THE GENERAL BOARD
UNITED STATES FORCES, EUROPEAN THEATER
APO 408

THE CONTROL OF TACTICAL AIRCRAFT IN THE EUROPEAN THEATER OF OPERATIONS

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REPORT

ON

THE CONTROL OF TACTICAL AIRCRAFT IN THE

EUROPEAN THEATER OF OPERATIONS

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INTRODUCTION

The Tactical Air Force operating in the European Theater of Operations had, as an integral part, a tactical air command cooperating with each army. An unusual degree of organization and operational flexibility enabled the Ninth Air Force to apply its total tactical power or any required portion of it where it could damage the enemy most materially and permit the Ground Forces most fully to exploit the enemy's diminished power to resist. The flexibility of the Tactical Air Force in diverting its power rapidly to meet critical situations on the ground, to nullify sudden enemy air opposition, or generally to shift from one phase of operations to another, frequently made it possible for individual Ground Force units to face and overcome superior strength in armor, fire power and troops. One of the means by which flexibility was gained was the close control of the aircraft by the tactical control group.

The tactical control group was organized to overcome the numerous problems which arose during the early stages of close cooperation of tactical air commands with armies in the European Theater of Operations. The tactical air commander was responsible for the effective use of fighter bomber and reconnaissance aircraft to assure efficient execution of air force missions and cooperation with the army commander in performing his mission.[6] It was found, however, that to attain this end the tactical air commander had to concern himself closely with the various separate units whose collective function was the close control of tactical aircraft. The air plan depended, for its rapid and flexible application to the ever changing situation, on the integrated functioning of the fighter control squadron, the signal air warning battalion, the radio intercept unit, and the signal company wing.[1]

The formation of the tactical control group welded these separate units into a smooth cohesive whole. In the process these units were broken down and reconstituted in such a way that their organizations were better suited for the functions which experience had shown they were to perform. A provisional tactical control group was organized in the XIX Tactical Air Command and similar organizations were in use in the IX and XXIX Tactical Air Commands, although not so designated.

The remainder of this report will be devoted to the description of the organization, employment and equipment of the tactical control group.

CHAPTER 1

TACTICAL CONTROL GROUP

SECTION 1

ORGANIZATION OF TACTICAL CONTROL GROUP

1. General. The tactical control group organization provids for a group headquarters and four or more squadrons. The exact number depends upon the tactical requirements. (See Fig. 1). From these

squadrons, there are formed in turn, additional ancillary radar units which operate various equipment furnished as the situation demands. Normally, there are one tactical control squadron, whose mission is to operate the tactical control center; and two or more additional control squadrons, each of which is equipped with heavy type radar, micro-wave early warning (MEW) or V-Beam for the operation of a forward director post (FDP). A communications squadron installs and maintains inter-unit communication facilities.[5]

2. Organization.[4] To provide for operations by varied components over a wide area, the tactical control group is organized on a cellular or team basis. By requisitioning and allocating teams as required, personnel and equipment are provided for all duties and functions, including:

a. Headquarters overhead. In addition to group headquarters personnel, provision is made for headquarters in separate squadrons in the quantity required for administration of outlying units. Mess teams are also furnished in quantity as required by the dispersal of teams.

b. Filtering, plotting, aircraft control, and flight information. These activities are normally conducted by a control squadron operating in a central installation known as the tactical control center, and are supplemented by other control squadrons operating outlying early warning-ground controlled interception (EW-GCI) radars, micro-wave early warning (MEW) radars, V-Beacon radars, and SCR 584's.

c. Direction finding (D/F) stations, for the location and assistance of friendly aircraft.

d. Ground observer posts, which with light warning (LW) and early warning (EW) radars provide the aircraft warning system.

e. All organic signal communications. Very high frequency (VHF) radio, high frequency (HF) radio, frequency modulated (FM) radio, wire and radio teletype are provided. All radar teams are furnished with equipment and personnel for maintenance of communications with the tactical control center.

f. Using element maintenance.

g. Medical and Chaplain functions.

SECTION 2

EMPLOYMENT

3. Control Squadrons.[4] The cellular organization of the tactical control group facilitates the ready formation of control squadrons, in quantity as needed and varying in personnel and equipment as required for the operation of a tactical air command. Since these operations vary considerably, the number and composition of the control squadrons were entirely flexible, and could be adapted to the differing requirements of counter air force operations, air attacks against hostile rear areas, and close cooperation with ground forces in the battle area. There are additional requirements in fluid and fast moving situations; in these, this type organization can be utilized to its fullest extent. A few of the many possible combinations permitted by this type of organization are presented as follows:

a. A control squadron operates the tactical control center. The tactical control group headquarters will also normally be located at this center.

b. In addition to the squadron mentioned above, the control group also has a number of other control squadrons. These control squadrons operate light warning units (LW Radar), heavy operating units (EW-GCI Radar), and ground observer teams, all of which report information directly to the tactical control center.

c. A control squadron may be designated with a forward director post as its headquarters. Such a squadron may, for instance, comprise one heavy operating unit (EW-GCI Radar) and several light operating units (LW Radar) and ground observer teams reporting directly to the F.D.P.

d. Another control squadron may be designated with its headquarters at a forward director post consisting of a control and reporting unit, heavy (MEW or V-Beam radar). This unit may be composed of a whole squadron, or it may be expanded to include one or more SCR 584's and other installations.

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CHAPTER 2

TACTICAL CONTROL CENTER

SECTION 1

ORGANIZATION & FUNCTION

4. Organization. The tactical control center is the focal point for the aircraft control and warning activities of the Tactical Air Command. It is the nerve center of the air command and secures current information concerning all air operations within its area. This information is forwarded to the combat operations room for command decisions. The control center is in communication with Tactical Air Command airfields and friendly aircraft in flight. It also directs the operations of forward director posts, battle area control units, radar stations, ground observer teams, and other elements of the tactical control group.[4]

5. Functions. Functions of the tactical control center include the following:

a. Conduct of the fighter defense of the Tactical Air Command area of responsibility. Fighter units are allocated to the control center for the purpose.

b. Aircraft control of offensive missions as directed by TAC headquarters (Fig. 2). The activities may include:

(1) Warning friendly aircraft of hostile flights in their vicinity.

(2) Vectoring friendly aircraft to target areas.

(3) Vectoring friendly aircraft to secondary targets.

(4) Vectoring friendly aircraft to forward direction posts (FDP's) or forward control teams (FCT's), which then take over.

(5) Changing the course of friendly aircraft to avoid interception or flak areas.

(6) As directed by the combat operation room, ordering mission to return to base when the air, ground or weather situation changes after the mission takes off.[5]

SECTION 2

EMPLOYMENT

6. General.[4] The tactical control center together with the forward director posts is responsible for directing aircraft in both offensive and defensive missions in the tactical air command area. It also aids in the air rendezvous of fighters and bombers, furnishes direction finding services for lost aircraft or those in distress, and provides information for all friendly aircraft within its area. Forward director posts are used to their maximum capacity in order to assure the most accurate control of all aircraft. Through dependable communications, the tactical control center keeps the forward director posts informed of all air operations in the area and briefs them on their particular missions. Close coordination is maintained between the control center and forward director posts at all times.

7. Interception Missions. Information of air activity received from reporting stations is plotted on the control center's operations board and forms the basis of defensive action if any flights are determined to be hostile. When interception is advisable, the senior controller dispatches fighters from those units allocated to the control center for air defense operations. Control of aircraft on intercept missions is allocated to the forward director posts and is not handled at the tactical control center except in an emergency.

8. Preplanned Missions.

a. The majority of the missions executed by the command are preplanned missions. These are planned either from requests from the ground forces, from intelligence reports, from air reconnaissance, upon orders from higher headquarters, or from the nightly planning conference. The senior controller should attend this conference. He should also attend the daily planning conferences held jointly by tactical air command and army headquarters. With the information obtained in this way and with the operations order received daily from the combat operations room, he can formulate his plans for controlling the scheduled missions. The tactical control center is kept informed by the combat operations room of the status of all missions as to time of take-off, targets, routes, etc. This continuing flow of information is transmitted to the forward director posts and battle area control units to facilitate efficient control of the mission.

b. As a flight becomes airborne, it calls the tactical control center giving the mission number. References to the aircraft status board or the field order identify the mission and the target. The control center may retain control of that particular mission, but will, if possible, delegate control to a forward director post, tactical air coordination officer, or battle area control unit,* depending on the type of mission and location of the target. Even though control is delegated to an outlying unit, the tactical control center maintains a listening watch and stands by with direction-finding systems to offer assistance in the event of an emergency.

9. Call Mission. Call missions are those directed against targets of opportunity which must be struck at once. Such missions are more difficult to control, are more expensive, and in general least effective. Targets are often small, well-dispersed, and difficult to locate. The control center is informed by the tactical air command as to the type and number of the mission, target, route, time of take-off, and any other pertinent data. After take-off, control of the mission is usually turned over to a forward director post or battle area control unit, whichever is best suited.

10. Reconnaissance Missions. The tactical reconnaissance group is one of the most important units available to the tactical air commander. It gives him most of his first and second priority type targets and many of his third priority type targets. Important information requiring immediate attention is reported by reconnaissance pilots to the control center by radio. Pertinent information received from reconnaissance pilots or from pilots on other missions is brought to the prompt attention of the tactical air command's A-3 representative. Vital information is relayed at once to the combat operations room, where it may result in an immediate-action air (or call) mission as described in paragraph 9.

11. Movement Liaison Section. For purposes of identification, aircraft control and flight information, the tactical control center is furnished with schedules of all friendly aircraft which are to operate in or pass through its area. Close liaison should be maintained with adjacent control centers and tactical air commands to aid in identification of flights passing from one area of responsibility into another. Flights which are not properly identified may be investigated by fighter units allocated to the tactical center for intercept missions.

*See paragraph 18.

12. Direction-Finding System. There are usually three or four direction-finding (D/F) stations in the tactical air command area which report to a triangulation table in the tactical control center. These stations report the azimuths of friendly aircraft. With two or more stations reporting on the same aircraft while it transmits for a fix, it is possible to locate the aircraft by the intersection of the azimuth reports. The D/F systems affords valuable aid in identifying flights, vectoring flights to targets, and in positioning lost or distressed aircraft so as to vector them to their base or to the nearest friendly airfield.[4]

13. Mobility. The tactical control center is equipped with duplicate operations room and communications facilities, which enable it to move by a leap-frog process, without interruption of aircraft control and warning activities. Movement of the control center may, however, be accomplished in another way: during a period when operations are light, complete control may be delegated to a forward director post until the control center is ready for operations at the new location.

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CHAPTER 3

FORWARD DIRECTOR POSTS

SECTION 1

ORGANIZATION AND EMPLOYMENT

14. Mission. With the use of personnel and equipment furnished by the radar control squadron, the mission of the forward director post is to offer by means of air-ground control all possible assistance to all friendly aircraft employed within the station's area of coverage, and to afford early warning of hostile or suspicious aircraft approaching areas which must be defended. In addition this type of radar station is used for general reporting purposes, thereby contributing to the comprehensive air picture on the operations board at the tactical control center. When a controller at a forward director post (FDP) is handling aircraft, he is able, by use of the radar equipment at his disposal, to maintain a constant watch over the flight in question, and to transmit to the pilot accurate "hot" information concerning the air and ground situation in his vicinity as it actually exists at the time of transmission. He keeps the flight in view of the radar equipment and knows at all times which spot on the radar tube represents the flight. Identification is made by several means--by giving vectors to fly, by using IFF or other beacons, or by the use of "window." Since the position of the flight is known accurately, the combat officer may order desired diversion at any time during the mission.

15. Functions.[3]

a. With the exception of normal maintenance periods the forward director post operates continuously. The reporting devices provide a constant watch of the air activity throughout its area of coverage. The control facilities--namely, the PPI scopes and air-ground communications channels--provide a means by which accurate and precise control is constantly afforded aircraft of the tactical air command while carrying out offensive or defensive missions. The controller at the forward director post can materially assist in the execution of missions by performing the following duties:

(1) Keep the controlled aircraft in an advantageous position relative to approaching hostile or unidentified aircraft.

(2) Assist the flight to reform in the event various elements become separated due to unfavorable weather conditions.

(3) Keep the flight leader advised of his position relative to the ground.

(4) Furnish accurate vectors to both air and ground targets.

(5) Vector the controlled aircraft around areas of concentrated enemy flak.

(6) Provide vectors to the nearest friendly airfield in event of emergency.

b. The following are types of missions which have been effectively controlled by forward director posts:[5]

(1) Night patrols and interception.

(2) Night intruder missions and photo-reconnaissance.

(3) Fighter sweeps and defensive patrols.

(4) Bomber escort.

(5) Armed reconnaissance.

(6) Fighter-bomber air-ground cooperation.

(7) Leaflet bombing.

(8) Air-sea rescue missions.

(9) Assisting battle area control units in cooperation missions.

Normally, the mechanics of control of a particular mission at the forward director post are set in motion by the receipt of the operations order of the day (by teletype or other means) from the tactical air command's combat operations section. The chief controller at the forward director post communicates with the chief controller on duty at the tactical control center; the missions for the day are discussed at length with particular emphasis being placed upon the station's coverage, the current technical performance of the radar equipment, the availability of controller personnel and any other details which might enhance or detract from the effective control of the missions set out in the operations order. Subsequently, certain missions are assigned to the forward director post for control. Information relative to weather conditions, times at which aircraft become airborne, very high frequency (VHF) channels, number of aircraft involved, altitude of flight, initial vector if possible, the serviceability of emergency landing strips and other pertinent details are furnished by the chief controller at the tactical control center. A controller at the forward director post is then assigned the mission. When the flight is airborne, the leader establishes VHF contact with the designated controller, who immediately identifies the formation on his plan-position indicator (PPI) scope. Thenceforth, the controller maintains continuous identity of the formation on his scope and offers all possible assistance until the mission has been completed. The controller has thoroughly briefed himself in advance, if the mission involves fighter-bombers he has pinpointed the primary and secondary target locations on his PPI scope. He has indicated on the scope flak areas, outstanding land-marks in the vicinity of the targets, and roads over which the enemy might be expected to travel if the target is a moving one.

16. Equipment. Operational equipment, among other items, includes the following:

a. Micro-wave early warning (MEW) or V-Beam heavy radar.

b. Height finding equipment if V-Beam is not furnished, preferably two or more units.

c. Six channels of very high frequency (VHF).

d. Two or more direction finding (D/F) units.

e. At least five "B" scans for reporting.

f. Seven plan-position indicator (PPI) scopes for control.

g. Standby D/F triangulation table with communications facilities to establish contact with all fixer stations employed by the tactical control center.

h. Operations room facilities which include a vertical plotting board, aircraft status board, height-tote board, D/F board, weather board, plan-of-attack board, maps and charts, air conditioning unit, heating unit and complete radar operations room communications system.

17. Location. The exact location of the station depends upon the number of forward director posts employed by the tactical control group. Normally, however, it is sited forward of the tactical control center, considering such factors as terrain and signal communications, and, if possible, placed at least twenty miles to the rear of the bomb-line. If the station is located too close to the area of intense activity, the aircraft when operating in that area present a small "pinched" picture on the scopes, thereby making accurate control extremely difficult.

SECTION 2

ANCILLARY CONTROL AND REPORT UNITS

18. Battle Area Control Unit.[5] The radar control squadron provides for the formation of a battle area control unit. This unit is provided with one or more SCR-584's or similar radar sets, two channels of very high frequency (VHF) and one direction finding (D/F) unit. The outstanding characteristic of the radar equipment (SCR-584) is its ability to "lock-on" and automatically track a formation of aircraft in flight, thereby enabling the controller to continually observe the aircraft while under his control. Obviously, extremely accurate control may be exercised at a unit of this sort, and excellent results are obtained by utilizing this equipment as a navigational aid to pin-point targets during periods of poor visibility, to control blind-bombing missions above a complete overcast, and to direct photo-reconnaissance missions behind the enemy lines at night. The battle area control unit (BACU) can track only one flight at a time, and cannot see other aircraft in the vicinity of the given flight. Therefore the heavy radar at the FDP must maintain watch for hostile aircraft and give warning when needed. This arrangement requires good liaison between controllers at the BACU and the forward direction post (FDP). The FDP controller must also be prepared to assume control in case the automatic tracking device in the BACU should develop mechanical difficulties.

19. Light-Warning Reporting Unit. A light warning unit is also furnished by the radar control squadron. Its primary function is that of reporting, and the equipment used is a highly mobile medium range radar. The set possesses a very low beam angle and is frequently utilized to report low flying aircraft in a given area, and to cover areas distorted by permanent echoes in the heavy radar set.

20. Ground Observer Unit. Ground observer teams are provided by the radar control squadrons to supplement radar coverage by reporting low flying enemy aircraft over friendly territory. An effective method of employment of the ground observer teams is to locate the personnel at various anti-aircraft artillery reporting centers, establish direct communications with the forward director post, and report all observations of the AAA network. This method greatly increases the volume of information received.

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CHAPTER 4

COMMUNICATIONS

SECTION 1

SIGNAL MEANS EMPLOYED

21. General.[5] Three distinct point-to-point communications systems are provided within the tactical control group:

a. Aircraft warning net.

b. Controller Liaison and operations net.

c. Administrative net.

In order that communications be available at all times regardless of certain failures, three means of communications are installed and operated simultaneously; namely, wire, VHF FM radio, and HF W/T radio. These three means of communications are terminated at switchboards and operations centers in such a fashion that it is only necessary for the operator to switch from one means to another as communication failures occur. Thus, operational difficulties caused by communication failures are held to a minimum and the efficiency of the control system is increased. Wire communication is considered as the primary means and VHF FM circuits as secondary. HF W/T radio is utilized only for administration and emergency situations. Couriers are also used for messages not transmissible by electrical means.

22. Wire. Wire communications is the primary means within the tactical control group. Tactical conditions permitting, wire is installed between the forward director posts, and the tactical control center, forward director post's and their associated light warning and ground observer and SCR-584 units. Normally, six wire circuits are installed between each Forward Director Post (FDP) and the tactical control center and utilized as follows:

1 circuit - Controller liaison

2 circuits - Plotting

1 circuit - Filter Officer liaison

1 circuit - Identification liaison

1 circuit - Administration

One simplex circuit is installed for a teletype channel. Three wire circuits and one teletype channel are utilized between each forward director post and SCR-584 unit; one for controller liaison, one for plotting, and one for administration. The teletype channel is used for transmission of field orders. Only in a static situation are the ground observer (GO) units connected to the forward director post (FDP) by wire, and then only one circuit is provided for the passing of information concerning friendly and hostile air activity.

23. Radio. Two types of radio communications are utilized within the tactical control group for point-to-point communications; VHF FM radio and HF W/T radio. The tactical control center and forward director posts are provided with VHF and HF radio for air-ground communications. With a few exceptions, radio circuits are considered the secondary means of communications and only supplement wire communications. The point-to-point

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radio circuits are normally installed before wire and used until wire circuits become available. The wire circuits installed between each forward director post and tactical control center are supplemented with VHF FM (1) radio using carrier equipment which provides a sufficient number of circuits for operation plus a teletype channel for transmission of field orders. Wire communications between the FDP (2) and SCR-584 units are also backed-up by VHF FM (1) radio using carrier equipment. Only one VHF FM (1) channel is necessary between the FDP (2) and its GO (3) and LW (4) unit. Normally, this is a push-to-talk circuit. All D/F (5) stations communicate with the tactical control center via VHF FM (1) radio which can here be considered the primary means of communications, since wire is installed only when the situation is static. VHF FM (1) radio circuits are established to adjacent tactical control and rear control centers to supplement wire circuits. High frequency wireless telephone (HF W/T) radio is used for emergency and administrative purpose only with the net control station (NCS) being located at the tactical control center. Stations forming the net are located at each FDP (2), SCR-584, GO (3) and LW (4) unit of the group. The VHF and HF radio equipment is used by the controller to pass and receive information from friendly airborne aircraft.

24. Regular and special couriers are used to transmit within the tactical control group: operational orders, intelligence summaries, target information and photographs, maps and overlays, airfield information, reconnaissance reports and emergency technical supplies.

25. Message Center. The message center is a group function and is charged with the receipt, transmission and delivery of all messages within the tactical control group, with the following exceptions:

a. Messages transmitted by the writer directly to the addressee by telephone or personal agency.

b. Messages handles through the army postal service.

c. Local messages.

d. Messenger service within group headquarters.

SECTION 2

THE COMMUNICATIONS SQUADRON

26. Mission.[5] The communication squadron organized under T/O & E No. 1-518T, consists of a sufficient number of wire, VHF FM radio and HF W/T radio teams to operate the group communications system exclusive of terminal equipment. This squadron will install wire, VHF FM repeaters and HF W/T circuits as directed by the group communications officer.

27. Functions of the Communications Squadron:

a. To install, maintain and operate communications at headquarters tactical control group, but not within the tactical control center.

b. To install, maintain and operate point-to-point communications (wire, radio and courier) within the control group exclusive of terminal equipment.

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(1) VHF FM: Very high frequency radio, frequency modulated.
(2) FDP: Forward Director Post.
(3) GO: Ground Observer.
(4) LW: Light Warning.
(5) DF: Direction Finding

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CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

SECTION 1

CONCLUSIONS

28. The need for a tactical control group to centralize in one organization all air warning and aircraft control functions of a tactical air command was clearly demonstrated in the operations of the tactical air commands of the Ninth Air Force.

29. A cellular organization of the tactical control group is preferable since it facilitates the formation of squadrons in quantity and type to meet the tactical situation confronting a particular control group.

30. The employment of the tactical control group and its squadrons as outlined in Chapters one, two, three and four above, was evolved during the operations of the tactical air commands of the Ninth Air Force and proved to be highly satisfactory.

SECTION 2

RECOMMENDATIONS

31. It is recommended:

a. That the material contained in Chapters one, two, three and four be disseminated to all concerned in the form of a War Department Field Manual for guidance in the organization, training and employment of Tactical Air Commands and Tactical Control Groups.

b. That any new developments of radar or other electronic equipment that could be used for air warning and aircraft control be made immediately available to Tactical Control Groups for their use in training personnel and the development of technique.

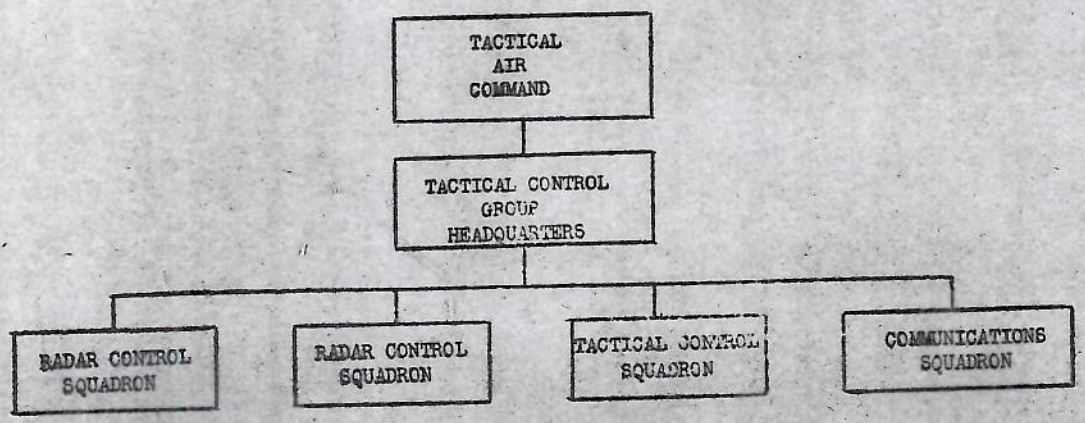
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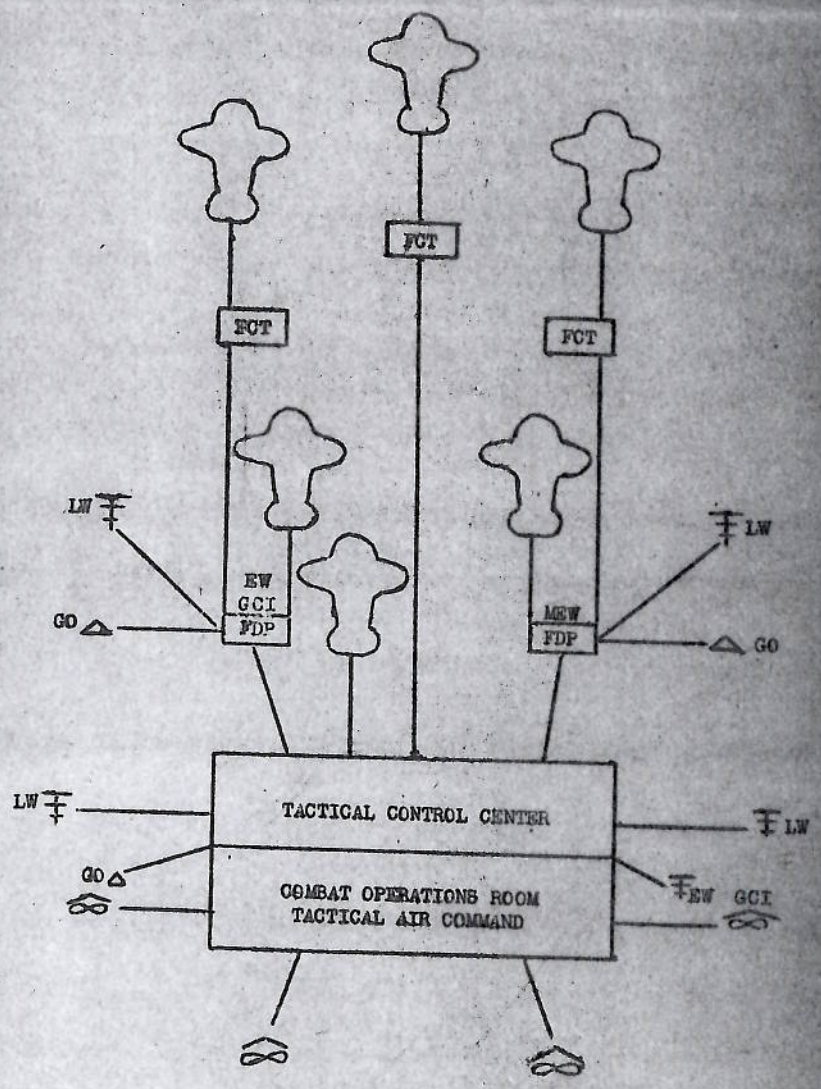
Figure 1



CONTROL OF OFFENSIVE MISSION

FCT-------Forward Control Team
FDP------Forward Director Post
MEW------Micro-wave Early Warning Radar
EW-GCI---Early Warning Ground Controlled Interception Radar
GO-------Ground Observer

Figure 2