was entirely in oblique hand-held operation.

The F-8 was also equipped with a lever for focus compensation for use with infra-red sensitive film.

Descriptive Data:

Lens focal length	25cm
Lens aperture	f4.5
Picture size	13x18cm
Roll size	18cm x 2.7m
Shutter	focal plane
Shutter speed	1/60-1/400 sec.

d. Type 99 Aerial Camera

This camera is a small, hand-held type, somewhat similar to the U.S. Navy Type K-20, and was used entirely for obliques.

Two models of the camera were found. The first was equipped with an f3.5 lens. However, more of the second type with an f4.5 lens were reported, as the advantages of a faster lens were not considered of such importance as to warrant increased production difficulties and costs arising from the manufacture of the faster lens.

The Type 99 camera utilized a film winding mechanism operated by turning one of the camera hand holds two twists of the hold, winding the film and cocking the shutter simultaneously. Perforated film was used for better film advancement.

Descriptive Data:

Lens focal length	15cm
Lens aperture	f3.5 or f4.5
Picture size	7.5x10cm
Roll size	20 exposure roll
Shutter type	focal plane
Shutter speeds	1/25-1/500 sec.

e. Type IV 70cm Reflecting Oblique Reconnaissance Camera

Although this camera was reported to have had only limited operational use, approximately twenty were produced for the Navy and a similar model tested by the Army. The camera utilized a 70cm lens for oblique operation, with a 70° reflecting mirror in the lens path to reduce the overall length of the camera so that it could be used for hand-held oblique operation. The pilot held the case of the camera in his lap and sighted the camera through a seven-power monocular finder. The overall weight was about 17kg (38 lbs.).

This camera was designed in the latter stages of the war for high altitude oblique photography and was first reported in limited use in the OKINAWA campaign. The camera design proved to be impractical, due largely to weight (38 lbs.), which made hand-held operation difficult, particularly at the high altitudes for which it was designed.

Descriptive Data:

Lens focal length	70cm with reflecting mirror
Lens aperture	f6
Picture size	12x15cm
Roll size	20 pictures
Shutter	focal plane
Shutter speeds	1/100-1/200 sec.
Operating voltage	12 volt or hand operated

f. 100cm Telephoto Experimental Reconnaissance Camera

This 100cm long-focus aerial camera was tested experimentally during the early stages of the war but did not prove suitable for operational use. The camera was equipped with a 90° reflecting mirror head which could be attached to the end of the lens tube to adapt the camera to either vertical or oblique operation. The design was not successful for two reasons: First, the angle of field of a 100cm lens with a 8x10cm plate size proved too small for practical use. Second, the total length of the camera was too great for the small reconnaissance planes, particularly for oblique use. Attempts to mount the camera flat on the deck of the plane for vertical use with mirror head were not practical. The basic design was discarded for operational use early in the war.

Descriptive Data:

Lens focal length	100cm
Lens aperture	f10
Picture size	8x10cm

Roll size ..... 20 exposures or 6 plates
Shutter ..... focal plane
Shutter speeds ..... 1/60-1/200 sec.

g. 70cm Telephoto Oblique Reconnaissance Camera

The 70cm oblique aerial camera was considered obsolete at the start of the war. Only plates were used and there were no provisions or adaptations made for roll film. It was designed as an oblique camera for patrol craft and saw some operational use in China. However, since it could not be easily mounted in the BETTY it was discarded after 1941.

Descriptive Data:

Lens focal length 70cm
Lens aperture f6
Picture size 13x18cm
Roll size ..... 6 plates
Shutter ..... focal plane unit
Shutter speeds ..... 1/90-1/750 sec.

h. 25cm Hand-Held Oblique Camera

The 25cm hand-held oblique camera was used before 1941, but its use during the war was practically negligible, as it was replaced by the F-8 oblique camera. This camera was constructed with a replaceable focal plane shutter unit and used glass plates exclusively. Two types were in use, differing only in the manufacturer of the lens. Some models were equipped with a Zeiss Tessar lens, others with R. KONISHI Hexar lenses.

Descriptive Data:

Lens focal length 25cm
Lens aperture f4.5
Picture size 13x18cm
Shutter type ..... focal plane unit
Shutter speeds ..... 1/90-1/750 sec.

i. Rb75 and Rb50 Mapping Cameras

The Rb75 and Rb50 were aerial mapping cameras acquired from Germany during the war, but were not used operationally because they were too large for satisfactory installation in Japanese aircraft.

Descriptive Data:

Lens focal length Rb75 75cm
Rb50 50cm
Lens aperture f6
Picture size 30x30cm
Roll size ..... 32cm x 60m
Shutter ..... leaf type
Shutter speeds ..... 1/75-1/300 sec.
Operating voltage ..... 12 volts

j. Attack Type Torpedo Camera

The attack type torpedo camera was a cylindrical instrument with a 35mm single frame camera located in the end of a tube which was used as the pilot's torpedo periscopic sight. The sight was used for

aiming during the torpedo training run, and the camera made a single frame exposure when the torpedo was dropped. From various computations it was possible to analyze the photographs made at the time of the drop to determine the accuracy of the torpedo attack run. This camera was considered satisfactory for training and was used throughout the war.

Descriptive Data:

Lens focal length	75mm
Lens aperture	f3.5
Picture size	24x36mm
Roll size	10 exposures - 35mm
Shutter	leaf type
Shutter speed	1/200 sec.

k. Torpedo Camera, Deck Type

The deck type torpedo camera was used as a training camera mounted aboard ships used for torpedo training attacks. The camera was operated on deck, with the shutter and film movement motor driven. The direction of the camera, with respect to the ship and the exact time of the exposure, was recorded on the negative of the attacking plane. Analysis of the attack technique was made from the photographic data obtained at the time of the torpedo drop. This camera was in common use in the early part of the war, but was discontinued in favor of the attack model.

Descriptive Data:

Lens focal length	25cm
Lens aperture	f4.5
Picture size	12x16cm
Roll size	40 exposures
Shutter Speed	1/150 sec.
Operating voltage	12 volts

l. Flack Spotting Camera

The flack-spotting camera used for anti-aircraft gunnery training was a prism camera mounted in aircraft used for towing target sleeves. The camera pointed aft in the plane and was hand operated to show deflection and elevation errors in firing, by recording the position of the shell burst with respect to the sleeve. The camera was used for training at the start of the war, but its use was discontinued.

Descriptive Data:

Lens focal length	30cm
Lens aperture	f4.5
Picture size	16x16cm
Shutter speed	1/200 sec.
Operating voltage	12 volts

7. Gun Cameras

a. Type 89 Gun Cameras

The Type 89 gun camera was a 35mm single frame exposure type, similar in appearance to a free machine gun. This model was used for free gunnery training before the war, but its use dwindled and it was discarded in 1943.

b. Experimental Type Gun Camera

A copy of the Fairchild W-7 gun camera was being tested experimentally for fixed gunnery training. This 16mm camera was modeled from one of the older types of U.S. gun cameras and was designed for wing mounting. It was only in the experimental stage during the war and was not used operationally or even for extensive training. Experimentation had not even progressed to a point where tests were made with the camera and guns firing simultaneously.

c. Cine Gun Camera Type 2

The Cine Type 2 camera was the latest navy development of a camera for free gunnery training. It was designed and developed in the last years of the war, but was produced only in limited quantity. The camera resembled a free machine gun, but was smaller than the Type 89 and used 16mm film.

8. Ground Type Cameras

Folding cameras using glass plates were used for general purpose ground photography. The cameras used normally supplied cabinet size (13x18cm) pictures, but some larger 11x14 inch copy and view cameras were used. Practically all of the cameras used by the Japanese Navy were equipped only for glass plates, although film pack was manufactured by the commercial photographic concerns.

A popular type ground camera was the Voigtlander 13x18cm view camera with an f4.5 lens on a rising-falling front. This camera was procured from Germany in large numbers before the war.

B. PROCESSING EQUIPMENT

1. For Aerial Film

Two types of aerial film developing tanks were used by the Japanese Navy, both similar in design to the U. S. Navy Smith-Fairchild equipment. Model I, admitted to be a direct copy of the Smith-Fairchild unit, was equipped with a reversing motor for film movement. A series of four solution tanks were included in the kit. This aerial film developer operated on 220 volts and was intended primarily for shipboard use.

Model II was similar to Model I except that no motor was supplied. Agitation and film movement were accomplished manually with winding knobs attached to the top of each spool.

Smaller size aerial film used with the Type 99 camera was processed in roll film tanks wound between long celluloid dimpled-type leaders.

2. Motion Picture Film

Military motion picture and 35mm gun camera film were generally processed on rack and tank type equipment.

3. For Plates

Wooden developing tanks or trays were used for plate development.

C. PRINTERS AND ENLARGERS

1. Aerial Film Printers

Aerial printers were generally single-picture contact printers, often not even equipped with rewind spools for handling roll film. The printers were not equipped with field illumination control for negatives of unbalanced density. Those most generally used were equipped with four incandescent bulbs supplying illumination through a diffusing medium. However, the four bulbs were not equipped with separate switches and all four were used for each exposure.

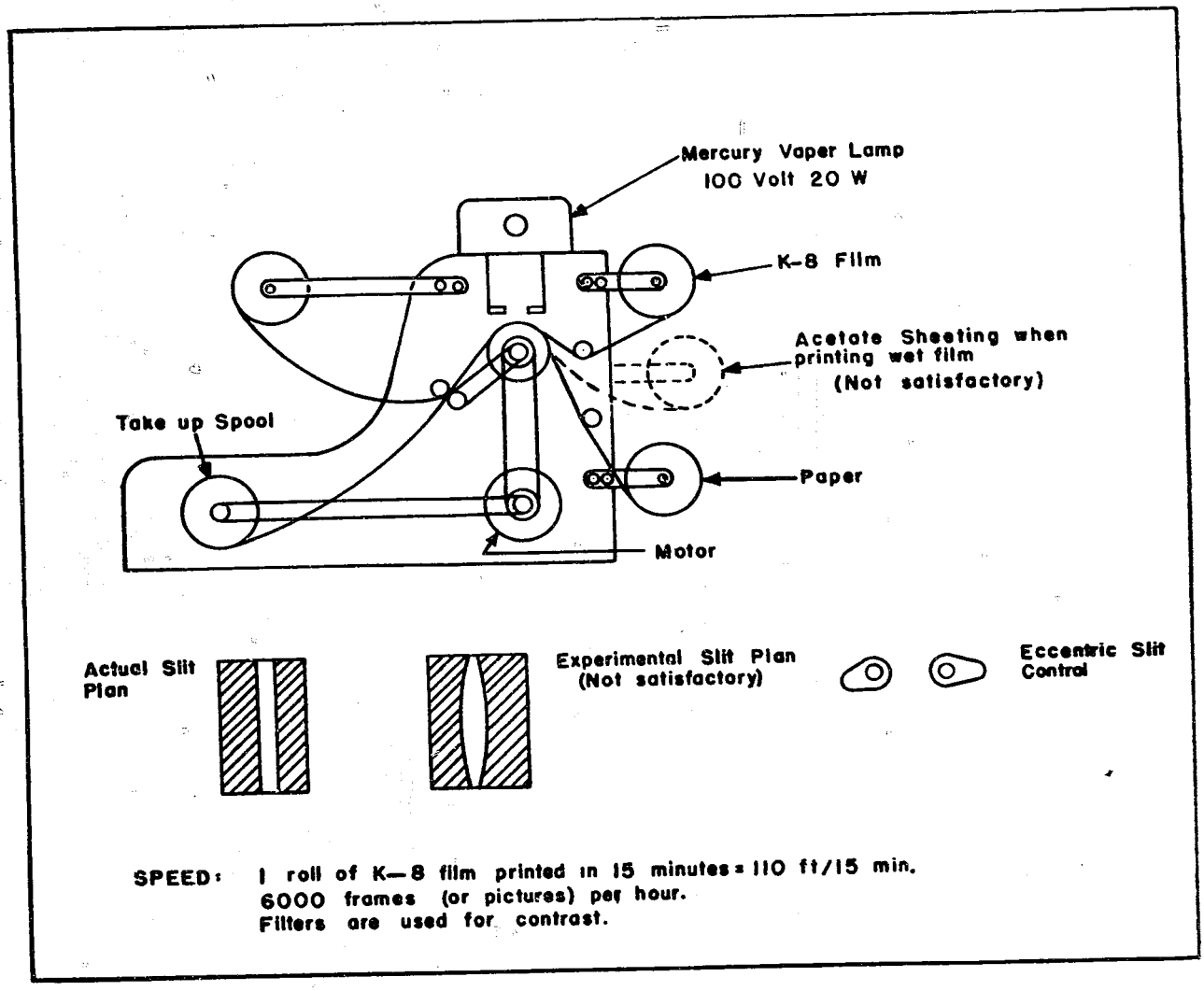


Figure 1

AERIAL ROLL PRINTER

2. Enlarging Printers

An enlarging printer was used for aerial film from the Type 99 hand-held camera. This enlarger was a fixed-focus type and enlarged the 6.5x9cm Type 99 negatives to 13x18cm cabinet size. The enlarger was equipped with roll film spool holders and could also be used for single frame exposures cut from a roll. Provision was also made for printing extremely dense negatives by using a photo flash bulb as a light source.

3. Standard Enlargers

Standard type enlargers used by the Japanese Navy were of the autofocus type, either procured directly from the United States prior to the war or designed from U.S. models. Most of the printing for the Navy was by contact methods, as the practice of enlarging negatives was not standard procedure.

4. Aerial Roll Printers

One aerial roll printer using roll paper was developed at the Branch, 1st Naval Technical Air Arsenal YOKOSUKA, by Mr. R. HOTTA, Chief Engineer at that laboratory. A sketch of the printer design is shown in Figure 1.

This printer, designed by Mr. R. HOTTA, was developed at NIRAYAMA in November 1944. The plans were then given to the TOKYO branch of the Fuji Camera Co. for production, but before it was started the TOKYO branch was bombed and the design was then sent to the OSAKA branch of the Fuji Company. Lack of material prevented production.

The printer is operated by passing negative aerial roll film across an illuminated slit while in contact with a roll of printing paper. The printer is equipped with a slit width adjustment for exposure control and was designed to print a 110 foot roll of negative film from the K-8 camera in 15 minutes.

Only one prototype model of this printer was made near the end of 1944 and tested at the Yokosuka Air Station. Ten thousand pictures (about 100 K-8 rolls) were printed without difficulty and the tests were considered satisfactory.

D. AERIAL DRYING EQUIPMENT

Under shipboard or combat conditions aerial film was dried by one of two methods:

(a) Squirrel cage equipment
(b) Festooning film from pegs, racks, ropes, or improvised hangers.

Drying usually required from two to three hours with the above methods. By using a 70% alcohol solution before drying the time was reduced to about two hours.

One mechanical film drier similar to the U.S. Navy Smith-Fairchild Type was designed at the 1st Air Arsenal. The design was the basic rotating drum type, hot air being blown on to the wet film as it made a single pass around the drum. The time required for drying 110 feet of 9 inch aerial film with this model was 45 minutes to one hour, and tests conducted were considered satisfactory. Although the use of this drier reduced the time required for a first print from reconnaissance film from four hours to about two hours, its advantages were not considered important enough to recommend large scale production.

E. ACCESSORIES

1. Intervalometers

The only type Intervalometer used by the Japanese Army and Navy was designed from the Fairchild B-2 type and operated by a worm-gear drive. Two intervalometers were usually included with each K-8 camera.

2. Filters

Four photographic filters were in general naval use. They are listed with their absorptive value and use in Table III.

TABLE III

ABSORPTIVE VALUE AND USES OF FILTERS

Filter	Color	Absorption Wave Length	Use
K-45	Yellow	4500°A	Aero I; Two-Color
K-50	Yellow	5000°A	Aero II
D-55	Green	5500°A	Aero (Infrequent)
R-60	Red	6000°A	Infra-Red

* * * * *

PART II - PHOTOGRAPHIC MATERIALS

A. SUMMARY

Three companies were supplying the Japanese Army and Navy with sensitized film and paper for military use. These companies were:

Fuji Photo Film Co., Ltd.
R. Konishi Photo Co., Ltd.
Oriental Film Co.

Of these three, the Fuji and Konishi Companies were supplying practically all the photographic film used and most of the paper, while the Oriental Company was supplying but a small part of the photographic paper. Until the end of the war, the Fuji Company was the only manufacturer of 35mm cine motion picture film. Sizes and quantities of films produced for the Japanese Army and Navy by the Konishi and Fuji companies are shown in Table IV.

Aerial film of two general emulsion types were produced for military use; aerial panchromatic and infra-red sensitive. The panchromatic type was used almost exclusively; the infra-red type, owing to its specialized nature and poor keeping qualities, found only limited use. Each of these emulsion types was produced by both the Fuji and Konishi companies, with practically no difference in photographic characteristics between the products of the two companies.

Investigations into higher panchromatic emulsion speed, greater infra-red sensitivity, increased infra-red emulsion stability, and two-color aero films were attempted, but only experimental results were achieved.

Photographic paper furnished to the Japanese Army and Navy was of the general chloride, chloro-bromide, or bromide types, and either gloss or semi-gloss surface. Three contrasts comparable to the United States manufacturing designation of #2, #3 and #4 were manufactured for each surface, but in some cases only the #3 contrast was supplied for military use. The Fuji Photo Film Co., Ltd., ODAWARA plant, was one of the largest producers of photographic chemicals. Chemicals were pre-weighted and packaged into developer and fixing formulas and supplied to the Army and Navy. Two developing and fixing formulas were made: one set for average conditions, a second for tropical use at high solution temperatures.

TABLE IV

PRODUCTION OF MILITARY FILM
R. Konishi Co.

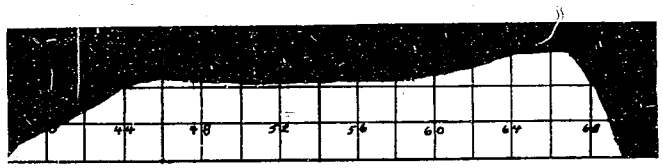
Size	Japanese Navy (Rolls)						Japanese Army (Rolls)					
	1941	1942	1943	1944	1945	Camera	1941	1942	1943	1944	1945	Camera
24cmx24m	300	700	2200	4514	1862	K-8			3500	7000	1622	No.1 Mod. 2
18cmx3.7m	2644	1322	2203	3525	3305	F-8						
18cmx7.5m			425	735		F-8						
9cmx2.3m		2780	1668	3500	2863	Type 99						
35mmx2.5m	4188	3490	10,470	26,035	32,945	Type 89 gun camera						
6.4cmx85cm	22,048	21,200	9116	2000	21,412	Small aerial camera	17,600	13,700	22,800	16,000	13,000	Small aerial
16mmx5.6m			300	300	50	Cine #2						
18cmx24m							13,300	1200	2200	5000	1000	
18cmx6m							2500	1900	6100	9750	1980	Aero Photo 20 cm
12cmx6m							4000	3200	4800	6400	4200	Aero Photo 20 cm
12cmx2m							2400	2640	2880	2400	500	1 meter focal length
20cmx60m									116	1303	50	"Topogon"
32cmx60m										296	100	"Topogon" Gun
35mmx1.6m											7500	camera

(Fuji Film Co. production was about 14,600 square meters of aerial film per month.)

B. FILM AND EMULSION CHARACTERISTICS

1. Aerial Film

a. Aerial Panchromatic Film

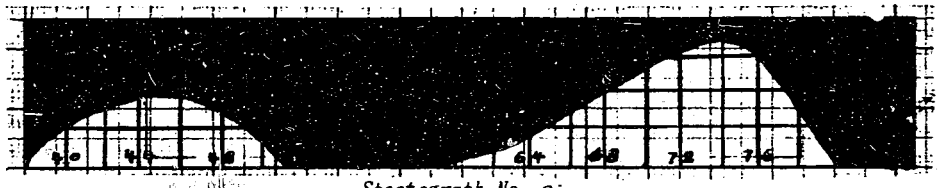


Spectograph No. 1

Average Exposure Conditions: 1/399 second f 5.6

(A sensitometric curve for the above film is discussed in Enclosure B.)

b. Infra-red Sensitive Film



Spectograph No. 2

FUJI EXTREME RED SENSITIVE AERO-FILM

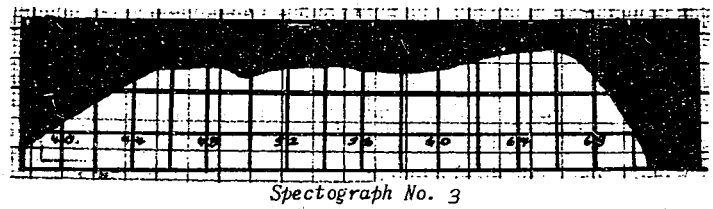
Average Exposure Conditions: 1/150 second f 5.6 with an.R-60 (red) filter

(A sensitometric curve for the above film is discussed in Enclosure B.)

Infra-red film was spooled for use with the K-8 and F-8 aerial camera. Glass plates were also coated for aerial use in these cameras.

Infra-red emulsions usually were considered stable under good conditions for three months, and were usable up to six months, with increasing loss of infra-red sensitivity.

c. High Speed Aero-Panchromatic Film (Experimental).



Spectograph No. 3

FUJI HIGH SPEED AERO-PANCHROMATIC FILM

Average Exposure Conditions: 1/500 second f 5.6

(A sensitometric curve for this emulsion is discussed in Enclosure B.)

This film was manufactured experimentally by the Fuji Photo Film Company, but was not produced for operational use in any sizable quantity.

d. Two-Color Aerial Film (Experimental).

Both the Fuji and Konishi Companies had perfected a two-color process for aerial reconnaissance. However, field processing proved to be so difficult that this project did not advance beyond the test stage for military use. The two-color film was exposed through a yellow filter to eliminate haze and processed in field developing tanks by using a coupling-developing subtractive reversal process.

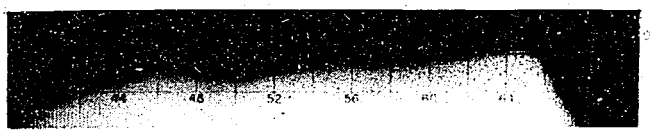
Average Exposure Conditions: 1/100 second f 5 with yellow filter

2. Motion Picture Films

The Fuji Photo Film Co., Ltd. was the exclusive producer of 35mm cine motion picture film. The following types of motion picture film were produced:

Cine Negative 35mm
Duplicating Negative
Cine Positive
Duplicating Positive
Sound Recording

Spectographs of each of the above listed motion picture films follow. Sensitometric curves of these films, discussed in Enclosure (B), have been forwarded under separate cover.



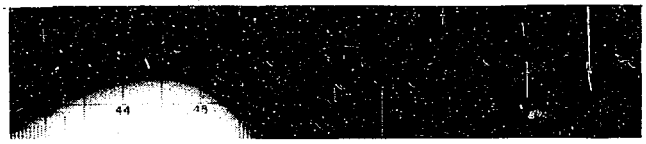
Spectograph No. 4

Spectograph No. 5

FUJI DUPLICATING NEGATIVE FILM

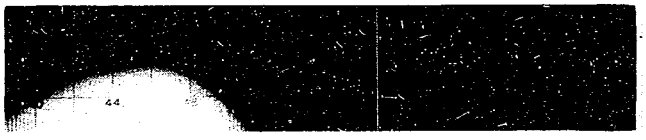
Spectograph No. 6

FUJI POSITIVE FILM



Spectograph No. 7

FUJI DUPLICATING POSITIVE FILM



Spectograph No. 8

FUJI SOUND FILM

3. Amateur Photographic Film

The following amateur photographic films have been produced by the two major photographic manufacturing concerns:

a. Neopan Roll Film, film packs, etc., of various amateur sizes. (Fuji Company)

Spectograph No. 9

FUJI NEOPAN FILM

Average Exposure: 1/200 second f 6.3

b. Fine Grain Panchromatic 35mm film Used in Leica, Contax, and Other Miniature Cameras (Fuji Company).

Spectograph No. 10

FUJI 35mm FINE GRAIN PANCHROMATIC FILM

Average Exposure: 1/50 second f 6.3

c. A color film for amateur use was being developed by the Fuji Company. This film was a three-layer emulsion which was processed by a coupler-developer subtractive reversal process.

Sensitometric curves for Fuji Neopan and Fine Grain 35mm film, discussed in Enclosure (B), have been forwarded under separate cover.

d. Sakura Roll Film, Film Packs, etc. (Konishi Company).

Spectograph and sensitometric data are almost exactly identical with Fuji Neopan Film described previously.

e. Infra-red Roll Film, Film Packs, etc. (Konishi Company).

Amateur infra-red film was sold before the war by the Konishi Company. This film was sensitized to 7500°A; however, as the film was for civilian consumption, speed sensitivity was sacrificed to produce satisfactory keeping qualities. The film, therefore, required relatively long exposures.

Average Exposure: 1/50 second f 4.5

f. Sakura 8 and 16mm Reversal Film (Konishi Company).

Black and white 8mm and 16mm motion picture films were manufactured for amateur use prior to the war. These films were developed by reversal processing procedures.

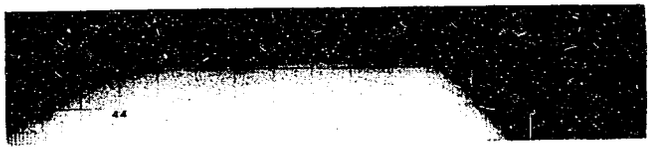
g. Sakura Color Film (Konishi Company).

An amateur color film in 35mm width was produced by the Konishi Co. shortly before the war. The film was a typical three-emulsion layer type which was processed by a subtractive reversal coupler-developer process.

Spectographs and sensitometric data for R. Konishi film emulsions, in Enclosure (G), forwarded under separate cover.

4. Special rpose Film

X-Ray film of similar type and characteristics was produced by both the Fuji and Konishi Companies.



Spectograph No. 11

FUJI RONTGEN FILM

Spectograph No. 12

FUJI RONTGEN FILM - DUPLITIZED

(Sensitometric curves of these films are discussed in Enclosure B.)

C. FILM MANUFACTURE

1. Fuji Photo Film Co., Ltd.

The Fuji Photo Film Co., one of the two largest photographic film manufacturers in Japan, is located at ASHIGARA near ODAWARA in KANAGAWA ken. Production of photographic material before the war was largely motion picture films, X-ray materials, photographic plates, amateur films, and photographic papers. During the war, aerial and motion-picture films and photographic paper were produced for both the Army and Navy.

Film production facilities and basic equipment used during the war included:

12	Film base digesters (4-acetate, 8-nitrate)
15	Film base manufacturing machines
2	Emulsion coating machines (film) Solvent recovery plant
30	Cine perforating machines
42	Film slitting machines
2	Paper coating machines
2	Plate coating machines

In July 1945 approximately one-quarter of the production equipment of the plant was removed and shipped to Manchukuo. However, this equipment was destroyed en route by bombing. The equipment remaining is generally of

German or Japanese design and manufacture. Production techniques did not appear to be as advanced as those currently used in the United States.

Detailed description of the Fuji Photo Film Co. is given in Enclosure (C).

2. R. Konishi Co., Ltd.

a. Film - The R. Konishi Photo Company Ltd., HINNO plant, TOKYO, produces only photographic film, but compares in size and production capacity with the Fuji Company. The production of this plant before the war was generally amateur and X-ray photographic film. Limited production and processing of color film were started just prior to the start of the war in 1941. During the war, aerial photographic film was manufactured for the Army and Navy.

Film production facilities and basic manufacturing equipment included the following:

7 Base manufacturing machines (70% nitrate, 30% acetate)
2 Film coating machines
1 Large scale experimental coating machine

Approximately one-quarter of the production equipment was removed from the factory during the latter stages of the war to escape bombing damage and is now being returned.

A large photographic research laboratory is also located at the HINNO factory. During the war, of the 1500 people employed there, 300 were in the research laboratory. At the present time, of 600 total plant personnel, 100 are engaged in some type of photographic research or development.

b. Paper - Photographic paper is produced by the R. Konishi Co. at their YODOBASHI plant in TOKYO. As there is little difference in photographic paper for civilian or military use, its production during the war was similar to that of earlier manufacture. Basic production equipment included two paper emulsion coating machines, one of which was operative, the other damaged by bombing. Equipment was similar to the Fuji equipment, of either Japanese or German design.

D. SENSITOMETRIC TESTS OF PHOTOGRAPHIC MATERIALS

Enclosure (B) contains detailed sensitometric data on the various photographic film and paper emulsions produced by the Fuji Photo Film Co., which are generally representative of all Japanese photographic products. This enclosure was compiled from data obtained in the company's research laboratory and includes also a discussion of the sensitometric conditions under which the material was examined. Curves have been forwarded under separate cover.

Attention to certain conditions of the tests is important before detailed comparative measurements or conclusions on the film emulsions tested are made. As different developers were used on different emulsion types under test, the data obtained is representative of the characteristics of the emulsion with respect to the particular developer used rather than to any fixed standard. Although the data obtained cannot be accurately compared sensitometrically, it is interesting and valuable because it shows the various emulsion type sensitometric responses under conditions which might be expected in normal use.

E. PHOTOGRAPHIC PAPER

A table of data on photographic paper follows:

MILITARY USE			
Name Designation	Type	Surface	Contrast
Aero chloride	contact	gloss	2, 3, 4
Aero chloro-bromide	enlarging	gloss	2, 3, 4
Aero bromide	enlarging	gloss	2, 3, 4

CIVILIAN USE

Name Designation	Type	Surface	Contrast
Portrait (Gaslight)	contact	matte or semi-matte	2, 3, 4
Chloro-bromide	enlarging	matte or semi-matte	2, 3, 4
Bromide	enlarging	matte or semi-matte or glossy	2, 3, 4

There is very little physical or photographic difference between the corresponding types of military and civilian paper. Generally, gloss or semi-gloss surfaces were supplied to the military; also, slightly thinner paper base support met required military use. The following photographic paper contrasts were preferred for military use:

Aero-chloride	Contrast 2, 3, 4
Aero-chloro-bromide	Contrast 3
Aero-bromide	Contrast 3

Photographic paper sizes furnished to both the Navy and Army are as follows:

$4\frac{3}{4}$x$6\frac{1}{2}$ inches	10x12 inches
13x18cm	32x32cm
18x24cm	18x22 inches
19x19cm	

No roll paper was reported produced for either the Army or Navy.

F. PHOTOGRAPHIC CHEMICALS

1. General

The largest producer of Japanese photographic chemicals during the war was the ODAWARA factory of the Fuji Photo Film Co. This plant manufactured elon, hydroquinone, and silver nitrate, and also pre-weighed and packaged chemicals into ready-mixed containers for field use. Two developer formulas, a developer addition formula, and two fixing formulas were prepared in quantity for the Japanese Navy and Army.

2. Developers

Two standard products were packaged for field use. The "koku" developer was a standard aerial developer formula, while the "netchi koku" was intended for tropical use. The "tenkazai" addition formula, which could

be added to the "koku" solution for tropical use, was also compounded at this plant. The developing formula (for four liters) follows:

Chemicals	"Koku"	"Netchi Koku"	"Tenkazai"
Elon	8 grams	6 grams	--
Hydroquinone	32 grams	10 grams	--
Sod. sulfite (anh.)	200 grams	80 grams	48 grams
Sod. carbonate (anh.)	120 grams	40 grams	--
Potassium bromide	8 grams	6 grams	0.8 grams
Sod. sulfate (anh.)	-- --	171 grams	--
Sod. Bisulfite	-- --	-- --	8 grams

3. Fixing Solutions

Two fixing solution formulas were packaged for military use. They were "koku fixing bath" and the "netchi koku fixing bath," and were used with the developers of the same name. (Quantities given in following table are for four liters.)

Chemical	"Koku"	"Netchi Koku"
Sod. thiosulfate	1050 grams	700 grams
Sod. sulfite (anh.)	100 grams	75 grams
Alum	100 grams	50 grams
Chrome alum	12.5 grams	12.5 grams
Glacial acetic acid	75cc	90cc

4. Chemical Packing

All chemicals were packed in rubber hydrochloride plastic skin sacks. Reducing agents for developers packed separately from the other chemicals, and the two sacks enclosed in one larger outer sack. In the fixing formula packing, glacial acetic acid was sealed into a small glass bottle, then put into a paper box and packed in a separate envelope with the alum. This sack and the other fixing agents were then packed into a large outer sack corresponding to the developer packing.

5. Manufacturing Procedures (See Enclosure (D))

Enclosure (D) is a report prepared for the Naval Technical Mission to Japan by the Fuji Photo Film Co., ODAWARA plant. This report lists in detail the steps, processes, and conditions for the manufacture of silver nitrate, elon, and hydroquinone. Information on developer and fixing agent packing is also included.

* * * * *

PART III - TECHNICAL DEVELOPMENT

A. SUMMARY

Research and development of new photographic equipment, products, and techniques for naval use were conducted at the Branch, First Naval Technical Air Arsenal, YOKOSUKA. However, the two largest Japanese photographic manufacturing concerns, the R. Konishi Photo Company and the Fuji Photo Film Company, also were conducting extensive research on photographic material for military use.

Infra-red camera and lens design, as well as film sensitization, were under investigation for improvement of military reconnaissance. Color photography, particularly the application of two-color film, also was investigated for aero-reconnaissance possibilities. Improvements in camera design, particularly the use of long focal length aero-telephoto lenses, were sought, and developer formulas and techniques for use with high solution temperatures were tried.

However, very little progress beyond equipment which existed at the start of the war was noted. Nor was there any evidence of the introduction of any entirely new photographic equipment, material, or technique either by the Japanese Army or Navy from 1940 up to the present time.

B. PHOTOGRAPHIC RESEARCH PROJECTS

1. Infra-Red Photography

Extensive research was undertaken by both large film manufacturing companies on the perfection of infra-red sensitive materials for aerial use. Infra-red film with sensitivity up to 7800°A and speed satisfactory for aerial use was developed and produced for military use. Special test films with sensitivities from 8500-9300°A were made, but stability and speed difficulties made them unsatisfactory.

The greatest difficulty encountered with the Japanese infra-red film - even that produced for military use - was sensitivity stability. Under the best conditions of storage, sensitivity deterioration was a problem after three months, and infra-red film generally was unsatisfactory for use after six months storage. These difficulties were never completely eliminated, and even at the end of the war, the use of infra-red film operationally was unsatisfactory owing to the supply problem of maintaining fresh film.

2. Chemicals for Tropical Use

Generally, the technique employed for photographic development at high solution temperatures was to use various quantities of sodium sulfate in the developer to reduce osmotic swelling of the emulsion. The following developers proved satisfactory at solution temperatures from 30° to 33°C:

Chemical	Quantity
Elon	2 grams
Sodium carbonate	10-20 grams
Sodium sulfite	120-150 grams
Sodium sulfate	50-65 grams
Potassium bromide	2 grams
Water to	1 liter

Five to six minute development at 30° to 33°C gave satisfactory results without reticulation.

The Fuji Photo Film Company, ODAWARA Plant, packaged a tropical developer for general use called "netchi koku", and also a chemical addition called "tenkazai" to be added to standard developers for tropical use. Formulas for these developers are given in Enclosure (D).

The Fuji company's research laboratory also perfected a tropical developing formula using paraminophenyl hydrochloride which was reported to give satisfactory results from 32° to 35°C. The formula follows:

Chemical	Quantity
Paraminophenol hydrochloride	6 grams
Sodium sulfite (anh.)	50 grams
Sodium sulfate (anh.)	45 grams
Sodium carbonate (mono.)	15 grams
Potassium bromide	3 grams
Water to	1 liter

Optimum working temperature of this developer was from 32° to 35°C., and, except for a slight increase in fog, it could be used without serious difficulty.

Test results were as follows:

Developer	Temp (°C.)	Time (min.)	Relative Speed (NSG)	Gamma	Fog
Koku developer Tropical	20	6	17	1.1	0.15
	30	11.5	14	1.0	0.15
	32	9	19	1.2	0.15
	35	7	23	1.2	0.15
	40	5	15	1.2	0.15

No pre-hardening solution of a formulin type was either in use or under investigation.

3. Two-Color Film

Attempts were made by both naval technicians and the two film manufacturing research laboratories to produce a two-color aerial process which could be used for military reconnaissance. Although a two-color aerial process with satisfactory characteristics was developed, so much difficulty was experienced with field processing that the project did not emerge from the experimental stage. The film perfected for use was exposed through a yellow filter for haze reduction; average exposure conditions were f 5.6 at 1/100 second with a filter. The most serious obstacle to field processing reported was the inability of the average Japanese military photographer to master the technique and procedure required.

The film produced experimentally for two-color aero work was a two-layer film, the top layer an orthochromatic emulsion and the bottom layer a panchromatic emulsion. No silver inner layer or filter material was used between the emulsions. However, a yellow filter (4500°A) was used in exposing the film. Processing sequence and solutions follow:

Solution	Processing Time (20°C)
First MQ developer	14 min.
Wash	10 min.
Red light exposure thru base (60 watt-25cm)	30 sec.
Green development	15 min.
Wash	5 min.
White light flash to emulsion side (60 watt-25cm)	30 sec.
Orange Development	10 min.
Wash	10 min.

Bleach	10 min.
Fix	5 min.
Wash	10 min.
Dry	

MQ Developer Formula

Metol	4gr
Sodium sulfite	50gr
Hydroquinone	8gr
Sodium Carbonate	40gr
Potassium Bromide	3gr
Potassium Thiocyanide	2gr
Water to	1000cc

Green Coupling Developer

Solution A

Metol	1gr
Sodium sulfite	10gr
2-amino-5-diethyl-toluene hydrochloride	2gr
Sodium carbonate	40gr
Potassium bromide	1gr
Water to	1000cc

Solution B

Methanol	100cc
2, 4-dichlor-1-naphthol	0.6gr
Aceto acetanilide	0.9gr

Orange Coupling Developer

Solution A

Metol	0.2gr
Sodium sulfite	10gr
2-amino-5-diethyl amino toluene hydrochloride	2gr
Sodium carbonate	40gr
Potassium bromide	1gr
Water to	1000cc

Solution B

Methanol	100cc
Para-nitro-benzylcyanide	0.25gr
Dichlor-aceto-acetanilide	0.75gr

Bleach

Potassium ferricyanide	30gr
Potassium bromide	60gr
Water to	1000cc

Fixing Solution

Sodium sulfite	15gr
Hypo	200gr
Water to	1000cc

Red Filter for Exposure of
Red Sensitive Layer

Acid Magenta	10 g/sq.meter
Tartrazine	4 g/sq.meter

4. Tropicalization and Packing

No special techniques or protection was reported to have been used on materials intended for tropical shipment. All aerial film was sealed in tin cans with adhesive tape before leaving the factory. However, vacuum packing was not practiced, and no special treatment to prevent fungus or mold growth was reported.

* * * * *

PART IV-MILITARY APPLICATION

A. SUMMARY

The Department of Naval Aeronautics directed and had cognizance of all photography for the Japanese Navy, although the actual supervision and administration was in the hands of the Optics Section of the Naval Technical Air Department. Supply sources of photographic materials for the fleet and air units were located at four large naval bases which served as shipping depots for all outlying areas. Two major photographic training schools provided operational and tactical photographic instruction to naval personnel. Aerial photo reconnaissance was usually flown in the MYRT (SAIUN) carrierbased plane with the photographer operating either a fixed vertical or hand-held oblique camera in the rear seat. Photographic reconnaissance was usually limited to high altitude work, and development of camera designs indicated a trend toward the general use of high-altitude oblique coverage in the later stages of the war. There were no indications that special applications of photography for instrument-dial recording, radar-scope photography, etc., were used by the Japanese Navy.

B. JAPANESE NAVAL ORGANIZATION

Japanese naval photography was, as stated above, under the direction of Department of Naval Aeronautics and administered by the Section of Optics of the Technical Department. Photographic and optical research and development were conducted through the Optics Branch of the First Technical Air Arsenal, YOKOSUKA. Enclosure (E) is an organizational diagram of the Department of Naval Aeronautics photographic and optical administration and control.

C. PHOTOGRAPHIC SUPPLY

Supply of photographic materials for fleet and air units was centered in four major naval supply depots. These depots not only served as supply sources for all bases outside of Japan but they also supplied smaller air base units and air depots at home.

Various supply points were located in the SASEBO and YOKOSUKA areas. In those areas most of the photographic equipment and materials were stored in caves. Huge quantities were piled into comparatively small and damp spaces and often stored along with ordnance, optical, or other equipment. This photographic material was generally damp, often moulded, and in poor condition. Some photographic gear was found stored in frame warehouses in the YOKOSUKA area, but no special protection against heat or humidity was provided for raw film storage.

As the same conditions were observed for many other items and supplies besides photographic materials, this arrangement of cave and outside storage may have resulted from a decision in the latter years of the war to disperse supplies and remove them from possible bombing targets. However, considerable quantities of photographic materials must have been lost through deterioration owing to storage in damp caves.

Supply Base	Relative Size	Area Supplied	Secondary Supply Points Serviced
SASEBO	1st	China, Formosa, Indo-China, Malay	Shanghai, Takao Singapore, Sana
YOKOSUKA	2nd	Marianas Marshalls, Gilberts	Saipan, Truk
KURE	3rd	Philippines, Java	Manila, Soerabaja
OMINATO	4th	Kuriles	Ternei

D. PHOTOGRAPHIC TRAINING

Two schools for the instruction of naval personnel in photographic techniques were operated by the Japanese Navy. A school for operational instruction was established under the direction of the Sunosaki Air Force in KASANA, Tateyamashi, Chiba-ken. Tactical photographic instruction was given by the Yokosuka Air Force at Yokosuka Naval Air Station.

Pilot training for torpedo runs and dive-bombing attacks utilized a special torpedo camera, described previously, and for dive-bombing, a 35mm Eyemo type motion picture camera. However, the lack of gasoline in the latter part of the war eliminated much of this type of training, and synthetic training, using photographs of models, was developed and in general use.

The Type 89-free machine gun camera was used in the early stages of the war, but discontinued in 1943. The Cine Type 2 Gun Camera had limited use for free gunnery in the later stages of the war, but was not developed extensively. Experimentation on a gun camera modeled after the obsolete Fairchild W-7 model was started, but tests were still incomplete at the end of the war. There was no report of gun cameras being used in any instances in combat, or for anything other than training.

E. OPERATIONAL TECHNIQUES

1. Aerial Reconnaissance

At the beginning of the war, aerial photographic reconnaissance was usually made from the JUDY scout plane. However, with the introduction of MYRT with faster, high altitude characteristics, practically all reconnaissance was flown from this carrier-base plane. A K-8 vertical camera usually the 50cm type - was mounted in the photographic MYRT and operated by one of the rear seat observers. Most of the vertical photography was flown at high altitudes, ranging 12,000 to 30,000 feet, using the K-8 or 25cm cameras.

Toward the end of the war, camera research and design development indicated a noticeable trend toward telephoto type cameras for oblique coverage at high altitudes. Because vertical reconnaissance coverage was becoming more difficult as air defenses improved, high altitude oblique cov-

erage was becoming more popular. The development of the Type IV 70cm reflecting oblique camera, used experimentally at OKINAWA, and a similar type developed for the Army with a 100cm lens, are examples of the trend in camera design for late operational techniques.

2. Night Photography

Although various academic attempts were made in experimentation with low aperture lenses for night reconnaissance, the flash bomb was the only technique utilized operationally. Fairchild K-14 (?) cameras were reported purchased from the United States before the war for use with aluminum-magnesium flare bombs. The camera shutter was opened with the bomb release and closed by a photo cell at the termination of the flash, but only about half of each negative was usable, owing to uneven illumination produced by the bomb. Operational altitude for night photography was said to be 20,000 feet.

3. Field Processing

Using tank type aerial developing kits and squirrel cage or natural drying methods, first prints from reconnaissance missions usually were received three to four hours after the return of the flight. The use of an alcohol bath reduced the time somewhat when rapid processing was required.

F. SPECIAL APPLICATIONS

1. Instrument Photography

Although some few instances were reported where Leica cameras were used to photograph instrument dials for test purposes, no general application or technique for this type of photography was reported.

2. Radar Scope Photography

No instances were reported.

3. Combat Record Photo Units

No photographic units were formed by the Navy especially to photograph combat action. Naval action was recorded by photographers regularly assigned to operating units, usually with plate type cameras. Civilian news photographers also were sent out in some cases to record combat action.

ENCLOSURE (A)

LIST OF PHOTOGRAPHIC MATERIAL COLLECTED AND SHIPPED TO THE UNITED STATES

Item	NavTechJap No.	Quantity
YOKOSUKA area		
Aerial camera, Type 99, 15cm f 4.5	JE21-3002	145
Aerial camera, K-8, 50cm	JE21-3010	6
Aerial camera, K-8, 25cm	JE21-3025	10
Aerial camera, F-8, 25cm	JE21-3001	85
Aerial camera, 70cm Oblique	JE21-3029	3
Aerial camera, Type 100, 40 cm	JE21-3026	1
Aerial camera, Flack spotting	JE21-3027	8
Aerial camera, 100cm experimental	JE21-3032	5
Aerial camera, Zeiss, 50cm	JE21-3034	3
Aerial camera, Type IV oblique	JE21-3031	9
Aerial camera, Small army type	JE21-3047	2
Aerial camera, Type 89 gun camera	JE21-3009	15
Type K-8, magazine set	JE21-3014	15
Type K-8, mount	JE21-3013	16
Type K-8, repair kit with intervalometer	JE21-3012	6
Flack spotting camera mount	JE21-3028	8
Type F-8, camera mount	JE21-3033	13
70cm oblique, mount	JE21-3030	7
Zeiss, magazine set	JE21-3035	5
Zeiss, vacuum pump	JE21-3036	3
Zeiss, spare parts and intervalometer	JE21-3037	2
Zeiss, developing machine	JE21-3038	4
Enlarging printer	JE21-3021	18
Torpedo attack camera	JE21-3039	3
Aerial developing kit	JE21-3040	3
Type 99 developing kit	JE21-3041	1
Miscellaneous K-8 parts	JE21-3012	1
Stereoscopes	JE21-3044	18
Photographic chemicals (Fuji)	JE21-3045	5
Lens, 100cm (Fuji)	JE21-3046	1
SASEBO area		
Camera, still	JE10-3000	2
Camera, F-8	JE10-3001	4
Camera, Type 99, f 4.5	JE10-3002	1
Camera, Type 99, f 3.5	JE10-3003	2
Camera, Hand Held Oblique, Tessar	JE10-3004	4
Camera, Hand Held Oblique, Hexar	JE10-3005	1
Camera, 11x14 view	JE10-3006	1
Projector, Type 99 scoring	JE10-3007	2
Developing set, gun camera	JE10-3008	2
Camera, gun, Type 89	JE10-3009	3
Camera, aerial K-8, 50cm	JE10-3010	3
Developing set, aerial	JE10-3011	1
Repair kit, K-8	JE10-3012	3
Mount, K-8	JE10-3013	3
Magazine set, K-8	JE10-3014	3
Spare shutter set	JE10-3015	1
Spare magazine set	JE10-3016	1
Plate developing tank	JE10-3017	1
Stereoscope	JE10-3018	1
Film, miscellaneous	JE10-3019	1
Chemicals, miscellaneous	JE10-3020	1

ENCLOSURE (B)

FUJI FILM CO., SENSITOMETRIC DATA

(Sample sensitometric curves discussed herein have been forwarded to: Director, Photo Science Laboratory, Anacostia, Washington, D. C.)

1. Negative Films

a. Samples:

Kodak	Super XX roll film
Fuji	FP (fine grain panchromatic) 35mm film
Fuji	Aero panchromatic film
Fuji	Roentgen film
Fuji	Roentgen film (35mm film for fluorography)
Fuji	Cine-negative film (35mm)
Fuji	Dup-negative film (35mm)

b. Sensitometer:

NSG (Nippon Shashin Gakkai) Type 2 sensitometer

c. Light Source:

Gas-filled tungsten lamp (operated at 2848°K.)
Combined with Davis-Gibson

d. Wedge:

Neutral gray silver wedge
Density difference for each step is 0,20

e. Exposure:

1/20 second
Log E at the 10th step is equal to 2,51

f. Developer:

E.K. D-16
E.K. D-76
F.D. (Fuji Developer)-4
F.D.-11
KOK (koku-aero) developer

	FD-4	FD-11	KOK
Metol	2.0gr	2.0gr	2.0gr
Sodium Sulphite (anh.)	50gr	80gr	50gr
Hydroquinone	4.0gr	8.0gr	8.0gr
Sodium Carbonate (anh.)	12gr	40gr	30gr
Potassium Carbonate	1.0gr	3.0gr	2.0gr
Water	1000cc	1000cc	1000cc

2. Positive Films

a. Samples:

Fuji	Dup-positive film (35mm.)
Fuji	Sound recording film (35mm.)
Fuji	Process film

ENCLOSURE (B), continued

b. Sensitometer:

NSG Type 1 sensitometer

c. Light source:

Gas-filled tungsten lamp (operated at 2848°K.)

d. Wedge:

Neutral gray silver wedge
Density difference for each step is 0,10

e. Exposure:

1/20 second
Log E at the 10th step is equal to 0,18

f. Developer: D-16

3. Printing Papers

a. Samples:

	Group
Ginrei (portrait gaslight)	1
Tone (gaslight)	1
Bellona (chlorobrimide)	2
Bromide	3
Aero gaslight	1
Electrocopyst	1
Oscilo	5
Aero bromide	4
Photostat	4

b. Sensitometer:

Fuji paper-sensitometer

c. Light Source:

Gas-filled tungsten lamp (operated at 2800°K.)
In the case of the higher speed papers, light intensity is reduced by opal glass.

d. Wedge:

Neutral gray silver wedge
Density difference for each step is 0,10

e. Exposure:

Group	Time of Exposure	Log E at the first step of wedge
1	10 seconds	3,98
2	10 seconds	2,01
3	5 seconds	1,66
4	5 seconds	1,17
5	7 seconds	0,17

f. Developer: Koku

ENCLOSURE (C)

FUJI PHOTO FILM CO., LTD., ASHIGARA PLANT
Statement of Film and Paper Production Facilities Contained in an Application for Permission to Convert to Essential Consumer Commodities.

20 November 1945

1. Name of Firm: Fuji Photo Film Company, ASHIGARA Factory

2. Location: No. 210 Nakanuma, MINAMI ASHIGARA-Cho, Ashigara Kami-gun, Kanagawa-Ken

3. General Description:

a. Land — 2,890,193 square feet

b. Buildings — 607,295 square feet

c. Main machinery and plant

Raw-film preparing machines	15 sets
Photographic-film preparing machines	1 set
Photographic paper preparing machines	2 sets
Dry plate preparing machines	2 sets
Other accessory machines	

d. Capital

¥15,000,000	ASHIGARA factory only
7,700,000	ODAWARA factory only
2,000,000	IMAIZUMI factory only
300,000	KAWAKAMI factory only
¥25,000,000	total

4. Ownership: 500,000 shares

2,214 share holders - Dai Nippon Celluloid Co., SHICHIDO, Sakai Shi, Osaka Fu

5. Company Officials:

President:	Sakae HARUKI
Managing Director:	Shigeo MORITA
Managing Director:	Setsutaro KOBAYASHI

6. Date Organized: 20 January 1934

7. Operation Before War (monthly production):

35mm cinema films	11,634,000 ft
Roll films	236,000 rolls (Brownie size)
X-Ray films	15,000 doz 10"x12"
Photographic papers	616,700 doz 4-3/4"x6½"
Dry-plates	160,000 doz 4-3/4"x6"

Prior to the incorporation of this company in January 1934, the factory was constructed and equipped by Dai Nippon Celluloid Company, Ltd., and named ASHIGARA Factory of Dai Nippon Celluloid Company, Ltd.

In September 1937 the factory was enlarged to increase production of celluloid film base and photographic film.

ENCLOSURE (C), continued

In October 1940 the factory was enlarged to increase production of X-ray film.

In July 1943 construction of a new plant was started in order to increase production of interlayer materials for safety glass, but was not completed.

8. Number Employed: Men - 850; women - 620

9. Operation During War (monthly production):

35mm cinema films	8,680,000 ft
Roll films	162,000 rolls (Brownie size)
X-Ray films	12,000 doz 10"x12"
Aero-films	14,600 sq m
Interlayers for safety glass	5,890 kg
Electric insulating thin foil	500 kg
Photographic papers	836,000 doz $4\frac{3}{4}$"x$6\frac{1}{2}$"
Dry-plates	123,000 doz $4\frac{3}{4}$"x$6\frac{1}{2}$"

10. Number Employed During War: Men - 740; women - 620

11. Operation Now Proposed:

35mm cinema films	7,000,000 ft
Roll films	200,000 rolls (Brownie size)
X-Ray films	15,000 doz 10"x12"
16mm films	1,000,000 ft
Cut films	100,000 doz $4\frac{3}{4}$"x$6\frac{1}{2}$"
Photographic papers	670,000 doz $4\frac{3}{4}$"x$6\frac{1}{2}$"
Dry-plates	50,000 doz $4\frac{3}{4}$"x$6\frac{1}{2}$"

12. Number To Be Employed: Men - 700; women - 500

13. Inventory of Machinery and Equipment:

a. Land — 2,890,193 square ft

b. Building — 607,295 square ft

c. Dry plate manufacturing equipment
(Monthly production capacity: 200,000 doz $4\frac{3}{4}$"x$6\frac{1}{2}$")

(1) 2 sets of combined glass washing, substrating, and drying machines.
(2) 2 sets of emulsion preparing plants.
(3) 2 sets of emulsion coating and drying plants.
(4) 4 glass cutting machines.
(5) 2 sets of conveyers.

d. Photographic paper manufacturing equipment
(Monthly production capacity: 1,000,000 doz $4\frac{3}{4}$"x$6\frac{1}{2}$")

(1) 2 sets of emulsion preparing plants.
(2) 2 sets of emulsion coating and drying plants.
(3) 8 slitting and cutting machines.
(4) 1 set of conveyers.

e. Photographic film manufacturing equipment
(Monthly production capacity: 120,000 meters of 1 meter width)

ENCLOSURE (C), continued

(1) 2 sets of emulsion preparing plants.
(2) 4 sets of film substrating machines.
(3) 3 paper slitting machines.
(4) 2 sets of collodion coating machines.
(5) 1 set of emulsion coating and drying plants.
(6) 30 perforators for cinema film.
(7) 42 film slitting and cutting machines.

f. Celluloid film base manufacturing equipment
(Monthly production capacity: about 45 tons)

(1) 15 sets of collodion mixers.
(2) 15 sets of film coating machines.
(3) 4 sets of solvent recovering plants.
(4) 3 sets of solvent distillation plants.

g. Miscellaneous plants

(1) 23 air blowers.
(2) 50 air washers.
(3) 54 pumps.
(4) 21 refrigerators.
(5) 534 various kinds of electric motors.
(6) 27 transformers.
(7) 4 sets of steam boilers.
(8) 61 various kinds of repairing machines.

14. Raw Materials on Hand:
(Parenthesis indicate materials for military use.)

Nitrocellulose	73,003kg	(4,080kg)
Acetylcellulose	37,172kg	(17,800kg)
Camphor	10,440kg	
Ether	15,002kg	(246kg)
Alcohol	2,815kg	(450kg)
Acetone	34,393kg	(11,500kg)
Gelatine	54,000kg	
Potassium bromide	27,502kg	(1,850kg)
Silver nitrate	2,500kg	
Benzol	4,367kg	
Baryta paper	120,000sq.m.	
Glass for dry plates	74cases	
Coal	800tons	

15. Estimate of Raw Materials or Products Required Monthly for Next Six Months:

Nitrocellulose	35,000kg
Acetylcellulose	6,000kg
Camphor	2,000kg
Ether	25,000kg
Alcohol	8,000kg
Acetone	15,000kg
Gelatine	7,000kg
Potassium bromide	1,500kg
Silver nitrate	3,000kg
Benzol	2,500kg
Methanol	3,000kg
Baryta paper	160,000sq.m.

ENCLOSURE (C), continued

Glass for dry plates	1,500cases
Black paper	2,500kg
Cardboard	20,000kg

16. Semi-Finished Goods on Hand:

Cinema film	4,000sq.m.
Photographic paper	20,000sq.m.
Celluloid film base	15,000kg

Corporations Supplying Materials

Nitrocellulose:

Dai Nippon Celloid Co., Ltd., Aboshi factory: Hyogo Ken, Ibo Gun, ABOSHI Machi, Shinzaike.

Acetate Cellulose:

Dai Nippon Celloid Co., Ltd., Arai factory: Niigata Ken, Nakakubiki Gun, ARAI Machi, Arai.

Glass Plate:

Mitsubishi Kasei Co., Ltd., Tsurumi factory: YOKOHAMA Shi, Tsurumi Ku, Suehiro Cho 1.

Mitsubishi Kasei Co., Ltd., Amagasaki factory: AMAGASAKI Shi, Nishi Mukojima Machi, 2.

Nippon Itagarasu Co., Ltd., Yokkaichi factory: YOKKAICHI Shi, Chitose Machi, 2.

Baryta Paper:

Mitsubishi Seishi Co., Ltd., Nakagawa factory: TOKYO To, Katsushika Ku, Nijiku Machi, 5 Chome.

Mitsubishi Seishi Co., Ltd., Takasago factory: Hyogo Ken, Kako Gun, TAKASAGO Machi, Aiya Machi, Bangai, Ichiban yashiki.

Gelatine:

Nitta Koshitsu Kogyo Co., Ltd., Kashihara factory: Osaka Fu, Minami Kawachi Gun, SHIKI Mura, Kashihara.

Nippon Hikaku Co., Ltd., Fuji factory: Shizuoka Ken, FUJIMIYA Shi, Omiya, 8.

Nippon Hikaku Co., Ltd., Senju factory: TOKYO To, Adachi Ku, Senjumidori Cho, 16, 1.

Ether:

Koto Ether Co., Ltd., Shimura factory: TOKYO To, Itabashi Ku, Shimura, Chogo Machi, 912.

ENCLOSURE (C), continued

Showa Ether Co., Ltd., Noborito factory: KAWASAKI Shi, Noborito Machi, 3500.

Showa Nosan Kako Co., Ltd., Tsukuda factory: OSAKA Shi, Nishi Yodogawa Ku, Tsukuda Machi, 4, 510.

Showa Nosan Kako Co., Ltd., Tsukizoe factory: Kumamoto Ken, YATSUSHIRO Shi, Tsukizoe Machi, 1556.

Alcohol:

Alcohol Distribution Co., Ltd., TOKYO To, Nihonbashi Ku, Odenma Cho 2 Chome, 1.

Acetone:

Nippon Gosei Co., Ltd., Ogaki factory: Gifu Ken, OGAKI Shi, Kanda Machi, 2, 23.

Dai Nippon Celloid Co., Ltd., ARAI factory: Niigata Ken, Nakakubiki Gun, ARAI Machi, Arai.

Balance Sheet

1943 Unit ¥ 1000.00

Debit	April	October	Credit	April	October
Land	665	689	Capital	10,000	10,000
Buildings	4,174	4,337	Legal reserve fund	505	570
Fixtures	538	562	Special reserve fund	2,100	2,300
Machinery	8,933	8,888	Dividend reserve fund	800	900
Cars & carriers	82	87	General retiring allowance fund	948	1,061
Implements & furniture	529	554	Legal retiring allowance fund	220	215
Construction a/c	173	1,971	Bills payable	3,496	657
Securities	1,121	1,153	Long-term debts	5,500	5,500
Trust deposit	1,157	1,201	Short-term debts		8,014
Inventory assets	8,921	10,191	Money unpaid in advance	5,669	3,531
Sales credit	2,853	4,210	Temporary receipts	76	5,499
Bills receivable	48	43	Money deposited	1,520	1,556
Cash & deposits	1,730	4,210	Carried forward profit	501	563
Credit receivable	14	33	Current-term profit	1,206	2,453
Temporary payment	1,171	1,424			
Securities for payment money deposited					
Total	32,541	42,819	Total	32,541	42,819

ENCLOSURE (C), continued

Profit & Loss Statement

Income of goods sold	13,110	15,230	Cost of goods	6,333	8,001
Other income	225	245	Expenditure	5,236	6,154
Carried forward amount of semi-finished & finished goods to the next term	3,328	4,461	Carried forward amount of semi-finished & finished goods from the previous term	3,888	3,328
			Current-term profit	1,206	2,453
Total	16,663	19,936	Total	16,663	19,936

Balance Sheet

1944	Unit ¥ 1000.00				
Debit	April	October	Credit	April	October
Capital unpaid	11,250	5,250	Capital	25,000	25,000
Land	704	755	Legal reserve fund	1,535	1,600
Buildings	4,351	4,595	Reserve for tax	1,200	1,750
Fixtures	619	621	Special reserve fund	2,500	2,700
Machinery installment	8,684	8,414	Dividend reserve fund	900	900
Cars & carriers	124	116	Reserve fund for study	100	100
Implements & furniture	548	537	Gen'l ret. allowance res. fund	1,187	1,305
Construction a/c	5,081	7,083	Legal ret. allowance res. fund	285	283
Securities	5,545	8,913	Bills payable	336	708
Trust deposits	1,451	1,587	Long-term debts	5,500	5,500
Inventory assets	11,676	14,894	Short-term debts	9,634	14,421
Sales credit	5,132	5,791	Money unpaid in advance	4,972	3,624
Bills receivable	75	1,090	Temporary receipts	885	2,171
Cash & deposits	1,451	1,864	Money deposited	2,105	2,442
Credit receivable	49	842	Carried forward profit	670	701
Temporary payment	2,238	2,047	Current-term profit	2,535	2,619
Res. deposit for tax	300	700			
Securities for payment money deposited	608	726			
Total	59,344	65,824	Total	59,344	65,824

Profit & Loss Statement

Income of goods sold	16,932	16,985	Cost of goods	8,894	9,100
Other income	263	456	Expenditure	6,847	6,399
Carried forward amount of semi-finished & finished goods to next term	5,542	6,219	Carried forward amount of semi-finished & finished goods from the previous term	4,461	5,542
			Current-term profit	2,535	2,619
Total	22,737	23,660	Total	22,737	23,660

ENCLOSURE (C), continued

Balance Sheet

1945		Unit	¥ 1000.00
Debit	April	Credit	April
Capital unpaid	5,250	Capital	25,000
Land	755	Legal reserve fund	1,665
Buildings	4,531	Reserve for tax	2,070
Fixtures	622	Special reserve fund	2,800
Machinery installment	8,108	Dividend reserve fund	900
Cars & carriers	200	Reserve fund for study	100
Implements & furniture	552	General retiring allowance reserve fund	1,424
Construction a/c	8,797	Legal retiring allowance fund	320
Securities	9,103	Long-term debts	5,500
Trust deposits	1,691	Short-term debts	17,872
Inventory assets	16,152	Money unpaid in advance	2,473
Sales credit	6,460	Temporary receipts	2,329
Cash & deposits	1,414	Money deposited	3,234
Credit receivable	1,799	Carried forward profit	742
Temporary payment	2,153	Current-term profit	1,871
Reserve deposit for tax	910		
Securities for payment money deposited	803		
Total	68,300	Total	68,300

Profit & Loss Statement

Income of goods sold	11,670	Cost of goods	9,587
Other income	466	Expenditure	2,944
Carried forward amount of semi-finished & finished goods to the next term	8,485	Carried forward amount of semi-finished & finished goods from the previous term	6,219
		Current-term profit	1,871
Total	20,621	Total	20,621

ENCLOSURE (D)

REPORT ON CHEMICAL PRODUCTION AT ODAWARA PLANT
Prepared by Fuji Photo Film Company for the
U.S. Naval Technical Mission to Japan

December 3rd, 1945

A. SILVER NITRATE

1. Outline Steps in Production

a. Dissolution of silver bullion

Nitric acid (40%) is added to silver bullion in a porcelain vessel and heated with steam at 100°C.

$$3Ag + 4HNO_3 = 3AgNO_3 + NO + 2H_2O$$

b. Exclusion of impurities

Silver oxide is added to the silver nitrate solution which contains nitrate salt of iron, copper, zinc, and lead as impurities; oxides of iron, copper, zinc, and lead are precipitated.

$$\left.\begin{matrix} Fe_2(NO_3)_3 \\ Cu(NO_3)_2 \\ Zn(NO_3)_2 \\ Pb(NO_3)_2 \end{matrix}\right\} + Ag_2O \longrightarrow \left.\begin{matrix} Fe_2O_3 \\ CuO \\ ZnO \\ PbO \end{matrix}\right\} AgNO_3$$

Silver oxide is obtained by adding sodium hydroxide to silver nitrate solution.

$$2AgNO_3 + 2NaOH = Ag_2O + 2NaNO_3 + H_2O$$

c. Evaporation and crystallization

After filtration, the filtrate is concentrated in the water bath. Silver nitrate separates out in the crystallized state. By means of repeated recrystallization, pure silver nitrate of 99.98% purity and of uniform quality is obtained. Then the mother liquor is excluded thoroughly by centrifugal machines and the crystals are dried by draft at 50°C.

(Note: The method of purification by silver oxide was invented by our chemists and is a very satisfactory method.)

Diagram of production follows on next page.

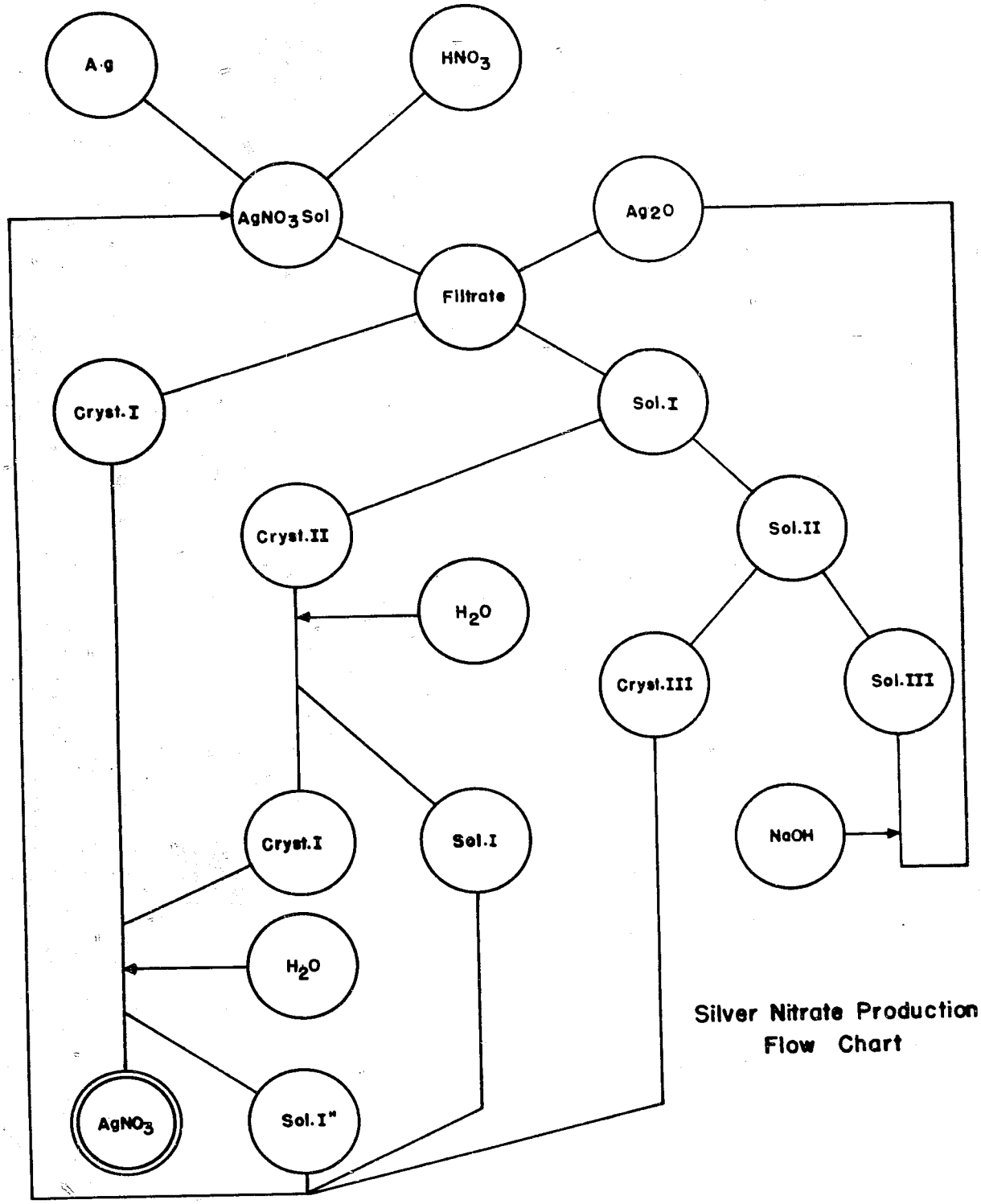
2. Nitric Acid

Obtained from Showa Denko, Daiichi Seiyaku

3. Silver Bullion

Obtained from Tanaka Kikinzoku Kogyo, and Kinzoku Haikyu Tosei

ENCLOSURE (D), continued



Silver Nitrate Production
Flow Chart

ENCLOSURE (D), continued

B. ELON

1. Outline Steps in Production

a. Manufacture of methylamine solution

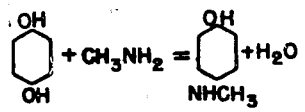
$$2HCHO + NH_4Cl = CH_3NH_2HCl + HCOOH$$

Ammonium chloride is added to formaline and the liquor is stirred and heated slowly to 105°C. Twenty-four hours are necessary to finish the reaction. Then the solution is cooled, unreacted ammonium chloride is filtered off, the mother liquor is concentrated under reduced pressure (20mm Hg) and the methylamine hydrochloride crystallizes out.

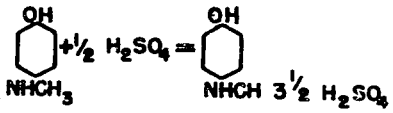
$$CH_3NH_2HCl + NaOH = CH_3NH_2 + NaCl + H_2O$$

Methylamine hydrochloride is dissolved in water, and sodium hydroxide solution is added to it; the evolved gaseous methylamine is absorbed by water. Six or seven hours are needed.

b. Manufacture of Elon



Hydroquinone and methylamine are reacted in an autoclave under a pressure of 200 - 230 lbs for six hours



Crude Elon obtained by introduction of Elon base into 50% sulphuric acid is purified by treating it with active charcoal and sodium sulphite.

c. Purity of Elon

The purity is expressed by the reducing value after Andresen's method and also checked by melting point.

Reducing value:	5.5
Melting point (decomp.)	260°C

Andresen's reducing value is the gram number of silver bromide reduced by 2.2 grams of Elon. (In the case of hydroquinone 1.8 grams of it are taken.)

2. Raw Materials for Elon.

Name	Where Obtained
Ammonium chloride	Konishi Yasubei, Ando Shoji
Formaline	Amagasu Kagaku Sangyo
Sodium hydroxide	Konishi Yasubei

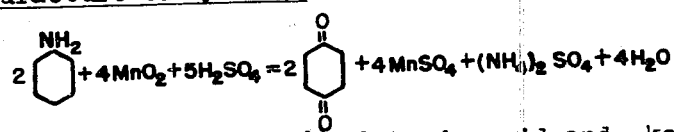
ENCLOSURE (D), continued

Hydroquinone	Fuji Photo Film Co., Odawara Factory
Sulphuric acid	Konishi Yasubei, Toko Shoji
Active charcoal	Miki Sangyo, Takeda Chobei
Sodium sulphite	Ai Kogyo Kenkyusho, Osaka Sarashiko

C. HYDROQUINONE

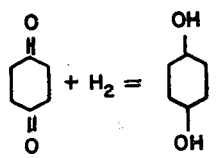
1. Outline Steps in Production

a. Manufacture of Quinone



Aniline is dissolved in 50% sulphuric acid and, keeping the temperature at 5° - 10°C, manganese dioxide is added slowly and stirred. The reaction is finished in twenty to twenty-four hours.

b. Manufacture of Hydroquinone



Iron powder is added in small portions to the quinone solution, obtained as above, and stirred. The temperature of the solution is kept at 10° - 12°C. It takes about ten hours to complete this reaction. The purification of raw hydroquinone is similar to that of Elon.

c. Purity of Hydroquinone

Reducing value after Andresen's method: 6.9
Melting point: 169°C

2. Raw Materials for Hydroquinone

Name	Where obtained
Aniline	Seiwa Sangyo, Nagase Sangyo
Sulphuric acid	Konishi Yasubei, Toko Shoji
Manganese dioxide	Nakamura Seirensho
Iron powder	Nihon Kuzutetsu Tosei Kaisha

D. SAMPLES

1. Chemicals

Hydroquinone	3 bottles - each 500 grams
Elon	3 bottles - each 500 grams
Silver nitrate	3 bottles - each 200 grams

ENCLOSURE (D), continued

2. Developing powder

"Koku" developer	30 packages
"Netchi koku" developer	30 packages
"Tenkazai" (additional chemical for "koku" developer to be used in tropical areas)	

2. Developing powder

"Koku" developper	30 packages
"Netchi koku" developer	30 packages
"Tenkazai" (additional chemical for "koku" developer to be used in tropical areas)	30 packages

3. Fixing Chemicals

"Koku" fixing chemical	15 packages
"Netchi koku" fixing chemical	15 packages

GENERAL INFORMATION

1. Mixture of methylal (dimethylmethane), dimethylamine, and trimethylamine is obtained as a by-product of Elon manufacture. The mixture of amines can not be utilized owing to the difficulties of the separation of the constituents. Methyl is isolated, but little use can be found.

By-products of hydroquinone manufacture are ammonium sulphate, manganese sulphate, and ferrous sulphate. They are not utilized at present.

2. Recovered ammonium chloride is re-used in Elon manufacture.

3. Silver nitrate, Elon and hydroquinone have not been shipped outside of Japan as separate chemicals. In general, precautions must be taken against moisture and alkali from glass containers.

4. Chemicals have not been shipped to tropical areas.

5. Faint coloring was found in some batches which were produced four years ago, but hardly any change can be observed in the carefully packed batches. (Hydroquinone is more stable than Elon.)

6. Developers were mixed for Army and Navy.

7. Formulas of developers are as follows:

Chemicals	"Koku" developer	"Netchi koku" developer
Elon	8gr	6gr
Hydroquinone	32gr	10gr
Sodium sulphite anhyd.	200gr	80gr
Sodium carbonate anhyd.	120gr	40gr
Potassium bromide	8gr	6gr
Sodium sulphate anhyd.	-	171gr

"Koku" developer is for both Army and Navy aerial photography. "Netchi koku" developer is for both Army and Navy aerial photography in tropical

areas. "Tenkazai" is the additional chemicals (sodium bisulphite 8 grams, sodium sulphite anhyd. 48 grams, and potassium bromide 0.8 grams) which are added to "koku" in tropical areas.

8. Chemicals for Mixed Developers:

Name	Where obtained
Sodium sulphite	Ai Kogyo Kenkyusho, Osaka Sarashiko
Sodium carbonate	Mitsubishi Kasei
Potassium bromide	Nihon Kuju Seihin Tosei Co.
Sodium sulphate	Toyo Shashin Kogyo, Takahashi Tokutaro Shoten

9. The total quantity of developers supplied to the Army was 82,914 packages (each for a four liter solution).

10. The total quantity of developers supplied to the Navy was 4,172 packages (each for a four liter solution).

11. Packaging of mixed developers: Elon and hydroquinone are put in a sack of rubber hydrochloride, sodium sulphite, sodium carbonate, and potassium bromide are packed in another sack of rubber hydrochloride or of paraffined paper, and the two sacks are packed in a pasteboard-box.

"Tenkazai" is put in a rubber hydrochloride sack, and ten units are packed in a pasteboard-box.

12. Fixing solutions were mixed for both Army and Navy.

13. Formulas of fixing solutions are as follows (each for a five liter solution):

Chemicals	"Koku" fixing chemical	"Netchi koku" fixing chemical
Sodium thiosulphate anhydride	1050gr	700gr
Sodium sulphite anhydride	100gr	75gr
Alum	100gr	50gr
Chrome alum	12.5gr	12.5gr
Glacial acetic acid	75cc	90cc

14. Chemicals for Mixed Fixing Chemical

Chemical	Where Obtained
Sodium thiosulphate	Arai Jichiro Shoten
Potassium alum	Furukawa Kagaku Kogyo, Kuroda Ichinosuke Shoten
Potassium chrome alum	Mitsui Kagaku Kogyo, Kuroda Ichinosuke Shoten
Glacial acetic acid	Azumado Yakuhin Kogyo

15. In the packaging of fixing chemicals, a glass bottle containing glacial acetic acid, stoppered with paraffined cork or rubber stopper, is put into a cylindrical paste-board box together with alum and chromium alum, and this box is packed in a rubber hydrochloride double sack with the mixture of sodium thiosulphate and sodium sulphite. Then the sack is packed in a pasteboard box.

ENCLOSURE (D), continued

16. No special package or special packing material was used for the acid chemicals of the fixing chemical. Our packaging was as explained in paragraph 15.

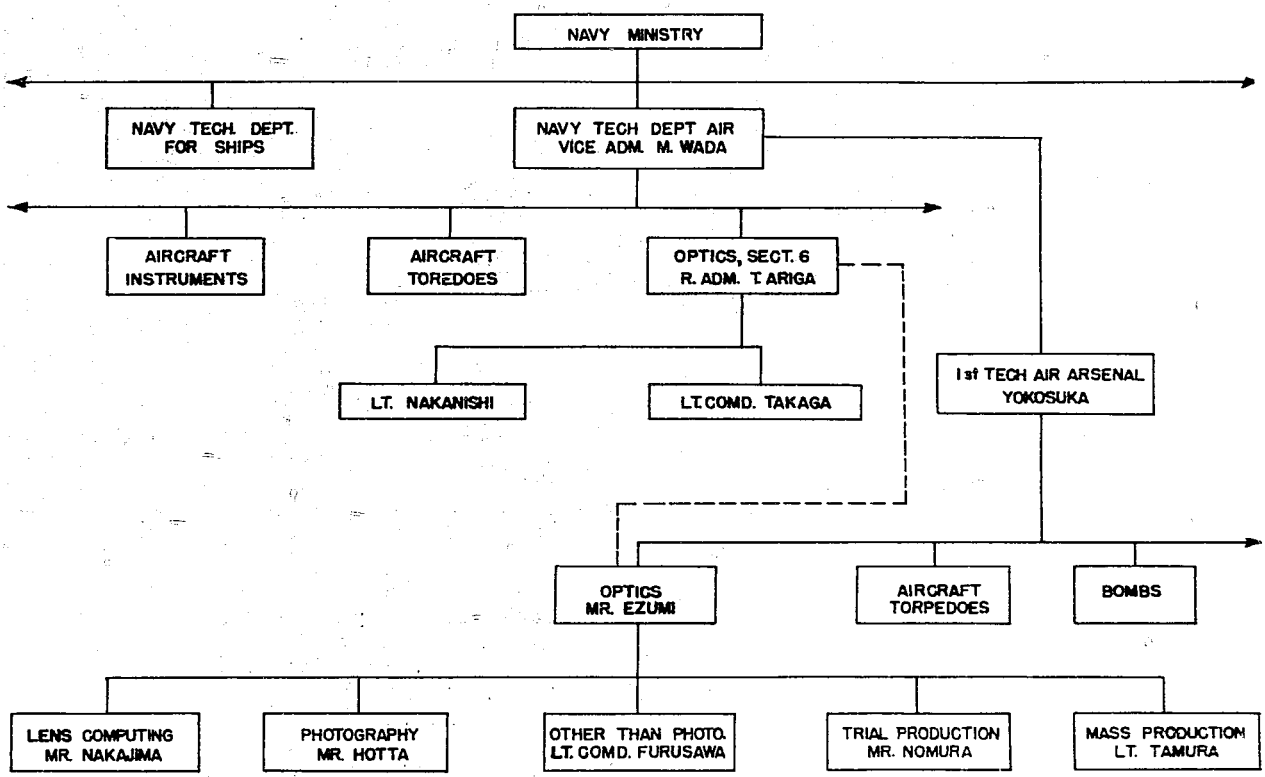
17. The total of fixing chemicals supplied for the Army was 49,129 packages (each for a five liter solution).

The total of fixing chemicals supplied for the Navy was 1000 packages (each for a five liter solution).

* * * * *

ENCLOSURE (E)

JAPANESE NAVAL PHOTOGRAPHIC ORGANIZATION



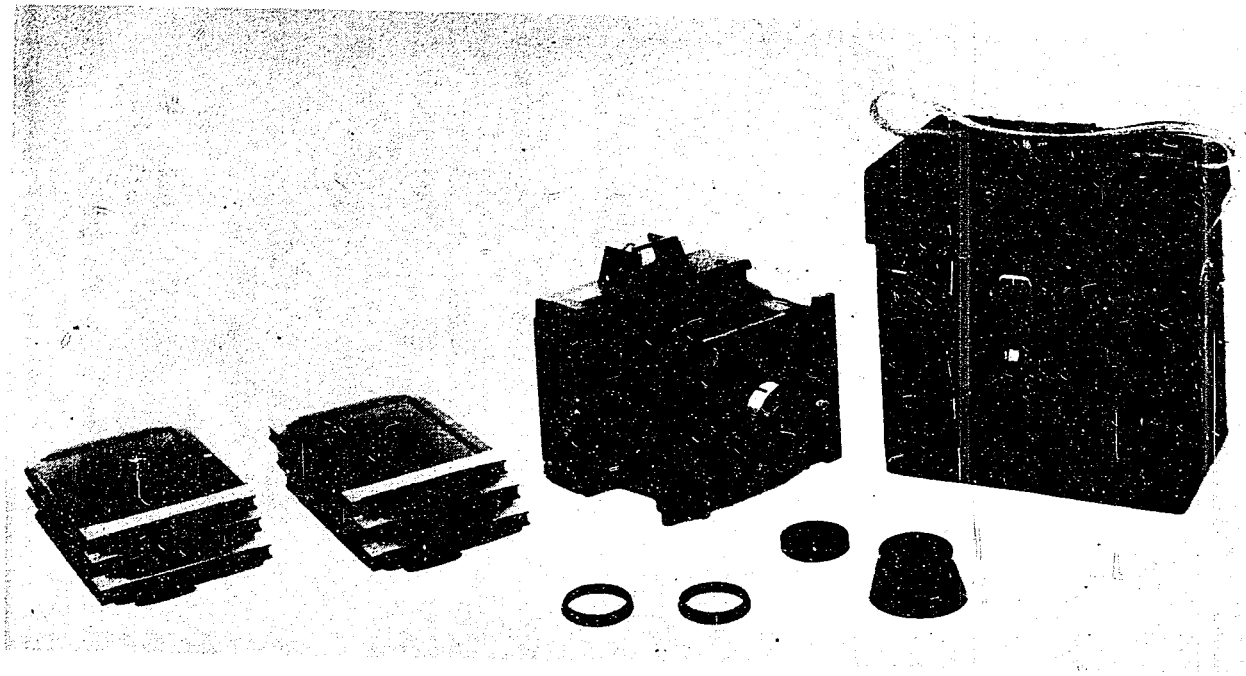
(Information obtained in interview with MR. EZUMI and MR. HOTTA at Branch, 1st Air Technical Arsenal, 23 October 1945)

ENCLOSURE (F)

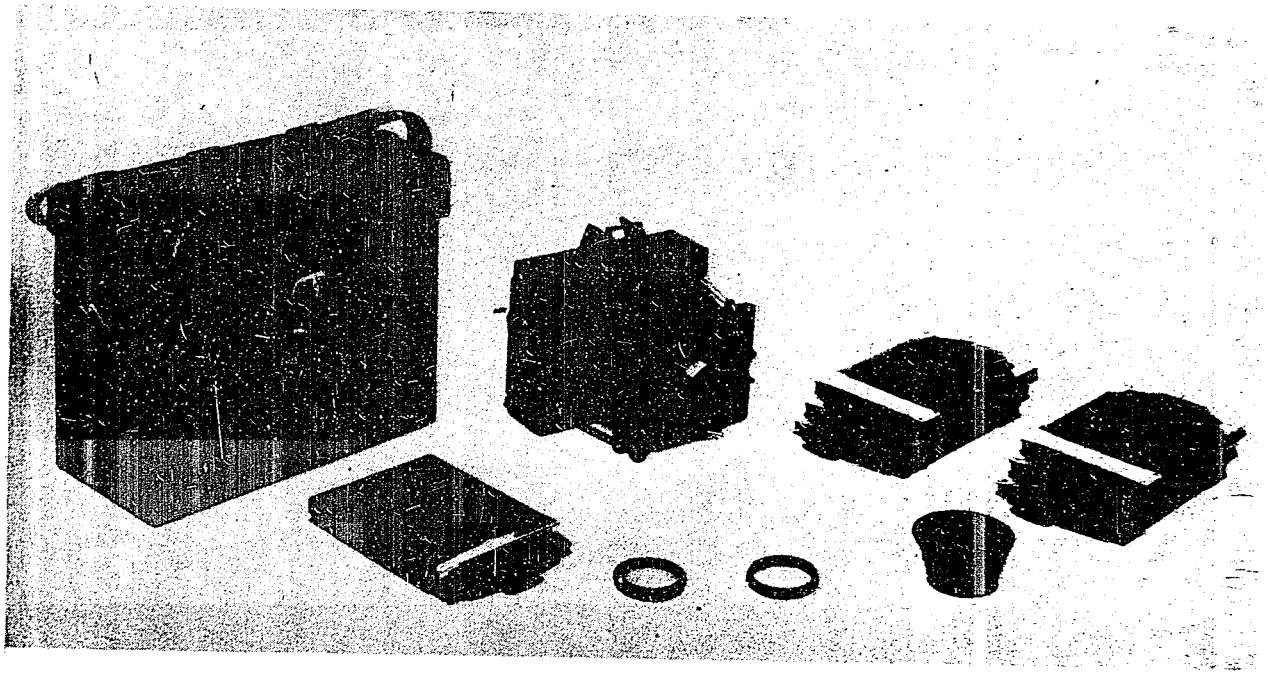
PHOTOGRAPHS OF JAPANESE AERIAL PHOTOGRAPHIC EQUIPMENT

LIST OF ILLUSTRATIONS

ENCLOSURE (F)

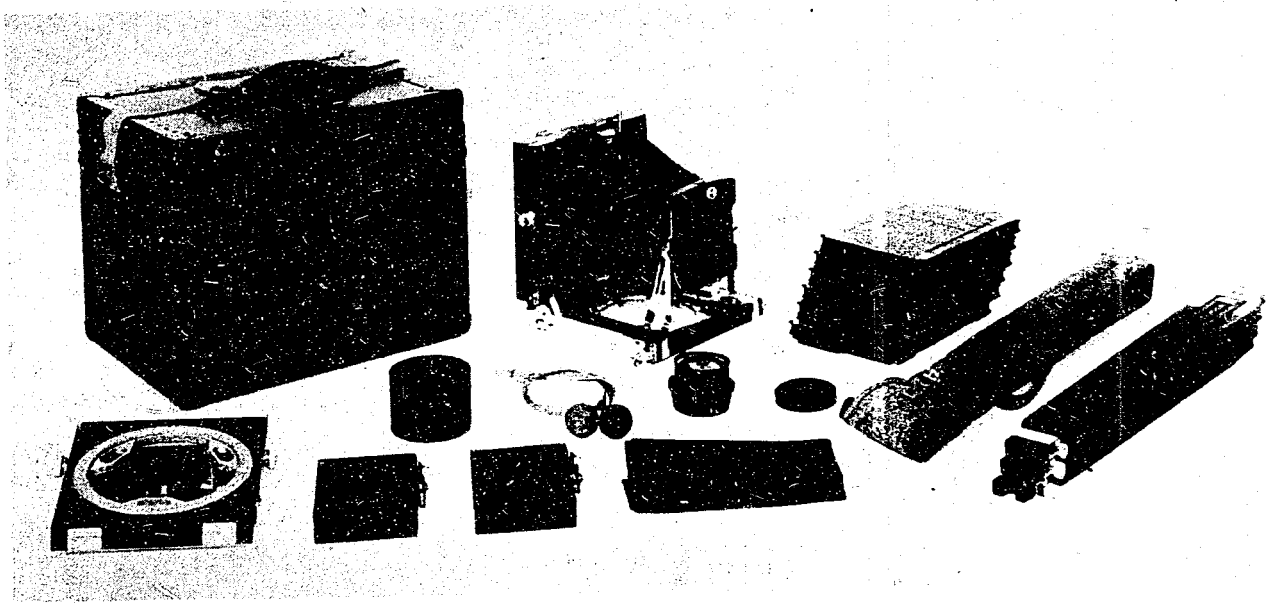


1. *Navy Folding Camera*

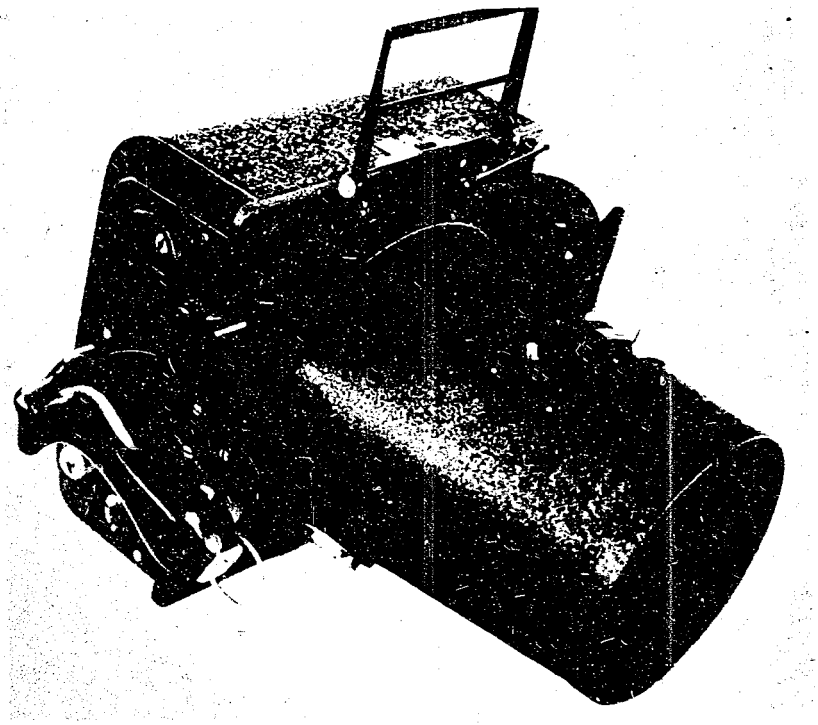


2 *Navy Folding Plate Camera*

ENCLOSURE (F), continued

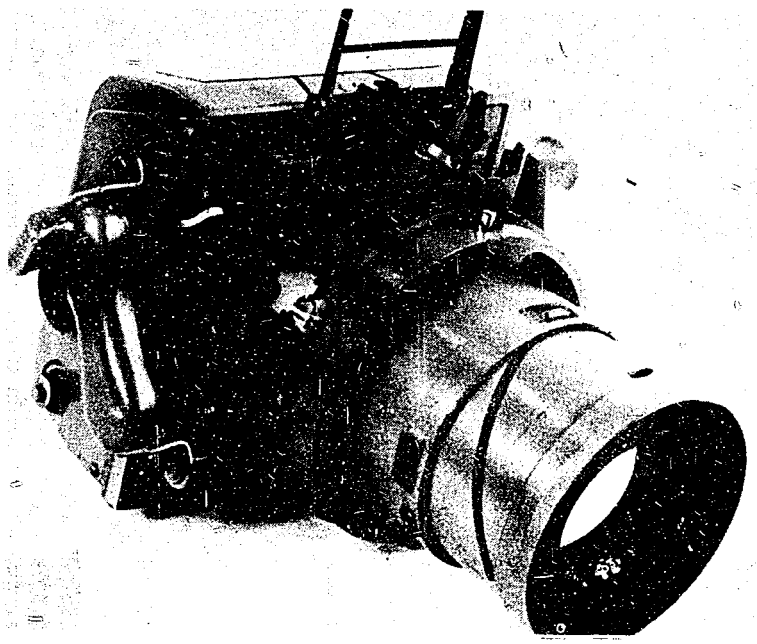


3. *Navy 11x14 Inclusive View Camera*

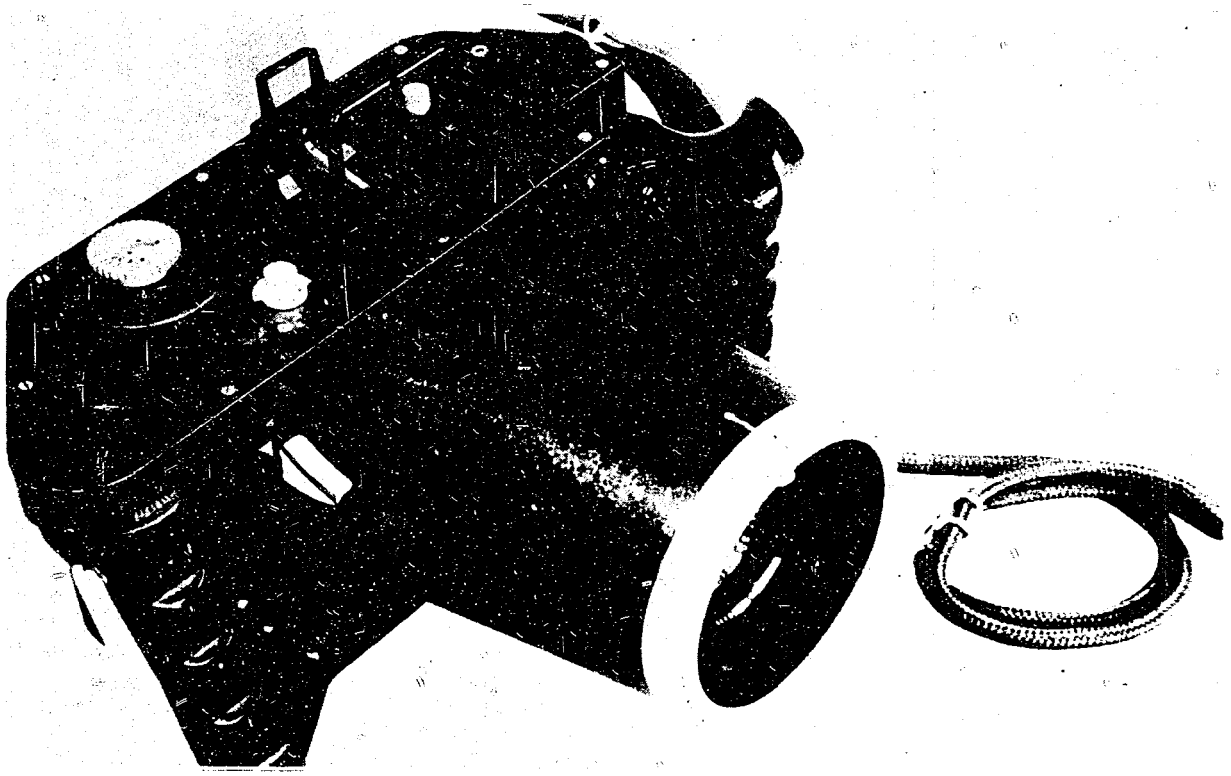


4. *Navy F-8 Camera*

ENCLOSURE (F), continued

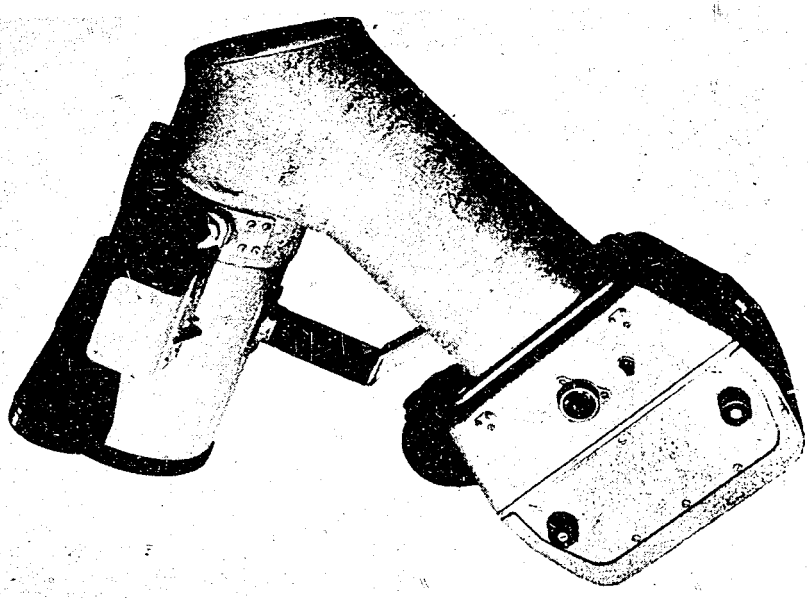


5. *Army Type 100 20cm Camera*

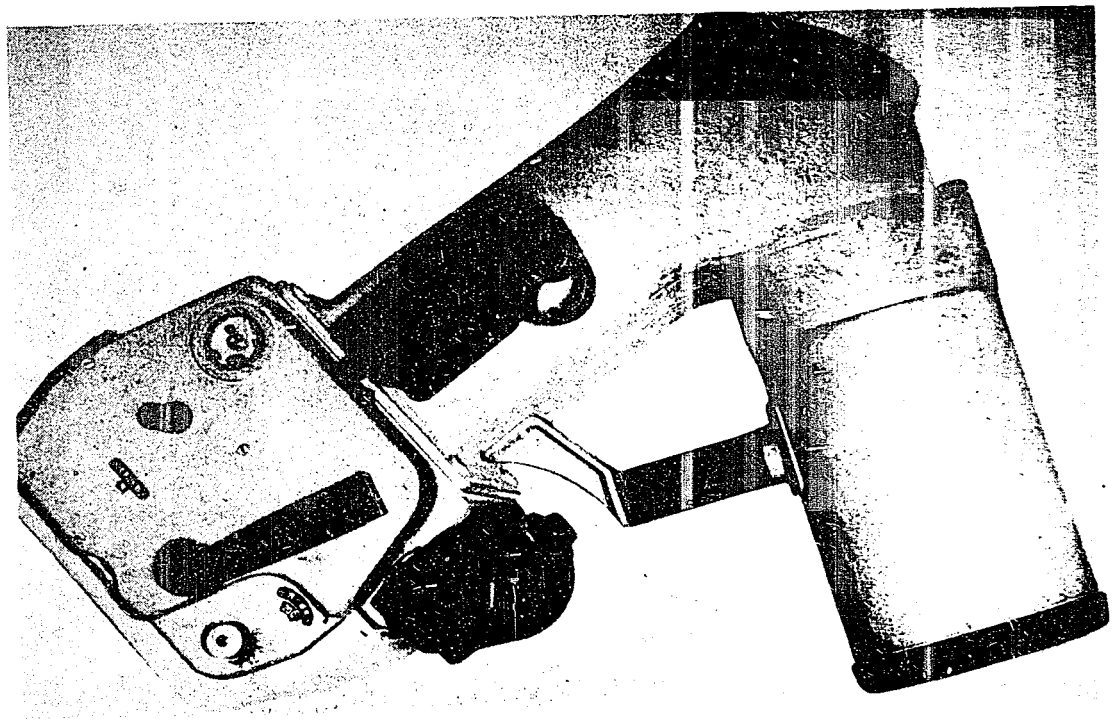


6. *Navy Type 99 Camera*

ENCLOSURE (F), continued

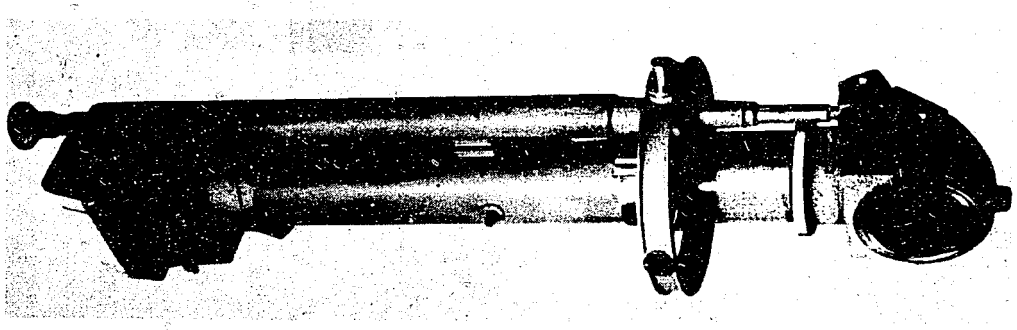


7. *Navy Type 1V 70cm Oblique Camera*

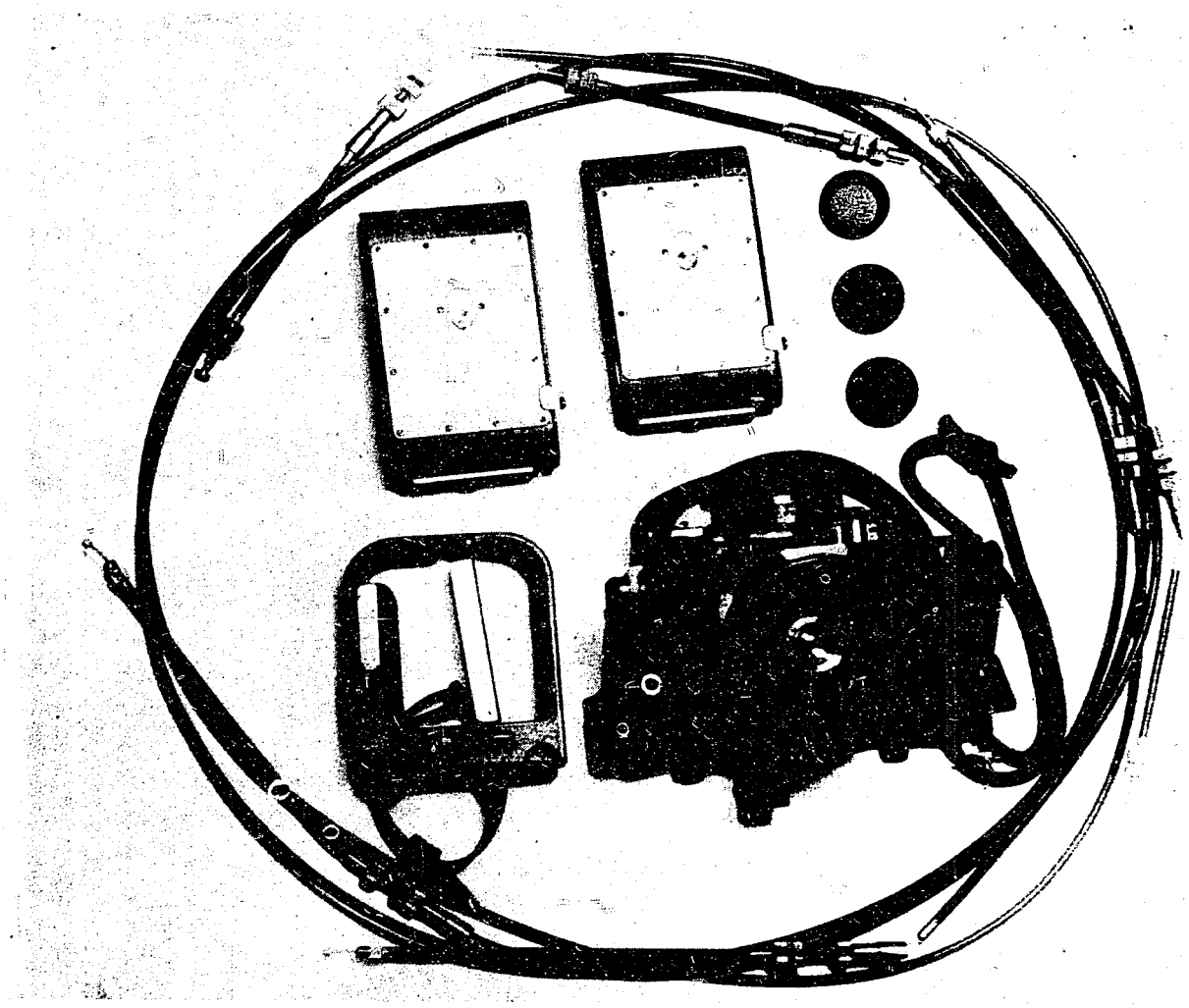


8. *Navy Type 1V 70cm Oblique Camera*

ENCLOSURE (F), continued

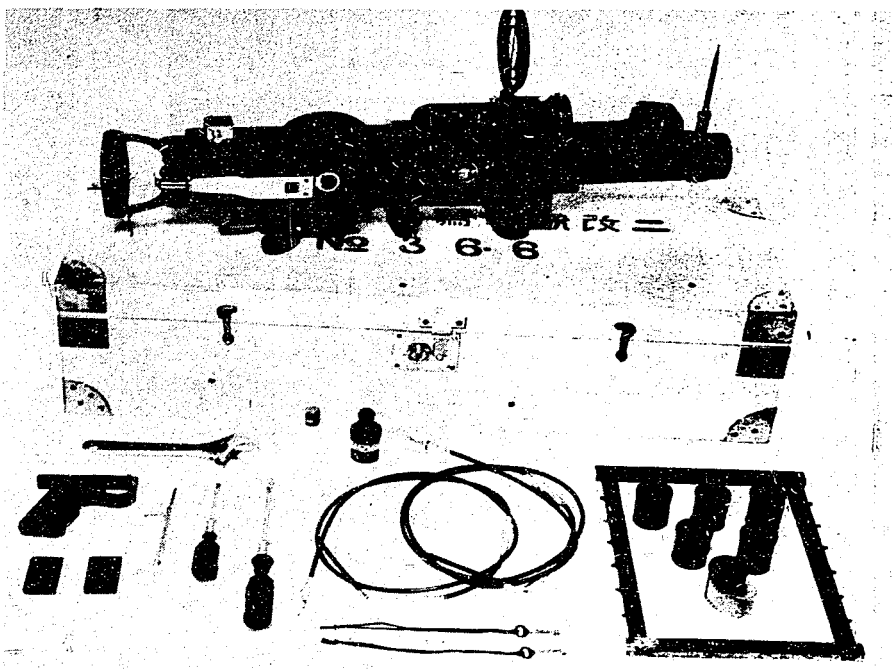


9. *Navy 100cm Tele-Photo Oblique Camera (Experimental)*

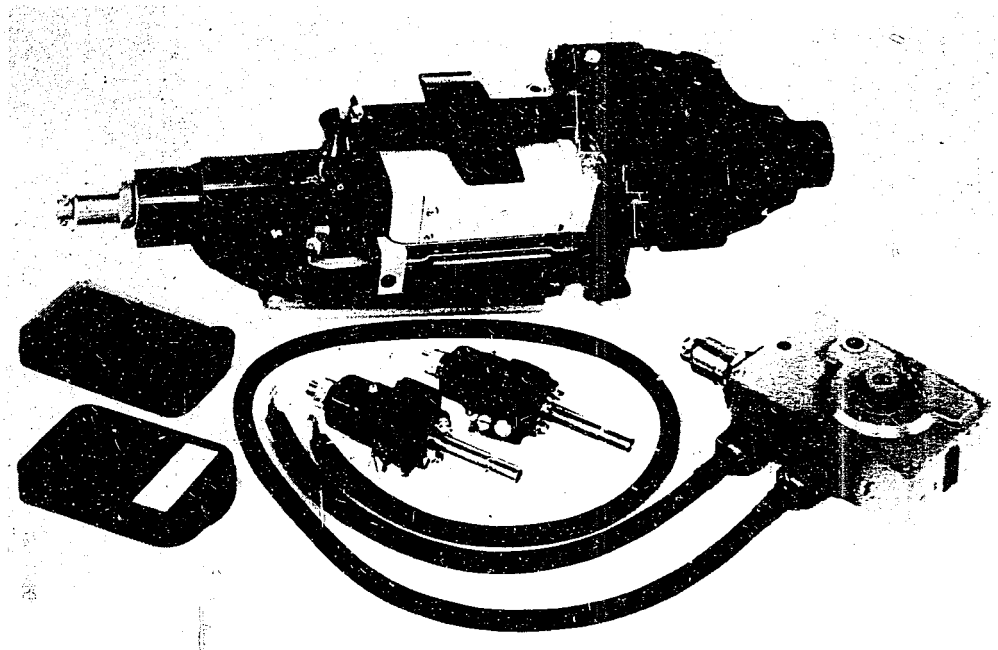


10. *Army Smallest G SK Camera*

ENCLOSURE (F), continued

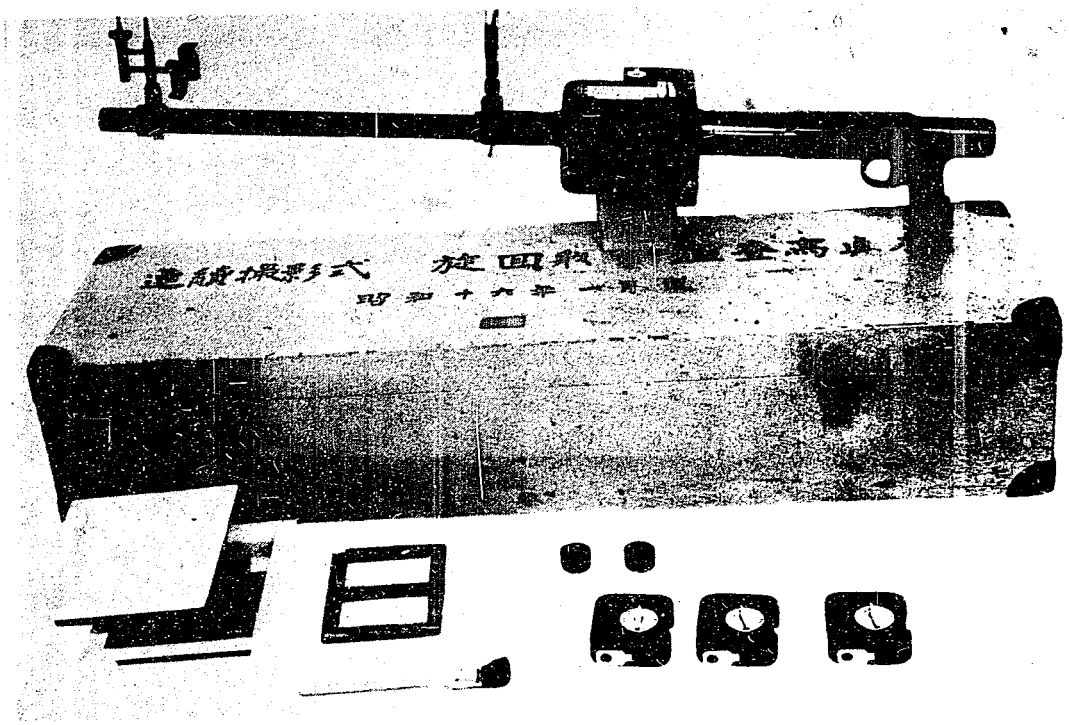


11. *Navy Type 89 Gun Camera*



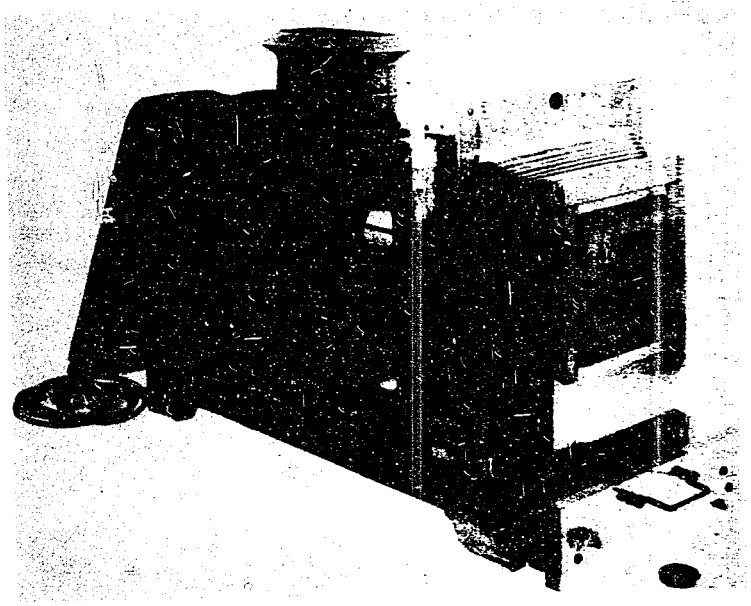
12. *W-7 16mm Gun Camera*

ENCLOSURE (F), continued

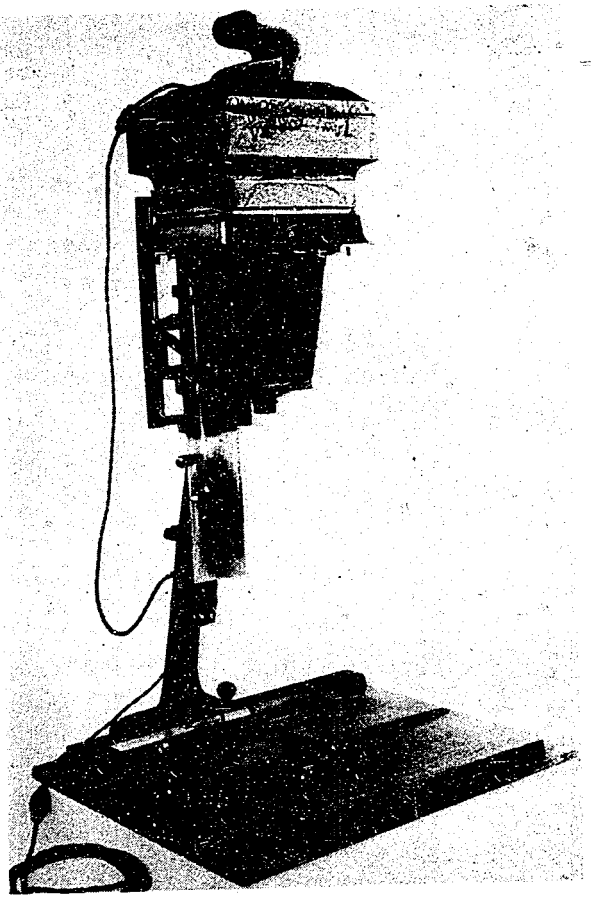


13. *Navy and Army Cine Type 2 16mm Gun Camera*

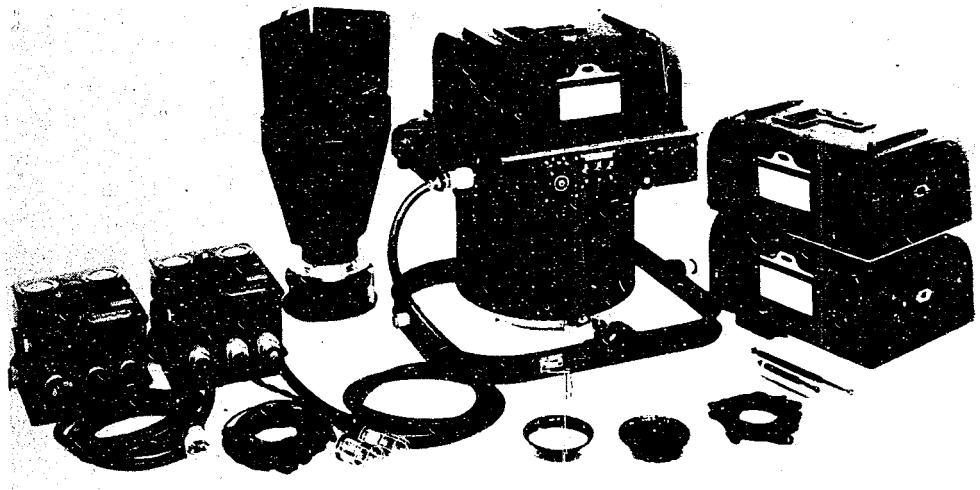
14. *Navy Simple Enlarger*



ENCLOSURE (F), continued

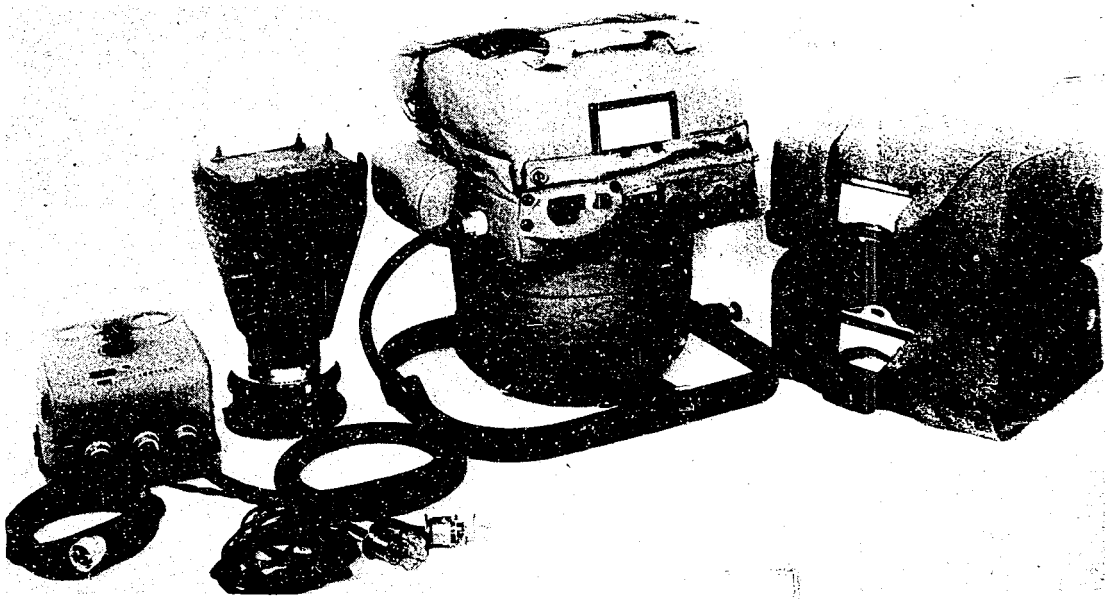


15. *Navy Autofocus Enlarger*

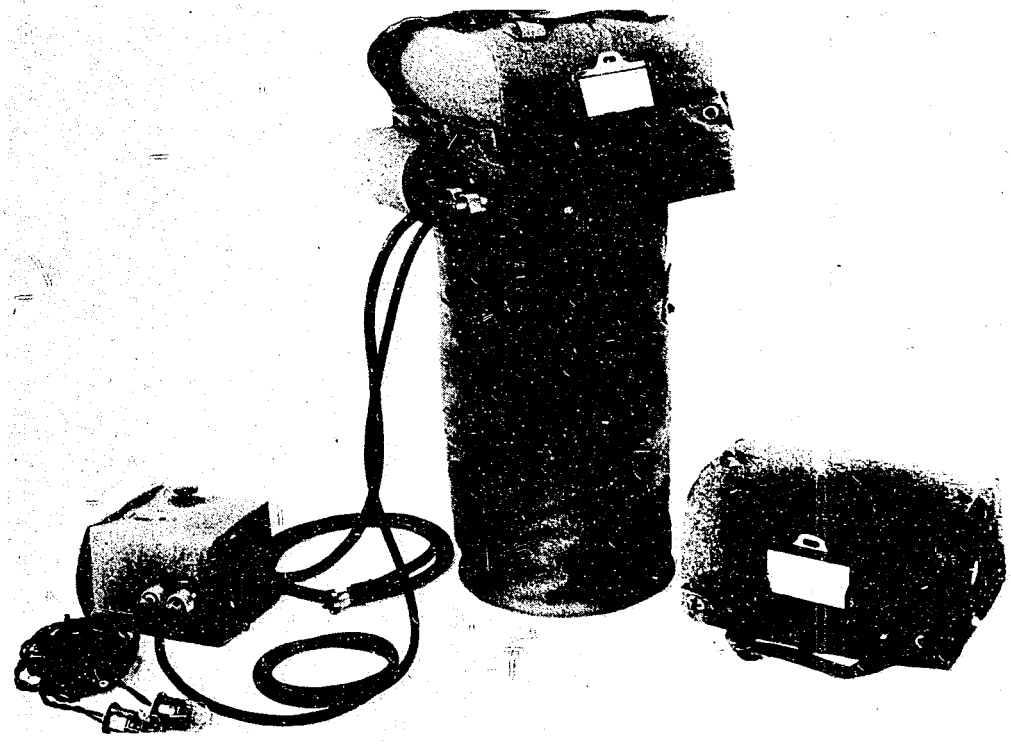


16. *Navy K-8 25cm Magazines and Intervalometers*

ENCLOSURE (F), continued

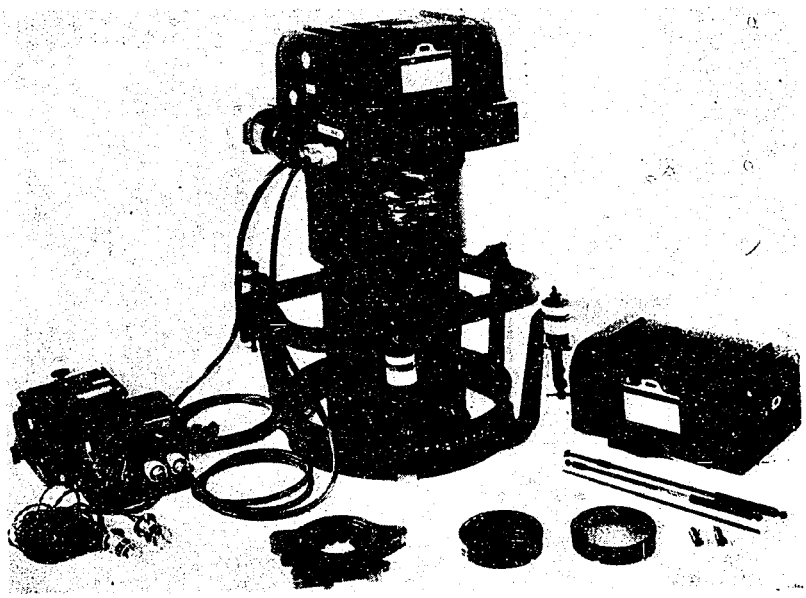


17. *Navy K-8 50cm Viewer Magazines Intervalometers*

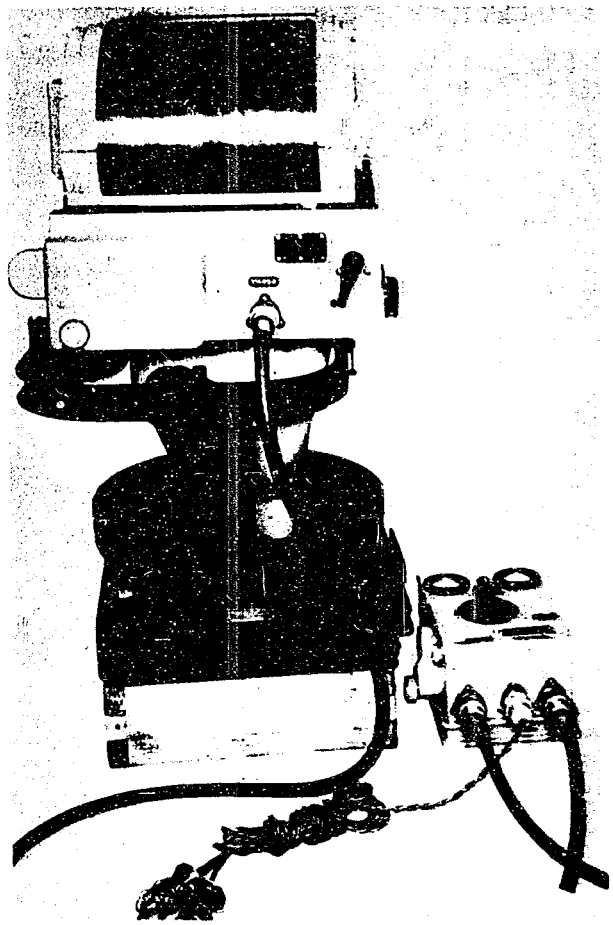


18. *Navy K-8 50cm Magazine and Intervalometer*

ENCLOSURE (F), continued

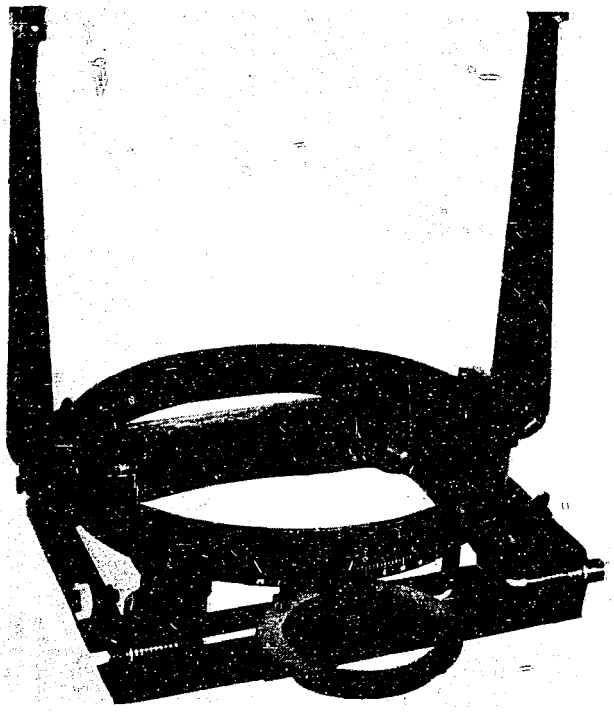


19. *Navy K-8 Magazines Viewer Intervalometer*

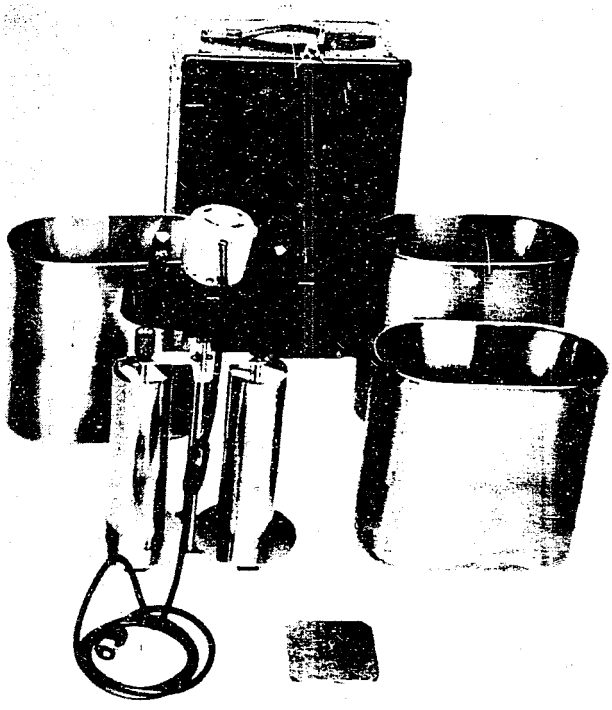


20. *Army Type 100 Installation*

ENCLOSURE (F), continued

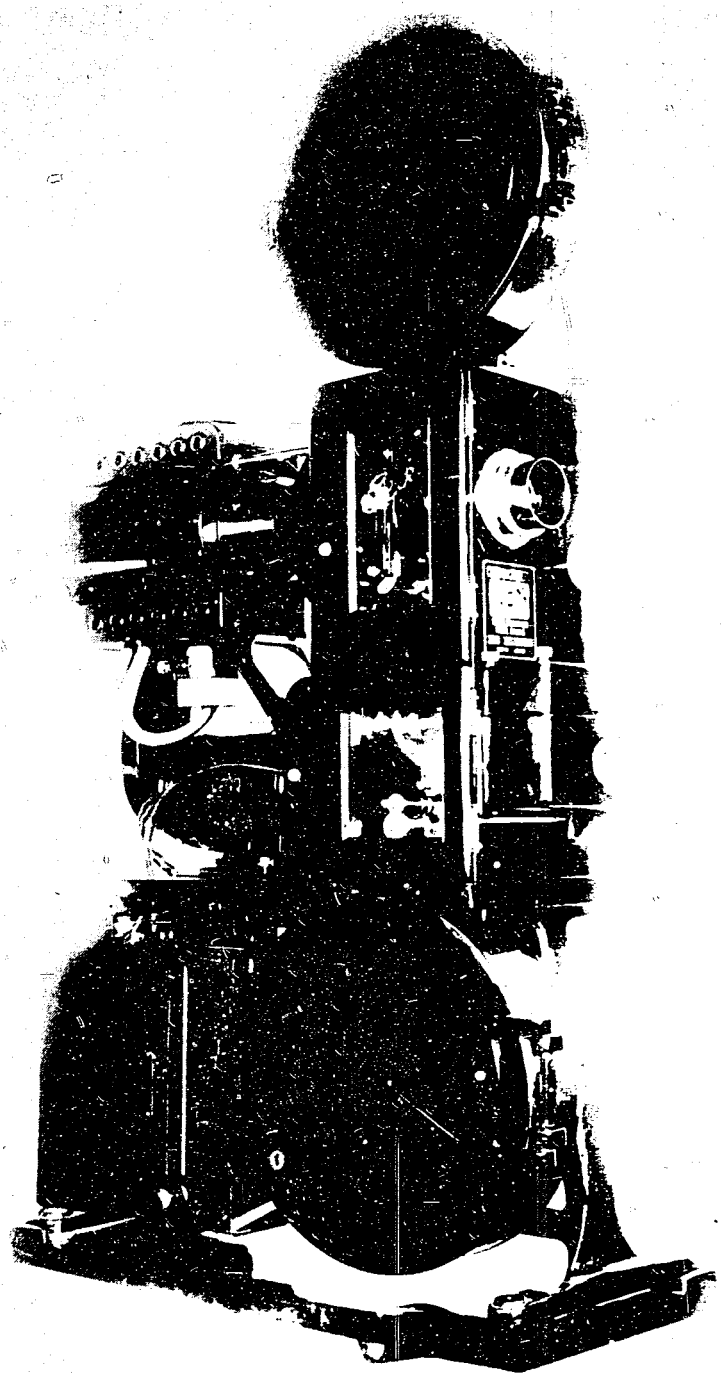


21. *K-8 50cm Mount*



22. *Navy Aerial Developing Set*

ENCLOSURE (F), continued



23. *Navy 35mm Projector*

ENCLOSURE (G)

R. KONISHI CO. SENSITOMETRIC DATA

(Forwarded under separate cover to Director Photo Science Laboratory, Anacostia, Washington, D. C.)