GCI OPERATIONS COMMUNICATION CHANNELS		GCI SWITCHBOARD (P-B-X)	GCI CONTROLLER	LIAISON OPERATOR	PPI READER	PLOTTER COMPUTER	RECORDER	CREW CHIEF	RADAR MECHANIC	GUARDS	PLOTTER GEN. SITUATION BOARD
VHF STATION	TRANS-RECEIVER OPERATOR	●	●								
		●	●					●			
AREA OPERATIONS ROOM	AREA CONTROLLER	●	●								
	GCI LIAISON	●	●	●							
	GCI PLOTTER	●			●	●	●				
	TELLER TO GCI	●									●
RADAR FILTER ROOM	PLOTTER	●			●						
NEAREST CHL RADAR STATION	OPERATOR	●	●	●							
"Y" SERVICE	(IF AVAILABLE)			●							
EACH ADJOINING GCI STATION	CONTROLLER	●	●	●							
GCI D/F STATION	OPERATOR	●		●		●					
ADMINISTRATIVE UNITS	ORDERLY ROOM	●						●			
	STOCK ROOM	●						●	●		
	GUARD TENT	●						●		●	
NIGHT FIGHTER AIRDROME	SQUADRON OPERATIONS	●		●							

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FIG. 1

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MASTER PHONE CHART FOR GCI STATION

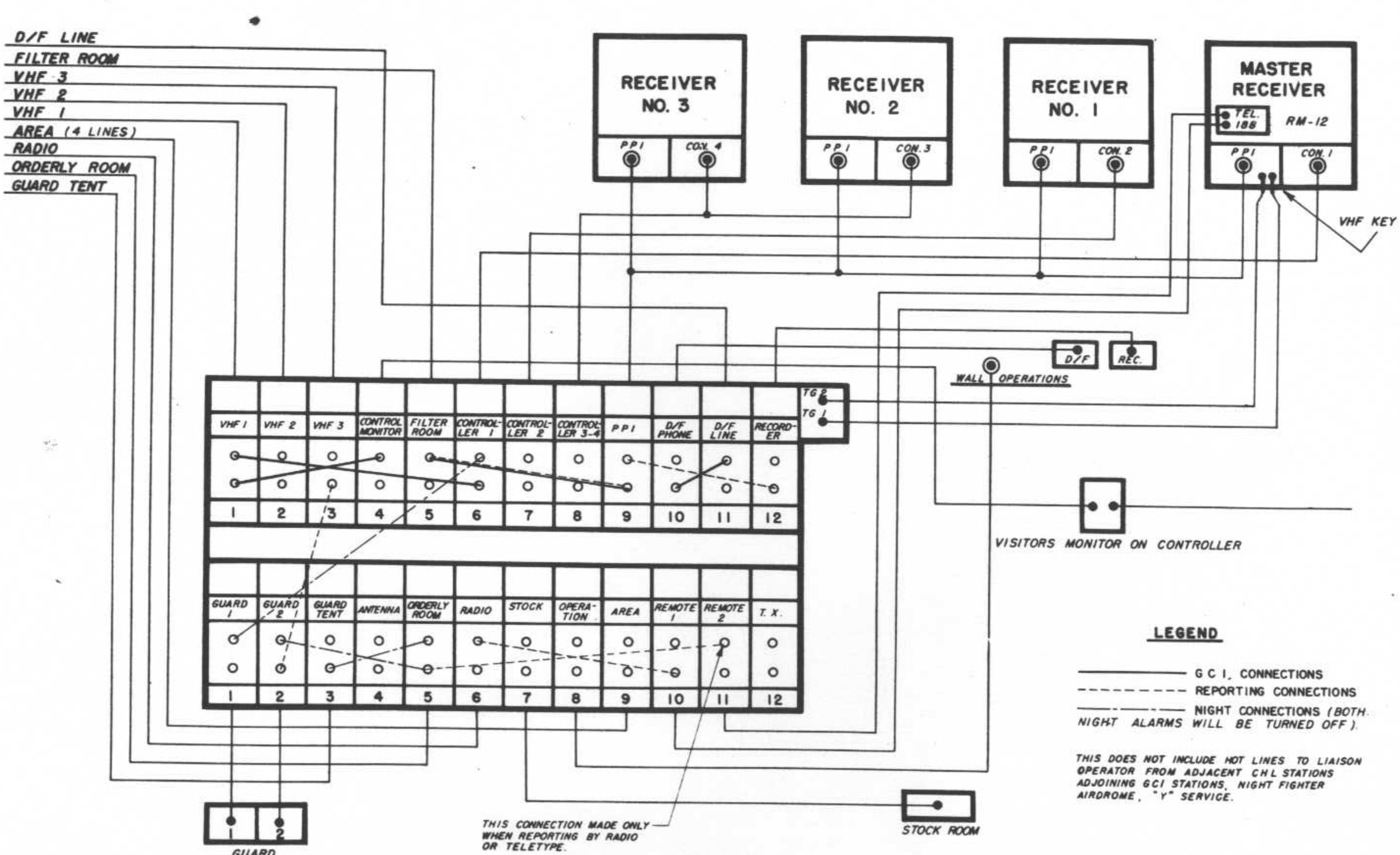

FIG. 2

f. Office
(Connected through switchboard)

g. Stock Room
(Connected through switchboard)

4. OPERATIONAL REQUIREMENTS

a. VHF Radio Telephone Station. - - There will be two lines connecting the adjacent VHF van - one for Direct VHF communication between Controller and Fighter Pilots, and one as a spare line. Another line should be run between station and VHF van for field telephones connecting the Crew Chief, Controller and VHF Operator.

b. Area Operations Room. - - Four lines connect the GCI station and Area operations room. One provides two-way speech between the GCI Controller and the Area Controller. A second hot line connects the liaison operator with the GCI liaison officer in Area. Over this line will flow the general information passed by the GCI Liaison Officer to the GCI station. A third hot line connects the Area Teller to the GCI General Situations Board Plotter. Not only will this line pass information to the GSB Plotter when the station is on intercept, but will suffice as an additional reporting line when the station is on reporting. The fourth line connects the PPI reader with the GCI Plotter in Area. Both the Plotter-Computer and Recorder are connected to this line by means of a one-receive head set, which enables them to hear plots as read by the PPI reader, as well as instructions given by the Controller. Grid coordinates of the target and fighter as seen on the PPI

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tube are read over this line.

c. Radar Filter Room. - - This is a hot line connecting filter room Plotter with the PPI Reader at the GCI station, and is used when the GCI station is reporting. If the radar filter room is adjacent to the Area Operations room, communication line No. 4 may be used for this operation.

d. Adjacent CHL Station. - - In the Theatre of Operations where there is no filter room, one line is provided from GCI to the nearest coastal radar station to:

(1) inquire whether IFF is showing on a target about to be attacked,

(2) obtain other information, such as height, etc. before the target is near enough for GCI heights, and

(3) as a means of communication between the two stations.

e. Adjoining GCI Station. - - Telephone connection should be provided with each adjoining GCI station. These latteral connections permit rapid transmission of messages and information concerning the passing of raids from one station to another.

f. Night Fighter Airdrome. - - If possible, a direct line connecting the Night Fighter airdrome with the GCI Liaison Operator will be provided. This line will be used primarily when the GCI station has some tactical control over Night Fighter operations, where

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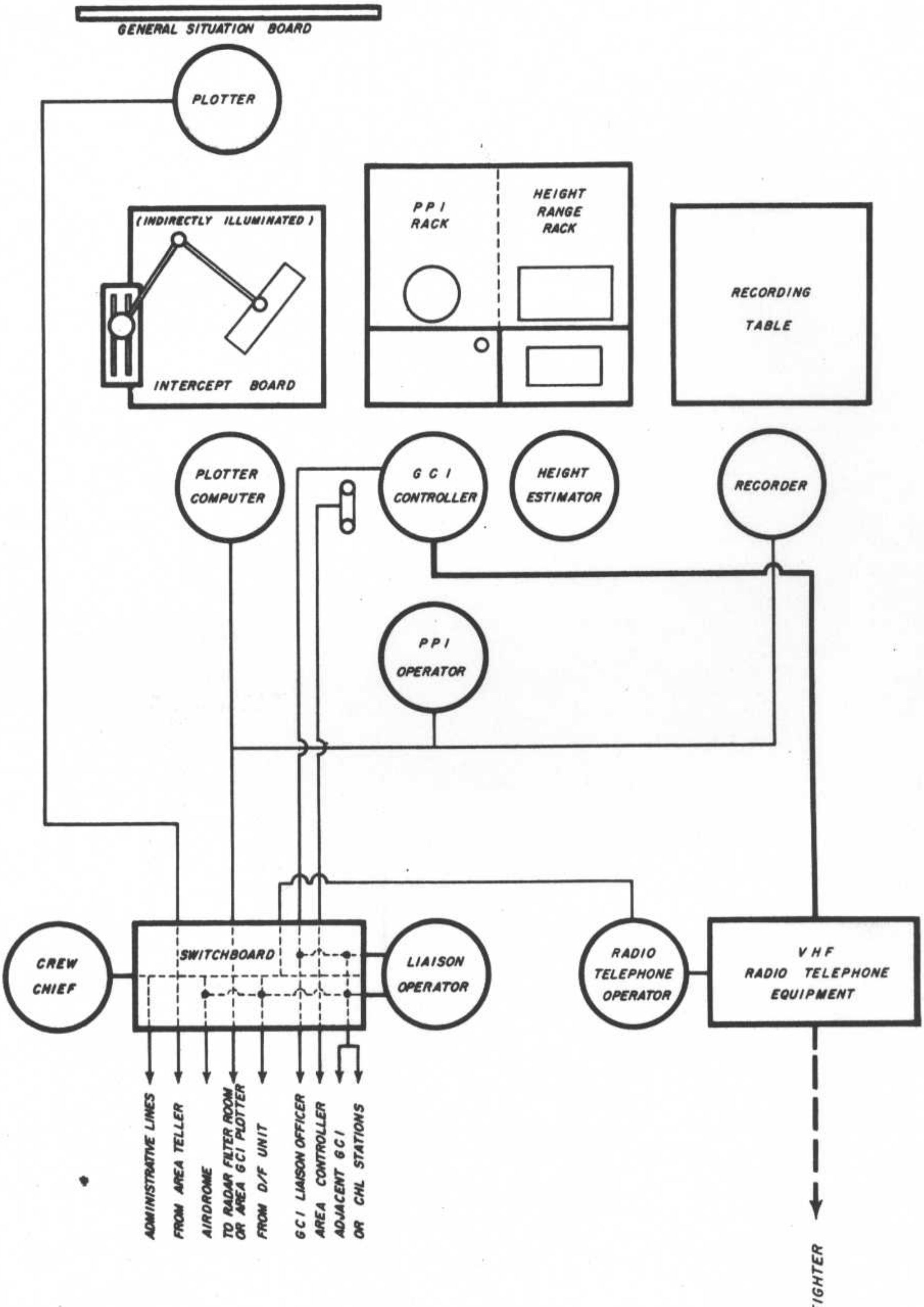

COMMUNICATIONS DIAGRAM FOR GCI

FIG. 3

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Area is not involved. It also provides liaison between squadron operations and GCI.

g. Administrative Units. - - An administrative line is provided to the orderly room, stock room guard tent, administrative headquarters, etc. This permits calls to be made for crew replacements, repair parts, and administrative functions.

h. GCI D/F Station. - - A telephone line from the D/F station to the GCI station is essential. This permits the D/F Operator to phone azimuth readings on aircraft to the Plotter-Computer for identification and dead reckoning purposes. If the new selsyn D/F Indicator system is used, a second line must be provided.

i. "Y" Service. - - This service usually supplied through Area, may be in some cases, direct. If "Y" Service is to be a direct connection, a hot line must be provided to the GCI Liaison Operator.

5. CONCLUSIONS: - - The afore-mentioned requirements and diagrams are based on multiple position operations. Figure 3 is provided as a standard layout for necessary communications for one console, one channel operation.

CAPABILITIES AND LIMITATION OF THE SCR-615

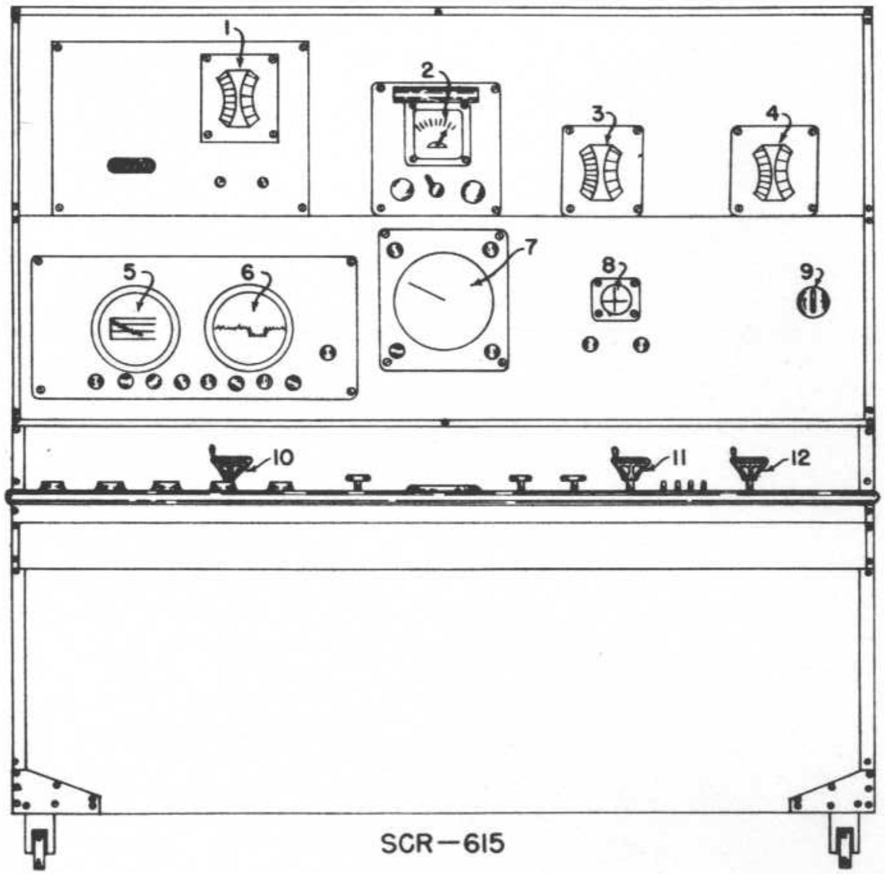
1. General: - The SCR-615 in its present form is definitely not a GCI set. It is the first American micro-wave set being quantity produced, and it is conceivable you may encounter one in your tour.

2. Description: - A console 6' wide and 5' - 4" high houses the display tubes and controls. The antenna is a rotating parobolic reflector type, 8' - 0" diameter, which is controlled for rotation and horizontal tilt by two controls on the operating console. The energy is transferred to the antenna in a rectangular, copper tube, called a wave guide, where a cone-shaped concentric rotator device known as a wobbler agitates the beam as it strikes the reflector. At a frequency of 10 centimeters (3,000 megacycles) the antenna parabola concentrates the energy into a very narrow beam of 4°. By agitation, the wobbler increases its coverage to 6°. A control wheel (#11) electircally controls the continuous rotation or sector sweep of the antenna. Continuous rotation through 360° is at the rate of 6 r.p.m. Antenna tilt, controlled by wheel (#12) permits vertical control of the beam from -10° to +90°. In other words the transmitted beam is like the beam from a flashlight and may be pointed as such when searching for a/c. A pip-matching meter (#8), with vertical and horizontal pointers will cross in the center when the beam is directly on the target. An elevation meter over the PPI tube will indicate elevation of a/c in thousands of feet when the pip meter is zero'd. The transmitter consists

of two 6' high 3' wide steel racks, housing the power supply section, oscillator unit, modulator unit, and antenna wave guide tuning unit. Output is 125 kilowatts at a frequency of 3,000 megacycles.

3. Display; - The echo is manifested on the time base of the 9" PPI tube (#7) in the form of a brilliant point of light, azimuth being read direct from a scale (#3). To the left of the PPI tube is the "A" scope (#5) and "R" scope (#6) panel with the direct reading range scale (#1) above. When a target is picked up on the PPI tube, rough range is noted and range wheel (#10) is cranked to set "A" scope range for pick-up. The "A" scope display is a horizontal time base of 10-mile range, whitish-green in color, in which the echo is an upward kick . The "R" scope magnifies any desired four-mile section of the "A" scope. By turning wheel (#10) the gate or recess upon reaching the end of the four-mile range moves back to the left side of the tube and moves right again as another four miles of range is inspected. When the echo being tracked is centered in the "R" scope, gate range may be read directly to 1/10 of one mile on the range scale (#1).

4. Capabilities and Limitations: - Set is very sensitive to siting and performs best looking over water. Interpreted display must be told to a polar grid coordinate board and transferred to grid coordinates creating additional lag. The continuous sweep display is not satisfactory for GCI, nor is it possible to sector sweep satisfactorily for GCI. Best effective range was found to be 50 miles.



SCR—615

KEY

1. RANGE IN MILES
2. ELEVATION IN FEET
3. AZIMUTH
4. ANTENNA INCLINATION
5. A SCOPE
6. R SCOPE
7. PPI TUBE
8. INDICATOR METER OF ANT. BEAM AZIMUTH AND TILT
9. 10-50-100 MILE RANGE SWITCH
10. RANGE & GATE CONTROL
11. AZIMUTH SWEEPING CONTROL
12. ANTENNA CONTROL

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S E C R E T

Nov. 1, 1943 SECT. B. - CHAP. XV

CONCLUSION: - The above set was an experimental model tested for GCI. Undoubtedly, production models have greater ability with increased power. The new M.E.W. Micro-wave set is similar to the SCR-615 inasmuch as it is a 10-centimeter set using a parobolic reflector antenna system, fed by a wave guide. Reports of reliable 70 to 100-mile range with GCI ability have been received. Its power output is understood to be 500 kilowatts.

S E C R E T

SECTION C

FUTURE EQUIPMENT

April 1, 1944 SECT. C. - CHAP. I.

The Craig Navigation Table and Interception Calculator

1. The Craig Navigation Table, which includes as an essential feature the Interception Calculator, is a mechanical means of computing much of the data needed by the GCI Controller to bring about a successful interception. When available, it is used in place of the simple Intercept Board, which is equipped only with the Craig Computer and lacks the refinements of the complete Navigation Table. In the summer of 1943, the Navigation Table was adopted as standard equipment by the U. S. Army Air Forces and is now being produced for use at each fixed type and mobile GCI station.

The principal components of this instrument are:

a. The navigation map, gridded, with superimposed compass rose, and lighted indirectly underneath.

b. The Craig Computer, the design and operation of which are treated fully elsewhere in this textbook.

c. The Interception Calculator, an instrument which calculates a cut-off vector for the controller.

d. The Azimuth Indicator, which projects a beam of light behind the Intercept Board along any given azimuth from the station's location, used as a means of displaying D/F bearings.

2. The controls of the Interception Calculator are located at the lower left hand corner of the table (see cut). Operating procedure as follows:

a. Determine true air speed of fighter and set fighter speed dial accordingly (the inner knob on lower set of dials, as marked)

b. Determine true air speed and heading of target, and set target speed and heading dials accordingly (the upper set of dials, as marked)

c. Obtain simultaneous plots on fighter target.

d. Set sliding transparent rule in position connecting the simultaneous plots, with the arrow on rule pointing from fighter plot to target plot.

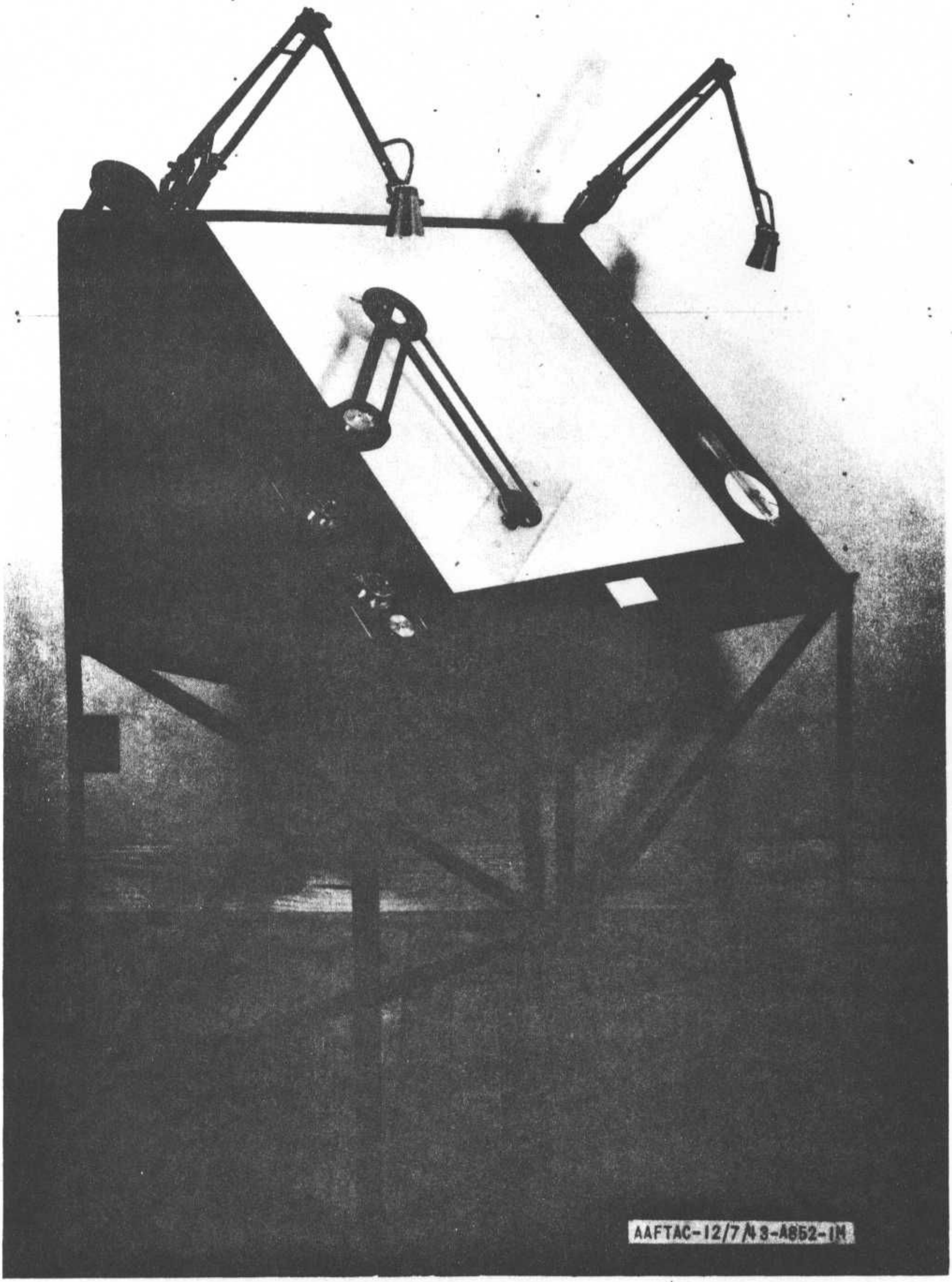
e. Align the two small white arrows along left edge of calculator by turning knob at bottom of dial panel (see cut).

f. Read "vector to intercept" opposite arrow on white scale along right edge of calculator. This is the cut-off vector that will bring the fighter to the target in the shortest possible time, assuming constant speed and heading of target.

g. The "speed of approach" also is indicated on the right hand scale. If this figure develops to be less, then the interception is obviously impossible, unless the fighter's speed can be increased.

h. The "Speed of approach" figure can be utilized by the plotter-computer and controller to calculate the time required to bring fighter and target together and complete the interception.

i. On the lower set of dials can also be read the compass bearing between fighter and target, which will remain constant through-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out the interception if target makes no change of speed or heading. By checking this bearing frequently on simultaneous plots during the interception, the plotter-computer can quickly discover any change of heading, speed or other evasive action attempted by the target.

3. It should be borne in mind that if the "vectors to intercept" is accurately calculated and executed, the fighter will be brought directly into the target at the point of interception. In many cases, therefore, the controllers will find it necessary to alter the fighter's speed or heading at the proper moment in the closing stages of the interception in order that the fighter may be brought in behind the target rather than abeam.

4. A possible disadvantage of the calculator is the time required to compute the necessary target speed and heading data, make the appropriate dial settings and read the resulting calculation. For any degree of accuracy it is considered that 2 or 3 minutes of target flight must be plotted. Delay is avoided, however, by estimating target speed and heading, giving a "snap" vector and checking this for accuracy when sufficient time has elapsed. As the GCI Controller gains experience, he finds that he has less and less use for a mechanical means of determining his cut-off vectors. In any case, however, the calculator is valuable and helpful in checking the vectors that are calculated mentally.

5. By means of the Azimuth Indicator, D/F bearings can be continuously and silently told through from the D/F station and accurately displayed on

the intercept board, without the use of an extra crew member to receive them by telephone.

6. The operator of the D/F station has a control box on the face of which there is a dial in the form of a compass rose. Upon determining a bearing on any aircraft with his D/F equipment, he sets the control box dial on the proper azimuth and pushes a button. This activates a rotating prism arrangement and light in the Navigation Table, and a bright narrow beam of light is shown for a few seconds on the face of the intercept board. This method of displaying the D/F bearings greatly facilitates such dead reckoning procedures as the one-station fix, and also provides a constant means of checking fighter identification.

THE SCR-636-A

I. DEFINITION. - Radar Set SCR-636 is a Ground Controlled Interception designed for transportation by aircraft, and ease of assembly. It is the first set of this type with capabilities satisfactory to GCI. The gross weight is 7000 pounds, of which no single piece of equipment weighs more than 300 pounds, except the power generator, which weighs 400 pounds. An experienced crew of five (5) men can assemble the station in an estimated six (6) hours.

II. COMPONENTS: - Reference is made to the reproduced photographs for a clear description of the entire unit. The station consists of the following components:

a. Operations Hut (18' long 12' wide 7' high)

b. Antenna tower unit consisting of furntable with 8 braces, 2 reflector frames and generating screen sections.

c. Transmitter BC-1186-A (or 602-T1 transmitter modified.

d. Receiver, SCR-588 (with "PPI" and "A" CRT)

e. Power control and Rectifier unit.

f. Antenna Switching unit BC-1188-A.

g. A.C. Power unit PE-75.

h. D.C. Power unit to rotate antenna, or a reversable operation from the antenna control unit mounted next to the receiver in the Hut. Speed of rotation is 2 RPM but provision is being made to increase this rate. Hand turning is also provided in case of power failure.

One novel feature disclosed in the photographs is the installation of the Antenna Switching Box for changing phase relation of the antennas in the Hut. You will recall the little house behind the top bay on the SCR-588 Antenna. This Phase switching unit has three purposes. Namely:

a. It provides a switching system whereby the same antenna may be used for transmitting and receiving.

b. It provides a feeder system to the receiver or the transmitter.

c. It provides a manual switching arrangement for connecting the antenna in phase and anti-phase for transmitting or receiving.

III. CHARACTERISTICS.

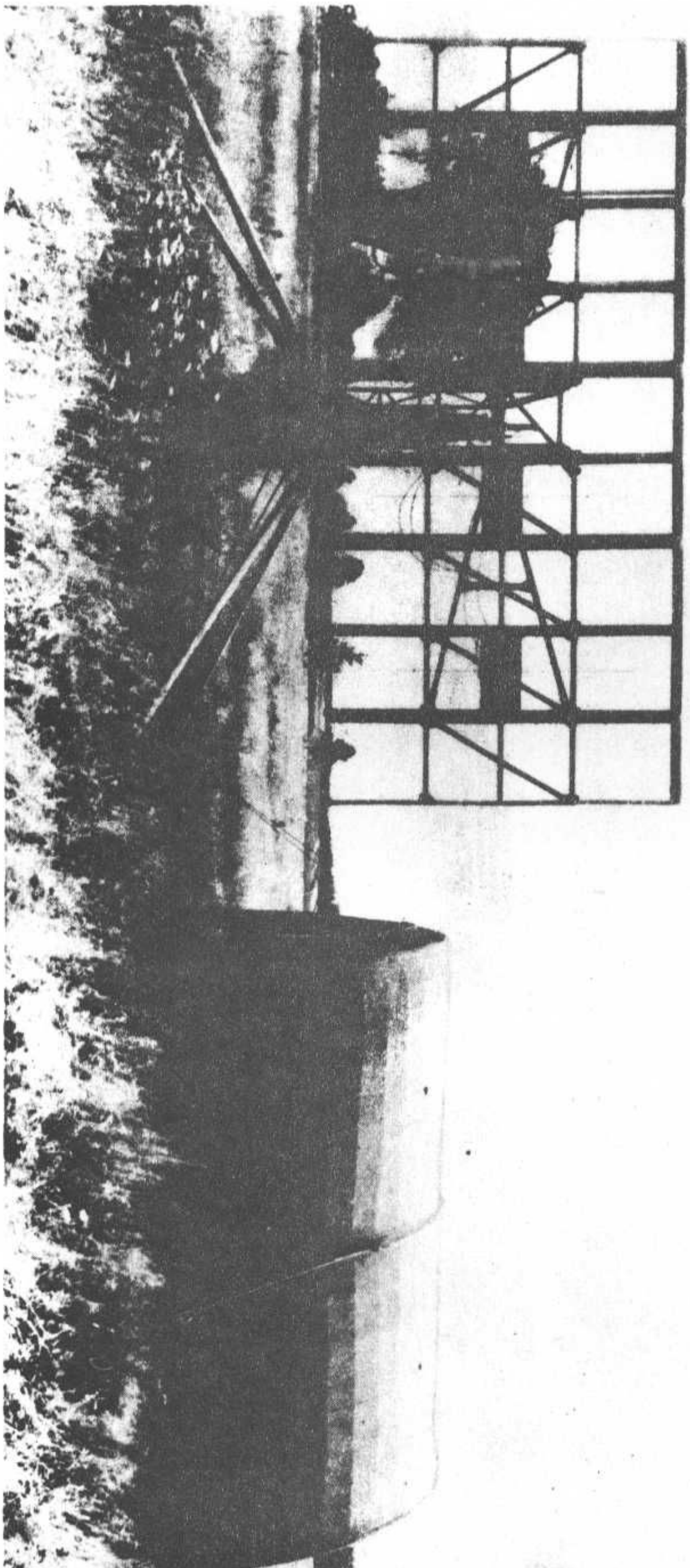
1. Operating frequency 209 MC/s (1.44 meters)

2. Pulse recurrence frequency 400 cycles/sec. of 2 microsec. duration.

3. Transmitter: Radio Set SCR-602 T_1 transmitter was modified for use on 110 V., 60 cycle A.C. 2 K/W.

4. Receiver: The Standard SCR-588 having a superheterodyne circuit with an IF frequency of 31 mc and a band width of 2 m.c. Both PPI and "A" Scan or (H & R) are provided.

5. Range: Search 90 mile, GCI 45 mile. (From center of PPI Tube out)



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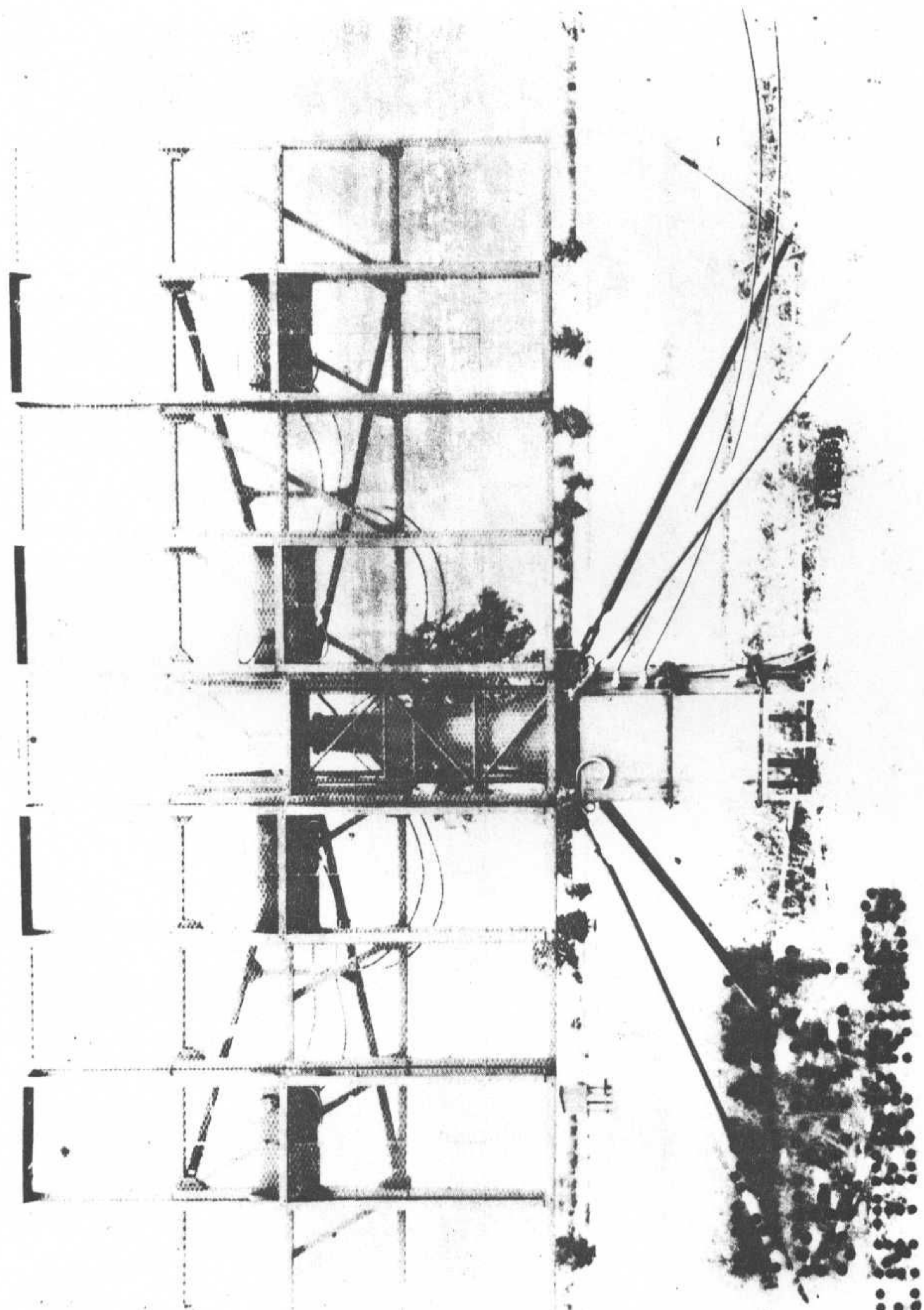

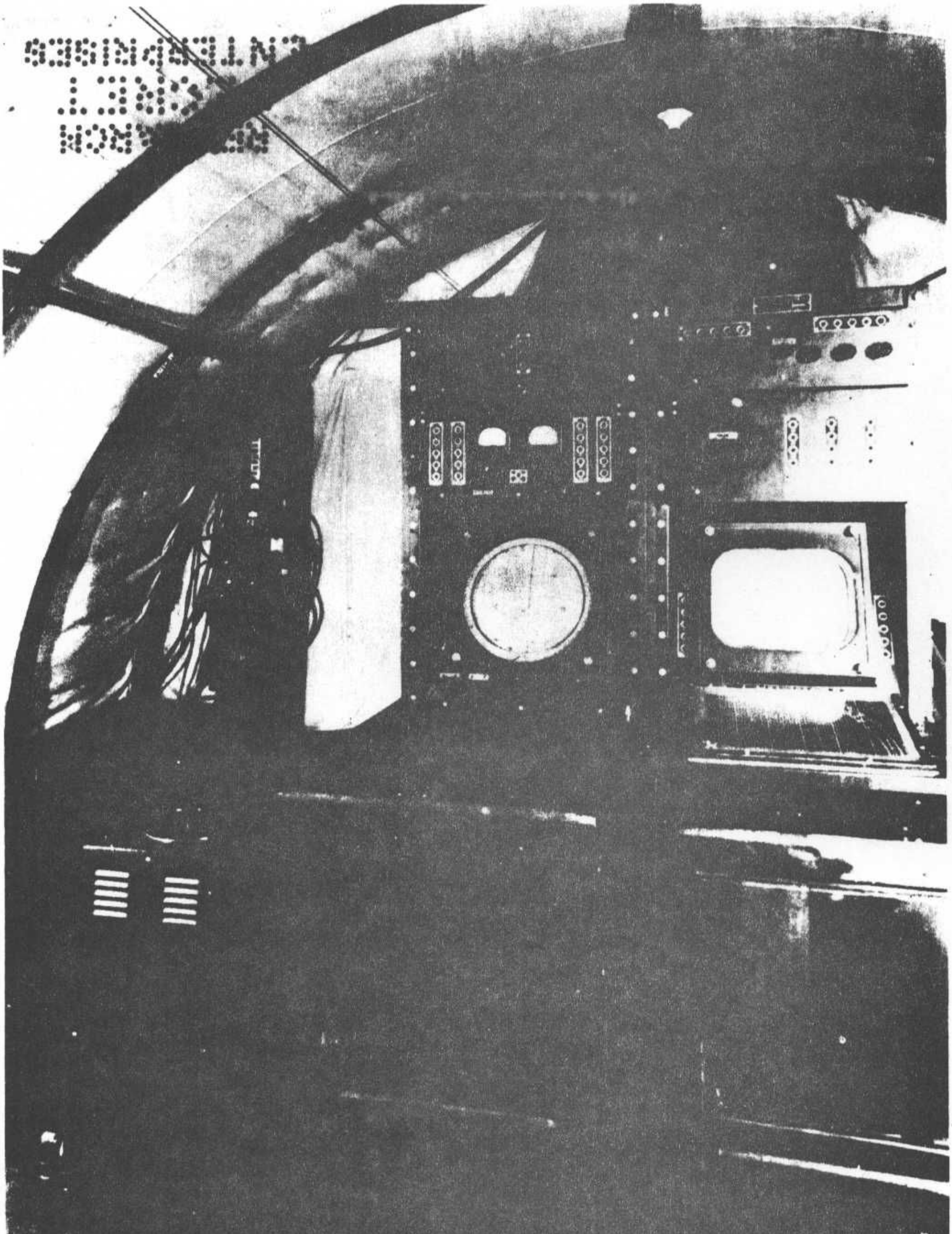

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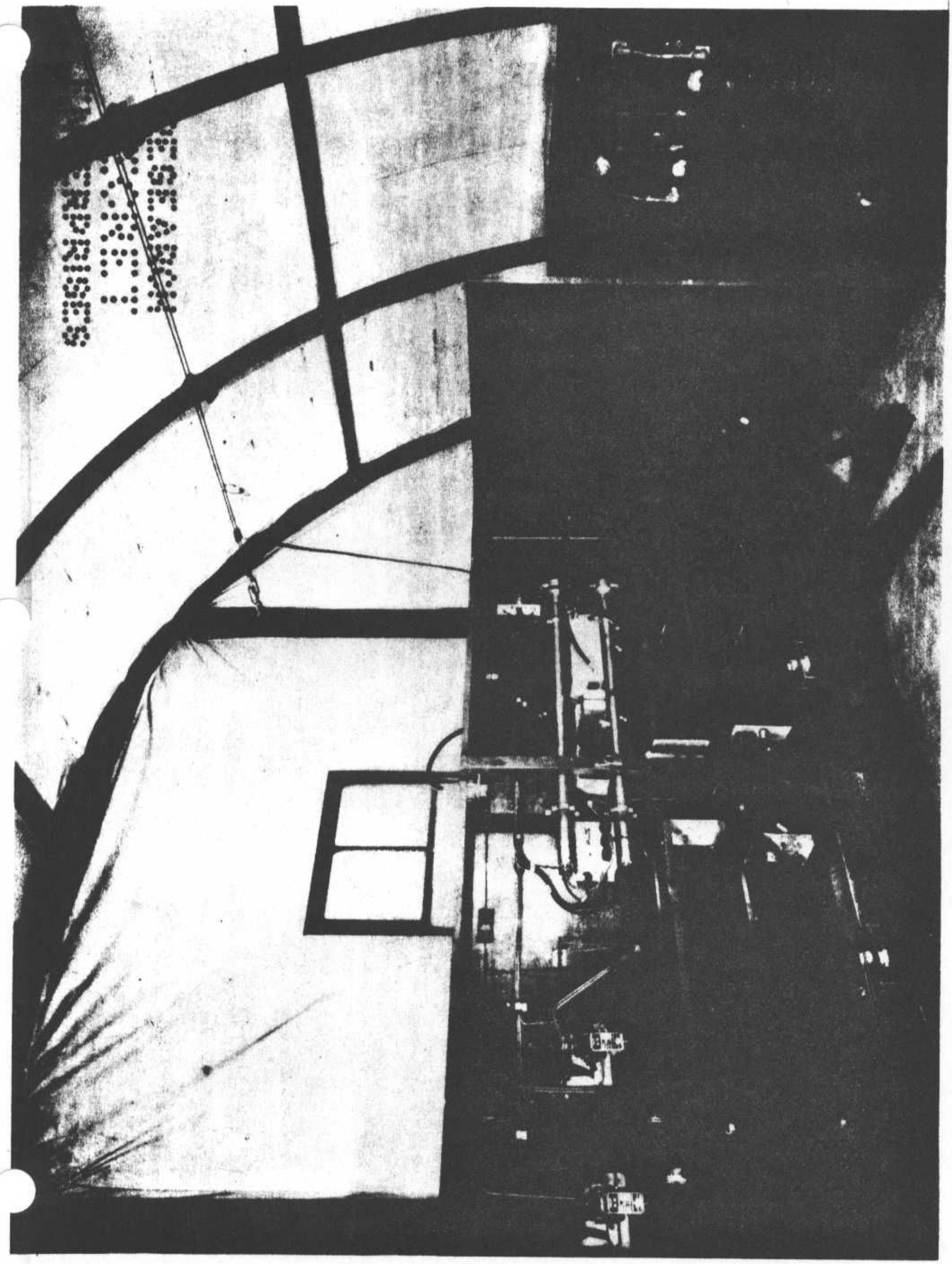

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6. Elevation: Elevation search coverage from line of sight up to 20 degrees, being designed for height finding.

7. Accuracy: Range to 1 mile, azimuth to 1 degree, elevation to ½ degree.

8. Antenna: The antenna is derived from the bottom half of the Radio Set SCR-588-B, GCI/CHL equipment, and is a broadside array, 4 dipoles high and 8 dipoles wide, electrically split so that it may be used for gap filling and height finding.

The antenna is mounted on a braced turntable which provides continuous rotation or sector sweeping.

9. Power Equipment: Two power units are necessary to operate the SCR-636-A.

a. Portable power unit type PE-75 which operates at 115 volts, AC, 60 cycles single phase supplies power for the station proper. This unit must be operated on leaded gasoline.

b. A "Homelite" 28½ volt, 2 K.W., D.C. generator is used solely for rotating the antenna. These units should be installed a minimum distance of 50 yards from the operating shelter. Additional requirements for power over and above those listed here are not considered a station responsibility. In other words, your SCR-636 comes complete as itemized, with no extra provision for communication or D/F power requirements.

10. IFF AND ANTI-JAMMING. - Provisions are being contemplated for the installation of IFF equipment as well as circuits to prevent,

or reduce to a minimum, interference.

CONCLUSION:

As far as can be determined, only the factory acceptance tests have been run on this set. Some conflicting reports as to its ability or apparent success has filtered down through many doubtful channels, and it is felt any criticism or condemnation is unjustified until this set has been to battle. A limited production is now nearing completion with rugged plans being mapped to prove its worth. The purpose of this paper is to call it to your attention and give you what descriptive material is available.

MISCELLANEOUS EQUIPMENT

A - THE SKIATRON - also called the "Color Trace Tube" (CTT) is one of the late developments in radar control. It consists of a small cathode ray screen, three inches in diameter, which picks up the aircraft echoes in the usual radar manner. The small purple aircraft echoes that appear are transferred by means of a series of lenses to a brilliantly lighted ground glass screen, which is about twenty-six inches in diameter. The whole above arrangement being built into a Craig Navigation Table.

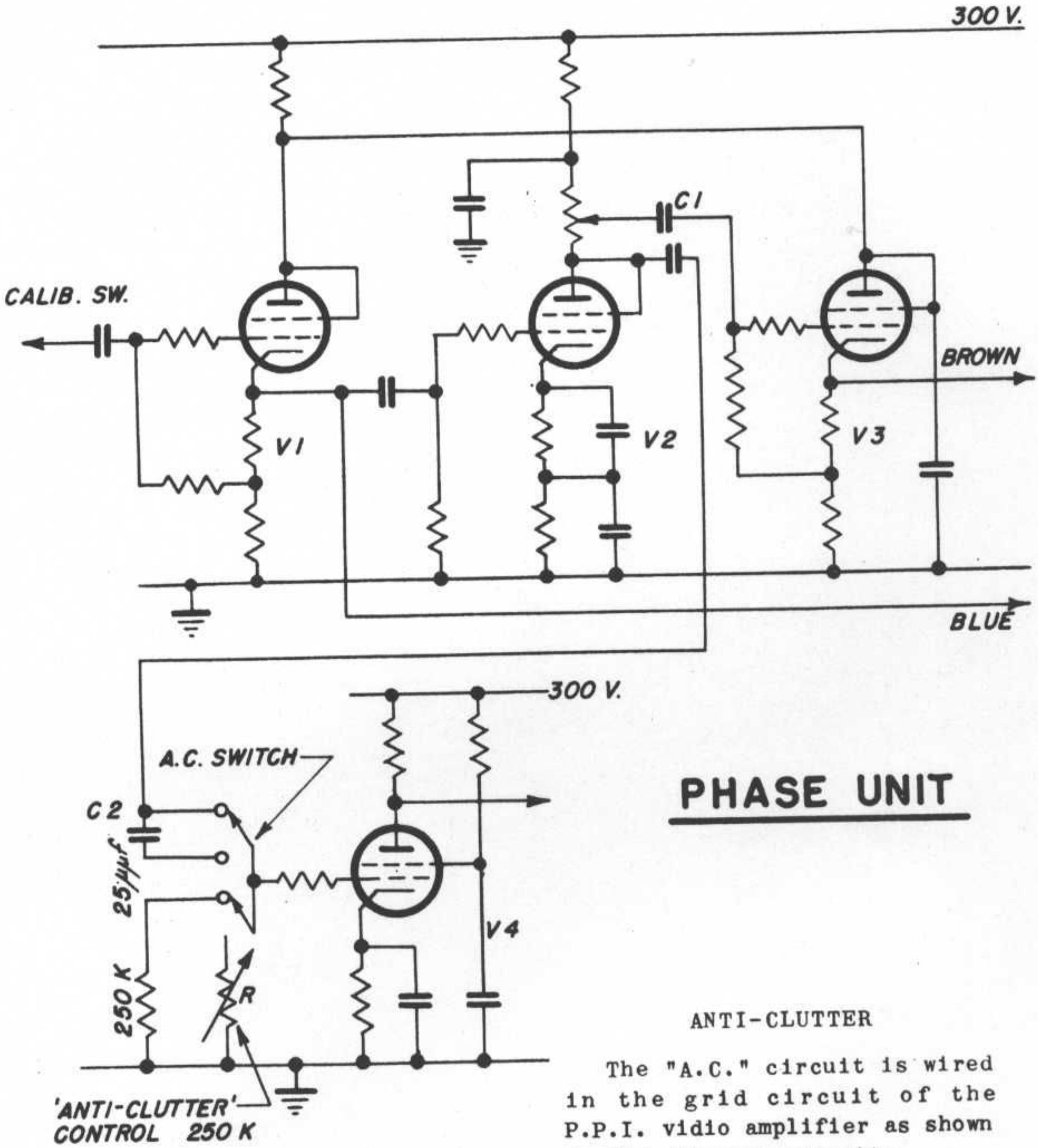
The general effect of this arrangement is a more compact and efficient system. Specifically, it eliminates the PPI operator and the plotter-computer positions since the controller plots directly on the ground glass screen and has available a Craig Computer. This plotting arrangement also does away with the human error factors arising from PPI and plotter-computer table plotting. The changes in course are immediately apparent and the controller is thereby closer to his problem. It is also believed that control of more than one aircraft would be an easy matter. At Sledgegreen, England a Skiatron was observed that employed a magic-lantern attachment that projected the aircraft echoes upon a large circular gridded screen. While no definite procedure for GCI controlling has been worked out, the idea opens up any number of possibilities for multiple control, control of fighter sweeps, and large defensive operations.

The United States Navy has developed equipment along the lines of the Skiatron which is designated as P-3-I. Little is known about the equipment beyond that it is a cabinet desk type of radar with a twenty-eight inch display. It is installed on the bridge of the ship and is considered by the navy to be equal, if not superior to the British Skiatron.

B. OFF CENTER TIME BASE - is a method by which the range of a station may be extended in any direction on the PPI scope. In a specific instance that was observed in England, the scope was set up for a range of seventy miles, sweeping the 360 degrees of the compass. However, the information desired was principally in a southerly direction. The time base apex was therefore moved some miles north of its former position. The result was that when the time base serving in a southerly direction, which was the usual advance for enemy attacks, the equipment was operating at its most advantageous range. In brief, then, by shifting the time base apex, the range can be extended in any direction. It is to be understood that all range gained in any one desired direction will cut down the range in the less important azimuths.

It is estimated that the time base center can be moved one third of the distance toward the edge of the scope without affecting the focus. By the employment of a system of coils, the center of the time base can be moved a still greater distance from center.

C. THE LIMITER CIRCUIT - The ground return area on the PPI scope represented up until recently, a region where operations were poor



PHASE UNIT

ANTI-CLUTTER

The "A.C." circuit is wired in the grid circuit of the P.P.I. vidio amplifier as shown in the diagram opposite.

With the "A.C." switch in the position shown, signals are fed through a normal time-constant circuit to the grid of V4. When the switch in in the alternate position, signals are fed to the grid of V4 through a variable short-time-constant circuit. (C_1 + C_2 and R) which serves to remove the low frequency components of the signal wave form.

In this manner the signals from blocks of P.E.'s are differentiated and the solid "body" of the P.E. wave form is removed. This serves to reduce the brightness of P.E.'s on the P.P.I. tube and allows a certain amount of plotting of signals through the P.E.'s.

Low frequency jamming effects are also reduced by this circuit.

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and result doubtful. Recently though, a method was observed by which the ground return was reduced sufficiently so that aircraft echoes could be read through it. By a switching arrangement on the receiver the permanent echoes can be broken up and made to appear as small echoes. The regular aircraft blips can, therefore, be read through the broken ground return. (See diagram and explanation Fig. 1.)

D. THE VEB OR VARIABLE ELEVATION BEAM - is a new departure in height finding equipment. This equipment observed recently in England operates on the principle of a floodlight. The antenna, about 120 feet high, contains nine sets of dipoles and at that particular station covered a field of vision of about 70 degrees. By a switching device it is possible to compare the responses received from the various sets of dipoles and thereby obtain satisfactory heights. The method of identification of any particular aircraft is accomplished by comparing the range of the aircraft on the R & S tube with the range shown on the VEB scope. There are certain advantages of the VEB: in the first place, relative altitude of aircraft can be read immediately; in the second place, the principle of determining height does not depend upon a split echo. Altitude can be read directly from the scope. Therefore, the accuracy in estimating heights does not depend upon the skill of the VEB operator. In the third place, the lobes of the VEB are very low and as a result, altitude can be determined at a very low angle. As against these advantages, the following disadvantages are apparent. VEB looks only in a limited direction on the flood-light principle. It can be jammed more easily than other types of radar. Finally, the antenna being 120 feet in height, makes it difficult to move.

E. IMPULSE SIGNALLING - is the sending out over normal VHF carrier wave a super audio note. The equipment set up at the ground station is tied into the VHF system; it is controlled by a keyboard similar to a typewriter. Pressing a key will send out a complete message which, when received at the aircraft, will be displayed on the plane's panel. At the time the message is being transmitted over the VHF carrier wave, it is possible to engage in normal R/T without affecting the super autio message. It takes 5 seconds to transmit the message and have it acknowledged by the aircraft. (This is not counting the time that it takes to set up the message at the ground station). It was stated that while super audio transmissions can be jammed, it takes six times the amount of strength to jam as it does to jam the normal R/T message. This system is so arranged that it is possible to transmit a particular message to 40 aircraft at the same time, or any particular message can be sent to one aircraft and the other 39 will not receive it. At the time the observers were in England, tests had not been carried out. A squadron of 12 aircraft have been fitted with the equipment. Various advantages appear in regard to this method of passing information to the aircraft. In the first place, as above set forth, it is very difficult to jam, and in the second place, any message that is received by the aircraft will be the correct message. This of course, is not true of very weak transmissions in the normal VHF message. In the third place, it would be much more difficult for the enemy to intercept the message. Furthermore, the equipment can scramble a message which will be automatically deciphered on the pilot's indicator.

The above description concerns British equipment only. This is stated so that the student will differentiate between the American and the British Impulse Signaller.. The American equipment still in the development stage, is simply an Impulse Oscillator tied into the VHF system. When the super audio note is received at the aircraft, it activates a set of relays and so throws on a signal light. The American signaller is used simply to warn the pilot to return from inter-plane communications to air-ground communications.

F. AI IN P-38 - Due to the high flying tactics of the Japanese bombers in the Southwest Pacific, the regular night fighter aircraft, the P-70, was found to be inadequate for GCI operations above 20,000 feet. After considerable experimentation with various planes, it was decided to fit the P-38 with night fighter equipment. The AI equipment is pressure sealed in the belly tanks of the plane, the radar operator is seated piggy-back behind the pilot with the display unit mounted on the rear of the pilot's seat.

This installation accommodated the SCR-540 AI. Another installation is now being completed on a P-38, enlarging the nose slightly, for the parabolic antenna of the SCR-720. The modulator, power unit and receiver will go in the belly tank as with the SCR-540. This is considered a temporary measure to meet present requirements in the South Pacific until the P-61 can be supplied. The P-61 performs very satisfactorily at altitudes up to 42,000 feet.

At the time of this writing it is still to early to make definite statement as to the results of the above arrangement, but with the capabilities of the P-3. in mind, the best of results is expected.

G. Capacity Switching. - The employment of capacity switching has eliminated the necessity of a phase-antiphase switch and an antenna selection switch. The capacity switch is a switch which rotates at 1500 rpm's, selecting in turn the various antenna combinations. Thus stations composed of multiple units and equipped with capacity switching, will afford to any single positions the same facilities for height finding and antenna position selection as would be available by complete manual control of antenna selection.

H. Four Foot Consoles. - A new console brought out by the British, and observed at Durrington, will have an American counterpart, it is understood. This is a new type of console for mounting the PPI tube and the H & R tube. The tubes in these consoles were mounted on a

45 degree plane similar to the intercept board. The height of the console was approximately four feet.

I. Double Antenna. ½ The double antenna provides an ingenious method of increasing the speed of obtaining information from a PPI tube without increasing the speed of rotation. On the front side of the antenna was the normal arrangement with horizontal dipoles, while on the back side of the antenna was mounted an additional array with vertical dipoles. By means of a switching device it was possible to transmit and receive from the opposite side of the antenna through the next 180°

J. 24-Inch CRT - Much interest has been manifest in the new Signal Corps 24-inch Cathode Ray Tube. Specific use of this tube is a conjecture at present, as present displays comparable in size have been optical projection from a small tube as in the Skiatron. It is understood this tube is cabinet mounted for display of echoes simultaneously received by several stations.

K. Pre-Amplifiers: - Some use has been made of Pre-amplifiers to boost the weak return reflection, though it is not expected they will meet universal installation. A pre-amplifier consists of a couple of stages of tuned radio frequency ahead of the radar receiver to amplify the signal before it is put through the regular receiver stages. This increase in signal gain also results in an increase of ground noise return. However, many signals which would otherwise fade are made persistent through this device.

Another use of the amplifiers has been to transfer over considerable distance the signal from the radar receiver to display unit many miles away. It is conceivable that control from the CRT may be done in the future at the Sector or Area room with the station located miles away.

Indirect Lighting of the PPI Tube - A new innovation in radar scopes is the indirect lighting of the PPI tube. This is accomblished by inscribing the grid lines directly into the back of the plexiglass scope face. Four small lights are arranged at even interludes around the edge of the plexiglass face. The bulbs are so dimmed that they do not light up the scope but rather diffuse over its surface. The effect is that the whole tube is gently lighted up while the inscribed grid lines stand out brilliantly.

The advantage in this arrangement can readily be recognized as soon as the room lights are turned out. Whereas the former black painted grid is difficult to see in a darkened room, the inscribed lines can be read with ease and greater accuracy.

1. DESCRIPTION

The SCR-627 designates a fixed type GCI Station made up of the component parts of the SCR-527, with the exception of the antenna. Instead of housing the equipment in vans for mobility as in the SCR-527, the equipment is set up in the regular AWS-1 building as a permanent fixed type installation. For details and photos of component parts refer to Sect. D., Chap. IV - Capabilities and Use of the SCR-527.

2. ANTENNAS

The antenna system on the SCR-627 is similar in electrical design to the radio set SCR-588. The antenna consists of three bays with the upper bay centered 25 feet above the ground, and the lower bay centered at 10 feet above the ground. The upper bay is 12 half-wave dipoles wide and 4 half-wave dipoles high. The lower bay is exactly the same, except that this arrangement can be split into two bays each of two dipoles high. The antenna is used both for transmitting and receiving.

The antenna is installed in a concrete pit approximately 6 feet deep and 12 feet square. The antenna and AWS-1 Building are to be laid out similar to those of SCR-588-B with the Maximum separation possible between the center of the antenna mount and the end of the AWS-1 building being 50 feet.

3. CAPABILITIES.

Since no actual tests have been conducted in this area to date, reference is made to the capabilities recorded for the SCR-588 and the SCR-527. Actually, the transmitter is considerably smaller than the SCR-588 transmitter, but its operation with the antenna described is reported by the AAFTAC Radar Group as being equal in all respects. It is felt considerable maintenance is eliminated with this installation as compared with the SCR-588.

4. INSTALLATION

The first installation of the SCR-627 is at Pasco, Fla., which is in the vicinity of Zephyr Hills, Fla. This unit will be operating on or about 15 January 1944 as a part time reporting and GCI Station, similarly to the SCR-588 Stations located at Winter Garden and Bushnell, Fla.

5. FIXED TYPE GCI STATION LAYOUT

Under the authority of the Air Forces Board, AAFTAC, Project (T-5) 22 was set up to develop a Standard Layout for a Fixed Type GCI Station. This Project was further sub-divided in recommendation requirements for the SCR-588 and SCR-627. Operational tests were conducted over a considerable length of time to determine the following considerations:

a. Type and size of building.

b. Operational requirements as to CHL, GCI, reporting only, multiple interception, etc.

c. Number of positions and most desireable spacing.

d. Display of information necessary to operations.

e. Lighting and operational fatigue.

f. External facilities of power, security, etc.

g. Alert rooms for operations and Crews.

h. Communication requirements, D/F, IFF, etc.

Recommendations were prepared in report form covering SCR-588 as a Fixed Type GCI Station, Capable of multiple control with simultaneous reporting, and various layouts of the SCR-627 ranging from single console CHL - Single Console GCI, to multiple control GCI with simultaneous reporting. The essence of these reports is covered by the material in this manual; however it was deemed advisable to reproduce two of the layouts recommended for Fixed Type GCI Stations. These layouts represent the desired installation fitted to the AWS-1 plus AWS-2 buildings, as the ultimate to be expected in station design, and the simpler layout fitted to the AWS-1 building.

DECLASSIFIED BY EXECUTIVE ORDER #11652

SECTION D

GCI CONTROLLING

DECLASSIFIED BY EXECUTIVE ORDER #11652

GCI TACTICS AND TECHNIQUE

The function of the GCI Controller is simply to employ the equipment, facilities, personnel and experience at his command in such a manner as to place a night fighter aircraft within AI range of a designated hostile aircraft in the minimum time. It will be seen that tactics will vary with the situation, but in general, certain successful methods have evolved, been tested and adopted as standard procedure. The term "within AI range" is of necessity defined by the capabilities and limitations of the airborne radar equipment. For the purposes of this discussion, the assumption is made that to complete a successful interception, the fighter will be placed behind the target (range not to exceed 1-½ or 2 miles), on the same heading, at approximately the same altitude (usually slightly below or above, as the situation may dictate), and with a slight overtaking speed (usually 20 to 30 mph).

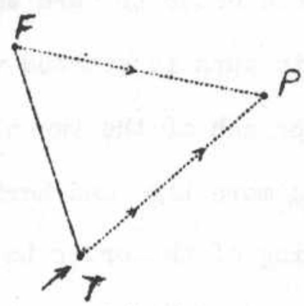
In the ordinary type of interception, in which it is assumed the controller has had sufficient warning to place a fighter on patrol in an advantageous position, there are two basic techniques - the "cut-off vector" and the "curve of pursuit." Often the successful interception resolves itself into a combination of the two.

It is essential that the first snap vector be given as soon as the positions of both aircraft have been determined. A more accurate cut-off intercepting vector, if it is necessary, can be given a short time later. But time must not be lost in moving the fighter in the general direction of an interception point and slightly behind it on the target's course, as soon as the two aircraft are sighted on the scope.

THE CUT-OFF VECTOR - Successful use of this technique presupposes some indication of the target's future track, based on previous plots that may have been furnished from the area board or from the PPI tube after the target has entered the GCI's effective area. The fighter is given a heading that will bring him to the target as quickly as possible. Since the target is not a stationary object, the controller must determine the point on the target's projected course which he can reach with his fighter in the minimum time. The cut-off vector is, therefore, the compass bearing from the fighter's present position to that imaginary point of interception. In the perfectly executed cut-off interception there need be only two headings given the fighter, (1) the cut-off vector and (2) the turn onto the target heading.

In computing the cut-off vector, the controller must bear in mind the relative speed of target and fighter. The greater the speed advantage at his disposal, the closer the interception point and the shorter the time required. A simple rule of thumb is helpful in visualizing the "mental triangle" that will result in a successful cut-off: The controller mentally constructs a triangle, using as a base the line between the fighter and target. By projecting from this base the course of the target as one side of the triangle, the controller will arrive at the correct cut-off vector if he visualizes the other side of the triangle with a leg slightly longer than the leg representing the target's course. This is assuming that the speed of target and fighter are practically the same. If the fighter has a speed advantage there, the leg of the triangle representing the fighter's path of flight should be made proportionately longer. The line from the fighter to the target, which is the base of the triangle, is called the line of true bearing and if the correct cut-off vector is given this line of true bearing will remain constant in direction at all times.

For example: (Fig. 1)



F = fighter's position at start of interception

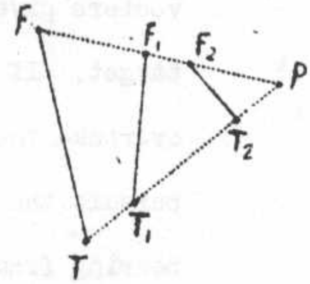
T = target's position at start of interception

P = point of interception

TP = target's projected course

FP = fighter's projected course on the cut-off

FT = line of true bearing



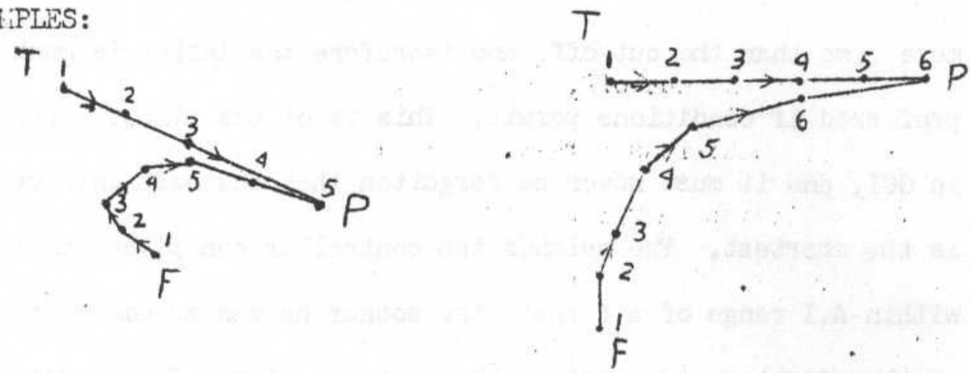
In this example if the direction of the line FT changes, then the controller must correct his cut-off vector - Thus: (Fig. 2)

Here the points T. and F. represent the position of the fighter and target as they have progressed along their paths. It will be seen that the line F. - T. no longer has the same bearing as the line F1-T1. It is obvious that the fighter is getting ahead of the target. Therefore the controllers must construct a new triangle and give a new cut-off vector to his fighter. In the example the line F2 T2 again has changed from the true bearing as represented by the line FT and it is obvious that in this case the target is getting ahead of the fighter and the controller must take appropriate action.

At the proper time in the course of the cut-off interception, the fighter is given the order to turn onto the target's heading. The point at which this turn is started varies, of course, with the angle and speed of approach of the two aircraft. A turn of 50°, for instance, will require more time and horizontal displacement than a turn of 20°. The timing of the order to turn is of the utmost importance, and is discussed fully in another section of this chapter.

THE CURVE OF PURSUIT - This method consists of a succession of vectors given the fighter to keep him constantly heading toward the target. If the fighter has some speed advantage, he will eventually overtake the target on the proper heading. To execute the curve of pursuit the controller has only to estimate or measure the compass bearing from fighter to target and give this to the fighter as heading. A new heading is given with each change of bearing. The resulting fighter track will appear as a gradual curve until the target is overtaken:

EXAMPLES:



T = Target's position at start of interception.

F = Fighter's position at start of interception

P = Point of interception

TP = Target's track

FP = Fighter's track

In each of the diagrams illustrated above it will be seen that at position (1) of the fighter, the fighter was given a heading toward position (1) of the target, and so on throughout the interception. The turn onto target's heading in this type of interception technique does not therefore present the problem of timing and displacement as is the case in the cut-off, for the final turn is simply the last of the many small vector changes.

A combination of the cut-off and curve of pursuit techniques may often bring good results, either method being employed in the early stages of the interception. The choice of methods will depend on the relative positions of target and fighter and the extent of the information available about the target's heading and speed.

Strictly followed, the curve of pursuit type of interception takes more time than the cut-off, and therefore the latter is much to be preferred if conditions permit. This is of the utmost importance in GCI, and it must never be forgotten that the best interception is the shortest. The quicker the controller can place one fighter within A.I range of a target, the sooner he can assume control of another fighter and start another interception. Too, under even optimum conditions the target will appear on the face of the PPI tube only a few minutes, and often one minute saved will mean a successful interception as compared with a miss. In the ever-important matter of identification the cut-off technique also has definite advantages. It is much easier, naturally, for the plotter-computer to dead reckon the fighter's path accurately on the straight cut-off vector than on the frequently changing vectors of the curve of pursuit. Thus when the fighter passes through a "fade" area his approximate position can be told with fairly good accuracy and he can be readily identified when his echoes again appear on the PPI. The same advantage applies in the case of the controller who mentally dead reckons on the PPI. If during the fading period it has been necessary to give one or more vector changes, subsequent identification becomes more complicated. It is obvious that in the curve of pursuit much more R/T conversation will be necessary than in the cut-off. This increases the chance of an order's being misunderstood and being improperly put into execution. Particularly is this true when R/T communication is poor - the fewer the necessary messages, the better.

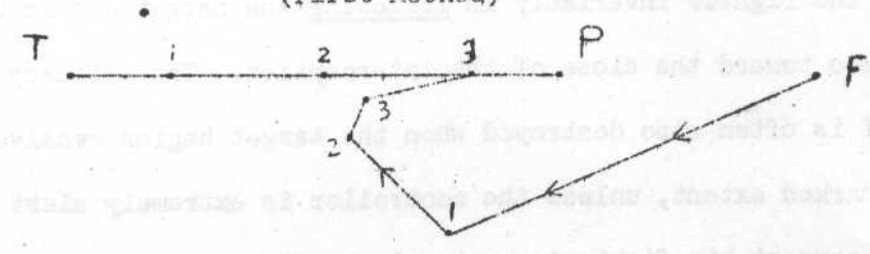
One of the disadvantages of the cut-off, particularly for the inexperienced controller, is that an incorrect vector if not changed in time may bring the fighter to the target's course just ahead of the target instead of behind. The curve of pursuit is consequently much safer, as the fighter invariably is <u>following</u> the target and is behind at all times toward the close of the interception. The efficacy of the cut-off is often also destroyed when the target begins evasive action to a marked extent, unless the controller is extremely alert and prepared to correct his fighter's vector instantly.

<u>THE HEAD-ON</u> - This is probably the most difficult type of interception for the GCI controller to handle, chiefly because when two aircraft approach each other on reciprocal or nearly reciprocal courses, their "speed of approach" is high, being the sum of the speed of each. Consequently, timing of orders must be precise, and R/T lag estimated much more accurately than usual. The controller running his first head-on interception is almost invariably astonished at the rapidity with which the two aircraft came together.

There are two methods of handling the head-on problem. The first, and most generally approved, is to vector the fighter rather widely off the reciprocal, then adopt the cut-off technique when sufficient lateral displacement has resulted. The second method is to vector the fighter off the reciprocal by only a few degrees, sufficient to provide only enough lateral displacement for a 180-degree turn onto target course at the proper moment. This method requires split second timing, and any error in calculation or delay in R/T at the crucial moment means the probable loss of the interception. It should not be attempted when there is any alternative available.

EXAMPLES:

(First Method)



T = Target's position at start of interception.

F = Fighter's position at start of interception.

P = Point of interception.

TP = Target's course.

FP = Fighter's course.

At point (1) the cut-off vector is given, with turns onto course at points (2) and (3).

(Second Method)

In this example the one turn onto course is started when fighter and target are each in their respective points (1), as indicated.

TURNS -- The final turn of the fighter onto the target's heading at the proper moment, with the proper displacement, is a vital maneuver which accurately measures the ability of the controller. As a practical matter the technique of the turn can perhaps be learned only through actual experience. However, there is a "rule of thumb" for calculating timed turns. Displacement is computed as follows.:

In a rate 1 turn (3 degrees per second), displacement will be roughly two-thirds (2/3) the distance the aircraft would cover in normal flight for the same period of time.

Example: Assume ground speed of 240 mph, or 4 miles per min. For a 90-degree turn, one-half (½) minute will be required. Therefore, displacement will be two-thirds (2/3) of two (2) miles, or one and one-third (1 1/3) mile. In the same say, displacement resulting from a 180 degree turn will be two and two-thirds (2 2/3) miles.

In the head-on problem, assume for example that the two aircraft approaching each other each have a ground speed of 240 mph. The controller already knows (see above) that he must have lateral displacement of two and two-thirds (2 2/3) miles, and has so positioned the fighter. He knows that the 180-degree turn will require one minute. In the time required for the turn, the target will have travelled four miles. During the turn, the net result of the fighter's action will be to take up the lateral displacement only. Therefore, a turn commenced when the aircraft are four miles apart will bring the fighter precisely to the target's position at the completion of the turn.

In making a turn of this nature the importance of R/T, lag asserts itself. In this example, the aircraft have a combined "speed of approach" of 480 mph. From the time the controller makes his decision to the time the pilot begins to execute the turn, a period of at least ten seconds have elapsed, during which period the gap between the aircraft will have narrowed by about one and one-third (1 1/3) miles. Considering this, and the fact that the fighter must be placed <u>behind</u> the target, in this particular example the controller would do well to order the turn when the gap measures about four and one-half (4 ½) to five (5) miles.

The "check turn" is a maneuver that the GCI controller may find useful from time to time. It is, in effect, a simple "sidestep" and can be used when the fighter is on the target's course but not positioned directly behind. The check is simply a turn of the indicated number of degrees in the indicated direction, followed by an immediate turn back onto the original heading. When used to displace the fighter to one side or the other so that he will de directly behind the target, the displacement resulting can be fairly accurately determined from the following table:

No. of degrees	Yds. displacement
10	100
20	300
30	600
40	1000
50	1500
60	2000

The order for the sidestep is given thus, in the case of a turn of 40 degrees to the left, to result in displacement of one thousand, (1,000) yards: "check forty port". When the maneuver is completed, the aircraft will be one thousand (1,000) yards to the left of its previous position and again on the same heading. It must be noted, in making use of the above tabulation, that these figures were computed on the basis of a ground speed of 180 mph and a Rate 1 turn.

The check turn also may be employed when the fighter is still heading on the cut-off vector but approaching the target too fast. The result then is simply to slow down the fighter's progress toward the interception point.

The check turn is not in great favor with experienced controllers, because a simple vector change in the right direction will get the same result, without loss of distance. When the fighter is found to be behind target on proper heading, but slightly to one side, it is best simply to change fighter's heading slightly in the direction of the target, so that the lateral gap will close gradually while the overtaking speed does not suffer.

RELATIVE SPEEDS - It is only reasonable to assume that in the majority of his operations the GCI controller will have fighter aircraft posessing a definite speed advantage over the hostile target, which will ordinarily be a larger and more heavily loaded ship than the fighter. Use of this advantage should be made at the start of the interception - in other words, the fighter should be given the maximum cruising speed with the first intercepting vector. As has been said before, it is desirable to complete the interception as quickly as possible, and high speed is one means of accomplishing this end. It is much easier to slow the fighter down in the late stages of the interception than it is to gain speed in an emergency.

When the fighter has been turned in behind the target on the proper course and is within theoretical AI range, care must be taken that his overtaking speed is not too great, lest he "overshoot" the target before his Radio Observer has time to order him to throttle back. The controller at this time should adjust the fighter speed so that it exceeds that of the target by no more than 20 to 30 mph. (assuming, of course, that such speed advantage is available to him). Should the fighter be too far behind the target for AI contact when turned onto course, his speed can be increased until he gets within range, but in any event the fighter pilot should be given some indication of the target's speed.

A good way to command a speed advantage is to keep fighter aircraft on patrol at altitudes higher than the known target altitude. This extra height can be converted into greatly increased speed in an emergency by ordering the fighter to dive to the lower target level. In cases where the controller finds himself without advantage either in speed or altitude he can still make a successful interception by sharpening his cut-off vector and endeavoring to bring the fighter in very much closer behind the target than is customarily necessary, thereby avoiding a long chase.

RELATIVE ALTITUDES - Roughly speaking, most types of AI equipment in use by the Army Air Forces will be found more effective in helping complete an interception if the fighter is brought in at very nearly the same altitude as the target. However there are a multitude of other factors to be considered in determining the altitude tactics to be employed in any particular interception.

If the fighter is placed too high, say above an angle of 20 degrees, he may have difficulty in descending during the AI phase without overshooting. If placed too low, say below a 30-degree angle, he may lose so much speed in climbing as to lose contact entirely. In the case of a low flying target, around 3,000 to 5,000 feet, and a fighter equipped with the SCR-540 AI, it is mandatory that the fighter be brought in well above, to avoid losing the target in the AI ground return. The effect of this maneuver is to keep the AI range at a maximum operational effectiveness.

The desirable relative altitudes of fighter and target very often will depend on weather and visibility conditions. On a moonlight night above an overcast, the fighter will prefer to approach from above, thus avoiding the chance of being silhouetted against the light background of the clouds. If flying below the overcast, he will prefer to approach the target from below. The controller must likewise keep the phase and position of the moon in mind and will direct his fighter in such a way as to avoid approach from a direction that will place him between a brilliant moon and the target.

In the final analysis, altitude tactics will be decided upon by conference and agreement with the night fighter squadron commander and pilots in the particular theatre in which the operations are being conducted, and with proper attention to the capabilities of the AI equipment being used and the general efficiency and experience of the air crews.

EVASIVE ACTION - The enemy night bomber can be expected to depart from the normal routine of straight and level flight at any stage of the approach. The type and scope of evasive action employed will generally depend on the ability and experience of the enemy pilot and navigator, and it may be in evidence throughout the run or only after the presence of night fighters is detected. Some of the common types of evasive action are:

1. Abrupt change of course.
2. An occasional orbit.
3. A "weave", consisting of regular changes of course to port and starboard.
4. Abrupt changes of speed.
5. The "roller coaster", alternate climbing and diving, with set throttle.
6. The "corkscrew", which consists of a combination of the weave and altitude changes.

The alert controller can successfully cope with most of these types of evasive action. The sudden change of course may require only a new cut-off vector, the important thing being to recognize the change and act immediately. The principal danger in the orbit is in flying the fighter through the orbit, where he might find himself in front of the target. If the fighter is in a position reasonably close behind the target, it may be possible for the controller to give the fighter an AI contact while following the target in the orbit. Usually, however, the best technique is to avoid the orbit, vectoring the fighter out of danger and into a position where he can be placed back on the target's course when the orbit is completed. The orbit is a rather effective method of evasive action, and to combat it effectively the controller must train himself to recognize its appearance on the PPI tube.

When the weave is encountered,the controller can either follow the zigzag course turn by turn or have his fighter fly a mean straight heading along the middle path of the weave, at some reduction in speed. This will enable him to get AI contact during the time the target is crossing the mean course on one of the legs of his weave.

The effect of the "roller coaster" is to give the appearance of erratic changes in speed, for PPI echoes and intercept board plots will appear successively close together during the climb, and far apart during the dive. Close attention to the PPI and intercept board is necessary to detect this maneuver. Care must be taken that the fighter does not overshoot, and successful interception will depend on the controller's anticipating the dive or climb at the time the fighter moves within normal AI range.

The abrupt reduction of speed is used by the enemy to cause the fighter to overshoot. It can be accomplished by throtteling back and lowering undercarriage, and possibly partly lowering flaps. When this action is recognized, the controller must realize that his fighter cannot slow his speed immediately - the process is gradual. The best counter-action is to vector the fighter off the course at a sharp angle, then turn back onto course.

R/T PROCEDURE - The proper R/T procedure for use in GCI is fully discussed in another chapter. However, certain of the terms or code words are more closely related to control tactics than others,and their proper application must be as fully understood. The word "punch" is given to alert the Radio Observer in the night fighter aircraft, and consequently should be given at the earliest moment when there is a possibility that a radar echo from the target may be observed on the R.O's screen. It is important to remember that "punch" may be given well before the fighter is put on the targets heading. In a beam or head-on approach, for instance, the R.O may often be able to abserve the target's movements long before he is asked to take over, and consequently can prepare himself to carry on with minimum delay and maximum efficiency. No useful purpose is served by delaying "punch" until just a few seconds before the controller is ready to give "Judy". The code word "Judy" is given when the fighter is well within AI range, one to one and one-half mile behind the target, on the same heading, and with properly adjusted relative altitude and overtaking speed. In other words it is a signal that the controller believes he has done all he can to complete the interception.

Throughout the interception, the controller will keep the fighter pilot advised of the target's position and action, in a sort of "running commentary" on the situation. Information passed on will usually include range, clock direction, direction of flight, speed, altitude and any type of evasive action that may be noted. Typical examples:

"Bandit range 15 miles at 10 o'clock, passing port to starboard, speed 200."

"Bandit range 5 miles at 12 o'clock, passing port to starboard on heading 120, at 15,000 feet."

"Bandit range 2 miles at 12 o'clock, 500 feet above you, speed 200, weaving course."

When giving fighter aircraft a new heading, the controller should never fail to indicate whether the turn should be made to port or starboard. this indication of direction of turn should be given before the heading, for instance: "Port 270." This enables the pilot to start his turn in the proper direction immediately, even if he fails to understand the vector and finds it necessary to ask for a repeat. It also obviates the need for the pilot's deciding which way to turn, with consequent delay and possible confusion.

GENERAL NOTES ON TACTICS - If you are not absolutely sure of the target's heading at the start of the interception, vector the fighter toward the target and give the cut-off vector later when a definite course is established. Never vector the fighter away from the target except to avoid overshooting or to gain displacement in a head-on situation.

Keep your plotter-computer on the alert for changes in heading or speed that may not be apparent on the PPI tube.

Watch the progress of fighter and target after AI contact is effected, so that you may be ready to give immediate assistance in case fighter loses contact.

Know and remember the limitations and capabilities of the AI equipment in use. For instance, much more precise positioning of fighter will be necessary when equipped with the SCR-540 than with the SCR-520 or SCR-720.

Plot fighter and target with chinagraph pencil on the face of the PPI tibe if you find it helps you in visualizing the situation or if the interception appears to be progressing through a known "fade" area. Such plots will be found helpful in rough dead reckoning on the tube face and in identification after a "fade" period.

R/T PROCEDURE FOR GCI

1. In GCI Interception, action is much faster and more instructions are given by the Controller than during any other form of Interception and it is because of this that the GCI R/T procedure is greatly shortened and very informal. When a night fighter is on the tail of an enemy bomber there is no time to spare for long call signs for the fighter and the control station, or for wordy instruction. Directions must be given as quickly as possible.

2. The code words and phrases used in connection with AI and IFF are secret. In this respect they differ from "code" words such as Pancake, Orbit, Vector, etc., the purpose of which, is merely to standardize and shorten the length of transmissions. Every care must be taken not to compromise these secret code words and phrases. Such phrases as "Target is three miles ahead: you should have joy", "I have no more information for you", "he is too low", "cannot see you", "you are too low", etc. can give away vital information, and must never be used, nor must there ever be any talk of "seeing blip", "Echos" or pictures. The following procedure has been devised with a view to denying to the enemy any indication of the precise nature, performance, range, etc., and the apparatus used.

3. Owing to the nature of GCI Control, it is not necessary, once R/T communication has been established, for full procedure to be employed. Provided R/T communication is satisfactory, abbreviated procedure is used.

4. During the whole of the approach the Controller will keep the pilot fully informed as to the position of the target in relation to the fighter e.g., 15 miles, 2 o'clock, its height and heading, and the direction of cross ing the fighter (e.g., port to starboard).

5. The following is a list of secret code words and phrases used in conjunction with GCI, conforming to both the American and British systems.

Vector	Alter course to ------------------
Vector Port	" " " port
Vector Starboard	" " " starboard
Port 10	" " " 10° to port (should not be used for changes of more than 20°)
Steer	Set course - - - - - - - - - - - - for "home".
Orbit	Circle(given either port or starboard).
Anchored	Am orbiting a visible orbit point.
Pancake	Land, refuel, re-arm.
Pancake Ammo	Returning short of ammunition.
Pancake Fuel	Returning short of fuel.
Pancake Hurt	Returning Wounded or Damaged.
Angels	Height in thousands of feet.
Mattress	Below cloud.
Popeye	In cloud.
Quilt	Above Cloud.
Speed	Always use indicated air speed.
Dive hard starboard	Emergency call to pilot to get him away from any area in a hurry.

Steady	Pilot gives "steady" when on new vector or speed.	
Level	Pilot gives "level" when he has reached angles.	
Check Starboard Sixty	Turn 60^{o} to the right, then turn back left to last heading being followed.	
Cockerel	IFF	
Make your Cockerel Crow	MK.IIIG	Switch on IFF
Strangle your Cockerel	MK.IIIG	Switch off IFF
Cockerel is strangled	MK.IIIG	IFF is switched off
Check your cockerel	MK.IIIG	Adjust your IFF
Weapon		AI
Flash your weapon		Switch on AI
Darken your weapon		Switch off AI
My weapon is flashing		My AI is turned on
My weapon is bent		My AI is unserviceable.
Contact		I have an indication on my AI
No Joy		I do not have an indication on my AI.
Contact lost		The indication on my AI has faded
Punch		You should very soon be obtaining a contact on the aircraft that is being intercepted.
Judy		Take over(or I am taking over) the interception.
Mother or Granny		Homing beacons
Cousin Maud or Cousin Jim		Patrol beacons
Baby		AI Beam approach beacon
May Day		Universal distress call

Mission complete	Pilot signifies that he has shot down bandit and wants directions for interception.
Any Joy	Are you having any luck with target
Oranges	Weather or Visibility
Oranges sour	" " " bad
Oranges Sweet	" " " good

NOTES:

1. It is recommended that in the present R/T procedure the word "vector" be eliminated in giving changes of heading and merely the figure given preced by either "port" or "starboard".

2. It should be made a standard practice to reduce R/T to the minimum. In the past it has been found that in some theatres of operation , R/T was too lengthy, thus enabling the enemy to monitor the channel and take appropriate evasion action. However, when it is practicable, a running commentary regarding the target's action and position will be used, thereby passing valuable information to the pilot.

The following is an example of Night Fighters R/T Procedure:

Aircraft - Lusty 23

Tower - Joe-Joe Control (Channel B)

Area - Tarpon (Channel A)

GCI - Bluefish (Channel D)

A/C - "Hello Joe-Joe Control, this is Lusty 23, Over"

Tower - "Hello Lusty 23, this is Joe-Joe Control. Loud and Clear. Over."

A/C - "Lusty 23. Loud and Clear. Out".

A/C - "Hello, Joe-Joe Control, this is Lusty 23, May I scramble. "Over."

Tower - "Hello Lusty 23, this is Joe-Joe Control Okay to scramble, "Out"

A/C - "Hello Joe-Joe Control, this is Lusty 23, Airborne, Over."

Tower - "Hello Lusty 23, this is Joe-Joe Control, call Tarpon on "A" for Able, Over".

A/C - "23. Wilco. "Out".

A/C - Hello Tarpon, this is Lusty 23. In position. "Over".

Area - "Hello, Lusty 23, this is Tarpon. Roger. "Out".

Area - "Hello, Lusty 23, this is Tarpon. Vector one eight zero. Over"

A/C - "Hello, Tarpon, this is Lusty 23. One eight zero, "Out".

Area - "Hello Lusty 23, this is Tarpon. Call Bluefish on "D" for dog. Over".

A/C - "Hello Tarpon, Wilco. Out".

A/C - "Hello Bluefish, this is Lusty 23, Over".

GCI - "Hello Lusty 23, this is Bluefish. Loud and Clear. Over".

A/C - "Hello Bluefish, Loud and Clear also, Out".

GCI - "Hello 23, Bandit for you. Port one five zero. "angels 10: Speed two thirty. Over".

A/C - One five zero. Angels 10. Speed two thirty. Out".

GCI - "Hello 23. Bandits range 15 miles at 10 o'clock, crossing port to starboard on heading of 170. Over".

A/C - Roger

GCI - "Hello 23, port 20. Bandits speed one ninety, 500 feet below you. Over".

A/C - "Port 20. Roger, Out."

GCI - "Hello 23, Range now 5 miles at 1 o'clock. Punch. Over".

A/C - "Punch. Out."

GCI - "Hello 23, Throttle back to two ten. Over."

A/C - "Roger. Two ten.

GCI - "Hello 23. Starboard onto one seven zero, target's heading. Over".

A/C - Starboard one seven zero. Out."

A/C - "Hello Bluefish. Contact. Over."

GCI - "Hello 23. Starboard 10, over."

A/C - "Starboard 10 out."

GCI - "Hello 23. Judy. Over."

A/C - "Judy. Out."

A/C - "Hello Bluefish. Tally-ho."

GCI - "Hello 23. Return to base, your steer is three five zero. Over."

A/C - "Hello Bluefish. Steer three five zero. Out."

A/C - "Hello Bluefish. See base, request pancake. Over."

GCI - "Hello 23, Change to "A" for Able and call Tarpon. Over."

A/C - "Wilco. Out."

A/C - "Hello Tarpon, this is Lusty 23. Request Pancake. Over."

Area - "Hello Lusty 23, this is Tarpon. Call Joe-Joe Control on B. for Baker. Over."

A/C - "Roger. Call Joe-Joe Control on "B" for Baker. Out."