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U. S. NAVAL TECHNICAL MISSION TO JAPAN
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29 November 1945

RESTRICTED

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

Subject: **Target Report** - Japanese Infra Red Devices, Article 1 - Control for Guided Missiles.

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

1. Subject report covering infra-red controls for guided missiles outlined by Target X-02 of Fascicle X-1 of reference (a), is submitted herewith.

2. The investigation of the target and target report were accomplished by Maj. E. R. Ricker, Engr. Technical Intelligence Section, Lt. E. G. Oxton and Sgt. Sperry Lea, Air Technical Intelligence Group.

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Captain, USN

RESTRICTED X-02-1

JAPANESE INFRA RED DEVICES
ARTICLE 1
CONTROL FOR GUIDED MISSILES

"INTELLIGENCE TARGETS JAPAN" (DNI) OF 4 SEPT. 1945
FASCICLE X-1, TARGET X-02

NOVEMBER 1945

U.S. NAVAL TECHNICAL MISSION TO JAPAN

SUMMARY

MISCELLANEOUS TARGETS

JAPANESE INFRA-RED DEVICES
ARTICLE 1 - CONTROL FOR GUIDED MISSILES

The Japanese heat-homing bomb was a free falling, infra-red guided, gyro stabilized missile, which was intended to be dropped from airplanes on ships at sea. The chassis consisted of a heat-sensing head, a body with two sets of mutually perpendicular wings both fore and aft, and a tail brake assembly. The heat-sensing head consisted of a rigidly attached thermopile arrangement behind which a spherical mirror was eccentrically mounted on a revolving shaft. Rotation of the mirror caused the heat-sensing head to scan a conical pattern directly in front of the missile. Sensing was amplified and transferred to the wing flaps for guiding control. Approximately 60 bombs were made and dropped in tests. but only a few actually responded to the heat control. The tests, however, did show promise and the designers were confident that they could make a successful heat-homing bomb.

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REFERENCES

Location of Target:

Yocho Machi Branch of the Army Ordnance Board, FUJIMI Mura, Suwa Gun, Nagano Ken.

Japanese Personnel who Assisted in Collecting Equipment and Documents:

Lt. Co. Toshio TAKESHITA, Seventh Military Technical Laboratory.

Japanese Personnel Interviewed:

Major M. KAGI, Yocho Machi Branch of the Army Ordnance Board. Specialized in Kego body design.

Major HIZUTA, Yocho Machi Branch of the Army Ordnance Board. Specialized in Kego body design.

Major SHIRAKURA, Yocho Machi Branch of the Army Ordnance Board. Specialized in Kego electrical circuit design.

INTRODUCTION

Parallel research was begun in March 1944 on a heat ray detector and three types of heat-seeking bombs, B-1, B-2, and B-3. Since the B-1 was apparently the only one showing promise, work on B-2 and B-3 was soon dropped. The scope of this report is limited to the type B-1 bomb, a heat-seeking, high angle, air-to-ship guided missile intended for use against surface targets at sea. Concentration on B-1 resulted in nine models, 101 through 109, of which only two, 106 and 107, were test-dropped extensively. Fifty to sixty of these were dropped from 3000 meters with a raft 10 meters x 30 meters as a target. Wood and coal were burned on the raft which was moored in a bay at HAMAMATSU. Only five or six of the bombs took control to the extent that a zig-zag course was observed. Adjustment appeared to be troublesome in that some bombs veered away from the target and thereby lost all heat control. Test drops were stopped in July 1945 while control surfaces were redesigned. The resulting models, 108 and 109, would have been ready for test drops in September 1945.

THE REPORT

Part I
GENERAL DATA ON HEAT-HOMING BOMBS

A. Description

The heat-homing bomb was a free falling missile, carried 20-30 kg of high explosive charge, and was given the name of KEGO. It was all wood except the nose section, tail (air brake) section and wing braces. It had four main wings and four tail wings. KEGO 109 was designed to be approximately two and one half times as large as 107, with a diameter of 30cm, length 5 1/2 meters and weight 800 kg. Two fuzes were used, a nose fuze for an instantaneous burst on a direct hit and a tail fuze for delayed action on a water hit.

B. Guiding System

Stabilization was accomplished with a restricted gyroscope for roll reference. Gyro precession closed contacts operating ailerons. Early models used a hydraulic system with mechanical linkage to two ailerons. Later models used four ailerons operated by electromagnets. Models 101 and 102 used electric gyros but these introduced too much static into the heat sensing unit amplifier, so that models 103 to 109 had air operated gyros. Air gyro rotation speeds varied with true air speed between 5000 and 8000 RPM. A bolometer of nickel strips of various arrangements provided the command transmission system. An eccentric spherical mirror was rotated behind the bolometer and scanned a cone having an apex angle of 40 degrees with a no-signal inner cone of approximately 15 degrees. The signal from the bolometer went through an amplifier and two relays to oil-driven servos which operated the wing flaps and elevators in the proper direction to make the bomb home on the heat source.

C. Aiming

Regular bombsight technique was used. Bombing tables for bombs of comparable weight were considered satisfactory without correction for drag of tail brake, lift of wings or change of course.

D. Launching

The bombs were designed to be hung by a hook and two braces, one under each side of the Army bomber K67. The lower bomb wings were retracted to give ground clearance, but were lowered after take-off. Shortly before the bomb was to be dropped, the KEGO power supplies and gyro were turned on. Before launching, a time switch in the bomb was set to turn on the heat-seeking controls for only the last 10 to 15 seconds of flight. Upon launching a wire was pulled which allowed the tail brake to fan out and the fuzes to become armed.

E. Results

Heat-sensing was observed in five or six of the missiles, the bombs having zigzagged back and forth in flight. Others, however, were observed to veer away from the heat target. There was some doubt as to what caused the missile to avoid the target, since accurate quantitative data were not taken. Equipment failures were believed to be the cause of most of the trouble, although background contrast was considered to be abnormal also. The time constant of the thermopile was two seconds but no abnormal significance was attached to time constant.

F. Production and Manufacturing Data

Production, by models, was as follows:

Model	Number Produced
101	10
102	5
103	designed only
104	designed only
105	designed only
106	50
107	30
108	designed only
109	designed only

Parts were manufactured by the following concerns:

Bomb body - Nagoya Arsenal, Atsu Department.

Bolometer - First Military Arsenal, TOKYO, Omiya Department.

Gyro - Hitachi Co., MITO.

Timing gear

Spring and gear parts - Hattori Jewelry Company.
Electrical contacts - Sumitomo Communications Branch.

G. Development Agencies and Key Personnel

The following agencies and individuals participated in development:

Military Ordnance Administration Board

Major FUJITA - gyro and airframe
Major HIZUTA - airframe
Major SONOBE - amplifier
Captain ABE

Seventh Military Laboratory

Prof. KONISHI, Shikan Gakko, OSAKA - Theoretical mathematical work
Prof. SANO, Osaka Imperial University - electrical design
Dr. ITAKAWA, Aeronautics Research Laboratory - aerodynamics design

H. Documents and Equipment

In all cases, persons interrogated asserted that all completed bombs, their components and blueprints were destroyed either by U.S. bombs or by the Japanese Army at the time of surrender, except for the following:

1. Drawings and blueprints listed in Enclosure (A).

2. Two mechanical time switches which have been shipped by ATIG to the Controlled Aircraft Section, Wright Field.

3. Two sensing heads, one without bolometer, found at the Seventh Military Laboratory at MATSUMOTO have been shipped to the Naval Research Laboratory, Anacostia, D.C., see Enclosure (B)

I. Observation

Although the heat-homing bomb was not perfected to a point where it would [illegible]t service requirements, it did show a few unique features. These were:

1. Scanning by rotating eccentric mirror with sensitive element stationary.

2. Use of four wings at angles of 45, 135, 225, and 315 degrees and co-ordinated tail surfaces.

3. Use of air brake to decrease speed of fall, and maintain airflow control.

4. Use of air driven gyroscope to minimize static in the electrical equipment.

Part II

DETAILED DESCRIPTION OF CONSTRUCTION AND OPERATION OF THE HEAT-HOMING BOMB

A. Airframe

1. Location of parts: The body of the B-1 was divided into three sections - heat sensitive head, war head, and fuselage. The head contained the rotating pick-up mirror, heat sensitive bolometer, and amplifier with batteries. The war head was located directly aft of the pick-up head. Behind this were mounted the main wings with four "flaps" and two or four ailerons depending on the model of the bomb. (See Figure 1) Oil servos used to operate the flaps were located at this point inside the fuselage. Between the main wings and the smaller tail wings the fuselage held the spherical oil reservoirs, oil control valves, stabilizing gyro, and batteries for the magnetic oil valves. In the tail of the bomb a folding umbrella type air brake was mounted. (See Figures 2 and 3)

2. Dimensions: The dimensions of B-1 bombs varied slightly from model to model. (See Figures 4 and 5.)

Model	Length	Diameter	Wing Span	Total Weight	Terminal Velocity
107	15.5 ft	1.65 ft	6.58 ft	1,600 lbs	335 mph
109	18 ft	1.65 ft	9.4 ft	1,760 lbs	360 mph

3. Construction: The covering for the pick-up head and the air brake were of steel construction; the remainder of the bomb was built of wood. A notable feature was the retractable under wings which allowed the bomb to clear the ground when hung beneath a Type Ki 67 bomber. An oil servo lowered wings to flying position when a valve was opened by a crank in the mother plane after take-off.

B. Heat Sensing System

1. Heat unit: The head unit was a wooden frame in which were mounted the bolometer, mirror, motor, distributor, amplifier, relay box, and battery case. (See Figures 6, 7, and 8.)

2. Window: The heat transparent window in the front of the bomb was a membrane of gum chlorate 10 microns thick, and 40cm in diameter. Support was provided by a mesh of piano wire forming 40 one cm squares directly behind the window. Transmission of the window substance was given at 80% throughout the infra-red spectrum with a slight drop in the 10 micron region. It was stated that little harm was done by direct sunlight. Rock salt was the only other suitable substance known to the persons interrogated, but it was not used for the window because of the size required.

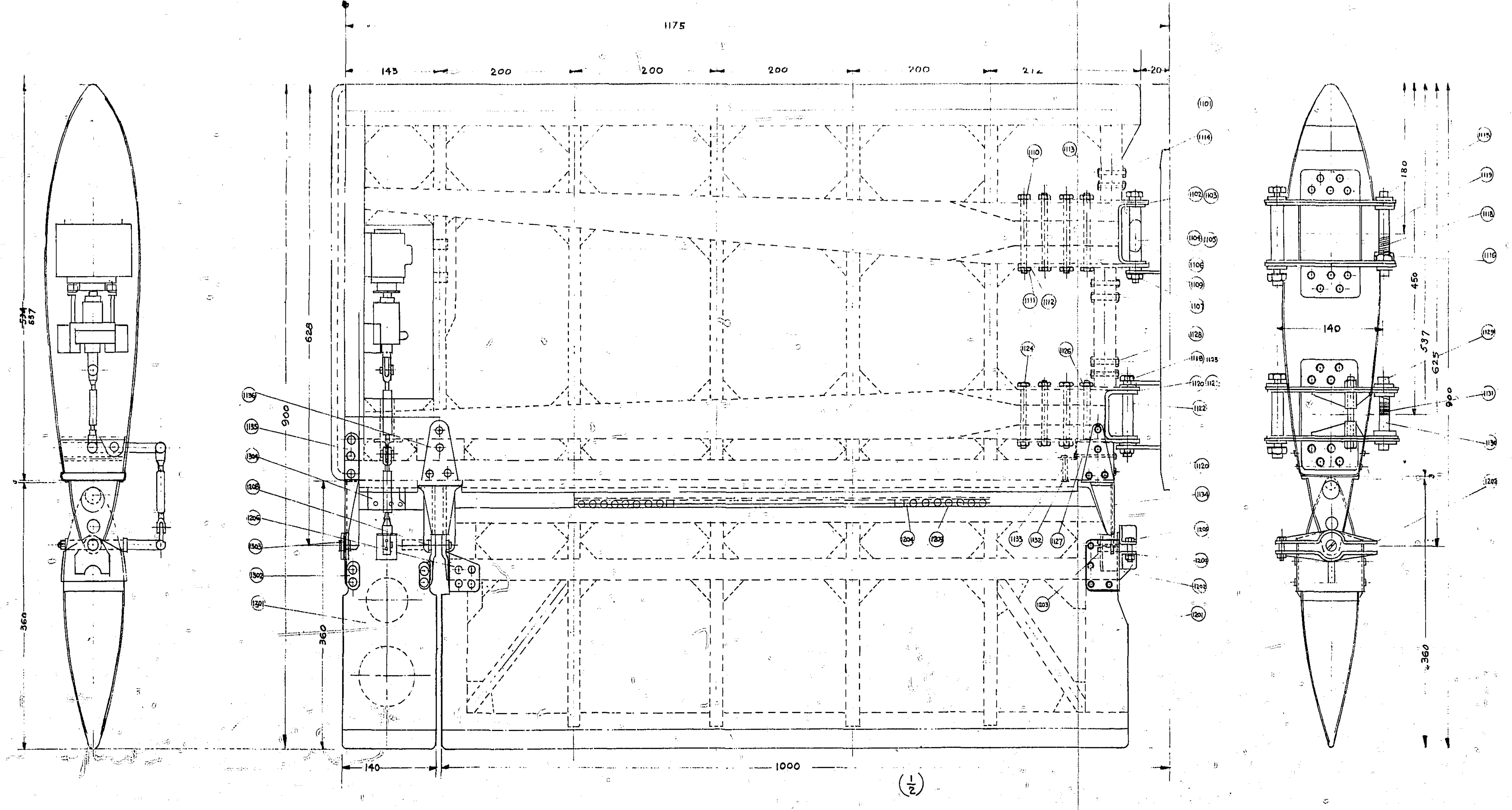


Figure 1
MAIN WING DESIGN--MODEL 109
(Dimensions in mm)

JAPANESE HEAT HOMING BOMB, KEGO

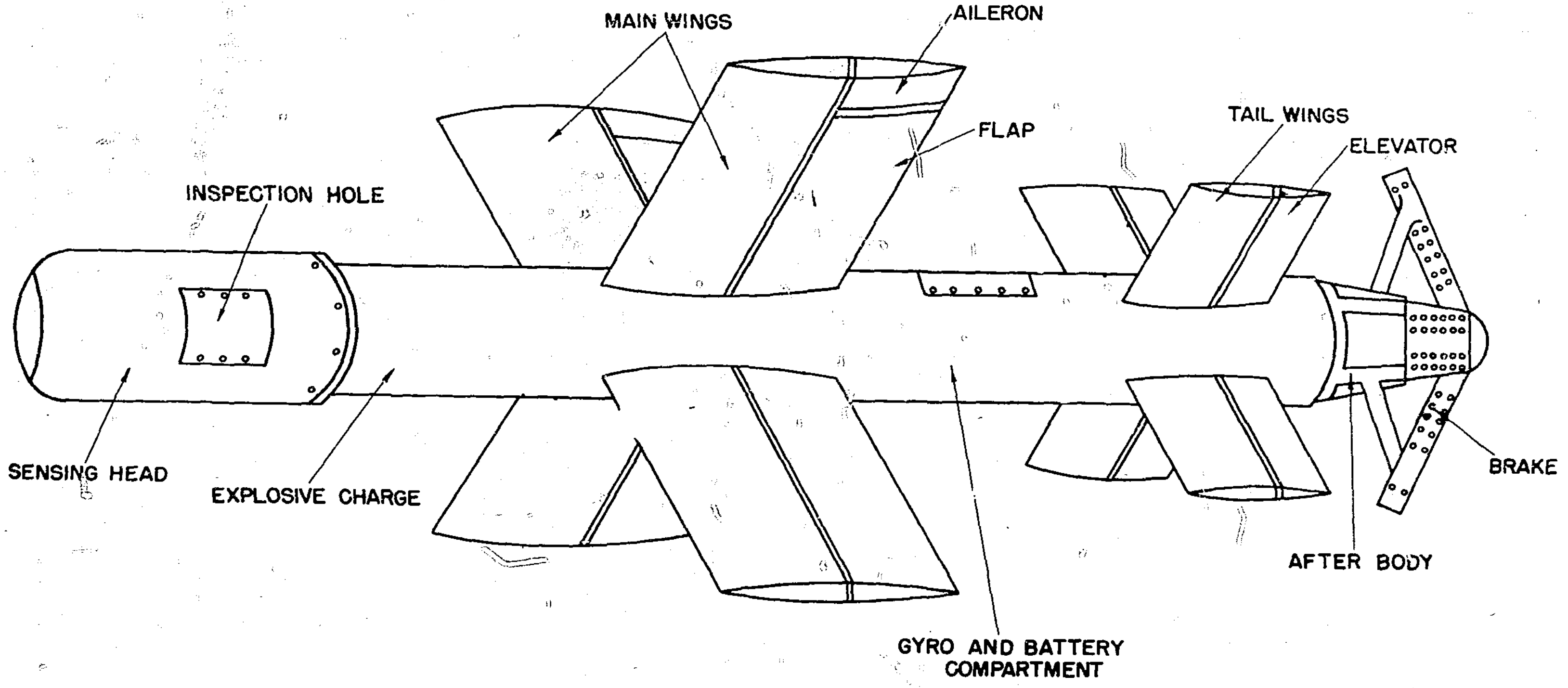


Figure 2
KEGO, PERSPECTIVE VIEW

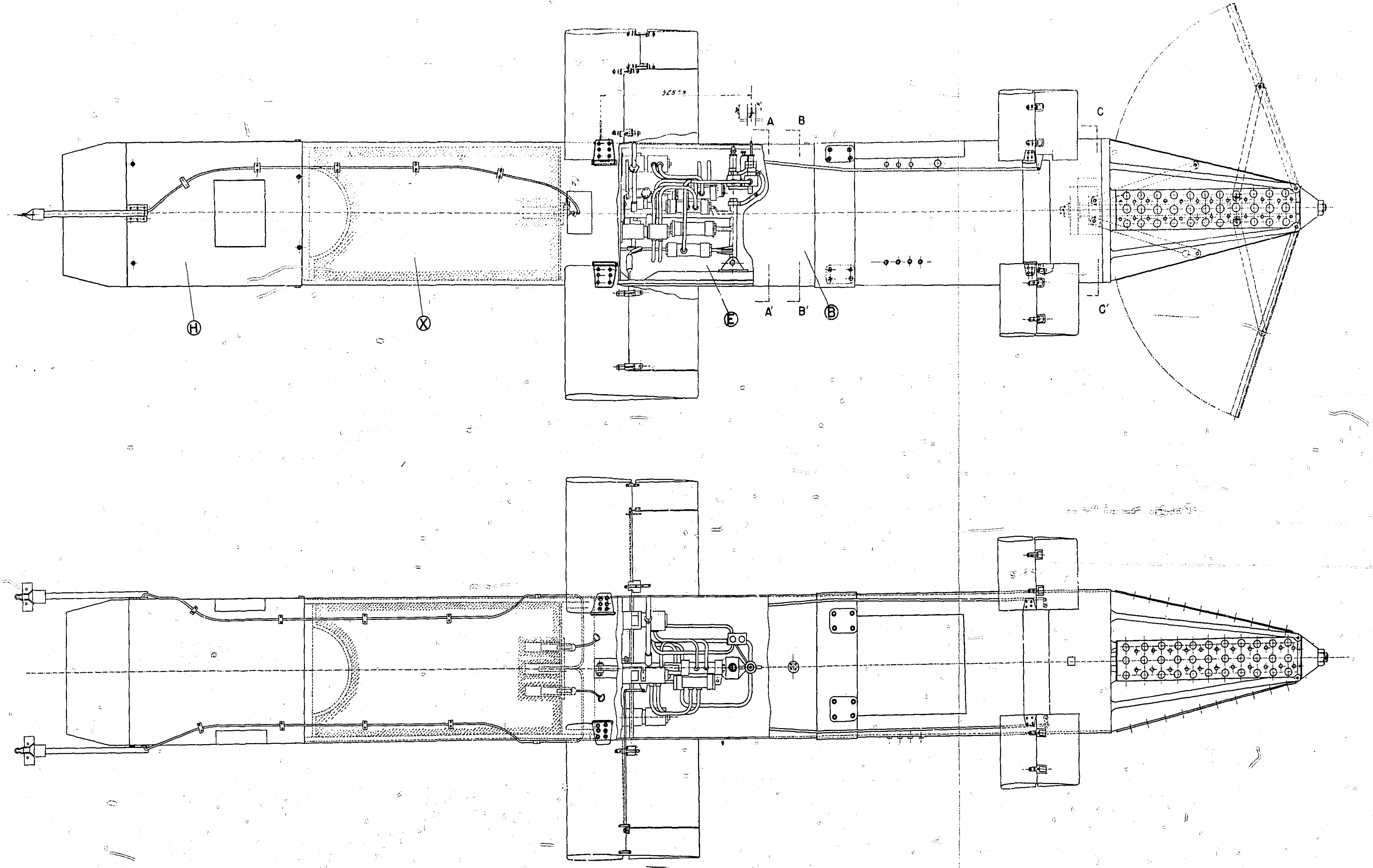


Figure 3
AIRBORNE GLIDER, MODEL 106
Location of Parts (Top and Side View)

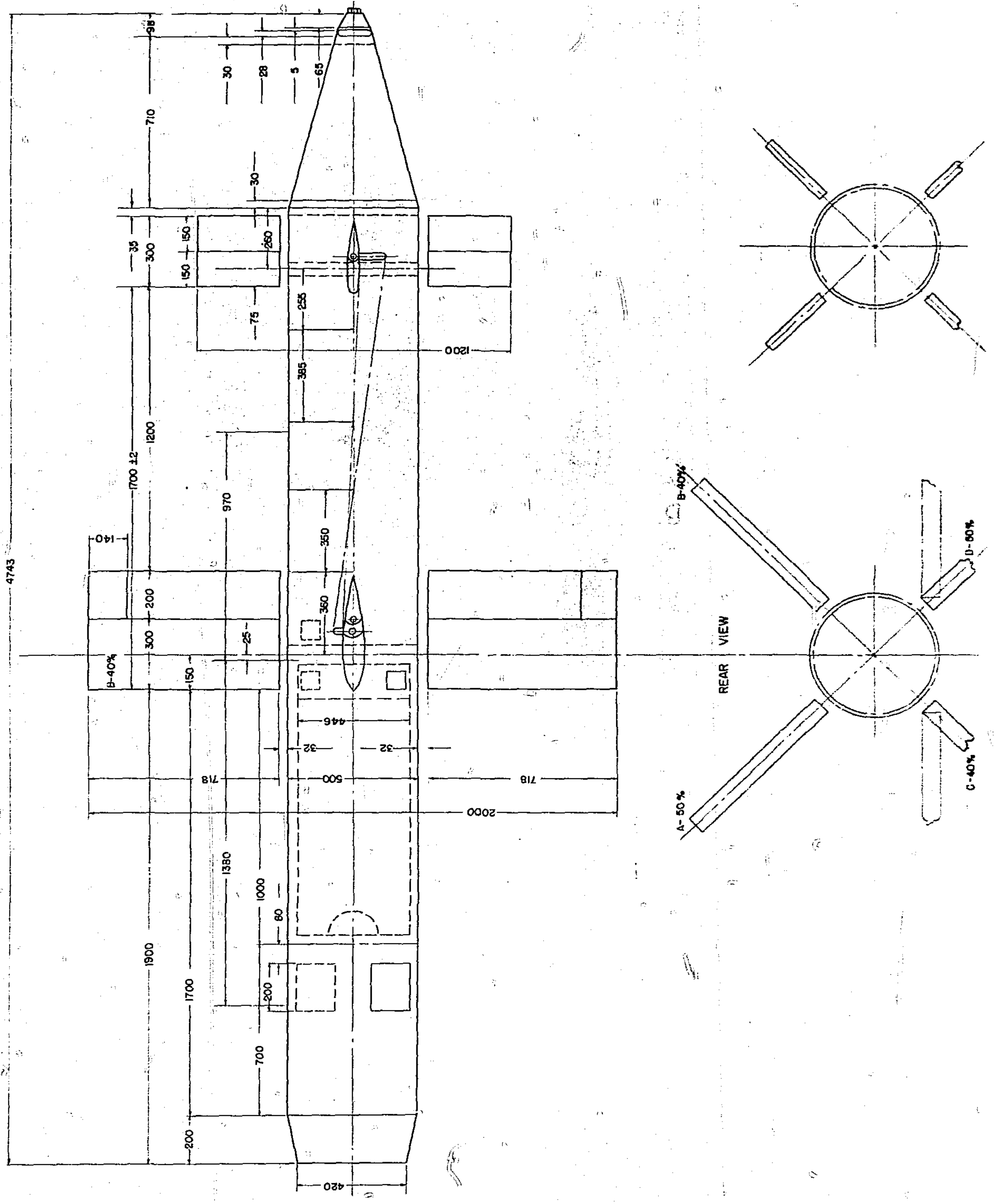


Figure 4
DIMENSIONAL DRAWING--MODEL 106

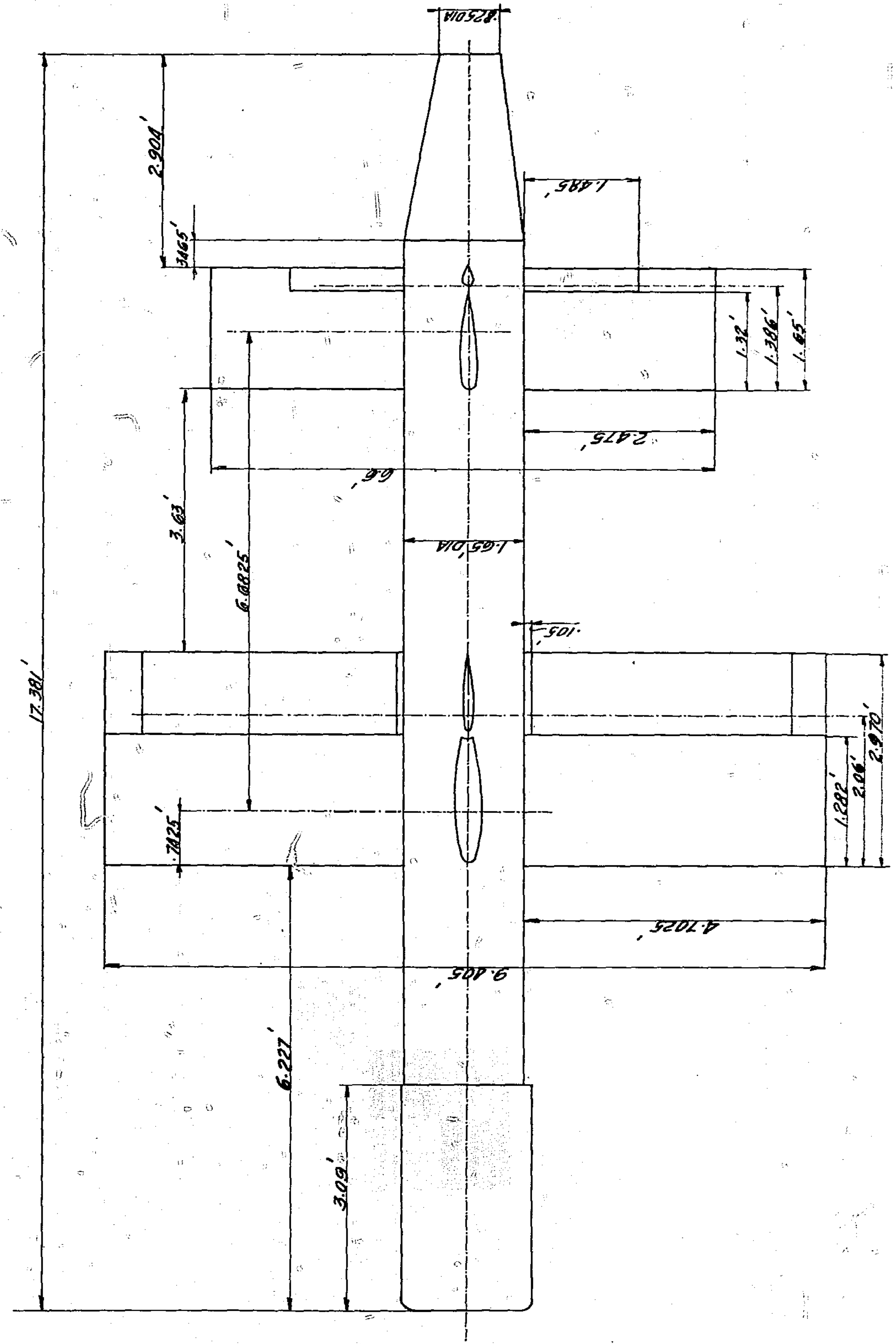


Figure 5
DIMENSIONAL DRAWING--MODEL 109
(All Dimensions in Feet)

3. Mirror: A rotating eccentric mirror was set in back of the head. It was driven by a small electric motor mounted directly behind the mirror. This motor also operated the revolving contact of the distributor. The scanning angle of the focal axis could be altered between 15 and 30 degrees from the bomb's axis of flight. (See Figures 6 and 9.)

4. Bolometer: In construction and composition the bolometers for the heat-homing bomb were said to have been similar to those used in the heat ray detector, for which the following data was obtained:

Composition: Nickel

Thickness: Two microns

Sensitivity:

1. 1/30° C at one meter: laboratory test (see Figure 10);
2. Man's face at 100 meters (327 ft);
3. 1000 ton ship from 2000 meters (6,600 ft) under ideal conditions.

Background for Research: Paper by Dr. Strong at Naval Research Laboratory, 1932.

In B-1 bombs, the bolometer strips were mounted behind a rock salt window 1.5mm thick in an air-tight case. Individual strips were mounted by brass pins in a bakelite case. (See Figure 11.) Various configurations were used or contemplated. (See Figure 12.) The head found at MATSUMOTO used four strips. (See Figure 7.)

The mirror system of the bomb focused upon the bolometer head heat concentrations located between the 40 degree cone maximum view and the 15 degree blind spot cone. The locus of areas found ahead of the bomb focused on the bolometer head was a circle around the outside of the head. (See Figure 13.) A resistance change in a bolometer strip caused by the passing of a heat signal upset the balance of a Wheatstone bridge allowing a signal from a local oscillator to be fed to an amplifier. (See Figure 11.)

C. Control System

1. Amplifier: The amplifier was contained in a metal case mounted in the head frame behind the mirror. (See Figure 14.) The four relays known collectively as the "second relay" were mounted on a chassis fastened to that of the amplifier. (See Figure 8.) Batteries supplying power for the amplifier and motor were located in the rear of the head frame, directly before the warhead.

A local oscillator impressed a signal of 2000 cycles across the Wheatstone bridge. (See Figure 11.) A change of resistance in a strip upset the bridge, allowing a portion of the oscillator signal, proportional in amplitude to the change of resistance (hence intensity of heat signal) to be fed to the amplifier. Miscellaneous frequencies such as random noise would not be passed by the amplifier which was tuned to the oscillator frequency of 2000 cycles. When a signal caused over 1ma plate current to flow through the final stage, the first relay would close. A "threshold" potentiometer was located in the previous stage determining the amplitude of signals required to activate the first relay. The closing of this relay grounded the rotating arm of the distributor, causing one of the four second relays to close. The distributor arm and mirror were driven together by the same electric motor, (1 1/2 RPM) hence that particular circuit with which the arm was in contact at any instant was that whose

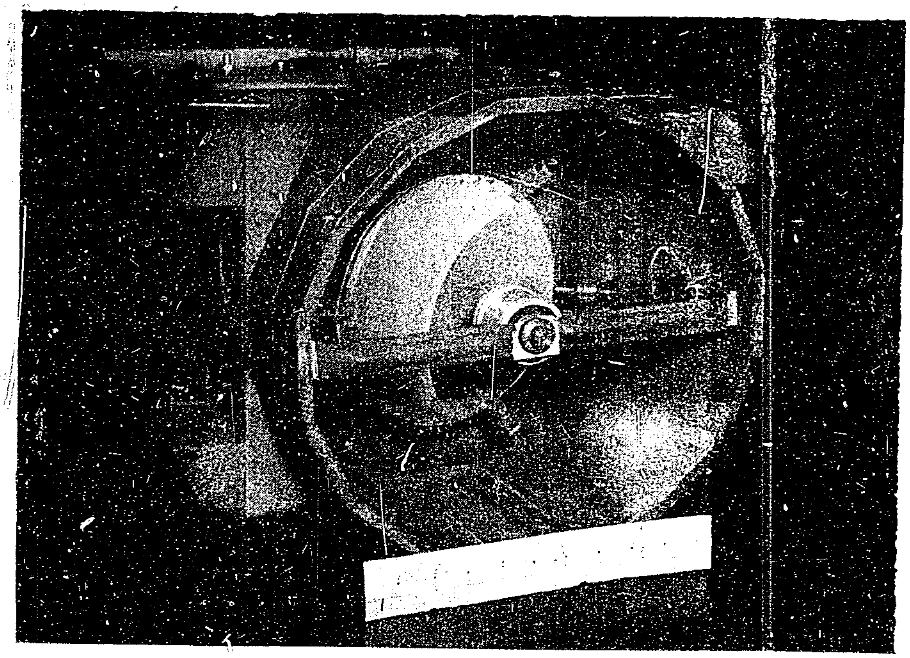


Figure 6
SENSING HEAD - FRONT VIEW

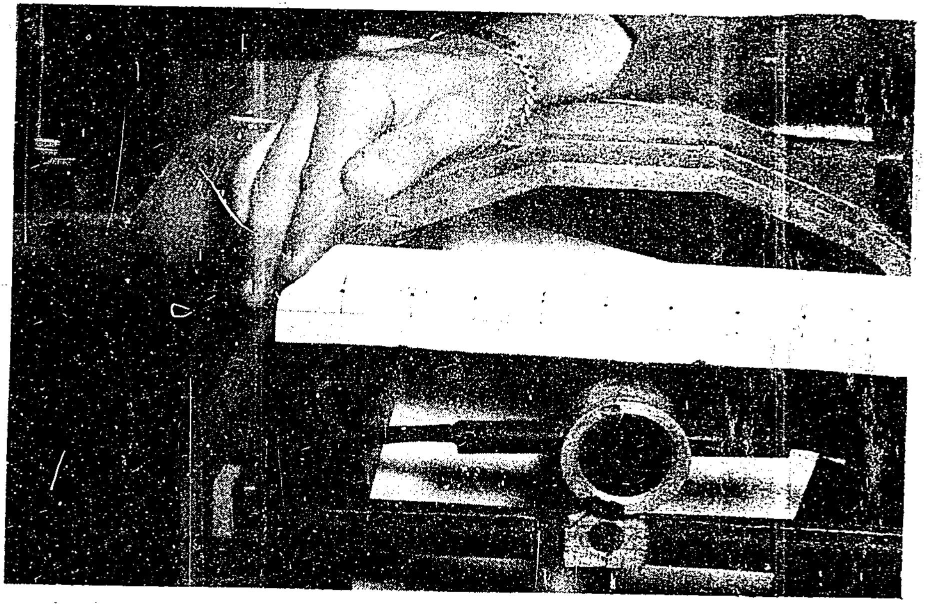


Figure 7
BOLOMETER UNIT

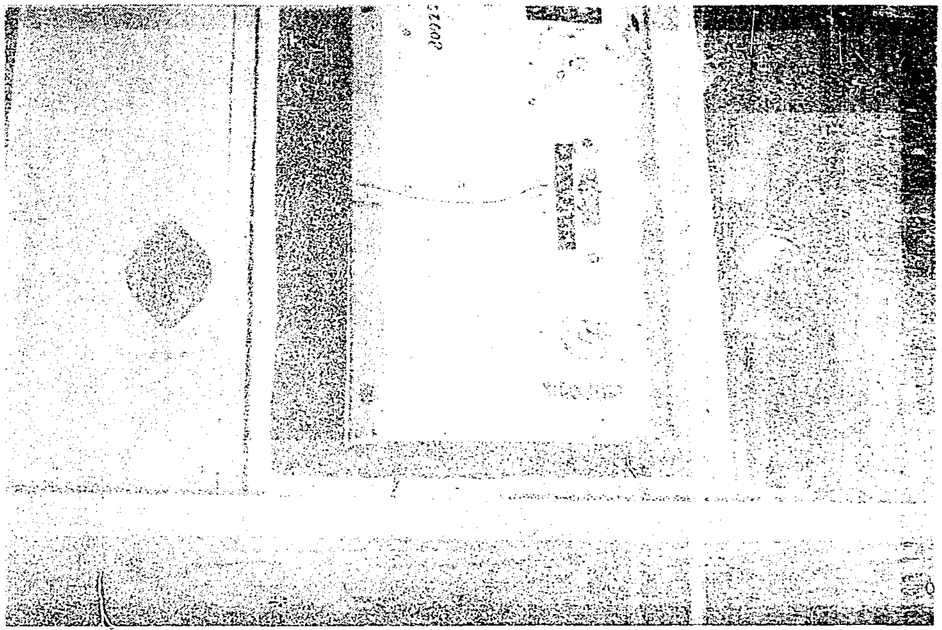


Figure 8

AMPLIFIER INSTALLED

activation would alter the course of the bomb towards the direction the mirror was looking. Thus, the closed second relay has energized a solenoid, which through a mechanical link controls an oil valve. (See Figure 15.) Oil now flowing into the servo cylinder has moved the piston and connected control surfaces to dive the bomb toward the heat source which the mirror had picked up while looking down. (See Figure 16.) The "flaps" on the main wings and the elevators on the tail wings are joined by a connecting rod which makes them operate simultaneously in opposite directions for maximum control effect of the bomb.

2. Hydraulic system: On all models a hydraulic system was used to operate the control surfaces and wing extension after take-off. The system also operated the two ailerons in models through B-107. Two accumulators held the oil supply under pressure. When the parent plane with bomb had taken off, the first needle valve was opened from the plane by a crank. (See Figures 16 and 17.) Oil flowing into the main wing and tail wing servos extended the lower wings from their horizontal position downward 45 degrees against the pressure of a spring which had held them retracted. Some time before release of the bomb the second needle valve was opened electrically from the plane. This fed the magnetically operated pilot valves through one of their four ports. The other three were: outlet to atmosphere, and two to the parallel control system servos.

In operation, due to the design of the system, the flaps and elevators, once operated, never return to the streamline position. When a heat source was picked up below the bomb's flight axis, the magnetic oil valve operated so that the control surfaces moved. When the heat source moved to the blind spot, and the magnetic oil valve returned to its original position, the servos were not moved back to the neutral position by the hydraulic system. However, due to leakage in the tubing, the control surfaces would gradually return to streamline under the force of the air-

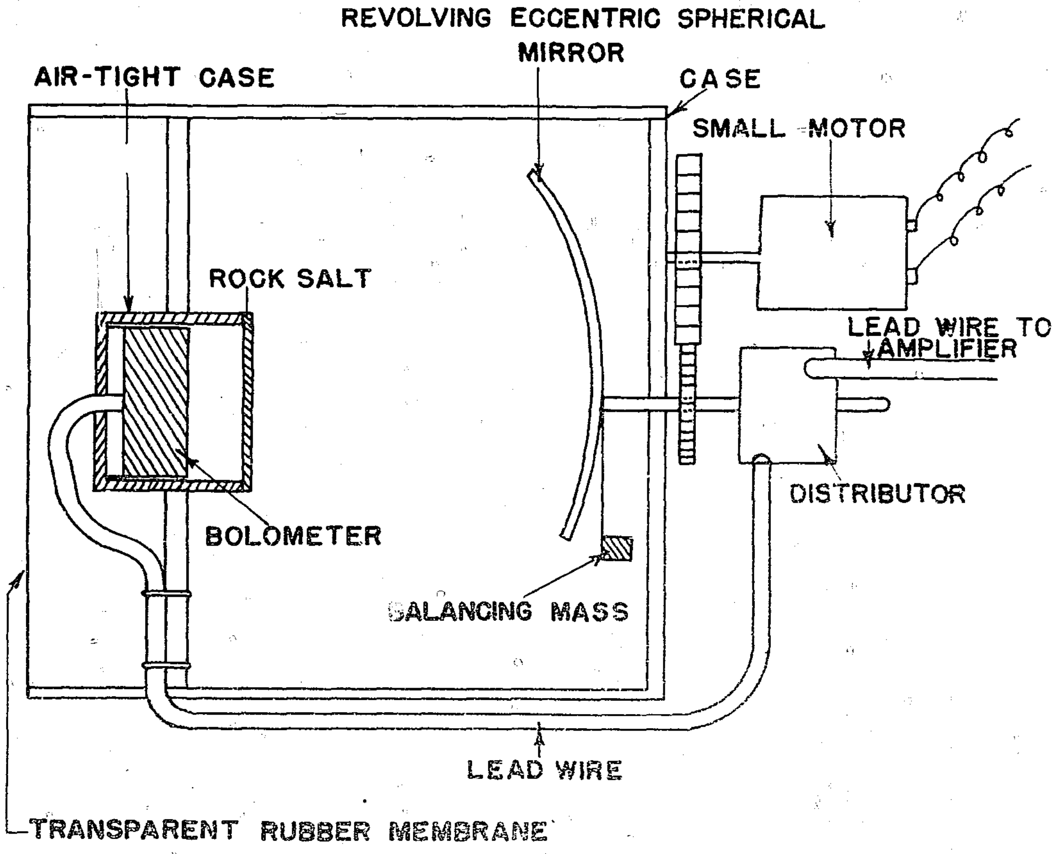
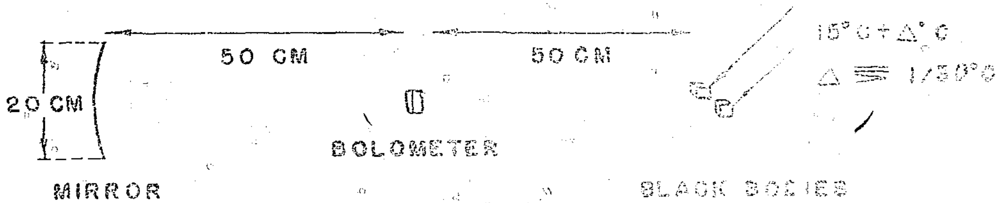


Figure 9
HEAT SENSING UNIT



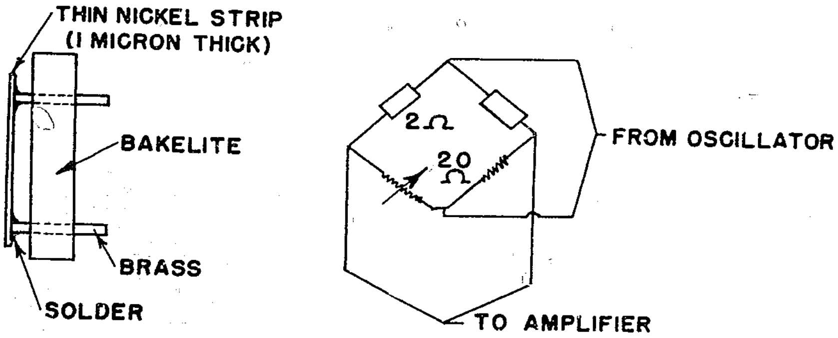


Figure 11
BOLOMETER

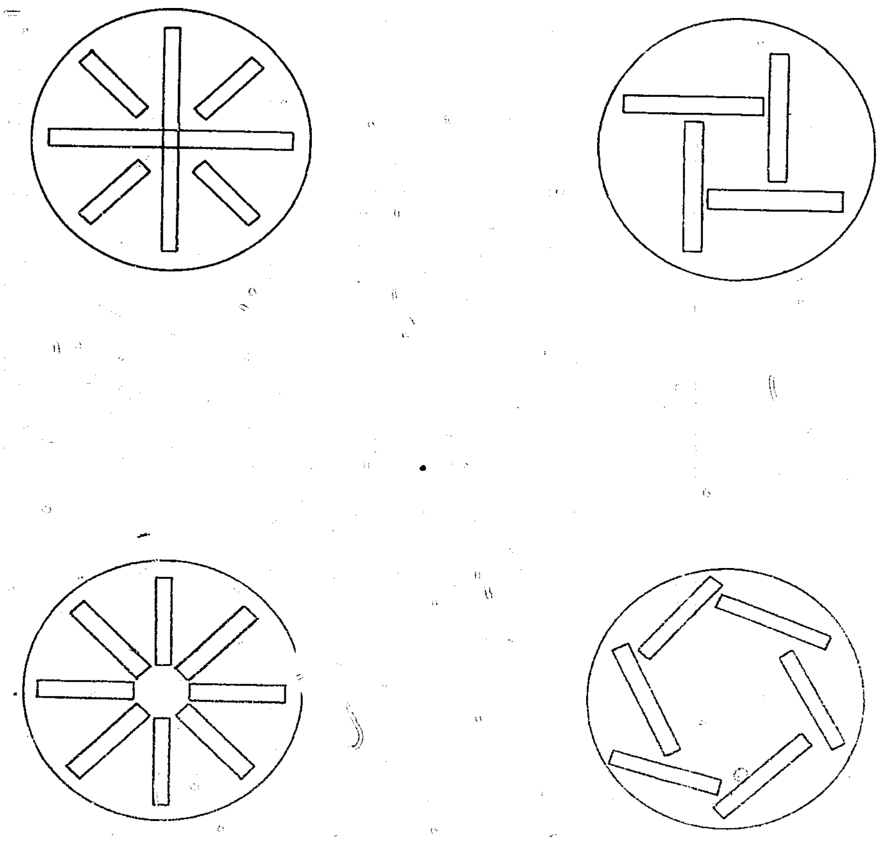


Figure 12
CONFIGURATIONS OF BOLOMETER STRIPS

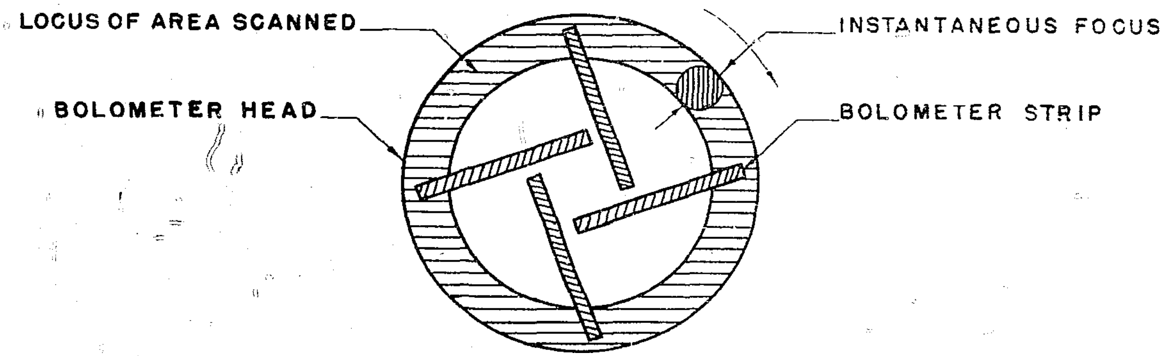


Figure 13
SCANNED PATTERN OF MIRROR ON BOLOMETER HEAD

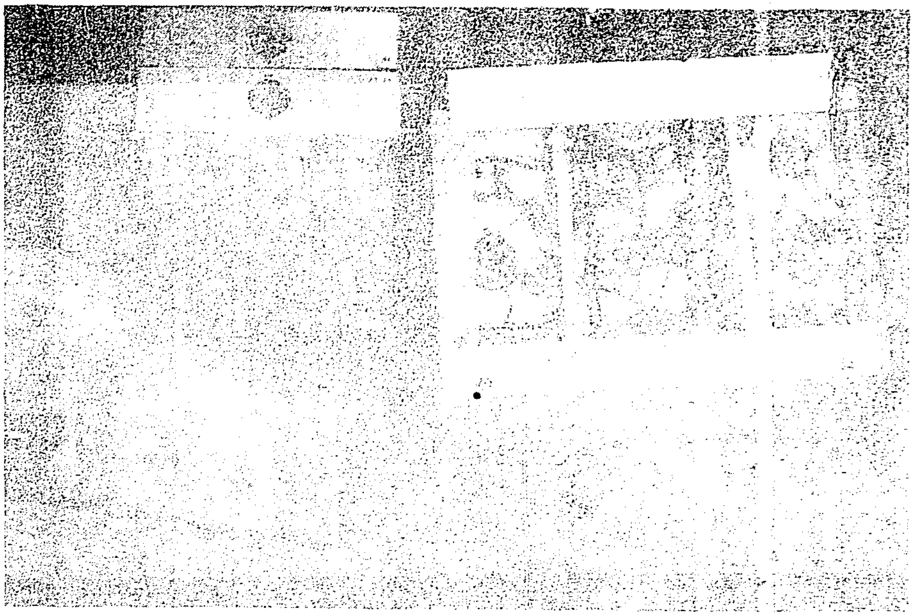


Figure 14
AMPLIFIER AND RELAY BOX

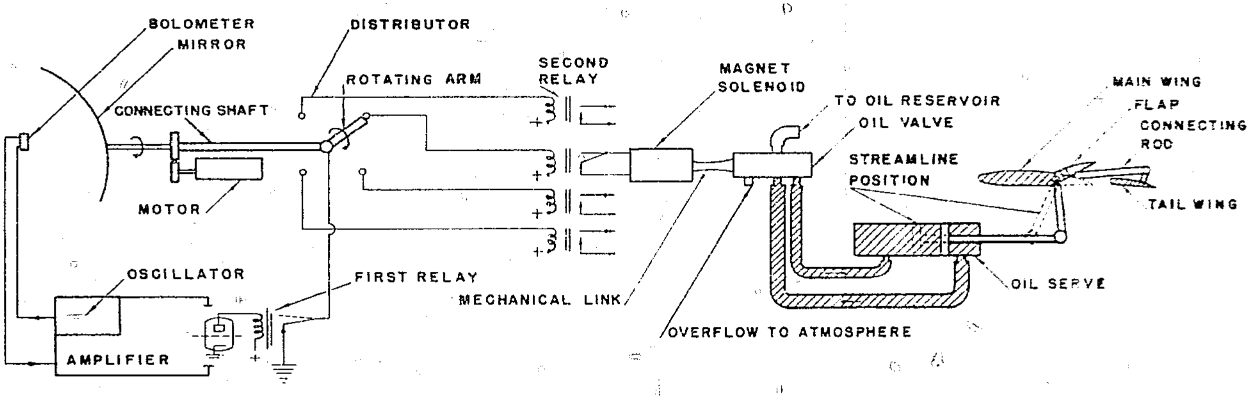


Figure 15
SCHEMATIC OF CONTROL SYSTEM UPON SENSING HEAT SOURCE BELOW FLIGHT AXIS

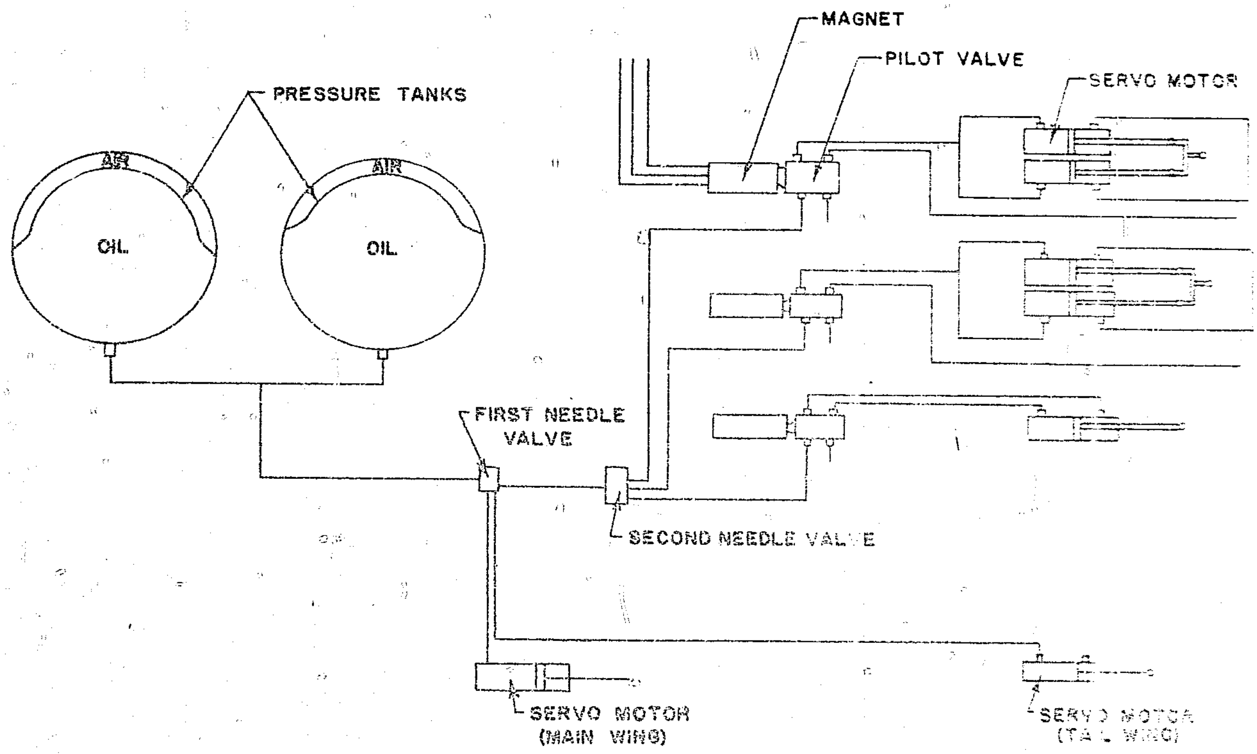
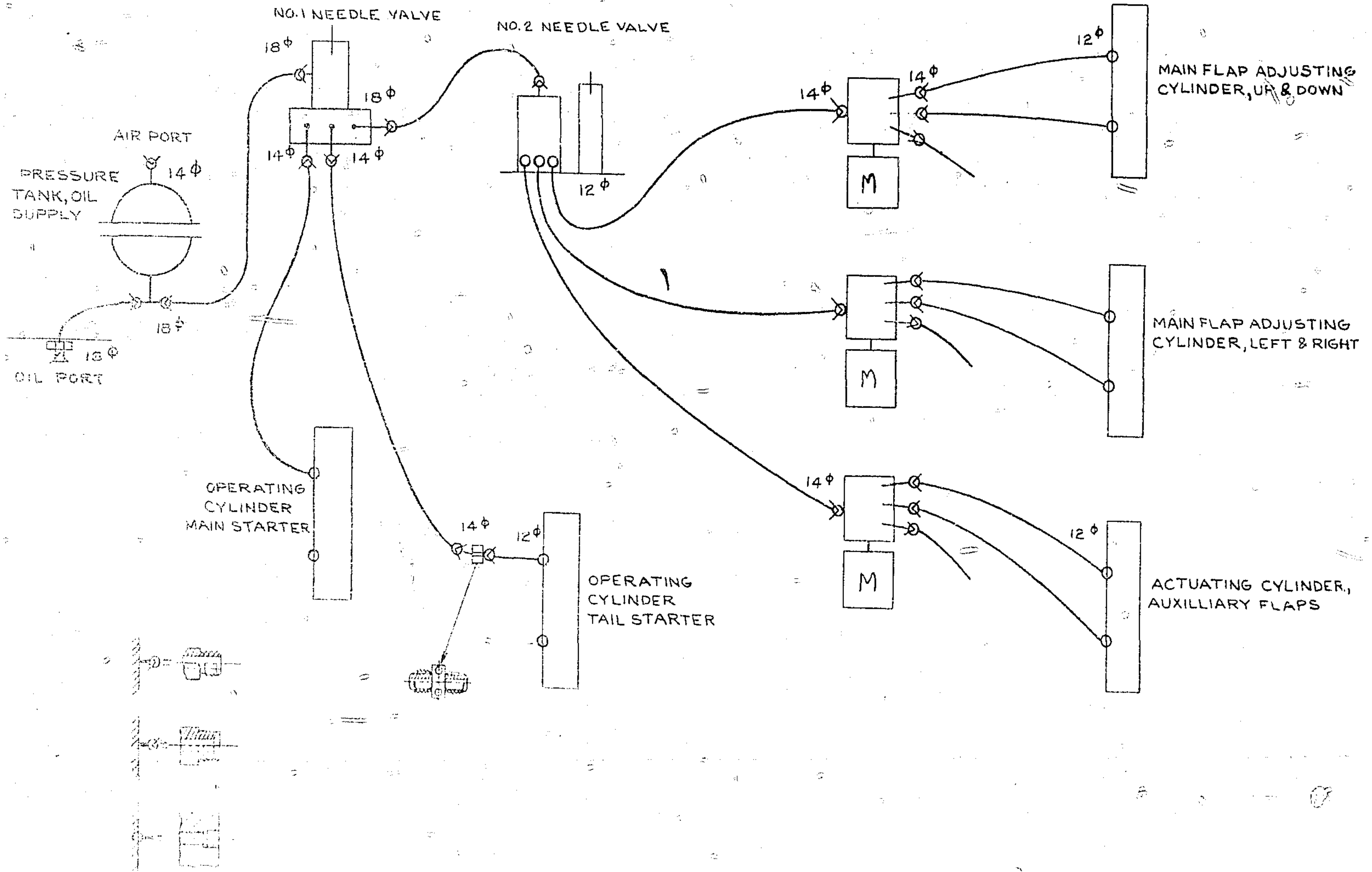


Figure 16
AUTOMATIC PILOT


NO.1 NEEDLE VALVE
NO.2 NEEDLE VALVE
18 ϕ
18 ϕ
14 ϕ
14 ϕ
AIR PORT
14 ϕ
PRESSURE TANK, OIL SUPPLY
18 ϕ
18 ϕ
OIL PORT
12 ϕ
14 ϕ
14 ϕ
12 ϕ
MAIN FLAP ADJUSTING CYLINDER, UP & DOWN
M
MAIN FLAP ADJUSTING CYLINDER, LEFT & RIGHT
M
14 ϕ
12 ϕ
ACTUATING CYLINDER, AUXILLIARY FLAPS
M
OPERATING CYLINDER MAIN STARTER
14 ϕ
12 ϕ
OPERATING CYLINDER TAIL STARTER

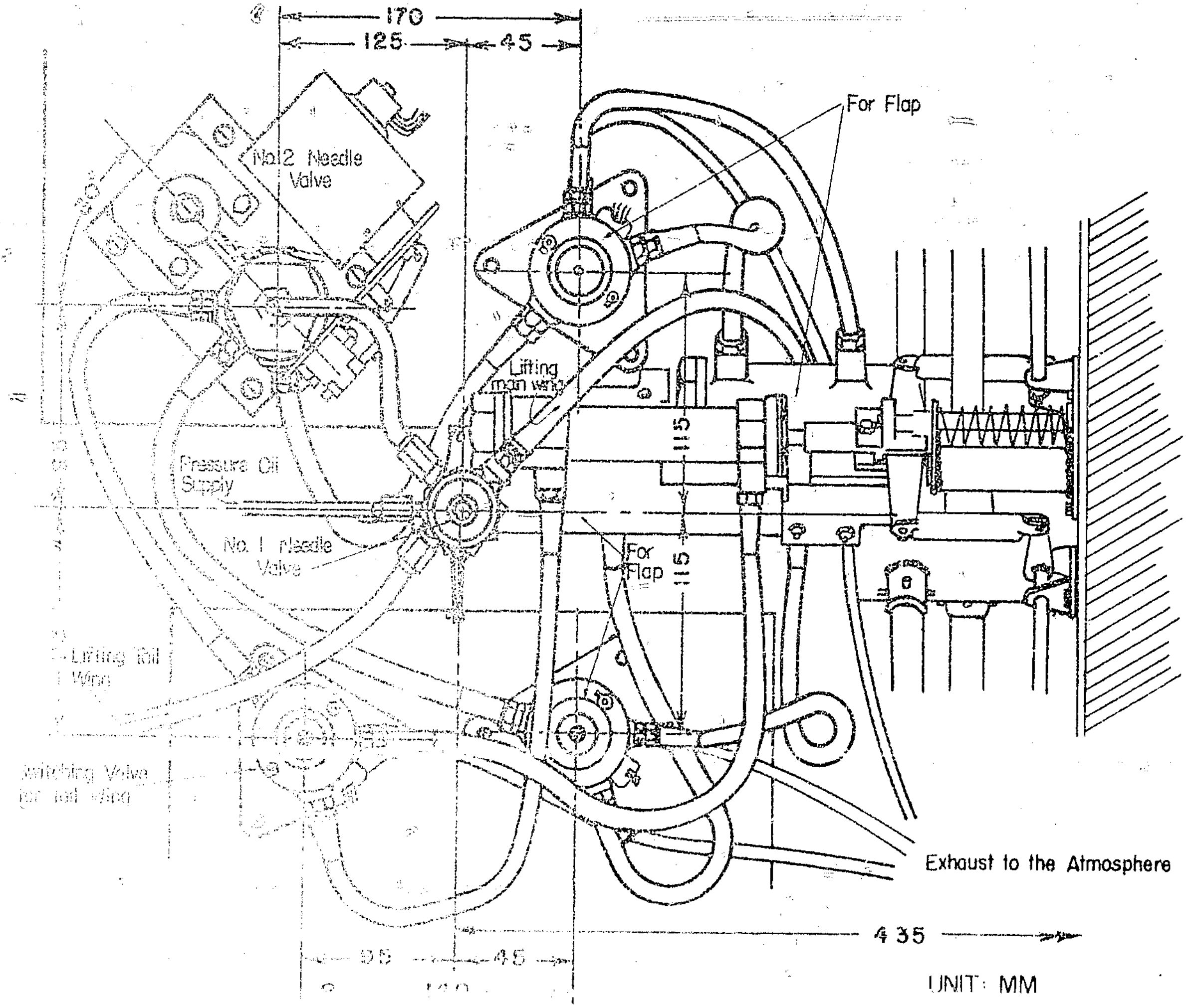


Figure 18
HYDRAULIC SYSTEM

stream. A signal from the opposite quadrant would reverse the position of the control surfaces through the hydraulic system. The control surfaces moved to a maximum of 20 degrees each side of streamline. Servo arrangement can be seen in Figure 16.

3. Gyro: The gryro "semi-stabilization" system of the bomb was unique, since airframe and airfoil of the bomb were symmetrical, and all four relays and servo systems identical, it made no difference which attitude the bomb was in at any instant. Thus rigid stabilization, which would have required a freely mounted reference gyro and constant operation of the airlerons, was not necessary. Instead it was merely required that the bomb be prevented from rotating at too great a velocity. An angular rotation of less than 360 degrees in 50 seconds was allowed. A simple system was employed to check greater rotation. An air driven restricted gyro of the type found in the standard turn indicator was used. The rotor axis was perpendicular to the longitudinal axis of the bomb, whose rotation therefore caused precession. When the bomb rotated faster than the critical velocity, the gyro precessing against an air damper brought two silver electrical contacts together. In models through B-107, this would activate a magnetic oil valve controlling an oil servo to two ailerons. Operation of these units was identical to that of the flaps. (See Figure 19.)

In model 109, the circuits closed by the gyro would operate the four magnetic servos in each main wing tip directly. In models 103-109 an air gyro was used as the previously tried electric gyros caused R.F. interference with the amplifier.

4. Gyro acceptance test:

a. Starting test: Rotor should revolve upon application of 10mm Hg.

b. Friction test: Gyro is brought to speed in 10 minutes, and left at maximum angular velocity for three minutes before pressure is cut off. Rotor should coast for a minimum of five minutes. (See Figure 20.)

c. Vibration:

(1) Visual check of vibration - with pressure of 30mm Hg, contact finger should not vibrate more than 0.5mm maximum.

(2) Air damper test - contact finger should return smoothly with no oscillation after precession.

d. Sensitivity: Gyro frame is turned simulating rotation of bomb. Damper is adjusted so that gyro will precess sufficiently to close contacts upon a rotation greater than 360 degrees in 50 seconds.

e. Electrical contacts: The silver coated contacts must stand repeated make and break contact at four amperes without corroding.

f. Cold test: Assembled gyro units were spot tested with the complete above procedure at -20°C.

D. Warhead

1. Explosive charge: The main charge of all B-1 bombs was located between the head frame and the main wings. The forward end was shaped for a hollow charge explosion which, it was claimed, would have pierced the superstructure or deck of any U.S. ship.

2. Fuzing: Two systems were used to detonate the main charge. One was designed for instantaneous explosion upon striking a solid object such as

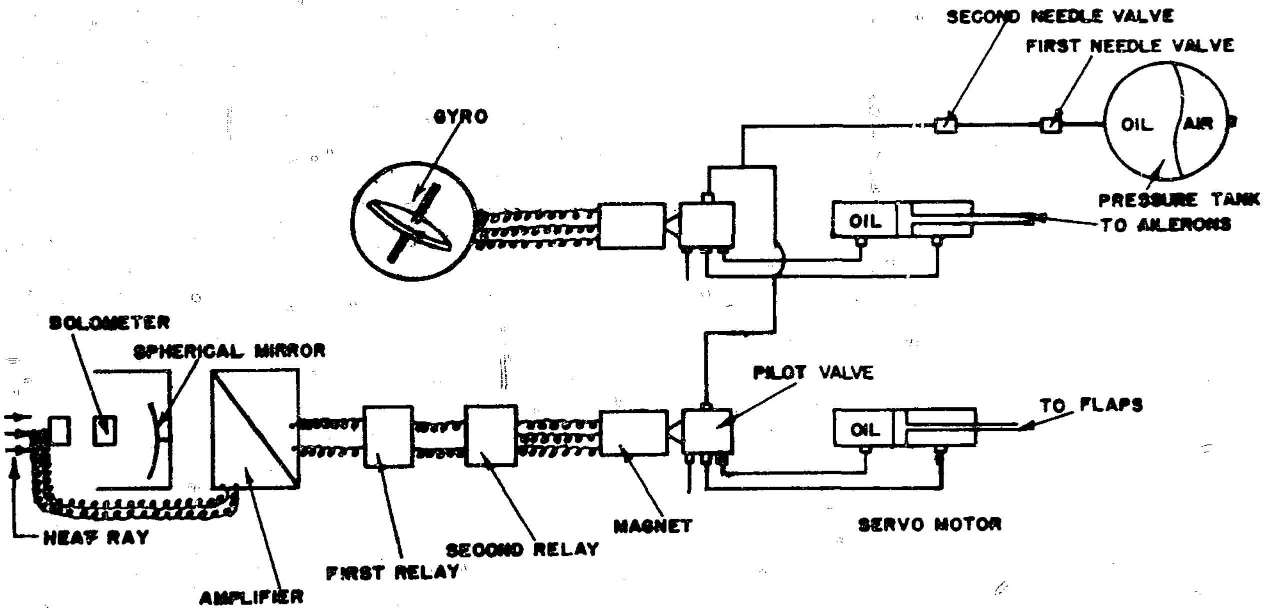


Figure 19
SCHEMATIC OF CONTROL SYSTEM

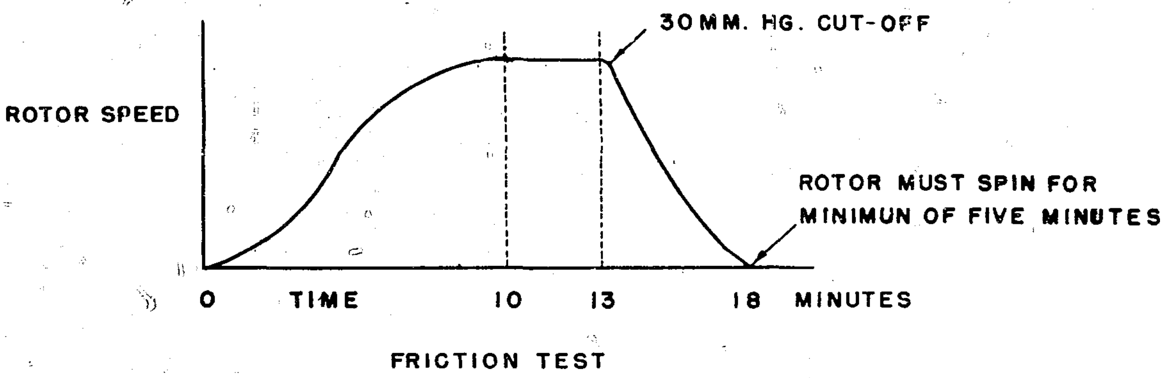


Figure 20
GYRO FRICTION TEST

a ship's deck. This system consisted of a primer in the rear of the main charge set off by contact of its two strikers protruding beyond the nose of the bomb. These were armed by small propellors when the arming wire was pulled upon release of the bomb. The second system was designed to detonate the warhead after a slight delay if it struck water, since a near-miss would cause greater damage to a ship if the charge exploded some distance below the water surface. The fuze used was described as a standard impact delay type, air armed by an anemometer, termed a "Robinson Cup Anemometer". It was assumed that the protruding strikers would survive the shock of entering the water and not set off the instantaneous system. It was said that no bombs were dropped with a live charge.

E. Bombing

1. Pre-flight: Provisions were made for checking circuits on the ground prior to dropping. A standard bomb truck was used to carry the bomb to its parent plane. Here it was hung by a unique method. A large Vee brace was built in the bomb bay whose apex extended a few inches below the skin of the parent plane. This supported the bomb above its center of gravity. Two cushioned braces were attached to the parent plane fore and aft of the supporting braces. The bomb was pulled up and held snug against these, being unable to sway or swing. The lower wings were held in a horizontal position by an internal spring. Connection of the electric plug, winding of the timer, and attachment of the arming wires completed pre-flight procedure.

2. Pre-drop: Ten minutes before the bomb was to be dropped the following preparations were made from the parent plane:

   a. The first needle valve was opened mechanically by a crank, extending the lower wings.

   b. The second needle valve was opened electrically feeding the oil servo system.

   c. A magnetic release allowed the air gyro to spin up.

   d. The amplifier pre-heat circuit was turned on. This was a loop of nichrone wire around the inside of the amplifier box.

   e. The mechanical timer was set, determining the interval during the bomb's fall before the control circuits were turned on. This usually occurred at 1000 meters (3,280 ft). (See Figure 21.) Before take-off the timer was wound up to its maximum duration of 50 seconds. The bombardier computed the time interval required for the bomb to fall to 3000 ft. This he would subtract from the 50 seconds of the timer. Looking at a stop watch, he closed a switch allowing the timer to unwind this "difference" time. Thus the timer's remaining duration would be that of the originally computed interval. It began operating upon the bomb's release, and on running out closed a contact, switching on the mirror, motor and amplifier. With these preparations the bomb was ready for release.

3. Release: A standard bombsight and bombing tables for a missile of equivalent weight were used. The bomb release switch started the timer. Arming wires, attached to the projecting striker vanes and anemometer of fuzing systems, were pulled out. A wire likewise released the tail brake, which opened immediately in the air stream. The speed of the parent bomber increased from about 210 to 250 mph upon release of the bomb.

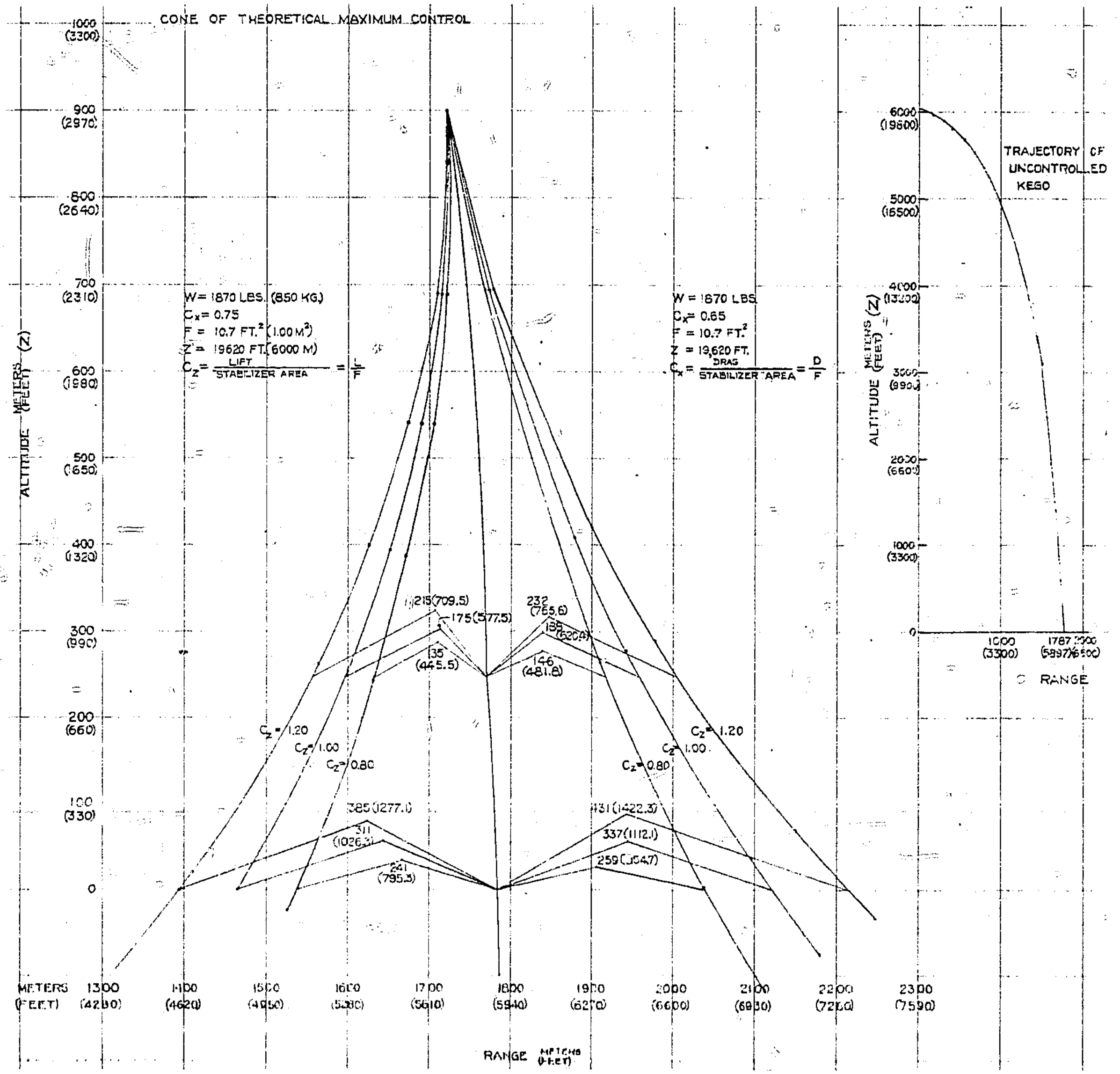


Figure 21

CONE OF THEORETICAL MAXIMUM CONTROL

F. Testing

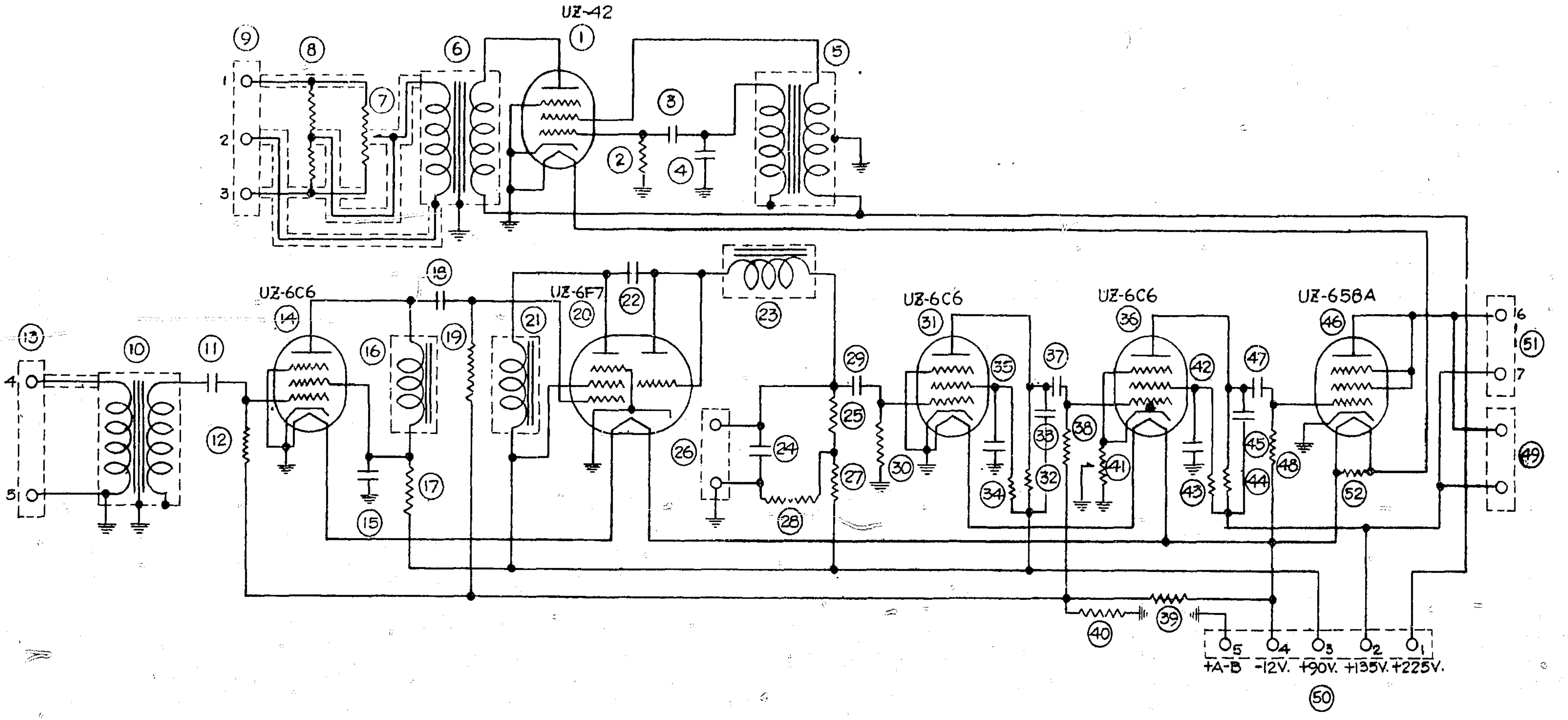
1. Drop testing: Drop testing was carried out at HAMAMATSU Bay between December 1944 and July 1945. The target raft, 10 meters x 30 meters, burned wood and coal. About 60 bombs, principally Types 106 and 107, were dropped at night. Altitude of release varied from 1500 to 3000 meters (about 5,000 to 10,000 ft). None were dropped on a moving target or raised for autopsy. Performance check was accomplished by a continuous exposure camera located beside the bay. A light on the tail of the bomb produced a trace which could be analyzed.

Only five or six were termed by the Japanese "successful", which denoted a bomb obviously picking up the heat signal and taking control. This is a poor showing considering the ideal conditions - an isolated, strongly heated target with a uniformly cool (10 to 20 degrees centigrade) background. However, the designers had great faith that their model 109 with its increased wing area would prove more successful.

2. Other testing: Wind tunnel tests were run at TACHIKAWA. (See Enclosure (A), items 2, 3, 4 and 5.) One bomb was vibration tested.

G. Wiring Diagrams

See Figures 22, 23, and 24.



NO.	DESCRIPTION	RATING	TYPE-MODEL	NO.	DESCRIPTION	RATING	TYPE-MODEL	NO.	DESCRIPTION	RATING	TYPE-MODEL
1	OSCILLATOR TUBE	UZ-42		20	H-F #2 STAGE AMPLIFIER DETECTOR TUBE	UZ-6F7		39	L-F #1 STAGE AMPLIFIER BIAS VOLTAGE DIV. RESISTOR-A	1KΩ	MK.A MOD.05
2	SPECIFIED RESISTANCE FOR OSCILLATOR	50KΩ	MK.A MOD.05	21	H-F #2 STAGE AMPLIFIER PLATE CHOKE COIL	30H		40	L-F #1 STAGE AMPLIFIER BIAS VOLTAGE DIV. RESISTOR-B	100Ω	MK.A MOD.05
3	OSCILLATOR COUPLING CONDENSER	0001μF 1000V	MK.A MOD. 2	22	DETECTOR COUPLING CONDENSER	0002μF 1000V	MK.A MOD. 2	41	GAIN ADJUSTOR TRANSFORMER RESISTANCE	5KΩ	
4	OSCILLATOR TUNING CONDENSER	.002μF 1000 V.		23	DETECTOR PLATE CHOKE COIL	30H		42	L-F #2 STAGE AMPLIFIER BY-PASS CONDENSER	1μF1000V	MK.A MOD. 2
5	OSCILLATOR TUNING TRANSFORMER	2:1		24	DETECTOR PLATE BY-PASS CONDENSER	01μF 1000V	MK.C MOD. 2	43	L-F #2 STAGE AMPLIFIER SPECIFIED RESISTOR	1MΩ	MK.A MOD. 2
6	OSCILLATOR OUTPUT TRANSFORMER	35:1		25	DETECTOR PLATE RESISTOR	1MΩ	MK.A MOD. 2	44	L-F #2 STAGE AMPLIFIER PLATE RESISTOR	250KΩ	MK.A MOD.05
7	BALANCED VARIABLE RESISTANCE	6Ω		26	SOCKETS			45	L-F #2 STAGE AMPLIFIER PLATE CONDENSER	002μF 1000V	CYLINDRICAL-PAPER
8	BALANCED RESISTANCE	2Ω	INTERM'L TERMINAL	27	DETECTOR PLATE VOLTAGE DIVIDER RESISTANCE, A	100KΩ	MK.A MOD.05	46	POWER OUTPUT TUBE	MC-658A	
9	BALANCED OUTPUT TERMINAL PANEL	0002μF 1000V	3 PRONGED TERMINALS	28	DETECTOR PLATE VOLTAGE DIVIDER RESISTANCE, B	20KΩ	MK.A MOD.05	47	OUTPUT COUPLING CONDENSER	01μF	MK.C MOD. 2
10	INPUT TRANSFORMER	1:50		29	L-F #1 STAGE AMPLIFIER COUPLING CONDENSER	01μF 1000V.	MK.C MOD. 2	48	OUTPUT SPECIFIED RESISTOR	500KΩ	MK.A MOD.05
11	HIGH FREQUENCY #1 STAGE AMPLIFIER COUPLING CONDEN.		MK.A MOD. 2	30	L-F #1 STAGE AMPLIFIER SPECIFIED RESISTOR	500KΩ	MK.A MOD.05	49	OUTPUT CHECK-SOCKET		
12	H-F #1 STAGE AMPLIFIER SPECIFIED RESISTANCE	500KΩ	MK.A MOD.05	31	L-F #1 STAGE AMPLIFIER TUBE	UZ-6C6		50	POWER SUPPLY TERMINAL PANEL		5 PRONG TERMINALS
13	BALANCED INPUT TERMINAL PLATE	1μF1000V	3 PRONGED TERMINALS	32	L-F #1 STAGE AMPLIFIER PLATE RESISTANCE	250KΩ	MK.A MOD.05	51	OUTPUT TERMINAL PANEL		
14	HIGH FREQUENCY #1 STAGE AMPLIFIER TUBE	UZ-6C6		33	L-F #1 STAGE AMPLIFIER PLATE CONDENSER	.002μF 1000V.		52	OUTPUT FILAMENT SHUNT RESISTOR	60Ω	
15	H-F #1 STAGE AMPLIFIER PLATE BY-PASS CONDENSER		MK.A MOD. 2	34	L-F #1 STAGE AMPLIFIER SPECIFIED RESISTOR	1MΩ	MK.A MOD. 2				
16	H-F #1 STAGE AMPLIFIER PLATE CHOKE COIL	30H		35	L-F #1 STAGE AMPLIFIER CONDENSER	1μF1000V	MK.A MOD. 2				
17	H-F #1 STAGE AMPLIFIER PLATE RESISTOR	1MΩ	MK.A MOD. 2	36	L-F #1 STAGE AMPLIFIER TUBE	UZ-6C6					
18	H-F #2 STAGE AMPLIFIER COUPLING CONDENSER	.0002μF 1000V.	MK.A. MOD. 2	37	L-F #1 STAGE AMPLIFIER COUPLING CONDENSER	01μF	MK.C MOD. 2				
19	H-F #2 STAGE AMPLIFIER SPECIFIED RESISTOR	500KΩ	MK.A MOD.05	38	L-F #1 STAGE AMPLIFIER SPECIFIED RESISTOR	500KΩ	MK.A MOD.05				

Figure 22

AMPLIFIER SCHEMATIC

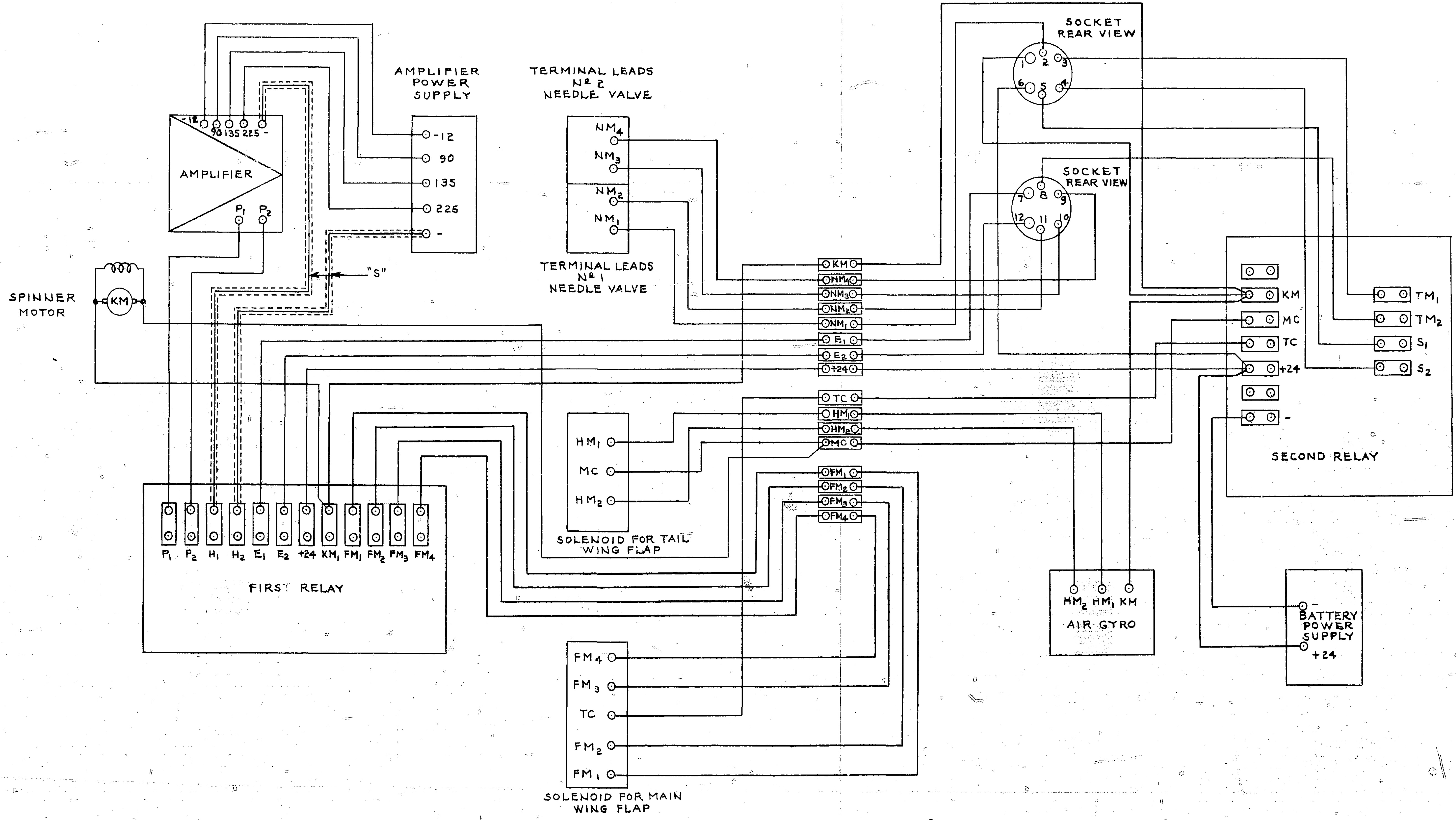


Figure 23

BOMB WIRING DIAGRAM

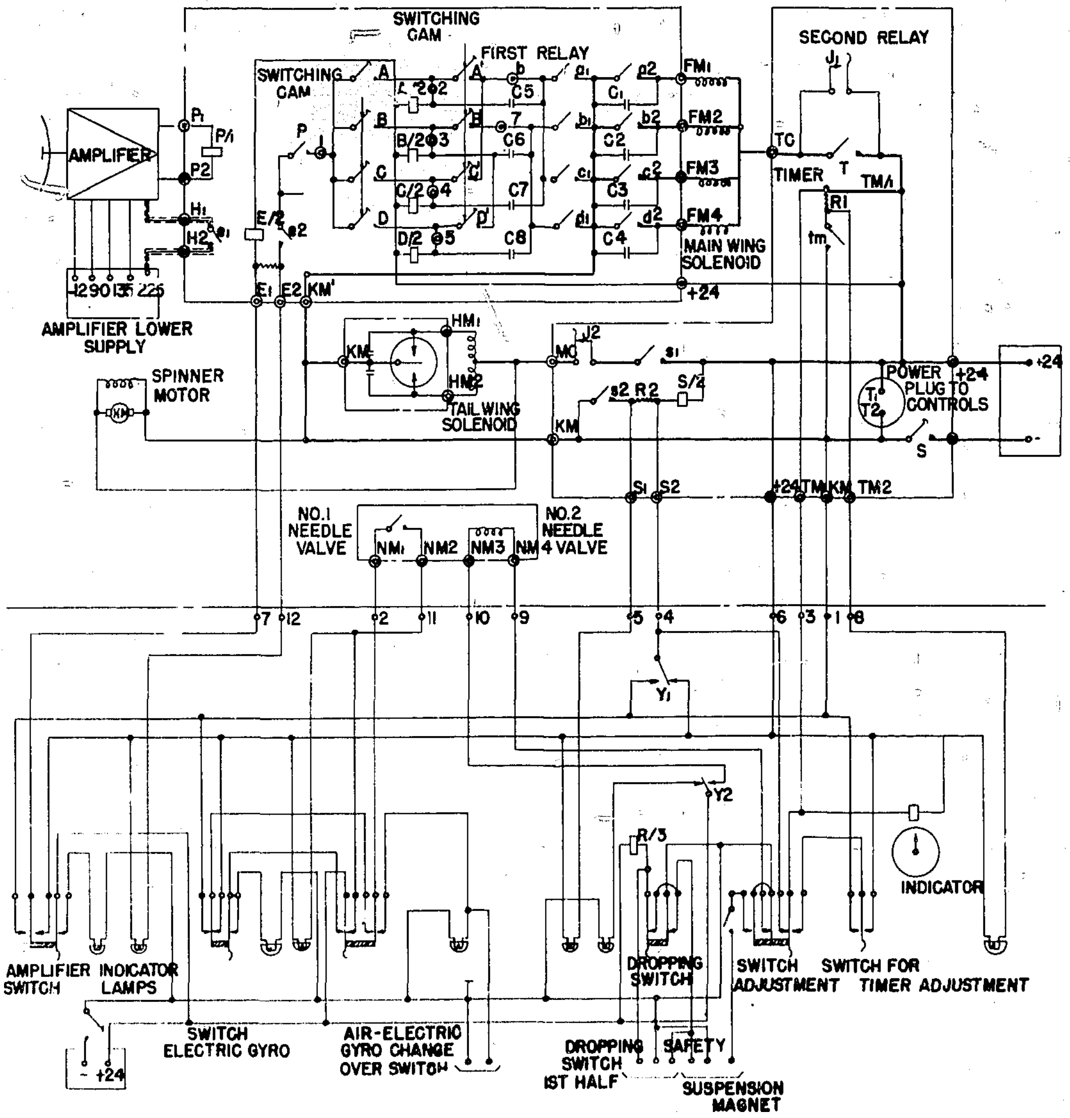


Figure 24

SCHEMATIC OF COMPLETE CIRCUIT - PLANE AND BOMB

ENCLOSURE (A)

LIST OF DOCUMENTS FORWARDED TO THE AIR DOCUMENTS DIVISION, WRIGHT FIELD, DAYTON, OHIO, BY AIR TECHNICAL INTELLIGENCE GROUP

1. Heat Seeking Bomb - Parts Lists and Transcriptions of Conferences on Development, Listing Officers and their Assignments in Project.
2. Characteristics of the B-107 Half Size Model Hanging in Wind Tunnel with Wings at Right Angles.
3. Characteristics of the B-107 Half Size Model Hanging in Wind Tunnel with Wings at 45 Degrees as in a Drop.
4. B-107 Half Size Model - Wind Tunnel Determination of Rolling Moments from Errors in Control Surface Angles.
5. B-106 Wind Tunnel Test Data.
6. Two View Drawings - Basic Designs of Heat Seeking Bombs B1, B2, and B3.
7. Bomb Rack for Heat Seeking Bomb.
8. Bomb Truck.
9. Second Needle Valve.
10. Gyro Acceptance Tests.
11. Drawings of Air Gyro Used in B-107, B-108, B-109.
12. Timing Device for all Models.
13. Air Gyro Compartment.
14. Electric Gyro Test Procedure.
15. Electric Gyro Sealed Case (2).
16. Tail Section.
17. Plane-Bomb Circuits (3).
18. Catalogue of Revised Drawings as of January 1945.
19. First Needle Valve.
20. Warhead Type 1.
21. Heat Seeking Bomb - Packing for Shipping.
22. Approximately 125 Blueprints of Miscellaneous Small Parts.
23. Flap Control Mechanism (Main Wing).
24. Tail Wing Folding System.
25. Tail Wing Structure.
26. Aileron Control System.
27. Air Brake.
28. Main Wing Structure Model 109.
29. Main Wing Folding System (Folded Position) B-109.
30. Fuselage Frame Tail Section B-109.
31. Spacer for Constant Pressure Tank B-109.
32. Fuselage Frame #8 and #479 B-109.
33. B-109 Miscellaneous Drawings Fuselage and Fittings.
34. Frame and Stringer Assembly Fuselage B-109.
35. Outer Skin Midsection Fuselage.
36. Nose Section Fuselage Assembly and Detailed Drawings with Charge (Warhead) Assembly.
37. Complete Fuselage Assembly B-109.
38. Connecting Piece between Nose and Midsection of Fuselage.
39. Second Needle Valve Model 2.
40. Main Wing Assembly, (Fixed Wing).
41. Oil Pressure Cock Model 2.
42. Nose Fuselage (Old Type).
43. Electronic Installation (Marked to be Discarded).
44. Midsection of Fuselage.
45. Bomb Circuit (Revised).
46. Gyro Unit Mounted.
47. Relay Box Circuit (Model 2).
48. Relay Box Assembly.
49. Dynamic Tube.
50. Complete Assembly B-10.
51. Aileron Control Device.
52. Summary of Results of Wind Tunnel Tests on KEGO Type B-2 (in English) ATIG Documents and Records File No. d-01-77.

ENCLOSURE (B)

LIST OF JAPANESE EQUIPMENT SHIPPED TO THE NAVAL RESEARCH LABORATORY, ANACOSTIA, D.C.

NavTechJap Equipment No.	Description
JE50-5816	Heat-Homing Bomb Head and Amplifier.
JE50-5817	Heat-Homing Bomb Head and Amplifier.