RESTRICTED

FM 4–187

WAR DEPARTMENT

ANTIAIRCRAFT ARTILLERY FIELD MANUAL

BARRAGE BALLOON
SERVICE OF THE BALLOON AND
BALLOON EQUIPMENT
LOW ALTITUDE

March 13, 1943

RESTRICTED

FM 4–187

ANTIAIRCRAFT ARTILLERY FIELD MANUAL

BARRAGE BALLOON SERVICE OF THE BALLOON AND BALLOON EQUIPMENT LOW ALTITUDE

UNITED STATES
GOVERNMENT PRINTING OFFICE
WASHINGTON : 1943

WAR DEPARTMENT,
WASHINGTON, March 13, 1943.

FM 4–187, Antiaircraft Artillery, Barrage Balloon, Service of the Balloon and Balloon Equipment, Low Altitude, is published for the information and guidance of all concerned.

[A. G. 461 (1–8–43).]

BY ORDER OF THE SECRETARY OF WAR:

G. C. MARSHALL,
Chief of Staff.

OFFICIAL:
J. A. ULIO,
Major General,
The Adjutant General.

DISTRIBUTION:
B 44 (2); IR and IBn 44 (10); IC 44 (25).
(For explanation of symbols see FM 21–6.)

TABLE OF CONTENTS

	Paragraphs	Page
CHAPTER 1. GENERAL	1	1
CHAPTER 2. BALLOON.		
Section I. Nomenclature	2–6	2
II. Characteristics	7–12	3
III. Construction and functioning	13–21	10
IV. Rigging	22–30	16
V. Packing	31–32	19
VI. Maintenance	33	19
CHAPTER 3. WINCH.		
Section I. Description	34–37	21
II. Installation and operation	38–42	23
III. Safety precautions	43–45	26
CHAPTER 4. FLYING CABLE.		
Section I. General	46–48	28
II. Operation	49–50	29
CHAPTER 5. GAS EQUIPMENT.		
Section I. Nomenclature	51	31
II. Handling, transporting, and storing gas	52–59	31
III. Safety precautions	60–64	37
CHAPTER 6. SITE	65–66	39
CHAPTER 7. ORGANIZATION AND COMMAND DUTIES OF PERSONNEL.		
Section I. General	67	41
II. Organization	68–71	41
III. Command duties	72–79	42
CHAPTER 8. OPERATING AND MANEUVERING ON LAND.		
Section I. Formation of balloon crew	80–81	45
II. Drill procedure	82–106	45
III. Maneuvering in emergencies	107–108	92
IV. Operating at mobile sites	109–111	102
V. Drill tables	112–125	103
CHAPTER 9. OPERATING AND MANEUVERING AT WATERBORNE SITES.		
Section I. General	126–132	136
II. Personnel	133	137
III. Equipment	134–143	138
IV. Operating and maneuvering	144–148	143
CHAPTER 10. RIGGING AND FABRIC REPAIR	149–151	148
CHAPTER 11. RECORDS AND REPORTS	152–155	149
CHAPTER 12. DEMOLITION OF MATÉRIEL IN EVENT CAPTURE APPEARS IMMINENT.		
Section I. Reasons, policies, and materials	156–157	150
II. Methods	158–168	151
APPENDIX. LIST OF REFERENCES		155
INDEX		157

RESTRICTED

ANTIAIRCRAFT ARTILLERY FIELD MANUAL

BARRAGE BALLOON

SERVICE OF THE BALLOON AND BALLOON EQUIPMENT

LOW ALTITUDE

CHAPTER 1

GENERAL

■ 1. SCOPE.—*a*. This manual gives a general description of site equipment and sets forth the duties of crews in handling low altitude ballonet barrage balloons and equipment.

b. The text refers particularly to the D–8 balloon, the M1 winch, and auxiliary equipment. The general principles stated herein also apply to handling the D–7, Mk. VII, Mk. VIII, and Mk. X balloons.

c. FM 4–108 covered both dilatable and ballonet low altitude barrage balloons. Increased emphasis on ballonet balloons has made it necessary to provide a manual solely concerning them. This manual thus supersedes the data on ballonet balloons in FM 4–108.

CHAPTER 2

BALLOON

	Paragraphs
SECTION I. Nomenclature	2–6
II. Characteristics	7–12
III. Construction and functioning	13–21
IV. Rigging	22–30
V. Packing	31–32
VI. Maintenance	33

SECTION I

NOMENCLATURE

■ 2. GENERAL.—The nomenclature of the balloon is illustrated in figures 1 to 6, inclusive.

■ 3. NAME PLATE.—A name plate is cemented on the nose of the balloon giving the type of balloon, the manufacturer's name, the balloon serial number, the weight, and the contract number.

■ 4. SIDES.—When the right side or the left side of the balloon is referred to in this manual, it means the balloon's right or left side, not the observer's. The nose of the balloon is considered the front, and its right and left sides do not vary with the position of the observer.

■ 5. ASSEMBLIES.—A complete balloon consists of these assemblies:

a. Envelope, with all rigging attached thereto.
b. Concentration fitting.
c. Gas valve.
d. Air valve.

■ 6. METHOD OF SHIPPING.—*a. Box.*—The balloon is shipped in a wooden box.

b. Balloon case.—The balloon is inclosed in a rubber-treated canvas case. If properly opened, this case can be used indefinitely. To open properly, start at one corner of the fabric seal, loosen the seal with the aid of benzol, benzine, or other suitable solvent and separate it from the remainder of the fabric without tearing it.

SECTION II

CHARACTERISTICS

■ 7. GENERAL.—Characteristics of the Mk. VII, Mk. VIII, D–7, and D–8 balloons are set forth in detail in FM 4–198 (when published). (The Mk. X balloon is a Mk. VII equipped with a lightning rod.) Slight variations from the standards printed therein may be found in the individual balloon because of tolerances provided for in Army specifications. Characteristics and approximate measurements of

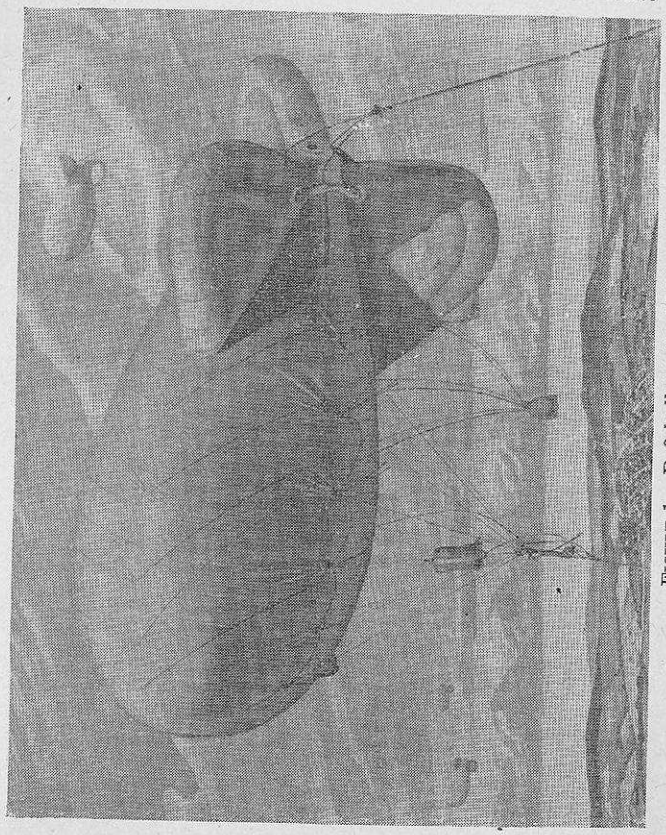


FIGURE 1.—D–8 balloon in flight.

the D–8 low-altitude ballonet balloon are outlined in paragraph 8.

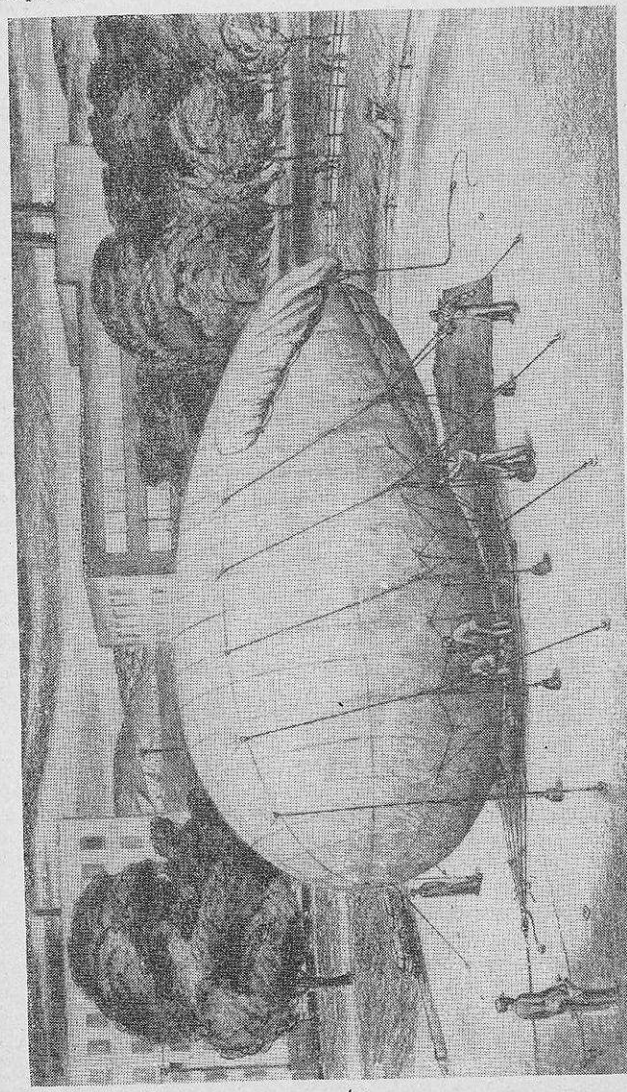


FIGURE 2.—D–8 balloon bedded down.

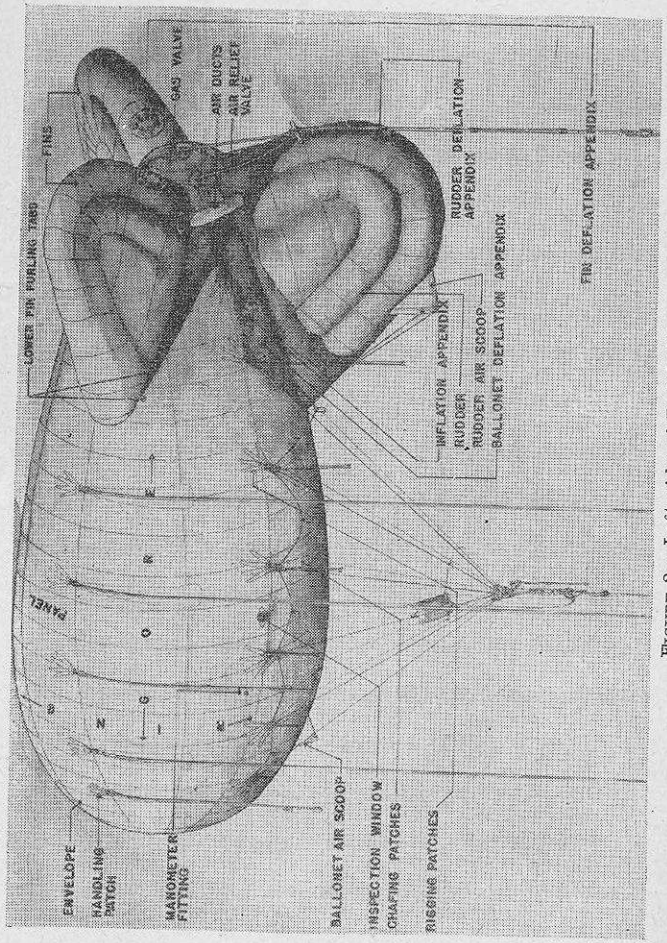


FIGURE 3.—Left side of D–8 balloon.

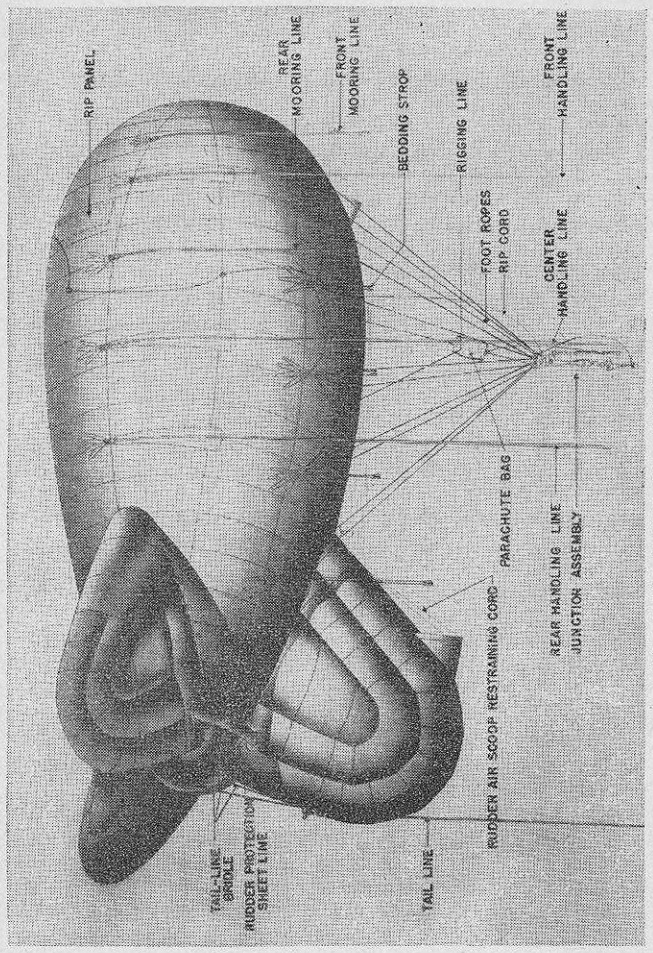


FIGURE 4.—Right side of D–8 balloon.

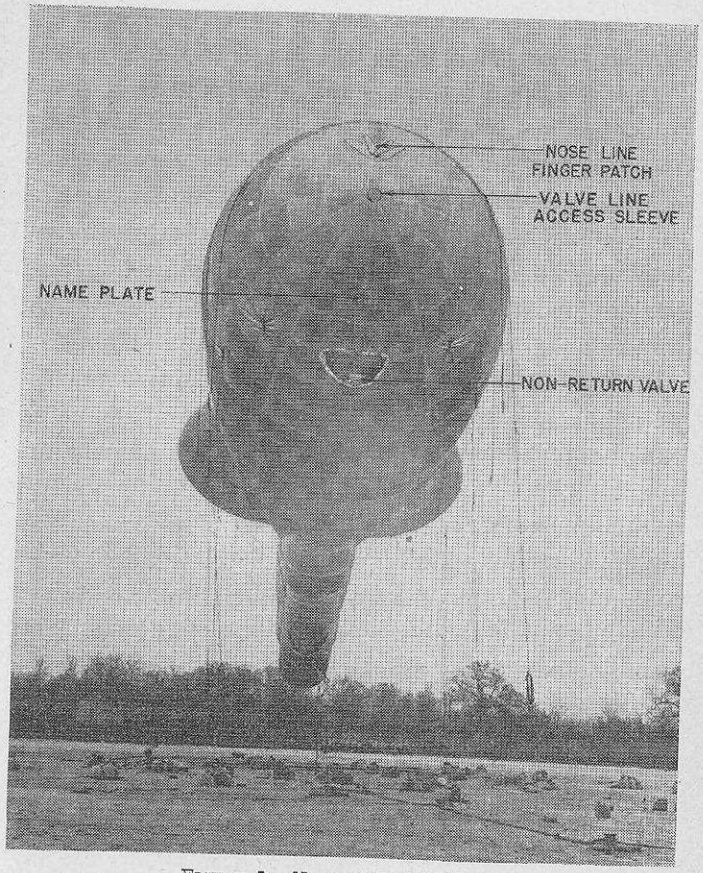


FIGURE 5.—Nose of D–8 balloon.

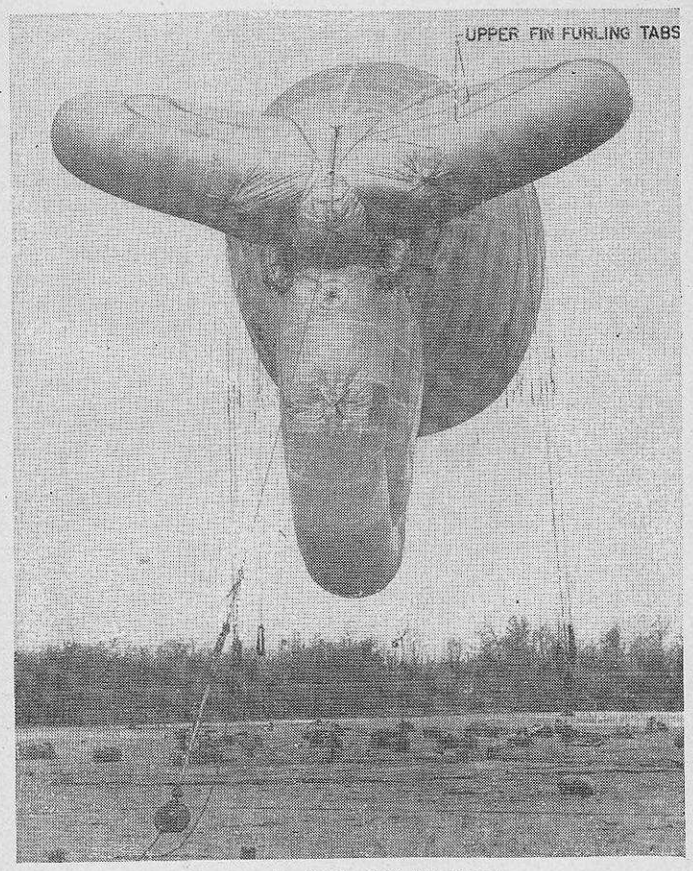


FIGURE 6.—Tail of D–8 balloon.

■ 8. DIMENSIONS.

	Feet	Inches
Length (overall, including stabilizers)	69	6
Length (envelope only)	68	6
Width (overall, including stabilizers)	31	4
Maximum diameter (envelope only)	27	0
Height (overall, bottom of concentration fitting to top of balloon)	44	6

	Feet	Inches
Length of mooring lines	16	6
Length of handling lines	70	0
Length of tail line	28	0
Length of rigging lines:		
Between Nos. 1 and 2 patches	8	6
Between Nos. 2 and 3 patches	9	6
Between Nos. 3 and 4 patches	11	6
Between Nos. 4 and 5 patches	12	6
Between Nos. 5 and 6 patches	15	6
Spare, at end for coiling	10	0
Overall, including knots	70	0
Length of foot ropes:		
No. 1	27	9
No. 2	26	2¼
No. 3	25	5⅛
No. 4	26	5⅜
No. 5	29	6¾
No. 6	35	6⅜

■ 9. WEIGHT.—The weight of the D–8 balloon is approximately 765 pounds. This figure may vary as much as 5 percent.

■ 10. VOLUMES.—Maximum volumes of the D–8 compartments are—

	Cubic feet
Gas compartment	23,500
Ballonet	11,790

■ 11. LIFT.—The D–8 balloon, when filled to five-sixths of its capacity with hydrogen of 98 percent purity, exerts a lift of about 625 pounds.

■ 12. ANGLE OF TRIM.—The balloon flies with its long axis tilted upward from the horizontal. This tilt is called the trim. The angle of trim is 3° in still air and increases with the wind velocity, approaching 14° in a wind of 60 miles per hour. The angle of trim will vary with volume and unit lift. With high-purity gas and low temperature, the balloon may have a negative angle (the long axis tilted downward). This must be corrected by ballasting the tail so as to produce a *minimum* of 3° in still air.

SECTION III

CONSTRUCTION AND FUNCTIONING

■ 13. ENVELOPE.—*a. Fabric.*—(1) The envelope is made of neoprene-proofed cotton fabric, the outer surface of which is aluminized. The fabric is described more fully in FM 4–196 (when published).

(2) The flexibility of neoprene-proofed fabric decreases in cold weather. Areas subjected to sharp bending should be checked frequently for fabric cracks. All neoprened fabric repairs should be made with neoprene-proofed material and neoprene cement.

b. Gores, rings, and panels.—(1) The balloon envelope, somewhat like the leather case of a football, is built of 12 gores.

(2) Each gore extends the whole length of the envelope and is lettered, according to position in the envelope, clockwise as the observer stands in front of and faces the balloon.

(3) Adjacent gores are made of fabric of opposite bias to prevent twisting when the fabric stretches under internal pressure. This construction insures the correct shape of the balloon at all times.

(4) Each gore is made up of 23 panels of approximately trapezoidal shape. These panels are numbered consecutively 1 to 23 from the nose to the tail. They overlap from the nose to the tail and from the top to the bottom.

(5) The nose of the balloon is formed by a circular fabric patch (nose patch) which is not included in the numbered panels.

(6) Each line of panels running around the balloon's short axis forms a ring. The rings are numbered in the same manner as the panels. Thus ring 1 is composed of all panels 1, etc.

(7) The tail is brought to a blunt point with a ring of small panels put together in a manner resembling a segmented orange peeling, and with a chafing patch extending down over the tip.

c. Seams.—The seams are lapped according to the method shown in FM 4–196 (when published) and are covered inside and out with tape. Taping is used to render the joint gas-

tight. It does not appreciably increase the strength of a joint.

■ 14. BALLONET.—*a. Diaphragm.*—The ballonet diaphragm separates the air compartment from the gas compartment. The diaphragm is of neoprene-proofed fabric. The diaphragm is not aluminized.

b. Air scoop.—(1) The ballonet air scoop is attached to the balloon with the opening facing forward. It is made as a separate assembly and is cemented to the balloon, *not* sewed to it.

(2) The air scoop has two moisture drain holes in the bottom near the seam. The air scoop also has a sleeve which is cemented to the mouth of the scoop. This sleeve is rolled up and secured by straps and buckles. The roll stiffens the leading edge of the air scoop, when the balloon is in flight. The sleeve may be rolled out and tied off, when it is desirable to prevent the scoop from picking up air. Additional stiffening of the air scoop is secured by a rope or rubber hose inserted into the leading edge of the air scoop.

(3) The ballonet air scoop surrounds a hole in the envelope fabric which allows air to enter the ballonet. Over this hole is a fabric tunnel which serves as a nonreturn valve. Wind opens the fabric tunnel in passing through, but the tunnel collapses over the air inlet and traps air in the ballonet when the pressure inside the ballonet becomes greater than the pressure outside. Personnel may inspect the ballonet through this inlet or enter it to make repairs, as it is large enough to admit a man's body.

c. Air relief valves.—Air relief valves are fitted in the ballonet portion of the envelope. When the air pressure inside the ballonet becomes too great, these valves open and let out excess air. Their aperture becomes wider as pressure increases. They close automatically when the pressure drops below the release stage.

d. Deflation appendix.—A cylindrical fabric tube called the deflation appendix is attached to the left side of the ballonet near the tail. This appendix normally is tied off tightly to prevent loss of air.

e. Drain holes.—Two ballonet drain holes are located on the center line of the balloon, one on the part of the ballonet

which is lowest when the long axis of the balloon is horizontal, and the other on the part which is lowest when the long axis is inclined to a positive angle of 8°.

15. EMERGENCY DEFLATION SYSTEM.—*a. Rip panel.*—The rip panel is located near the top right side of the envelope. Its shape is that of a narrow rectangle with a small taper at the top where ripping is initiated. It covers a series of elliptical holes in the envelope.

b. Rip cord.—The rip cord is of rope, colored red, with the lower end served to prevent fraying.

16. GAS VALVE.—*a. Type.*—The balloon is fitted with an interior line-operated gas valve system. This system is composed of an 8-inch valve with a maximum valve diaphragm opening of one inch, a nose assembly, a ballonet strop assembly attached to the ballonet by a circular spider patch, and a valve operating line assembly.

b. Operation.—This system operates in the following manner: The valve line is actuated by the ballonet diaphragm. As the gas expands, the ballonet diaphragm is pushed lower until the ballonet strop pulls down on the center of the valve operating line. The valve is opened until enough gas has been released to stop the process.

17. AIR VALVE.—The pressure in the ballonet is relieved by an automatic plastic air valve on each side of the balloon. The air valves are located about the center of the balloon, slightly below the ballonet seam.

18. MANOMETER CONNECTION.—*a. Location.*—A manometer connection is located on the left side of the balloon.

b. Uses.—The manometer connection has three uses:

(1) Testing pressure with the manometer.
(2) Sampling gas so that a purity test can be made.
(3) Topping-up.

19. INSPECTION WINDOWS.—*a. Number and location.*—Two oval inspection windows, each of plexiglass in a plastic frame, are located on the envelope, one on each side.

b. Use.—The inspection windows enable personnel to look inside the gas chamber. The windows may be covered by a fabric flap when not in use. To view the interior, both

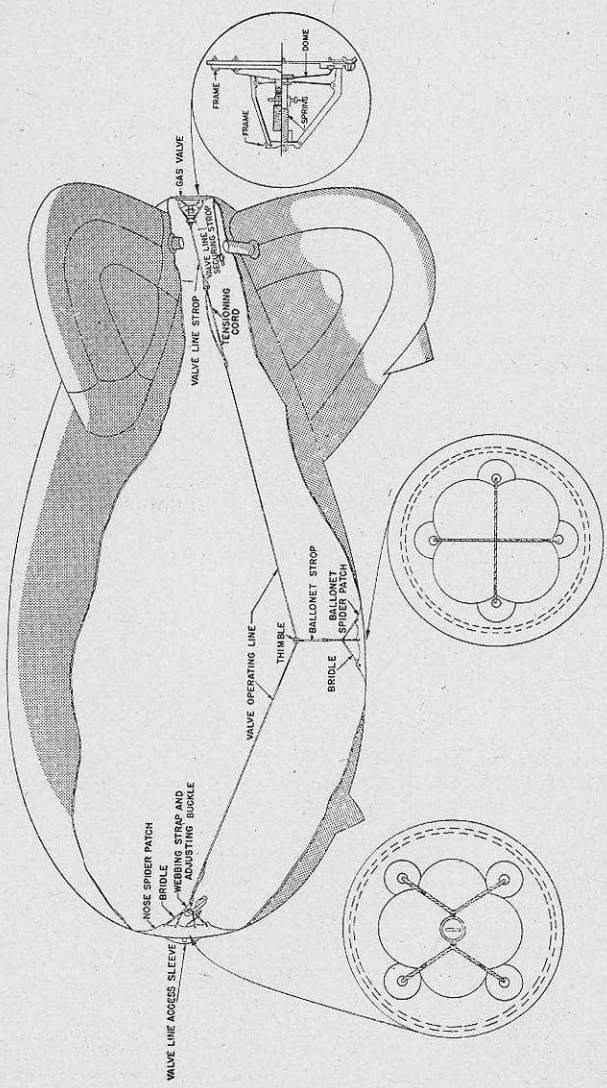


FIGURE 7.—Interior line-operated gas valve system.

should be uncovered. Thus one admits light enough so that the interior of the gas chamber can be seen through the other.

■ 20. INFLATION APPENDIX.—*a. Location.*—An inflation appendix is located on the left side of the envelope, near the tail.

b. Use.—This appendix is the major inlet for gas inflation and also affords access to the gas chamber by personnel.

■ 21. STABILIZERS.—*a. Number and location.*—There are three stabilizers located near the rear of the balloon. Their purpose is to help maintain the balloon's designed characteristics while flying. Popular usage has established the names of the two lateral stabilizers as the "fins" and the vertical stabilizer as the "rudder." They will be referred to thus throughout this manual.

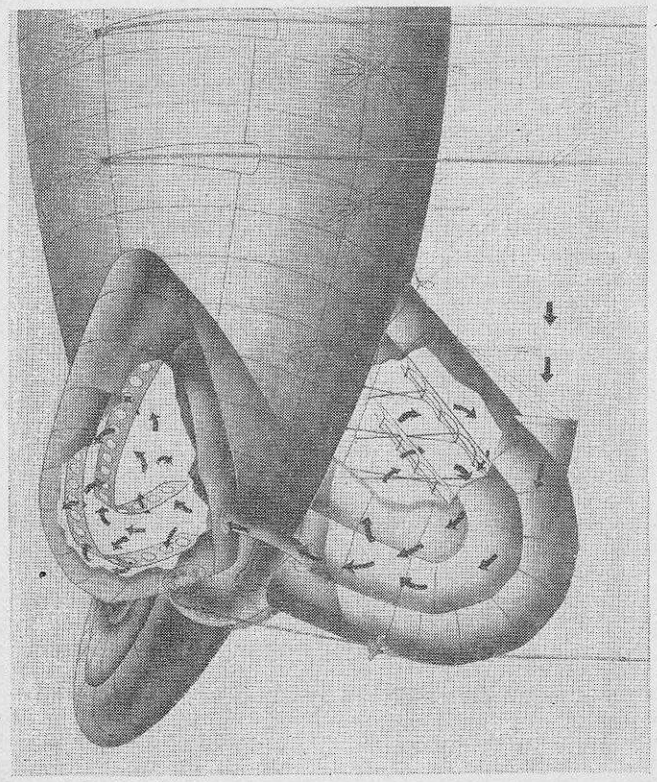


FIGURE 8.—Rudder.

b. Inflation.—The rudder and fins are air inflated through the rudder air scoop.

c. Rudder (see fig. 8).—(1) The rudder, made of neoprene-proofed cotton fabric, is located below the balloon envelope and between the fins. It is composed of panels cemented and taped together on the outside. The panels are numbered from the front to the rear.

(2) The rudder air scoop is large enough to allow personnel to enter through it. Its leading edge is stiffened with rubber hose held loosely in the hem of the scoop, and is supported by lacings attached to the rudder. Two drain holes are provided to allow for the escape of accumulated water.

(3) An air relief valve is in the rear of the rudder to relieve excessive pressure.

(4) A deflation appendix, covered by a flap which is secured by straps and buckles, is also located in the rear of the rudder.

(5) Two air ducts are located at the top of the rudder near the tail of the balloon. One leads to each fin. The air passes from the rudder to the fins through these ducts as pressure builds up in the rudder.

(6) Drain holes located in the bottom of the rudder drain off accumulated moisture.

(7) Spacer cords made of hemp rope are interlaced between the walls of the rudder. These spacer cords help maintain the shape of the inflated rudder.

(8) Seams on both the rudder and fins are lapped and are covered with tape on the outside only.

d. Fins.—The fins, two in number, are made of neoprene-proofed cotton fabric. The fins are similar to the rudder in shape and construction, but are smaller and have no air scoops or drain holes. Spacer curtains, serving the same purpose in the fins as the spacer cords in the rudder, are constructed in the fins. The fins are inflated through the air ducts in the top of the rudder and are normally deflated through deflation appendixes located on their trailing edges.

SECTION IV

RIGGING

22. GENERAL.—Rigging consists of—

a. Ropes, both fiber and wire, attached to the balloon above the upper lethal device link.

b. All means of attachment of those ropes either to the envelope or to the flying cable.

23. CONCENTRATION FITTING (see fig. 9).—*a. Nomenclature.*—The balloon is rigged to include a concentration fitting mentioned in its relationship with the complete balloon in paragraph 5. This fitting consists of—

(1) Two foot-rope shackles.
(2) One triangular plate.
(3) One bell crank.
(4) One junction-strop shackle.
(5) One junction strop.

b. Function.—The concentration fitting connects the foot ropes of the balloon to the upper link and thus to the cable terminal assembly. The foot-rope shackles are larger than the junction-strop shackle to provide a broad bearing surface for the foot ropes.

24. PATCHES.—*a. Designs and functions.*—Patches have numerous functions on a balloon and are designed according to those functions. Patches and their functions are described fully in FM 4–196 (when published).

b. Construction.—Each patch is made as a separate assembly and is attached to the balloon when the envelope is completed. Patches are always cemented to the balloon, never stitched to it. Thus a damaged patch can be removed and replaced without difficulty or damage to the balloon.

c. Rigging and handling patches.—(1) The rigging patches are a series of patches located slightly below the equator of the balloon, and are numbered 1 to 6 from nose to tail.

(2) The handling patches are a series of patches located above the equator of the balloon.

25. RIGGING LINES.—*a. Number and location.*—There are two rope rigging lines. Each passes from front to rear on

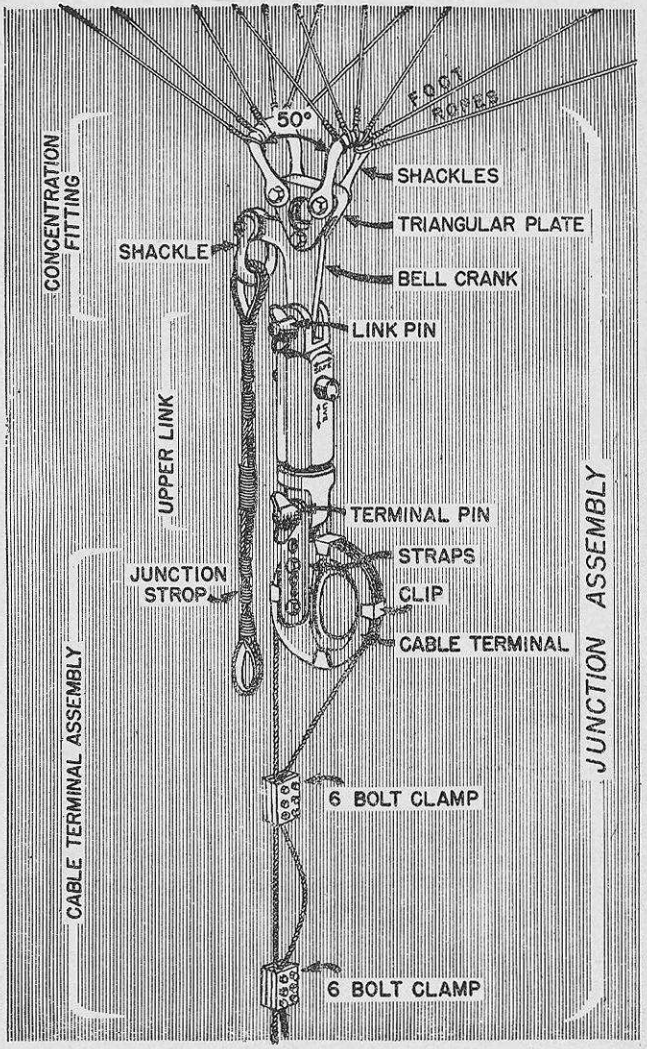


FIGURE 9.—Concentration fitting assembly.

each side of the balloon, going from one rigging patch to another.

b. Method of attachment.—(1) A clove hitch is used to attach the rigging line to the hollow ring in each of the six rigging patches on each side of the balloon.

(2) Each rigging line hangs loosely, in bridles, between patches. When rigged for flying, a grommet is attached to the line between each two rigging patches. Extra length of rope is provided at each end of the line, that is, at the Nos. 1 and 6 patches, where the line is coiled.

c. Use.—The rigging lines are used when the balloon is bedded down. Sandbags are attached to the grommet at the center of each rigging line bridle. These sandbags provide part of a flexible anchorage for securing the balloon.

■ 26. FOOT-ROPES.—*a. Number and location.*—There are 12 flexible wire foot-ropes on the balloon, six on each side.

b. Method of attachment.—The foot-ropes are attached, by Nicopress sleeves at their upper ends, to rigging patches. Each foot-rope is numbered to correspond to its patch. Each foot-rope has a flexible eye at its lower end, formed by using a Nicopress sleeve. At their lower ends, foot-ropes are attached to the concentration fitting.

c. When a replacement balloon is sent to a site, it will not necessarily have a concentration fitting attached.

■ 27. HANDLING LINES.—*a. Number and location.*—Three rope handling lines are secured to each side of the envelope.

b. Splicing.—Each handling line has a looped cut-splice in it, used for bedding down the balloon.

■ 28. MOORING LINES.—Two rope mooring lines are attached at each side of the balloon in the same manner that handling lines are attached. Each mooring line terminates in a soft eye and has a looped cut-splice in it, used for bedding down the balloon.

■ 29. TAIL LINE.—A rope tail line is attached by a toggle to a bridle which is secured by double sheet-bends to three patches cemented to the tail of the balloon, one between the fins and one between each fin and the rudder. The latter two legs of the bridle must go between the air ducts and the

envelope to prevent damaging the balloon and cutting off the air to the fins.

■ 30. NOSE LINE.—A rope nose line is attached to a patch on the nose of the balloon. This line is removed when the balloon has been inflated.

SECTION V

PACKING

■ 31. GENERAL.—The balloon is packed at the factory for the safest and most economical shipment. To understand how to unpack the balloon properly, it is necessary to know how it was put into its box.

■ 32. PROCEDURE.—Four steps are taken in packing the balloon:

a. The rip cord is fastened so that the rip panel cannot be accidentally pulled in shipment. This fastening must be removed before the balloon is flown.

b. All metal parts and other parts which might damage the fabric are wrapped in scrap cloth. Foot ropes, mooring lines, and handling lines are folded and placed in fabric bags.

c. The balloon is stretched out flat with the ballonet down and the envelope is folded toward the center. The balloon then is rolled from the nose toward the tail, care being taken that all air (or gas) is expelled. It then is wrapped in its rubber-treated canvas bag.

d. The balloon is put into its box. The valves, which have been removed from the balloon, are clamped securely into place in the special locker provided for them in the bottom of the box. After the balloon has been put into the box, the concentration fitting, wrapped in scrap cloth, is added.

SECTION VI

MAINTENANCE

■ 33. KITS.—Maintenance of the balloon and balloon equipment makes it necessary to have available replacement parts, repair materials, and tools. Maintenance kits are issued to barrage balloon units. These kits are—

a. Balloon site equipment, BB, LA.
b. Rigging and fabric repair equipment, BB, LA.
c. Winch maintenance equipment, BB, LA (second echelon).
d. Armorer equipment, BB, LA.
e. Lethal device maintenance equipment, BB, LA.
f. Weather station maintenance equipment, BB.
g. Gas workers equipment, BB, LA.
h. Emergency repair equipment, BB, LA.

CHAPTER 3

WINCH

Paragraphs
SECTION I. Description 34–37
II. Installation and operation 38–42
III. Safety precautions 43–45

SECTION I

DESCRIPTION

■ 34. DEFINITION AND PURPOSE.—The winch is a machine used to store, pay out, and haul in flying cable. With a winch a balloon can be raised, lowered, or controlled in flight.

■ 35. NOMENCLATURE.—The standard winch is the M1, the nomenclature of which is shown in figures 10 and 11.

■ 36. DIMENSIONS.—The approximate dimensions of the skid-mounted M1 winch are:
a. Length.—11 feet 11 inches.
b. Width.—4 feet.
c. Skids.—Two channel beam, 34 inches apart (outside measurement), running lengthwise of the under side of the winch.
d. Height.—4 feet 3½ inches, without cage and exhaust pipe extension; 6 feet 5 inches, with cage and exhaust pipe extension.
e. Weight.—4,575 pounds with gasoline, oil, and water but without cable; 5,205 pounds with 7,000 feet of 7/32-inch cable; and 5,156 pounds with 7,000 feet of .24-inch cable.

■ 37. ASSEMBLIES.—The barrage balloon winch consists of five major assemblies:
a. Power plant.
b. Clutch and transmission.
c. Traction drums and storage drum.
d. Lead-off gear.
e. Frame.

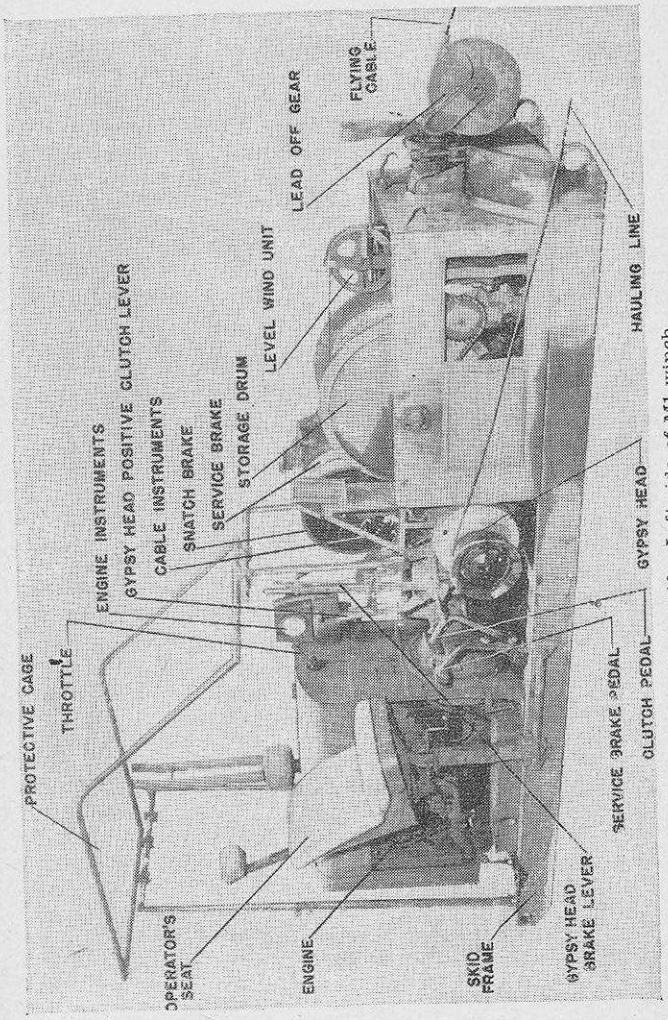


FIGURE 10.—Left side of M1 winch.

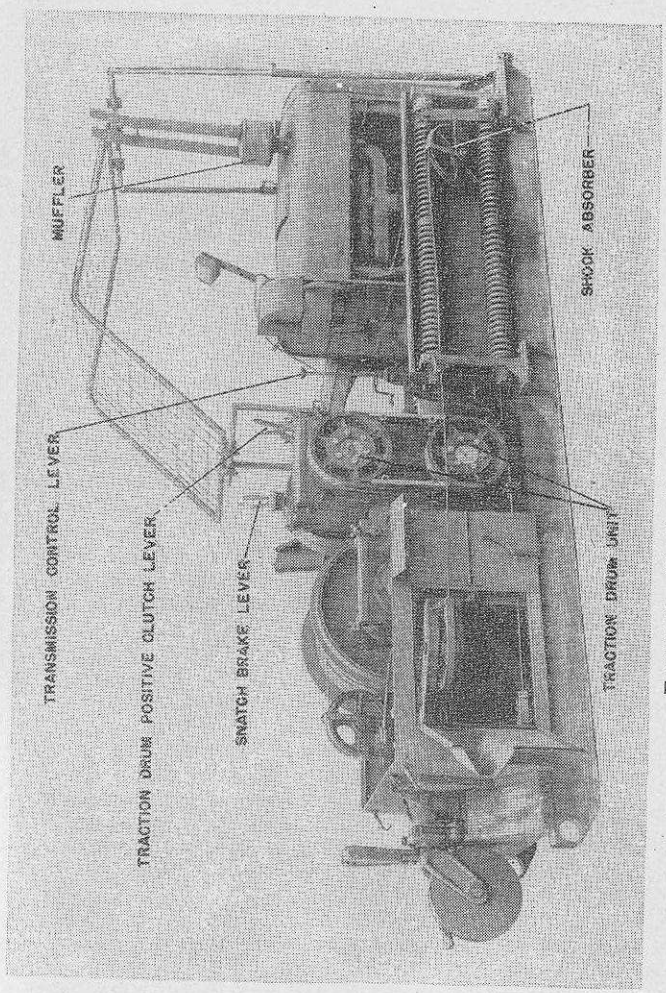


FIGURE 11.—Right side of M1 winch.

SECTION II

INSTALLATION AND OPERATION

■ 38. METHODS OF FLYING.—The balloon may be flown in two ways from the winch:

a. Direct.—The point of ascension being the lead-off gear.

b. Indirect.—The point of ascension being remote from the winch.

■ 39. ANCHORAGES.—*a.* The standard winch anchorage is made of concrete, constructed so that the winch can be slid onto it and made secure. This anchorage is discussed in FM 4–184 (when published).

b. When the standard anchorage is not available, an emergency anchorage of deadmen is used as described in FM 4–198 (when published).

c. The winch is always thoroughly grounded to dissipate electricity.

■ 40. OPERATOR'S RESPONSIBILITIES.—*a.* The winch operator is responsible for the proper anchoring of the winch and snatch-block.

b. The winch operator checks the winch to see that it is properly lubricated and in good running order. He takes the necessary steps to ground the winch and snatch-block. He also checks these electrical connections frequently to make certain that none of the grounded connections is broken.

c. The winch operator checks the cable threading on his winch to make sure that the cable rides freely in the sheave grooves and not on any other projections.

d. The winch operator or his assistant helps the riggers in fastening the cable in the junction assembly. The cable is threaded twice around the cable terminal in the junction assembly and the free end clamped to the standing part of the cable near the cable terminal ring. The free end is fastened with a second clamp a short distance below the first, a small amount of slack being left in the free end between the clamps. (See fig. 9.)

e. The winch operator will not raise or lower the balloon without orders from the balloon chief, except in case of emergency.

f. The winch operator keeps the winch log and renders a daily report to the balloon chief concerning the hours the winch is run and all repairs made or required.

■ 41. HANDLING DIVING BALLOONS.—*a.* The problem of following a definite procedure for handling a diving balloon is a

difficult one because it requires a thorough understanding of atmospheric conditions and of the effects of temperature and wind on a balloon. It also requires a knowledge of the behavior of a balloon, a knowledge that can be gained only by experience. The fact that a balloon *usually* follows a definite cycle in its gyrations, however, makes it possible to set forth a procedure which will result in the loss of fewer balloons. This procedure will be of little use unless followed by an operator with a basic knowledge of external factors affecting balloons.

b. Procedure for operating the winch when a balloon dives *during* a haul-down which *has been ordered* is as follows (see fig. 12):

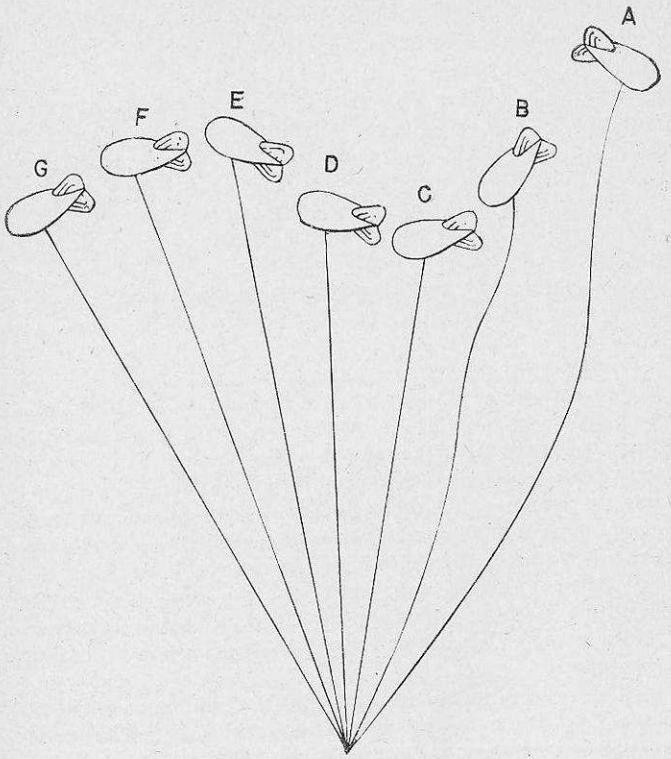
(1) When the balloon goes into a nose dive or shows a tendency to dive, slow down the rate of haul to a speed which will just barely prevent the formation of an abnormal cable sag; do not attempt to make the cable taut after the sag has been taken up, as this will accelerate the dive.

(2) As soon as the balloon comes out of its dive and begins to ascend, haul in cable as rapidly as possible. Continue rapid haul-down unless the balloon tends to go into another dive.

(3) Most balloons will come out of their dives before reaching the earth, and start to ascend. (This is not true of a balloon that is heavy with ice or snow or which is "sailing" on its side.)

c. The preceding paragraphs apply to balloons above 500 feet. When the balloon is below 500 feet there is a tendency, because of turbulent air currents below this altitude, for the balloon to dive and gyrate. If the balloon is brought down at a rapid pace in this area, usually no trouble will be encountered. Should diving occur, however, the balloon should be handled exactly as explained above.

■ 42. SPEED OF ASCENT AND DESCENT.—If the balloon is allowed to rise too fast it will valve gas as well as air. If it is lowered too rapidly, the ballonet will not fill with air; thus the balloon will become flabby, and in a strong wind the nose will cup in and start the balloon into a dive. When a descending balloon is within approximately 500 feet of the ground, it should be pulled down at the maximum rate so



(1) A, B, C, take in slack cable only.
(2) D, E, F, haul in rapidly.
(3) G, reduce hauling speed. If balloon goes into another dive, repeat steps (1) and (2).

FIGURE 12.—Method of handling a diving balloon.

that the force pulling in the balloon will help keep it from diving.

SECTION III

SAFETY PRECAUTIONS

■ 43. CRANKING.—The crank handle should be grasped with fingers and thumb extended and joined. If the operator follows this procedure and gives the engine a quick quarter

turn, his arm or wrist will not be strained or broken by an engine kick-back.

■ 44. ELECTRICAL PRECAUTIONS IN GENERAL.—*a.* The winch and central anchorage must be grounded at all times to prevent static electricity from building up a high enough potential to cause damage to equipment or injury to personnel, and to provide a ground for lightning.

b. Under all weather conditions the following electrical precautions will be observed:

(1) Insure that the grounding rod or mat, wire, and connection are in good order, that a perfect electrical bond is made between them, and that the rod is clean and bright.

(2) For asphalt, concrete, or similar bases, drill a hole through the hard surface and drive the rod into the earth. Put water around the rod.

(3) For rocky or stony soil, lay the grounding rod or mat on the ground and tamp with wet loose soil.

(4) *The grounding rod or mat is to be in wet contact with the ground until flying operations are completed.* If the balloon and winch must be moved when the balloon is flying, the grounding rod or mat must be dragged on the ground and reburied and rewet as soon as possible.

■ 45. CLOSE APPROACH OF THUNDERSTORM.—The following precautions will be observed when a thunderstorm approaches close to the balloon position:

a. The winch operator will remain on his winch ready for immediate action.

b. The remainder of the crew will not approach closer than 50 feet to the winch or ground wire.

c. If the cable has to be touched for any reason, the operator will stand completely on the winch chassis before touching the cable.

d. During these conditions, getting on and off the winch should be avoided; but if getting on or off is unavoidable, the operator will get on or off by jumping. He must not come in contact with the ground and the winch simultaneously.

CHAPTER 4

FLYING CABLE

	Paragraphs
SECTION I. General	46–48
II. Operation	49–50

SECTION I

GENERAL

■ 46. DESCRIPTION.—The standard flying cable is the M2 cable. It is .24 inch in diameter and is composed of six wires laid around a fiber core which is impregnated with grease to lubricate the strands. The wires are of high-tensile steel, protected against corrosion by a zinc or tin coating. Technical information on this cable, as well as the 7/32-inch cable which is substitute standard, will be found in FM 4–196 and 4–198 (when published).

■ 47. DEFECTS.—Typical defects which should be watched for in flying cables are—

a. Loops and kinks.—When a balloon dives, the flying cable may slacken and form a helix, the turns of which may, as the flying cable tightens again, pull into a loop and form a kink.

b. Wear.—Wear is of two types—abrasive and fatiguing.

(1) Abrasive wear occurs when a foreign substance rubs or grates against the wire. Metal is removed from the surface of the wire, with a consequent reduction of cross-sectional area and thus of strength. This type of wear can be recognized by the unnaturally dull, scraped appearance of the wire.

(2) Fatigue occurs during the normal use of a cable and is caused by the repeated bending under stress necessary in paying out and hauling in. This type of wear is not likely to become serious during the normal working life of a cable. Fatigue can be recognized by the smooth, bright appearance of the worn surface.

c. Corrosion.—Corroded wires rapidly lose their initial strength. A corroded cable will withstand fewer reversals than a cable free of corrosion. (One reversal of a flying cable is completed when a balloon has been payed out from close-haul to operational height and has been hauled in again to close-haul.)

d. Broken wires.—If a broken wire is detected in a flying cable, the flying cable should be secured between the balloon and the broken wire. The broken part of the cable can no longer be trusted to hold the balloon; therefore, by using a clamp and strop or some other means of attachment, all of the strain imposed by the balloon must be shifted to that part of the cable above the break. Once this shift is accomplished, the balloon can be hauled down with a maneuvering spider or by some other means, depending on the local situation. The balloon can then be bedded down. When the balloon has been bedded down, the end of the cable, up to and including the damaged portion, should be cut off, provided sufficient cable remains on the winch storage drum for operational use. If insufficient cable would result, the whole cable must be replaced. *The margin of safety in a standard flying cable is so low that the failure of one wire alone is sufficient to render the cable unserviceable.*

e. Miscellaneous.—Other weaknesses which may lead to serious defects in a flying cable include distortion of the flying cable, open lays, and protruding or broken cores.

■ 48. INSPECTION.—*a.* Daily, when conditions permit a low rate of haul-in or pay-out, the flying cable should be inspected for broken wires, loops, or kinks. Loops or kinks must be closely examined, the action to be taken depending on the extent of the damage.

b. The cable must also be inspected for open lays and protruding or broken cores. These may not necessarily render the cable unserviceable in the first instance, but should be marked with red paint and examined at every subsequent reversal for development.

c. The cable terminal assembly attachment and the tightness of six-bolt clamps should be checked.

SECTION II

OPERATION

■ 49. USE.—*a.* The first time it is spooled onto a winch, the flying cable should be well oiled by passing it through a rag dipped in engine oil. It is especially important that the first 2,000 feet of a new cable to be spooled onto a winch should be well oiled because this portion is not normally in use. The

510518°—43——3

practice of pouring oil onto the cable on the storage drum is not approved.

b. At least once a month, or if the cable has been subjected to abnormal stress, 2 feet of flying cable should be cleaned off at intervals with a rag soaked in engine oil, and polished afterward with a dry rag. The sections should be examined closely.

c. Solvent must *not* be used to clean the flying cable. The best method of cleaning the cable is to set up a box filled with oily rags or waste so that the cable passes through the box and consequently is cleaned and lubricated each time it is hauled in or paid out. Cleaning is always important. Cleaning the cable removes grit which might damage traction drums and sheaves. Lubrication is only incidental at land sites but important at waterborne sites.

d. Should the presence of stranded or kinked cable be observed during these operations, paying out or hauling in is to be stopped and the defective portion examined.

e. Further operation of the cable is not to take place until authorized by the responsible officer.

f. A record of any defect is to be made.

■ 50. FLYING LIFE.—*a.* The expected flying life of a cable is either 700 or 1,000 reversals, depending on operating procedure as outlined below.

(1) *For life of 700 reversals.*—After 350 reversals cut off 100 feet from the balloon end of the flying cable and make a record on the winch maintenance form. The cable may then be used up to 700 reversals, provided it is free from defects.

(2) *For a life of 1,000 reversals.*—(*a*) After 350 reversals, cut off 100 feet.

(*b*) After 500 reversals, reverse the flying cable end for end. This will involve rereeving the cable into the winch so that the former balloon end of the cable is reeved first onto the storage drum. The cable may then be used for a further 500 reversals, making a total of 1,000 reversals.

b. The life of the flying cable is normally to be 1,000 reversals. If, however, for some particular reason it has been impossible to carry out the reversing of the cable end for end after 500 reversals, the life cannot be expected to exceed 700 reversals.

CHAPTER 5

GAS EQUIPMENT

		Paragraphs
SECTION I.	Nomenclature	51
II.	Handling, transporting, and storing gas	52–59
III.	Safety precautions	60–64

SECTION I

NOMENCLATURE

■ 51. INFLATION EQUIPMENT.—Gas inflation equipment at the site is shown in figures 13 and 14.

SECTION II

HANDLING, TRANSPORTING, AND STORING GAS

■ 52. GENERAL.—Since the supply of helium is limited, hydrogen normally will be used for inflating barrage balloons. Hydrogen gas is colorless, odorless, and tasteless. Any volume of hydrogen containing more than 15 percent of air is dangerous, and when the purity of gas within a balloon falls below 85 percent, the balloon must be deflated. Safety rules and regulations prescribed for hydrogen also will be observed when helium is used in order that safety will become a matter of habit.

■ 53. FIRE.—*a. Prevention.*—Certain amounts of impurities are present in the balloon at all times, and therefore the danger of fire or explosion may be present. The following fire preventive measures should be observed at the balloon bed, hydrogen gas generator, hydrogen cylinders, nurse bags, and storage tanks:

(1) No fire or other source of ignition must be permitted within a distance of 150 feet.

(2) A specific smoking area should be designated at a distance of at least 150 feet.

(3) The sentry on duty will at all times enforce fire prevention regulations.

(4) Signs should be erected to denote the limits of the danger and smoking areas.

(5) All animals should be kept away from above listed installations as a precaution against static electricity.

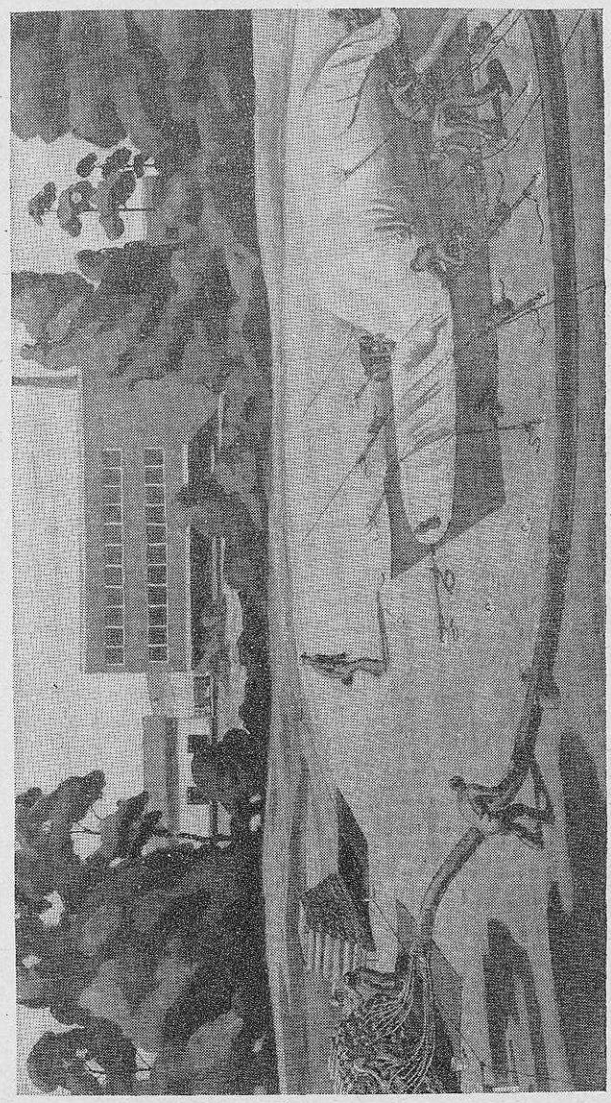


FIGURE 13.—Panorama of inflation lay-out.

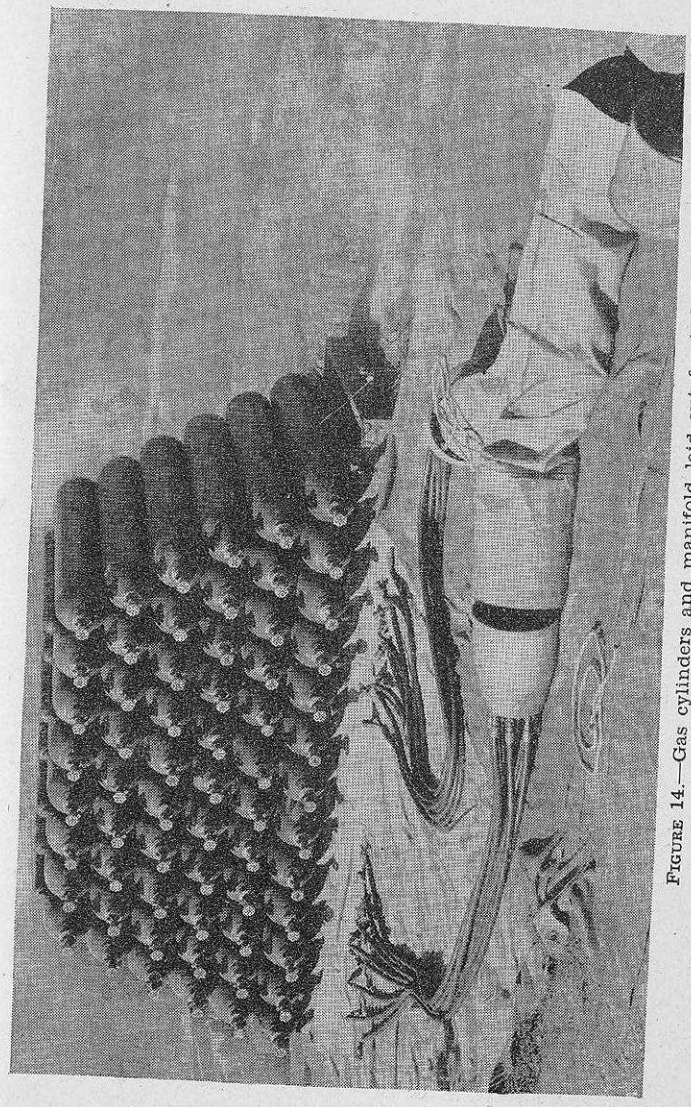


FIGURE 14.—Gas cylinders and manifold laid out for inflation.

b. Action in case of fire.—If a gas fire occurs and a balloon inflated with hydrogen explodes, burning particles of fabric will be spread over a large area. In case of fire at a balloon site or other installations listed above, the following action should be taken:

(1) The person who first observes the fire will call FIRE! Other persons in the vicinity will repeat the call until they are certain that all are aware of the fire.

(2) All gas cylinder valves will be closed immediately.

(3) If, in the judgment of the balloon chief, it is possible to extinguish the fire, he will order all available men to combat the blaze.

(4) If at any time, in the judgment of the balloon chief, personnel will be seriously endangered by remaining at the site, he will order personnel out of the danger zone by the command: ABANDON SITE. Other personnel will repeat the command until certain that all are aware of the order.

(5) When the site is ordered abandoned, personnel must act at once. Every soldier should RUN, so as to clear the immediate area. The eyes must be protected and the face covered to avoid breathing flames.

■ 54. IDENTIFICATION OF CYLINDERS.—*a.* Gas cylinders are identified as follows:

(1) Army hydrogen cylinders are painted with a standard olive-drab paint or are galvanized with the neckbands and caps painted olive drab. The word "Hydrogen" is painted on the cylinder body.

(2) All navy hydrogen cylinders are painted black with a white band around the middle.

(3) Commercial hydrogen cylinders are usually painted black.

(4) Army helium cylinders are painted olive drab with a yellow neckband and cap or are galvanized with a yellow neckband and cap.

b. In case the repainting of hydrogen, helium, or other gas cylinders is necessary in the field, the colors and markings listed above should be used.

c. All hydrogen and helium cylinder valves have left-hand threads.

■ 55. HANDLING OF CYLINDERS.—In the handling of gas cylinders the following rules should be observed:

a. Because of high pressure, cylinders must always be handled with care. They should never be dropped or subjected to heavy jars. This rule also applies to empty cylinders.

b. Cylinders must never be exposed to fire or heat. They should be protected from the direct rays of the sun by means of suitable covers. Otherwise, the increase in pressure due to superheat may rupture the safety disk.

c. The valve-protecting cap should always be either on the valve or atop the cylinder stack. It must never be handled carelessly or left to lie in the dirt.

d. Gas cylinders should always be handled by two men. One man should handle each end of the cylinder, and they both should avoid striking the cylinder caps and possibly causing a leakage of gas.

e. Cylinder stacks at the site should conform to the following rules:

(1) Maximum number of cylinders in each stack, 63.

(2) Maximum height of each stack, 6 tiers.

(3) Minimum distance between stacks, 10 feet.

f. Cylinders should be stacked on dunnage. Each cylinder of the bottom row should be securely chocked.

g. Each stack of cylinders should be electrically grounded at all times. For materials and technique of grounding, see FM 4–184 (when published).

h. As the cylinders are stacked, the valve outlets should be pointed downward with all the valves on the same side of the stack.

i. Unless dunnage is high enough so that such a trench is unnecessary, a trench 6 inches wide and 6 inches deep should be dug directly underneath the line of valves. This will allow the inflation manifold hose to be connected properly to the valves of the bottom tier of cylinders.

j. When preparing to discharge a cylinder, all connections and joints should be cleansed of dirt, grit, and foreign materials before making the connections. A brush, such as the one provided in the balloon site equipment, BB, LA, or a rag can be used. Care should be taken to see that all joints are gas tight.

k. When a cylinder is opened, it should be labeled at once with the letters MT marked near the valve with chalk or crayon.

l. The valve of an empty cylinder should be kept closed to prevent air from entering the cylinder.

m. The valve of a gas-filled cylinder will be opened only when it it attached to a manifold hose or a pressure gage. To blow out dirt, the valve should be cracked slightly.

56. DEFECTIVE VALVES.—The only repair to a gas cylinder valve made in the field is to tighten the gland nut to prevent leakage. A valve which cannot be opened by hand or is suspected of being defective should be marked DEF and the cylinder returned. If damage to the valve is suspected, take the cylinder out of service and test it. Soap and water can be used in testing for leaks.

57. DAMAGED CYLINDERS.—The rules below apply to cylinders which are damaged or suspected of being damaged:

a. If a cylinder has been exposed to fire, mark it DEF and return it. The cylinder must be tested before being used again.

b. If a cylinder is dented by rough handling, mark it DEF and return it, together with a full explanation. The cylinder must be tested before being used again.

58. SHIPMENT OF CYLINDERS.—When cylinders are shipped by railway car, motor truck, or boat, they should be stood on end and should be securely chocked to prevent undue motion, and should be placed in well-ventilated compartments. Hydrogen should not be shipped in closed boxcars.

59. STORAGE OF CYLINDERS.—The cylinder and cap should be given a new coat of paint before being stored. Cylinders should be stored in a shed that has free ventilation, so as to prevent the accumulation of hydrogen in the event of a leaky valve. When an empty cylinder is to be stored for 4 months or more, water collected in the cylinder should be removed. The cylinder should then be rinsed three times with dried hydrogen at 50 pounds pressure. To prevent rust inside the cylinder, it should be filled to 30 pounds pressure with dried hydrogen.

SECTION III

SAFETY PRECAUTIONS

60. GENERAL.—*a.* All precautions to prevent igniting the hydrogen gas should be observed.

b. Neoprene causes skin irritation. In order to prevent irritation, all men working with neoprened balloons during inflation, deflation, or topping-up must be fully clothed.

61. INSPECTION.—*a.* Before inflation, the area around the balloon bed should be thoroughly inspected and all sharp objects removed. The ground cloths should then be thoroughly cleaned and inspected, and the one near the cylinder stacks wet down to prevent fire.

b. A balloon should never be gas-inflated unless all air is exhausted from the envelope and the inflation tube.

c. All connections in the inflation system from the gas cylinders to the balloon must be made gastight before the inflation starts. Manifold hose and gas cylinder connections must be carefully protected when not in use.

62. INFLATION.—*a.* The inflation tube should be rolled up to force out all air, attached to the manifold, rolled out flat, and attached to the balloon appendix.

b. When the inflation starts, each gas cylinder valve must be cracked (opened very slightly) before the full volume of gas is released. Freezing of the valve is thus prevented.

c. While inflating the balloon, the men should walk on the fabric as little as possible. Those men walking on the fabric should be in their stockinged feet or should wear clean, soft rubber-soled or fabric-soled shoes.

d. The balloon fabric must not be dragged. Pulling of fabric must be kept at a minimum.

e. While the balloon is being inflated, the inflation tube must not be allowed to become kinked or twisted. If there is a wind, the tube should be fastened with stakes or sandbags.

f. A balloon should not be inflated in a wind of more than 20 miles per hour, unless it is absolutely necessary.

g. Men working with the balloon should not wear or carry rings, sharp tools, or any metallic objects which might tear the balloon fabric.

h. Men working with the balloon must wear leather or cotton gloves or keep their fingernails closely trimmed.

i. If inflation takes place inside a building, ample ventilation is essential.

■ 63. CLOTHING WORN BY CREW.—Whenever practicable, members of a balloon crew should not wear woolen outer clothing while working around the inflated balloon, since it is possible for wool to create static sparks capable of igniting hydrogen. Woolen outer clothing is most dangerous during deflation. When woolen clothing is worn during deflation, a cotton outer garment must be worn. Cotton caps or some other headcovering which will not create static always should be worn around a balloon. There should be no undue concern over the wearing of woolen clothing in cold weather, when crews are performing the drills prescribed in this manual.

■ 64. PRECAUTION DURING DEFLATION.—When the purity of hydrogen gas within a balloon falls below 85 percent, the balloon is in a dangerous condition and should be deflated. These rules should be followed in deflating:

a. Deflate when static electricity is least likely to form. Dew or rain hampers the formation of static electricity. In dry weather, the best time to deflate is after sunset or before sunrise.

b. Keep all personnel and equipment not required for the deflation at least 150 feet away from the balloon.

c. Make only one opening in the balloon. More than one opening may permit a surge of air through the balloon, and a dangerously explosive mixture of hydrogen and air may result.

CHAPTER 6

SITE

■ 65. DEFINITION.—The site is that area on which a balloon is maneuvered and operated. It includes—

a. The bed.

b. The maneuvering area.

c. Operations hut and sometimes living quarters for the crew.

■ 66. REFERENCE DATA.—Statistical details pertinent to the site and site installations, including a bill of materials, will be found in FM 4–184 and 4–198 (when published). Relationship of site components is shown in figure 15.

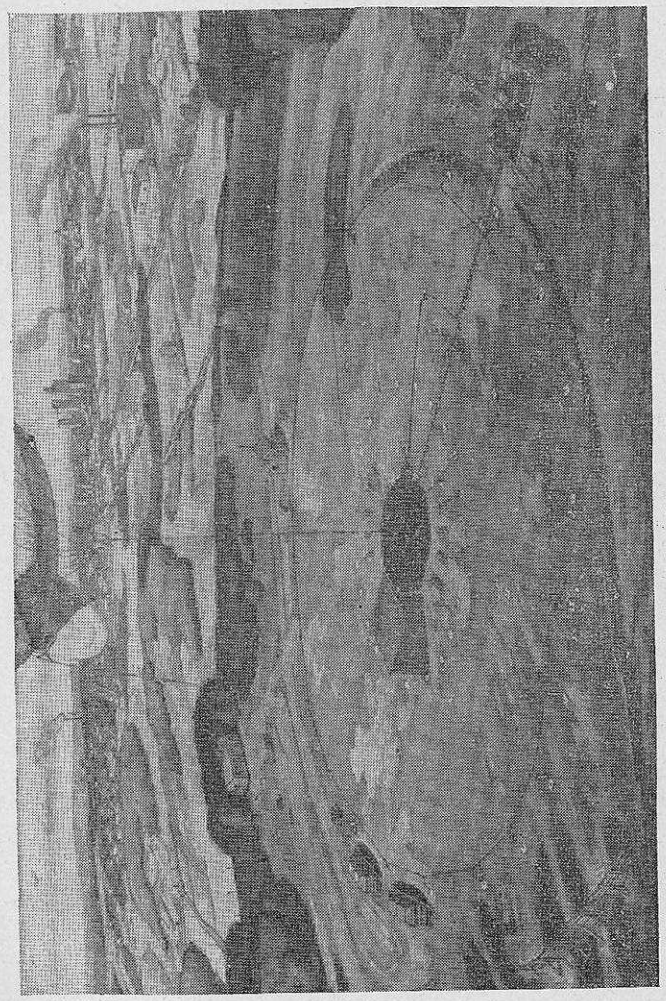


FIGURE 15.—Relationship of site components.

CHAPTER 7

ORGANIZATION AND COMMAND DUTIES OF PERSONNEL

		Paragraphs
SECTION I.	General	67
II.	Organization	68–71
III.	Command duties	72–79

SECTION I

GENERAL

■ 67. SCOPE.—Organization and command duties of personnel come under the headings of technique. (See FM 4–182 when published.) Therefore, discussions in this chapter will be confined largely to general terms.

SECTION II

ORGANIZATION

■ 68. ECHELONS HIGHER THAN PLATOON.—Service of the balloon and balloon equipment largely is the task of the platoon. However, higher echelons perform functions where knowledge of the servicing task is necessary. This is particularly true in the battery and the battalion.

■ 69. PLATOON.—The barrage balloon platoon is composed of a platoon headquarters and nine squads, each squad operating one balloon. Platoon headquarters is not an administrative unit, its functions being tactical. Platoon personnel consist of two officers and 130 enlisted men.

■ 70. BALLOON SQUAD.—*a.* The balloon squad is composed of—

1 sergeant, balloon chief.
1 technician, grade 4, winch operator.
1 technician, grade 5, gas worker.
1 technician, grade 5, trained as armorer and winch operator.
1 technician, grade 5, trained as crewman and armorer.
1 technician, grade 5, trained as crewman and chauffeur.
6 privates, crewmen.
1 private, basic.

b. The squad contains ample personnel for all of its tasks, even when the normal furlough rate and the possibility of inclement weather are taken into account. When not alerted, the squad may be used to set up ground defenses, to prepare smoke-screening materials and to perform such other tasks as may be required.

■ 71. BALLOON CREW.—A balloon crew consists of the men necessary to handle the balloon during any given operation. The number of men in the crew will vary with different operations.

SECTION III

COMMAND DUTIES

■ 72. PLATOON COMMANDER.—The platoon commander has the following responsibilities:

a. Supervising the technical training and efficiency of platoon personnel.

b. Organizing or supervising the organization of balloon sites.

c. Setting up local defenses.

d. Insuring safety of personnel and equipment.

e. Handling the balloon tactically, as prescribed by higher authority, or, in case of emergency, in accordance with his own judgment.

f. Setting up a platoon communication net.

g. Obtaining an adequate supply of inflation gas for the balloons of his platoon.

h. Investigating the circumstances and making a report in the case of loss of or damage to a balloon.

i. Reporting fully on all hits, whether involving enemy or friendly aircraft.

■ 73. PLATOON EXECUTIVE.—The duties of the platoon executive are to—

a. Be second in command of the platoon.

b. Assist in training the platoon.

c. Aid the platoon commander in carrying out his duties.

■ 74. PLATOON CHIEF.—*a.* The platoon chief is a staff sergeant. He assists the platoon officers in carrying out their

duties. Either he or a commissioned officer is on duty at all times that the command is alerted or in readiness, or that any balloon is inflated or in flight.

b. He supervises preparation of all records required to be kept by platoon headquarters and subordinate units.

c. He prepares duty tables, under the direction of the platoon commander, and makes certain that sufficient personnel is on hand to perform all tasks.

■ 75. CHIEF GAS WORKER.—The chief gas worker is a staff sergeant. He assists the platoon commander in the execution of all duties pertaining to gas and inflation.

■ 76. PLATOON RIGGER.—The platoon rigger, a technician, grade 5, makes minor repairs to rigging and fabric. Each platoon has one rigger.

■ 77. COMMUNICATION CORPORAL.—A corporal performs the communication tasks at platoon headquarters.

■ 78. BALLOON CHIEF.—The balloon chief is a sergeant. He is in charge of one balloon site and the squad assigned thereto. His responsibilities are—

a. Taking charge of the balloon site and commanding the balloon squad.

b. Commanding the balloon crew in all operations.

c. Training the balloon squad.

d. Inspecting and maintaining all equipment on the site.

e. Organizing the squad into reliefs so that the necessary personnel will be available at all times to perform any duty that will be required.

f. Detailing members of the squad to various duties, such as guard duty.

g. Executing the commands of higher authority.

h. Enforcing safety regulations at the site.

i. Policing the site and maintaining sanitary conditions.

j. Commanding the balloon squad in action against air and ground forces.

k. Keeping records at the site.

■ 79. OTHER PERSONNEL.—*a. All members.*—Each member of the balloon squad is responsible for acquiring a high state

of proficiency in performing his particular duties and for learning the duties of each of the other members of the squad, so that eventually any member of the squad can perform the duties of any of the other members.

b. Side chiefs.—In addition to performing the duties prescribed in the drill tables, each man acting as side chief is responsible for the proper execution of commands as they apply to duties of the crew on his particular side of the balloon, reporting when certain commands have been executed and moving men from their normal positions when necessary for the safety of personnel or equipment.

c. Winch operator.—The winch operator is responsible for operation of the winch and for maintenance of the winch, cable, and central anchorage snatch-block. Other members of the balloon crew will be trained to operate the winch but the man designated as winch operator will be responsible for its proper maintenance.

d. Gas worker.—The gas worker is responsible for the operation of gas equipment during inflation and topping-up, and for the maintenance of gas equipment.

e. Armorer.—The armorer is responsible for the inspection and maintenance of the lethal devices.

f. Technicians and crewmen.—Technicians and crewmen charged with specific responsibilities will keep the balloon chief informed on the condition of balloon equipment at all times.

CHAPTER 8

OPERATING AND MANEUVERING ON LAND

	Paragraphs
SECTION I. Formation of balloon crew	80– 81
II. Drill procedure	82–106
III. Maneuvering in emergencies	107–108
IV. Operating at mobile sites	109–111
V. Drill tables	112–125

SECTION I

FORMATION OF BALLOON CREW

■ 80. GENERAL.—Safety of personnel and equipment and speed in adjusting to changing conditions of battle and weather make necessary the adoption of standard procedures at balloon sites. Every crew member must learn as quickly as possible the duties of his fellow crew members, and the entire crew must be so trained that it can function no matter what the hour or the situation.

■ 81. FORMATION OF CREW.—*a.* The maximum number of squad members that normally fall in to form a crew is 11, including the balloon chief. This allows for one man on the telephone and for one man away on pass. However, if all squad members are present and their services are needed, as during a storm, all will fall in.

b. At the command 1. BALLOON CREW, 2. FALL IN, given by the balloon chief, the crew forms in two ranks 15 paces in front of the nose of the balloon, facing left. The balloon chief stands 5 paces in front of and facing the center of the front rank. (See fig. 16.) The men who normally act as side chiefs will fall in as Nos. 1 on the right of the formation, and the man who normally acts as winch operator will fall in on the left flank of the front rank.

SECTION II

DRILL PROCEDURE

■ 82. GENERAL.—*a.* This section includes certain explanatory notes that must necessarily accompany the drill tables given

510518°—43——4



FIGURE 16.—Balloon crew in formation.

subsequently. It lays down the proper sequence for various operations, the drill orders to be used, and the members of the crew responsible for carrying out and reporting completion of individual orders.

b. It is essential that the correct sequence of each operation be followed closely at all times. The purpose of a standard drill is to train soldiers so that they can perform their duties quickly, coolly, and efficiently under adverse conditions. For successful operation of a balloon and balloon equipment during a battle, a storm, a blackout, or any other type of emergency, personnel must know their routine duties and their stations so thoroughly that they can tackle any problem clear-headedly and immediately. Thorough training with standard drills improves morale, reduces danger to personnel and equipment, and increases efficiency.

■ 83. POSITION OF BALLOON CHIEF.—When giving orders, the balloon chief should always use a megaphone, stand clear of the balloon, and move to positions from which he can observe all operations and from which his orders can be heard.

■ 84. TELLING OFF.—Before posting his crew, the balloon chief tells the members their duties. This is called "telling off." There is a vital reason for telling off the crew to their various duties. Often in actual practice the desired maneuver must be performed with whatever personnel is available on the site at the time; this may be a total of 5, 6, 7, 8, 9, 10, 11 or 12 men. Unusual weather will influence the balloon chief in assigning duties to crewmen when telling off. Each time the balloon is handled, the balloon chief must assign the essential duties in connection with handling the balloon. Thus the winch operator, the crewman at the rip cord, the crewman at point of attachment and central anchorage snatch-block, and the crewman at the spider must be designated, even though the minimum number of men is being used for the maneuver. It is unreasonable to expect crewmen to remember the duties for the various crew members when the strength of the crew varies. When a crew is told off, each member of that crew receives direct instructions from his balloon chief which clear any misunderstanding in his mind as to what is expected of him. Experience shows

that many balloon casualties have been caused by confusion in the minds of crewmen; therefore telling off should be performed. For operational purposes, a balloon crew must be versatile. Crewmen must be taught the duties of every position of the crew. Telling off is a definite aid in this training and enables the balloon chief at all times to make the most efficient use of whatever crew is available for the maneuver at hand.

■ 85. POSITION OF CREWMEN.—At the command 1. DETAILS, 2. POSTS, the crew members move to their posts at a run. As soon as any member of the crew has completed an order, he moves immediately to his next point where duties will be required and stands at attention awaiting the next order.

■ 86. REPORTING.—Completion of each command will be reported as laid down in the drills. The side chiefs report completion of an operation on their respective sides of the balloon by reporting "Right (left) side ready." The balloon chief will not give any subsequent command until he has received the reports indicating that the previous command has been carried out correctly.

■ 87. REPEATED ORDERS.—Orders to the winch operator and gipsy-head operator will be repeated by these operators.

■ 88. DEFINITIONS.—*a. Point of attachment.*—The term "point of attachment" refers to the position of the balloon when the balloon is flying with its junction assembly 3 to 6 feet above the central anchorage snatch-block. When a balloon is to be bedded down from the flying position, it is brought first to point of attachment. If it is to be flown from a bedded-down position, it is brought first to point of attachment.

b. Close-haul.—If a balloon is moored at point of attachment, it is said to be at "close-haul." The three methods of mooring at point of attachment (close-hauling) are "tail-line mooring" and "mooring-circle close-haul" and "midship mooring." On water-borne sites, the term close-haul may be broadened to include flying the balloon as near the point of attachment as practicable.

■ 89. SAFETY.—If any member of a crew observes the fouling of a block or any part of the balloon rigging when the balloon is being raised or lowered on the bed, he will promptly shout the order STOP WINCH to prevent an accident. Under no other circumstance is a member of the crew to give an order, but he is always to draw the attention of the balloon chief to any occurrence appearing to require the balloon chief's attention.

■ 90. TRAINING DRILLS.—*a. Purpose.*—The training drills given in *b* below outline the procedure and sequence in performing the various operations, give the commands to be used, and designate the men who execute the various commands and the men who report completion of the commands. These training drills are supplemented by the drill tables given in Section V and the explanatory notes contained in this section.

b. Detailed drills and master orders.—For training purposes, all of the commands given in the training drills should be used. When the crew becomes sufficiently trained so that each member knows his duties thoroughly, MASTER ORDERS are used in accordance with instructions from higher authority, and the duties to be performed between MASTER ORDERS are performed automatically by the crew. MASTER ORDERS are printed in capital letters in the drill procedure given in the paragraphs below.

■ 91. PREPARING BED.—*a. General.*—Bedding down is an essential part of several of the procedures hereinafter described. Preliminary to bedding down, the bed must be prepared.

b. Procedure for forming crew.—Balloon chief and ten men are needed.

Balloon chief commands:

1. BALLOON CREW, 2. FALL IN.
COUNT OFF.

Balloon chief tells off:

Front rank, left side.
Rear rank, right side.
Nos. 1, both ranks, side chief and cradle legs and rigging lines.
Nos. 2, both ranks, cradle legs and rigging lines.

Nos. 3 and 4, both ranks, mooring and tensioning slips.
No. 5 F/R, winch.
No. 5 R/R, hauling tackle.

Balloon chief commands:

1. LEFT, 2. FACE.
1. DETAILS, 2. POSTS.
PREPARE THE BED.

NOTE.—If the balloon is at close-haul, No. 5 F/R will assist No. 5 R/R.

c. Procedure for placing equipment.—The crew members place equipment in position, or check it if it already has been placed, in preparation for bedding down.

■ 92. INFLATION.—*a. Preparation of site.*—All ground equipment is laid out properly. Sandbags, ballast blocks, cradle slips, grommets, and all other bedding-down equipment are placed just as if the balloon were to be bedded down immediately. Seven ground cloths are laid over the bed, their long direction being the direction of the wind. The inflation manifold, inflation tube, thimbles, tie-off cords, and all other gas equipment are arranged conveniently. The mooring and tensioning slips are prepared for use.

b. Procedure for forming crew.—Balloon chief and ten crewmen are needed.

Balloon chief commands:

1. BALLOON CREW, 2. FALL IN.
COUNT OFF.

Balloon chief tells off:

Front rank, left side.
Rear rank, right side.
Nos. 1 both ranks, side chiefs.
Nos. 2 both ranks, handling and mooring lines.
Nos. 3 both ranks, cradle slips and rigging-line sandbags.
No. 4 front rank, gas worker.
No. 4 rear rank, gas party.
Nos. 5 both ranks, gas party.

Balloon chief commands:	*Carried out by—*	*Reported by—*
1. LEFT, 2. FACE	All crewmen	
1. DETAILS, 2. POSTS	All crewmen	
UNPACK THE BALLOON	All crewmen	
LAY THE BALLOON ON THE BED	All crewmen	
(If the balloon comes packed in a valise the command is: ROLL THE BALLOON ON THE BED.)		
SPREAD THE BALLOON	All crewmen	
UNWRAP RIGGING	Nos. 2, 3, and 5	Nos. 1
RIG THE BALLOON	Nos. 1, 2, 3, and 5	Nos. 1
PREPARE FOR INFLATION	Nos. 4 and 5	No. 4 F/R
COMMENCE INFLATION	All crewmen	
CEASE INFLATION	Nos. 4	No. 4 F/R

NOTE.—Upper cradle slips, rigging-line sandbags, and tensioning slips are attached as inflation progresses so as to have the balloon completely bedded down when inflation is finished. The nose should be kept on the ground as long as possible, so as to prevent the wind from blowing under the balloon. When the nose is released, a crewman should be detailed to hold open the ballonet air scoop so that air may enter the ballonet at the earliest possible moment. At the command CEASE INFLATION, the flying cable is attached. The balloon chief makes a check to insure that the balloon is properly bedded down.

c. Unpacking the balloon.—At the command UNPACK THE BALLOON, the entire crew removes the balloon from its container and places it on the spread ground cloths, headed into the wind, with the ballonet next to the ground cloths.

d. Rigging the balloon.—When the balloon has been spread on the bed, the balloon chief commands: RIG THE BALLOON. The balloon chief checks at the nose of the balloon to see if the gas-valve line is tied off properly. Then he goes to the rear of the balloon where assisted by No. 1 R/R, he installs the gas valve, checking the adjustment of the valve-line buckle and tying off the valve-line access sleeve. No. 1,

rear rank, is the only man who walks on the balloon; he attaches the rip cord to the rip panel. The rip cord is attached to the rip panel with a sheet-bend and a half hitch, and the free end of the rip cord is seized to its own standing part. The rip cord then is fastened to the envelope with break-away cord. This break-away cord is tied with a clove hitch to the rip cord; then the ends are passed through the ring on a circular patch and are tied together with a square knot. There are three circular patches on the emergency deflation system. The rip cord is tied to a suitable point on the bed with plenty of slack left in the line. If handling lines have not been marked previously, Nos. 2 and 3 measure and mark the handling lines at the points where they will be tied into the spider, and attach the handling and mooring lines to the proper patches on the balloon. Nos. 3 attach the running nose line to the nose handling patch. The running nose line has a soft eye in one end. The other end is served. The served end is reeved through the patch strop and is fastened to the eye-spliced end with a single or a double sheet-bend. A mooring slip is attached to the 37-foot mooring circle and hooked into the running nose line. Sandbags are placed on the nose if necessary. The purpose of this arrangement is to keep the nose of the balloon under control, especially in windy weather.

e. Preparing for inflation.—(1) While the balloon is being rigged, the gas worker and gas party remove the caps from the gas cylinders, connect the inflation tube to the manifold and ground the manifold, and connect the inflation tube to the inflation appendix. The inflation tube comes in two sections, and is connected in the following manner:

(*a*) A thimble is placed inside the end of the section at the balloon.

(*b*) The thimble assembly then is placed inside the inflation appendix, so that the inflation appendix covers not only the thimble but also the inflation tube around the thimble. The inflation appendix is large enough so that it must be drawn up snug and the excess folded around the thimble assembly.

(*c*) Elastic cord (a length of shock cord) or nonelastic tape is used to tie off the thimble assembly tightly. The cord or tape has an eye in one end. The cord or tape is

wrapped once around the junction of the thimble, inflation tube, and inflation appendix; the free end is passed through the eye and pulled tight. Then the cord is wrapped around *in the same direction* as many times as the length of the cord will allow. The free end is secured by wrapping it several times around the standing part which formed the original loop around the thimble assembly.

(*d*) The two sections of inflation tubing are joined over a thimble. The thimble is put inside the end of the section which is attached to the balloon. The end of the section leading to the gas cylinder stack is passed over the thimble and the end of the tube leading from the balloon. The thimble assembly is tied off in the manner described above.

(*e*) The end of the inflation tube at the gas cylinder stacks is passed over the manifold (or over the junction of two manifold assemblies, if a Y-type arrangement is used) and is tied off in the manner described above.

(2) The balloon chief commands: PREPARE FOR INFLATION, after which he and the side chiefs inspect to make certain all arrangements have been made properly, and the crew members take their posts approximately as shown in figure 17.

f. Inflating.—After all preparations for inflation are completed, the balloon chief commands: COMMENCE INFLATION. Nos. 4 operate the gas-cylinder valves and manifold during inflation. No. 5 F/R holds up the inflation tube at the inflation appendix to prevent choking. No. 5 R/R holds the gas valve at the tail of the balloon in vertical position until it is out of reach. Nos. 3 attach the upper cradle slips and rigging line sandbags on their respective sides of the balloon as inflation progresses, working from the tail to the nose. Nos. 2 adjust the mooring slips as inflation progresses, working from the tail to the nose, and attach the tensioning slips to the mooring and handling lines when inflation has proceeded to the point where this can be done. The side chiefs supervise the operations on their respective sides of the balloon, and the balloon chief supervises the overall inflation procedure. The balloon chief also checks the gas valve for proper operation during inflation, and as inflation nears completion he inspects the ballonet diaphragm to determine when inflation should cease.

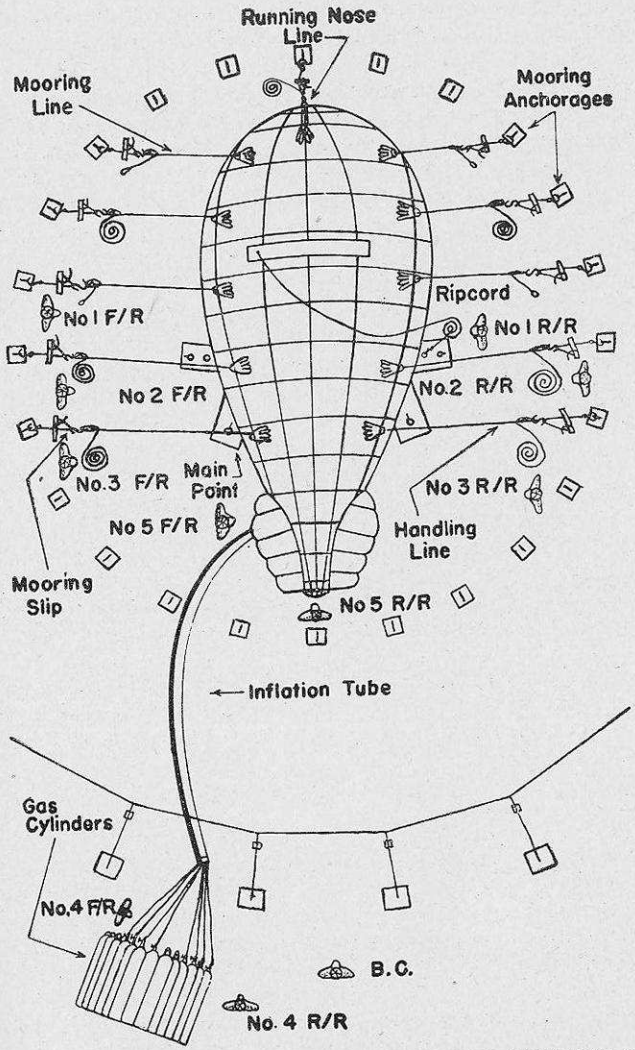


FIGURE 17.—Crew members at posts for command PREPARE FOR INFLATION.

g. Completion of inflation.—When sufficient gas has been injected into the balloon, as determined by a visual inspection of the diaphragm, the balloon chief commands: CEASE INFLATION. At this command, the flow of gas into the balloon is stopped; the inflation appendix is tied off; gas equipment is replaced; the cradle slips, rigging-line sandbags, mooring slips, and tensioning slips are adjusted so that the balloon is properly bedded down; the running nose line is removed; the foot ropes are attached to the junction assembly, and the flying cable is attached to the balloon. (See table I.)

Caution: If any cylinders are partly emptied when the command CEASE INFLATION is given, those cylinders are allowed to become empty. The small amount of extra gas will do no harm in the balloon, whereas a half-emptied cylinder is useless at the site.

■ 93. MECHANICAL HANDLING.—*a. General.*—Mechanical handling is the method of getting the balloon from bed to point of ascension, or vice versa, with the aid of the gipsy-head on the winch. (See fig. 18.)

The gipsy-head overcomes the lift of the balloon by pulling on the handling lines. Manual handling achieves the same objectives, using manpower applied to a block and tackle. The mechanical method of handling the balloon is the quicker and preferred method, and manual handling should be used only if the winch is not equipped with a gipsy-head or if the gipsy-head is out of order. Manual handling is explained in paragraph 94.

*b. Procedure for forming crew.**—Balloon chief and ten men are needed.

Balloon chief commands:

1. BALLOON CREW, 2. FALL IN.
COUNT OFF.

*If as many as two men are absent, the crew is formed as follows:
Balloon chief tells off—
No. 1, front rank, side chief, point of attachment, and center handling line.
No. 1, rear rank, side chief, rip cord, and center handling line.
Nos. 2, both ranks, front handling lines and spider.
Nos. 3, both ranks, rear handling lines and rudder.
No. 4, front rank, winch operator.
No. 4, rear rank, gipsy-head and central anchorage.

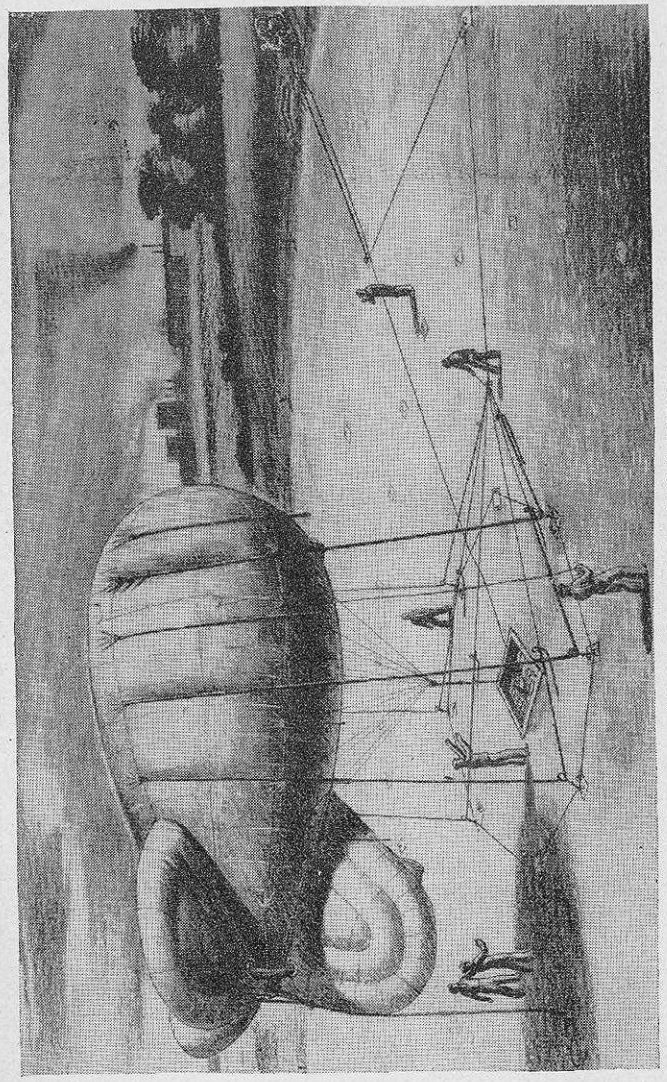


FIGURE 18.—Mechanical handling.

Balloon chief tells off:

Front rank, left side.
Rear rank, right side.
No. 1 front rank, side chief and point of attachment.
No. 1 rear rank, side chief and rip cord.
Nos. 2 both ranks, front handling lines and spider.
Nos. 3 both ranks, center handling lines.
Nos. 4 both ranks, rear handling lines and rudder.
No. 5 front rank, winch operator.
No. 5 rear rank, gipsy-head.

Balloon chief commands:

1. LEFT, 2. FACE.
1. DETAILS, 2. POSTS.

NOTE.—When bedding down with a crew of eight, No. 4 R/R oils the cable, if necessary, and also switches off the rip link before the lines are brought in to reeve and tie. He then proceeds to the gipsy-head. This relieves No. 1 F/R of duties which otherwise would require him to be at two places at once.

Bed to point of attachment.

Commands	*Carried out by—*	*Reported by—*
START UP WINCH	No. 5 F/R	No. 5 F/R
Remove slips from handling lines	Nos. 2, 3, and 4	Nos. 1
Man the spider	No. 2 R/R	No. 1 R/R
HAUL IN ON GIPSY-HEAD	No. 5 F/R	
WATCH BLOCKS (given immediately after above command)	All crewmen	
STOP HAULING	No. 5 F/R	
Unfurl rudder and fins	Nos. 4	Nos. 1
Remove cradle slips and rigging-line sandbags	Nos. 2 and 3	Nos. 1
Remove slips from mooring lines	Nos. 1	Nos. 1
Man central snatch-block, spider and rudder	No. 1 F/R, No. 2 R/R, and Nos. 4	Nos. 1
Unfasten rip cord	No. 1 R/R	No. 1 R/R

PAY OUT GIPSY-HEAD	No. 5 F/R	
WATCH BLOCKS	All crewmen	
Fasten rip cord	No. 1 R/R	No. 1 R/R
Switch on rip link	No. 1 F/R	No. 1 F/R
Untie and unreeve handling lines	Nos. 2, 3, and 4	Nos. 1
Disengage gipsy-head, engage winch	No. 5 F/R	No. 5 F/R
Watch storage drum	No. 5 R/R	

NOTE.—Now the balloon can be close-hauled, or flown. If the balloon is to be flown, No. 5 R/R is detailed to watch the storage drum before paying out cable.

Bedding down.

Commands	*Carried out by—*	*Reported by—*
STOP WINCH (or START UP WINCH if balloon is not flying)	No. 5 F/R	No. 5 F/R
Switch off rip link	No. 1 F/R	No. 1 F/R
Reeve and tie handling lines	Nos. 2, 3, and 4	Nos. 1
Disengage winch, engage gipsy-head	No. 5 F/R	No. 5 F/R
Man central snatch-block, spider and rudder	No. 1 F/R, No. 2 R/R and Nos. 4	No. 1
Unfasten rip cord	No. 1 R/R	No. 1 R/R
HAUL IN ON GIPSY-HEAD	No. 5 F/R	
WATCH BLOCKS	All crewmen	
STOP HAULING	No. 5 F/R	
Fasten rip cord	No. 1 R/R	No. 1 R/R
Attach slips to mooring lines	Nos. 1	Nos. 1
Attach cradle slips and rigging-line sandbags	Nos. 2 and 3	Nos. 1
Attach slips to handling lines	Nos. 2, 3, and 4	Nos. 1

PAY OUT GIPSY-HEAD	No. 5 F/R
Overhaul spider	No. 2 R/R
Tension handling-line slips	Nos. 2, 3, and 4
Furl rudder and fins	All crewmen

NOTE.—Leave gipsy-head engaged and winch disengaged and tie off fins and rudder after furling.

c. Procedure for bedding down.—(1) When a balloon is to be bedded down from the flying position, it is first brought to point of attachment. If the balloon is tail-line moored, it is to be treated as though at point of attachment for the purpose of bedding down; the wire pyramid is simply allowed to collapse as the balloon is hauled down onto the bed, and the tail line is detached from the tail-line bungee strop before the balloon is bedded down. In windy weather, the tail-line can be untied and manned to steady the balloon during the process of bedding down. If the balloon is at mooring-circle close-haul, it is brought to point of attachment for the purpose of bedding down by casting off the sandbags on the front handling lines and untying the rear handling lines from the transverse strop and unreeving them from the blocks on the mooring circle. If the balloon is at midship mooring, it is to be treated as though at point of attachment for the purpose of bedding down; the wire pyramid is simply allowed to collapse as the balloon is hauled down onto the bed, and the trolley assembly is detached from the running line before the balloon is bedded down.

(2) When the balloon is being hauled down onto the bed, the man at the central anchorage stands so that the junction assembly is between him and the spider. With palms up, he parts the foot ropes to right and left, taking care not to become entangled in the rigging or flying cable in case the balloon should accidentally rise. As soon as the junction assembly is lowered to the central anchorage snatch-block, he covers it with a fabric pillow, which he should have in a convenient position for the purpose.

(3) When the balloon is being hauled down onto the bed, the men on the rudder draw the rudder as far as possible to one side, and one man inserts his arm into the rudder air

scoop so as to let out some of the air from the rudder. If the balloon comes down slightly off wind, the rudder is pulled to the downwind side.

(4) The order STOP HAULING is given when the lowest point of the ballonet is about 18 inches from the ground. This is of particular importance to enable the balloon to be bedded correctly.

(5) The rip cord is tied to a suitable main point on the bed, and the upper cradle slips, rigging-line sandbags, and mooring and tensioning slips on the mooring lines are attached as rapidly as possible, the men working from nose to tail. The upper cradle slips and rigging-line sandbags are tensioned sufficiently to bring the balloon down to its correct and final position on the bed, so that the ballonet air scoop is just clear of the ground, the envelope is about 18 inches above the central anchorage, and the junction of the rudder and ballonet is from 3 to 5 feet above the ground.

(6) The mooring and tensioning slips are attached to the handling lines after the balloon is in its final position on the bed. When the order PAY OUT GIPSY-HEAD is given, the winch operator eases away on the gipsy-head sufficiently for the spider to be moved toward the central anchorage (overhauled) so that the tensioning and mooring slips on the handling lines can be tensioned, leaving handling lines slack from grommets to spider.

(7) When the balloon is bedded down for a period of time the rudder must be furled. After all of the ground rigging has been put in place, all members of the crew assist in furling fins and in fastening the rudder-protection sheet to the balloon.

(*a*) The rudder-protection sheet is laid on the bed directly under the rudder.

(*b*) Nos. 4 deflate the rudder as the balloon is bedded down, one by untying and keeping open the rudder deflation appendix and the other by holding open the nonreturn valve in the rudder air scoop.

(*c*) The tie lines on the front end of the sheet are tied to circular patches on each side of the ballonet by means of a single bow knot.

(*d*) Working toward the tail and fastening the hooks on each side simultaneously, the men hook the sheet to the rudder-protection sheet lines, making certain that the hooks

on the edge of the sheet are turned outward, so that the balloon fabric will not be damaged. To facilitate this operation, the men fastening the hooks report to each other as each hook is attached, for example, "First hook fastened," "Second hook fastened," etc. Only one hook is placed on the rudder-protection sheet line between adjacent circular patches.

(*e*) The left side of the rear end of the sheet is fastened by running the tie line through the thimble of the rearmost circular patch and then lacing this line through the eyelets in the end of the sheet and tying it to the rearmost circular patch on the right side of the rudder with a single bow knot. This line should be drawn up tightly in order to gather or make tucks in the rudder-protection sheet.

(*f*) The tie line on the right side of the sheet is tied to the rearmost circular patch with a single bow knot.

(*g*) To remove the rudder-protection sheet, the single bow knots are untied and the hooks are taken off.

(8) When the balloon is bedded down for a period of time, the fins also must be furled. Two fin-furling lines are provided for this purpose. To furl the fins it will be necessary to use a stepladder, which will be placed with the steps facing the balloon. It is unnecessary to rush the job of furling the fins, as there always will be sufficient time to carry out the following procedure exactly. Hastily furling the fins or using knots or procedure other than given below will result in a loss of time when it is necessary to unfurl the fins quickly.

(*a*) The fins are deflated through the deflation appendixes, and then are rolled under until the upper and lower fin-furling tabs meet. The appendixes are tied off immediately after rudder and fins are furled.

(*b*) The crown of the eye-splice on the fin-furling line is passed up through the lower forward tab and then through the corresponding upper front tab.

(*c*) The line is gathered into a single bight, and this bight is pushed through the projecting crown of the eye-splice, leaving about 1 inch protruding. The eye-splice is pulled back so that the tabs are drawn close together.

(*d*) A bight is drawn through the next lower tab and up through the corresponding upper tab so that it protrudes about 1 inch. A bight is taken in the remainder of the line and passed through this protruding loop, the loop is pulled back, and the tabs are drawn close together.

(*e*) From this point, the procedure is repeated.

510518°—43——5

(*f*) The fins are released by pulling the free end of the furling line and removing the furling line from the balloon.

d. Procedure for going from bed to point of attachment.—Normally, the handling lines are left tied off to the spider while the balloon is bedded down, although they are untied from the spider, unreeved from the bed blocks, and tied off to the mooring-circle anchorage as a storm precaution. The flying cable always remains attached to the balloon. The balloon is hauled down with the gipsy-head just enough to take the tension off the upper cradle slips and rigging-line sandbags. *Rudder and fins are unfurled. All slips and rigging-line sandbags are then removed from the balloon.* The rip cord is untied and manned. The gipsy-head is then paid out to raise the balloon to point of attachment. Care should be exercised to make sure that the central-anchorage snatch-block is in an upright position, with no kinks in the cable. No. 1 R/R fastens the rip cord to the standing part of the flying cable between the two cable clamps by means of a bowline.

■ 94. MANUAL HANDLING.—*a. General.*—The principle of manual handling is the same as that for mechanical handling. The operational procedure is modified only to the extent of substituting manpower for mechanical power. (See fig. 19.)

b. Procedure for forming crew.—Balloon chief and 10 men are needed. The number required to haul on the tackle will depend to some extent on the weather, but all available crewmen should always be used.

Balloon chief commands:

1. BALLOON CREW, 2. FALL IN.
COUNT OFF.

Balloon chief tells off:

Front rank, left side.
Rear rank, right side.
No. 1 front rank, side chief and point of attachment.
No. 1 rear rank, side chief and rip cord.
Nos. 2 both ranks, front handling lines.
Nos. 3 both ranks, center handling lines.
Nos. 4 both ranks, rear handling lines and rudder.
No. 5 front rank, winch operator.
No. 5 rear rank, spider and tackle.

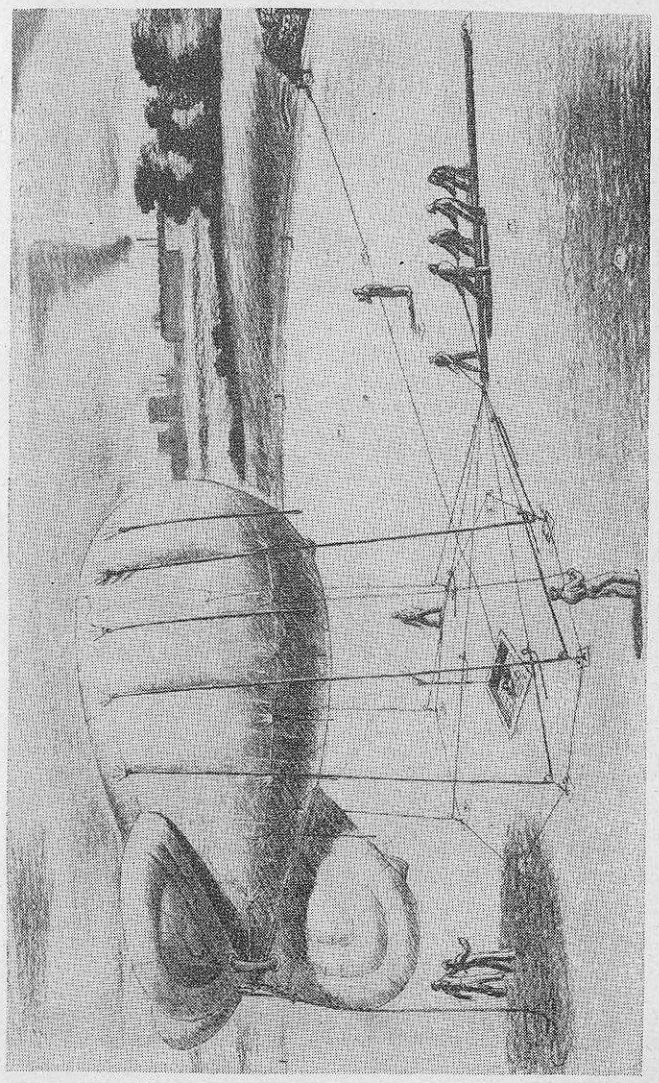


FIGURE 19.—Manual handling.

Balloon chief commands:
1. LEFT, 2. FACE.
1. DETAILS, 2. POSTS.

Bed to point of attachment.

Commands	*Carried out by—*	*Reported by—*
START UP WINCH	No. 5 F/R	No. 5 F/R
Remove slips from handling lines	Nos. 2, 3, and 4	Nos. 1
Man the tackle	Nos. 2, 3, 4, and No. 5 R/R	No. 5 R/R
HAUL IN ON TACKLE	Nos. 2, 3, 4, and No. 5 R/R	
STOP HAULING	Nos. 2, 3, 4, and No. 5 R/R	
Tie off	Nos. 2 and No. 5 R/R	No. 5 R/R
Unfurl rudder and fins	Nos. 4	Nos. 1
Remove cradle slips and rigging-line sandbags	Nos. 2 and 3	Nos. 1
Remove slips from mooring lines	Nos. 1	Nos. 1
Unfasten rip cord	No. 1 R/R	No. 1 R/R
MAN THE TACKLE	Nos. 2, 3, 4, and No. 5 R/R	No. 5 R/R
Untie tackle	Nos. 2 and No. 5 R/R	No. 5 R/R
Man the central snatch-block	No. 1 F/R	
EASE OFF TACKLE	Nos. 2, 3, 4, and No. 5 R/R	
HAUL IN ON WINCH	No. 5 F/R	
STOP WINCH	No. 5 F/R	
Fasten rip cord	No. 1 R/R	No. 1 R/R
Switch on rip link	No. 1 F/R	No. 1 F/R
Untie and unreeve handling lines	Nos. 2, 3, and 4	Nos. 1

NOTE.—Now the balloon can be flown or close-hauled. If the balloon is to be flown, the balloon chief must detail a crewman to watch the storage drum before paying out cable.

Bedding down.

Commands	*Carried out by—*	*Reported by—*
STOP WINCH (or START UP WINCH if balloon is not flying)	No. 5 F/R	No. 5 F/R
Switch off rip link	No. 1 F/R	No. 1 F/R
Reeve and tie handling lines	Nos. 2, 3, and 4	Nos. 1
Man the central snatch-block and rudder	No. 1 F/R and Nos. 4	Nos. 1
Unfasten rip cord	No. 1 R/R	No. 1 R/R
Man the tackle and spider	Nos. 2, 3, and No. 5 R/R	No. 5 R/R
PAY OUT WINCH	No. 5 F/R	No. 5 F/R
STOP WINCH	No. 5 F/R	No. 5 F/R
HAUL IN ON TACKLE	Nos. 2, 3, and No. 5 R/R	
WATCH BLOCKS	All crewmen	
STOP HAULING	Nos. 2, 3, and No. 5 R/R	
Tie off	No. 5 R/R and Nos. 2	No. 5 R/R
Fasten rip cord	No. 1 R/R	No. 1 R/R
Attach slips to mooring lines	Nos. 1	Nos. 1
Attach cradle slips and rigging-line sandbags	Nos. 2 and 3	Nos. 1
Attach slips to handling lines	Nos. 2, 3, and 4	Nos. 1
UNTIE	Nos. 2, 3, and No. 5 R/R	No. 5 R/R
Overhaul spider	No. 5 R/R	
Tension handling-line slips	Nos. 2, 3, and 4	
Furl rudder and fins	All crewmen	

NOTE.—The rudder and fins are furled and tied off ready for the next order to fly.

■ 95. TURNING BALLOON ON CRADLE BED.—*a. General.*—Every possible care is to be taken to keep the balloon headed into the wind at all times. It will often be difficult to observe from

the rigging patches whether the nose of the balloon is off wind; however, when the nose of the balloon is denting first on one side and then on the other side, due to a surge of gas within the balloon, or when the upper cradle slips are closer to the balloon on the leeward side than on the windward side, these are sure indications that the balloon needs to be turned. A wind sock should also be placed on each site to help determine the position of the balloon relative to the wind. In calm weather, one or more men can be detailed to turn the balloon. In conditions of high wind and rapid changes of wind direction, it is necessary to turn the balloon as rapidly as possible and an adequate crew must be used. The safety of the balloon will often depend on prompt action in starting to turn the balloon when the wind changes.

b. Procedure for forming crew.—Balloon chief and eight men are needed.

Balloon chief commands:

1. BALLOON CREW, 2. FALL IN.
COUNT OFF.

Balloon chief tells off:

Front rank, left side.
Rear rank, right side.
Nos. 1 and 2 both ranks, cradle slips and rigging-line sandbags.
Nos. 3 and 4 both ranks, mooring and tensioning slips.
Move nose left (or right).
Prepare right (or left) side first.

Balloon chief commands:

1. LEFT, 2. FACE.
1. DETAILS, 2. POSTS.

c. Procedure for turning.

Commands	*Carried out by—*	*Reported by—*
Untie, unreeve, and coil handling lines	Nos. 3 and 4	Nos. 4
Transfer lower cradle slips and foot ropes	Nos. 1 and 2	Nos. 1
MOVE FIRST PICKET	Nos. 3 and 4	Nos. 4
Move second picket	Nos. 3 and 4	Nos. 4
Move third picket	Nos. 3 and 4	Nos. 4
Move fourth picket	Nos. 3 and 4	Nos. 4

Move fifth picket	Nos. 3 and 4	Nos. 4
BED DOWN		
Transfer rip cord	No. 1 R/R	No. 1 R/R
Replace lower cradle slips and foot ropes	Nos. 1 and 2	
Pass upper cradle slips under flying cable	Nos. 1 and 2	
Adjust mooring slips	Nos. 3 and 4	Nos. 1
Move tackle	Nos. 2	
Reeve and tie handling lines	Nos. 2, 3, and 4	Nos. 1

NOTE.—Foot ropes are always to be replaced in their normal positions when the balloon is bedded down after turning and are never to be left withdrawn through the eye-splices of the bedding strops.

d. Preparing to turn.—The lower cradle slips are unhooked from the grommets on the octagon, starting on the leeward side, and are hooked onto the bedding strops on the relative rigging patches so that each of these lower cradle slips runs upward alongside the corresponding upper cradle slip. In windy weather, both sets of slips should be tensioned to insure that the balloon is held firmly to the cradle leg ballast in every case. Tension of these slips on the windward side should be firmer than on the leeward side. Each foot rope is drawn up through the loop of its rigging patch or the bedding strop so that it will be kept clear of the cradle legs and ballast while the balloon is being turned. If the balloon must be turned only one point from a main point, the handling lines need *not* be untied from the spider and coiled up to hang below their looped cut-splices.

e. Turning.—(1) Each mooring slip (complete with tensioning bags) is moved one point on the mooring circle. If the balloon is being turned clockwise (nose right, tail left), the mooring slips are moved in a clockwise direction, starting with the front mooring slip on the left side of the balloon and the rear mooring slip on the right. For turning counterclockwise, the right front and left rear mooring slips are moved first. One man hauls outward on the mooring slip to enable another man to unhook the slip from the mooring-circle anchorage and move it to the next point. A slight movement of the adjusting block may be necessary; however, the blocks should not be moved indiscriminately. When the

handling and mooring lines are tied off to the mooring-circle anchorages, as in storm precautions, these must also be untied and moved. Movements of individual mooring slips along the circle are described as picket movements. When all mooring slips have been moved one picket each, the balloon has been moved one point on the mooring circle.

(2) There may be times when slight adjustments on the mooring slips are desirable to facilitate turning under adverse conditions. For example, when turning a balloon in a clockwise direction (nose right, tail left), the right nose and left tail mooring slips should be taut, and the left nose and right tail mooring slips should be slack. A simple way to apply this principle is to adjust the tension of the mooring slips (and the handling and mooring lines, if these are tied to the mooring-circle anchorages) so that the first and second ones moved on either side are left slack, the third ones moved are left firm, and the fourth and fifth ones moved are left tight. This procedure will allow the balloon to swing with ease.

(3) At the same time the mooring slips are being moved, the rigging-line sandbags and the cradle leg ballast are shifted around progressively by crewmen working from the nose and tail of the balloon, meeting at the middle of the balloon at the conclusion of every point turned. The rate of movement of these sandbags controls the speed of turning the balloon.

(4) The safety of the balloon during the operation of turning is almost entirely dependent upon the care taken in moving the mooring slips. Upon completion of every point turned, the tension of mooring and tensioning slips is to be adjusted. Attention must also be paid to the correct height of the balloon, as there is a tendency for the balloon to be lowered during the operation of turning. Work on the two sides of the balloon should proceed at an equal pace. Experience will teach the proper distance that ballast and sandbags should be moved to accomplish a turn of one point.

(5) The rip cord is left fastened to a suitable main point, and is transferred to another when necessary either during turning or after.

(6) Turning movements of the balloon are undertaken one point at a time. No attempt should be made to force

the balloon around by undue hauling on the mooring slips. If the balloon does not turn readily, the balloon chief should stop operations immediately and determine the trouble.

f. Bedding down after turning.—(1) The lower cradle slips are replaced on the octagon, and spare grommets should be available on the octagon for this purpose. The foot ropes are replaced in their normal positions. The hauling tackle is moved to another hauling anchorage if necessary. The handling lines are reeved through the bed blocks and tied off to the spider, or are tied to the mooring-circle anchorages.

(2) After the balloon has been turned, cradle slips are unhooked and passed under the flying cable, to prevent fouling of the flying cable. If the pyramid is still attached, upper cradle slips will be passed under the pyramid legs to prevent fouling. If the balloon is turned several points, it may be necessary to take these precautions during the turning operation.

■ 96. TAIL-LINE MOORING.—*a.* Tail-line mooring is highly desirable if sufficient space for a tail-line mooring circle is available, since from this position the balloon can be flown or moored in a minimum of time and with a minimum of personnel. A balloon can be either flown or bedded down from a tail-line mooring position. (See fig. 20.)

b. Procedure for forming crew.—Balloon chief and five men are needed.

Balloon chief commands:

1. BALLOON CREW, 2. FALL IN.
COUNT OFF.

Balloon chief tells off:

No. 1 front rank, side chief and point of attachment.
No. 1 rear rank, side chief and rip cord.
No. 2 both ranks, tail line.
No. 3 winch operator.

Balloon chief commands:

1. LEFT, 2. FACE.
1. DETAILS, 2. POSTS.

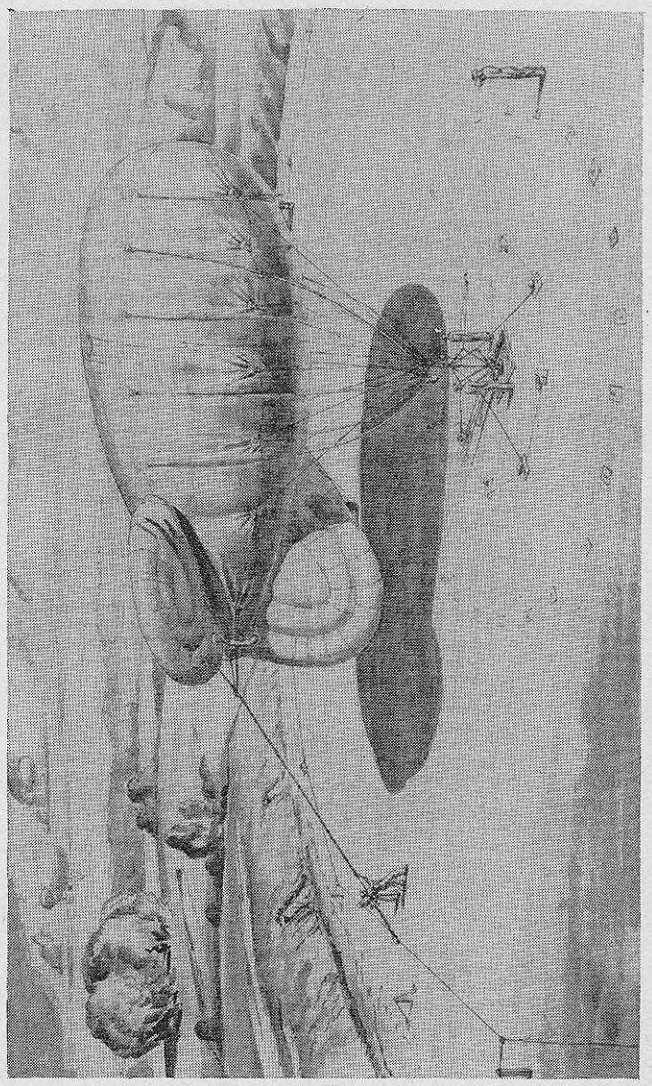


FIGURE 20.—Balloon at tail-line mooring.

To fly.

Commands	*Carried out by—*	*Reported by—*
START UP WINCH	No. 3	No. 3
HAUL IN ON WINCH	No. 3	
STOP WINCH	No. 3	
Transfer rip cord	No. 1 R/R	No. 1 R/R
Switch on rip link	No. 1 F/R	No. 1 F/R
Unshackle	No. 1 F/R	No. 1 F/R
Untoggle tail line	Nos. 2	No. 2 F/R

NOTE.—Before paying out flying cable, the balloon chief details one crewman to watch the storage drum.

To moor.

Commands	*Carried out by—*	*Reported by—*
STOP WINCH	No. 3	
Toggle and hold tail line	Nos. 2	No. 2 F/R
Switch off rip link	No. 1 F/R	No. 1 F/R
Shackle on	No. 1 F/R	No. 1 F/R
PAY OUT WINCH	No. 3	
Transfer rip cord	No. 1 R/R	No. 1 R/R
Tension and tie off tail line	Nos. 2	No. 2 F/R

■ 97. TURNING BALLOON AT TAIL-LINE MOORING.—*a.* When the balloon is at tail-line mooring, one strop is always detached from the tail-line mooring-circle cable. The block to which the tail line is attached is thus free to ride two sections of the cable. When the wind shifts sufficiently to bring the block into close proximity with one of the supporting strops, it is necessary to open a new section of the cable and to close the one no longer required by the movement of the block. This switch is made by releasing the supporting strops nearest the block and by reengaging the one previously released.

b. To engage and release the strops, a tackle arrangement called a handy-billy is used. The handy-billy enables one man to make the switch.

■ 98. MOORING-CIRCLE CLOSE-HAUL.—*a.* Mooring-circle close-haul is used on established sites where sufficient space is not available for a tail-line mooring circle, and the balloon in operation has not been rigged for midship mooring (see

par. 100). A balloon can be either flown or bedded down from a mooring-circle close-haul position. (See fig. 21.)

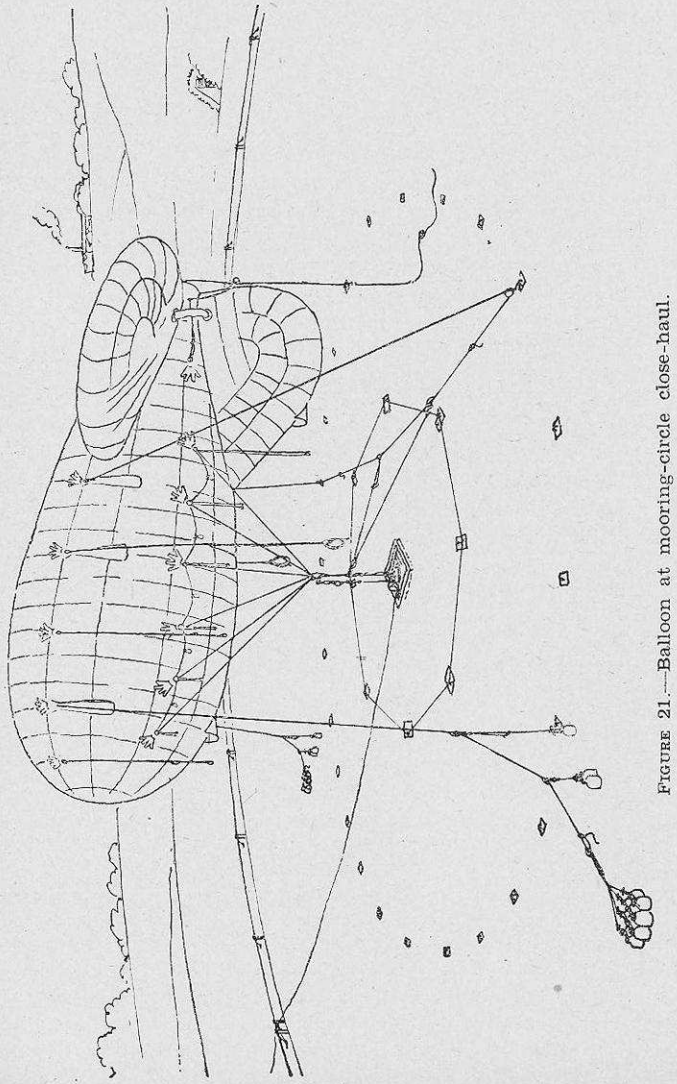


FIGURE 21.—Balloon at mooring-circle close-haul.

b. Procedure for forming crew.—Balloon chief and seven men are needed.

Balloon chief commands:

1. BALLOON CREW, 2. FALL IN.
COUNT OFF.

Balloon chief tells off:

No. 1 front rank, side chief and point of attachment.
No. 1 rear rank, side chief and rip cord.
Nos. 2 both ranks, front handling lines.
Nos. 3 both ranks, transverse strop and rear handling lines.
No. 4 front rank, winch operator.

Balloon chief commands:

1. LEFT, 2. FACE.
1. DETAILS, 2. POSTS.

To fly.

Commands	*Carried out by—*	*Reported by—*
START UP WINCH	No. 4	No. 4
HAUL IN ON WINCH	No. 4	
STOP WINCH	No. 4	
Slack off tensioning slip	No. 1 R/R	No. 1 R/R
Unfasten and man rear handling lines	Nos. 3	Nos. 3
Transfer rip cord	No. 1 R/R	No. 1 R/R
Switch on rip link	No. 1 F/R	No. 1 F/R
Unshackle	No. 1 F/R	No. 1 F/R
Unfasten and man front handling lines	Nos. 2	Nos. 2

NOTE.—Before paying out flying cable, the balloon chief details one crewman to watch the storage drum.

To moor.

Commands	*Carried out by—*	*Reported by—*
STOP WINCH	No. 4	
Reeve and tie rear handling lines	Nos. 3 and 1	Nos. 1
Switch off rip link	No. 1 F/R	No. 1 F/R
Shackle on	No. 1 F/R	No. 1 F/R
PAY OUT WINCH	No. 4	
Transfer rip cord	No. 1 R/R	No. 1 R/R

Tension running slip	No. 1 R/R	No. 1 R/R
Fasten sandbags and snubbers to front handling lines	Nos. 2 and 3	Nos. 2

NOTE.—If there are any folds or creases under the rear handling patches, tension in the rear handling lines must be relaxed slightly. If the wind drops, it will be necessary to take up the tension in the rear handling lines. In either case the running tensioning slip must be slacked off and the rear handling lines untied and tied again to the transverse strop.

■ 99. TURNING BALLOON AT MOORING-CIRCLE CLOSE-HAUL.—When a balloon is moored at the mooring-circle close-haul position, it may be necessary to turn the nose of the balloon if the wind direction should change. Under normal conditions this operation may be successfully carried out by three crewmen under the direction of the balloon chief. The front handling line on the leeward side is moved first. The sandbags are untoggled from the spider. The spider and the sandbags attached to the cut-splices remain attached to the handling line. The sandbags are dragged to the new position and placed a little too far out, so that they can be brought in when they are toggled onto the spider. The other front handling line is moved similarly. The snubbers are adjusted again and the single sandbag tensioned so that it just touches the ground. When the nose of the balloon is anchored in its new position, the tail is moved. One man slacks off the running tensioning slip, another hauls down on the standing part of the rear handling line on the windward side, while the third member of the crew removes the bed block and carries it to its new position on the mooring-circle anchorage and attaches it. The crew then goes to the other rear handling line and moves the block a corresponding number of points. After the turning is completed the running tensioning slip is tensioned.

■ 100. MIDSHIP MOORING.—*a. Definition.*—Midship mooring is a method of securing the balloon by means of the 37-foot circle and the pyramid so that the nose of the balloon can swing into the wind. The balloon rides at midship mooring much as it does at tail-line mooring. (See fig. 22.)

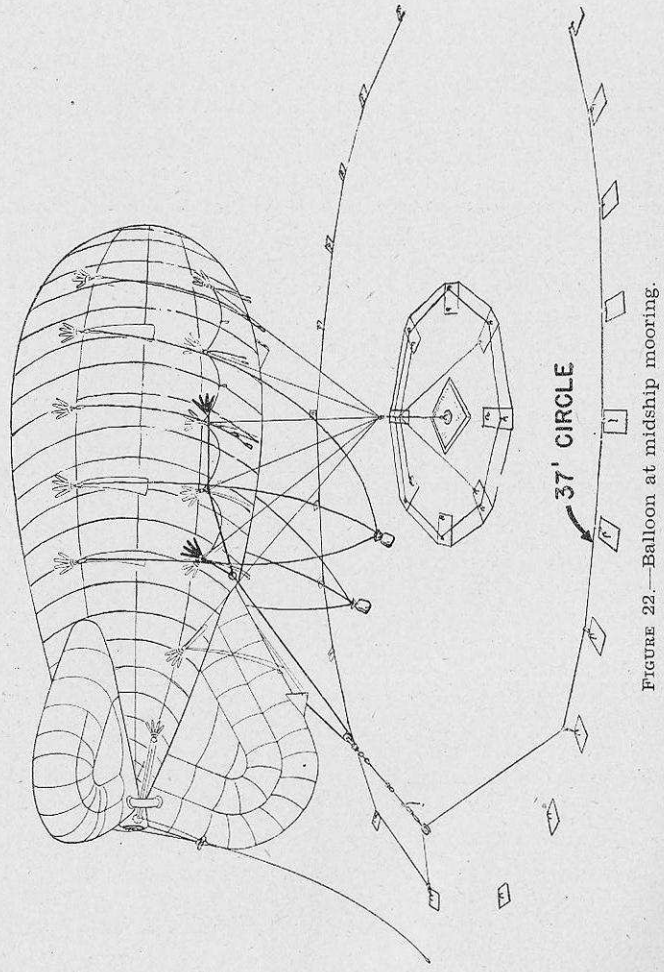


FIGURE 22.—Balloon at midship mooring.

b. Advantages.—Midship mooring has four advantages over mooring-circle close-haul:

(1) Less space is required for securing the balloon at midship mooring.

(2) The balloon may be flown or moored more quickly when using midship mooring.

(3) The flexibility of midship mooring allows more freedom for the balloon to vane with the wind.

(4) The number of crewmen required is reduced from seven to five.

c. References.—Dimensions and method of placing ground rigging will be found in FM 4–184 (when published). Reference is made to FM 4–196 (when published) for special rigging required on the balloon.

d. Procedure for forming crew.—Balloon chief and five crewmen are needed.

Balloon chief commands:

1. BALLOON CREW, 2. FALL IN.
COUNT OFF.

Balloon chief tells off:

No. 1 front rank, side chief and point of attachment.
No. 1 rear rank, side chief and rip cord.
No. 2 front rank, running line.
No. 2 rear rank, tail line.
No. 3 winch operator.

Balloon chief commands:

1. LEFT, 2. FACE.
1. DETAILS, 2. POSTS.

To moor: Commands	*Carried out by—*	*Reported by—*
STOP WINCH	No. 3	No. 3
Switch off rip link	No. 1 F/R	No. 1 F/R
Reeve running line	No. 2 F/R	No. 2 F/R
Shackle on	No. 1 F/R	No. 1 F/R
PAY OUT WINCH	No. 3	
STOP WINCH	No. 3	No. 3
Transfer rip cord	No. 1 R/R	No. 1 R/R
Tension and tie off running line	No. 2 F/R	No. 2 F/R

NOTE.—Throughout these operations, No. 2 R/R steadies the balloon by holding the tail line. In case of a strong wind, the balloon chief may designate No. 1 F/R to assist on the tail line after the pyramid has been shackled onto the junction strop and the winch is payed out.

To fly: Commands	*Carried out by—*	*Reported by—*
START UP WINCH	No. 3	No. 3
HAUL IN ON WINCH	No. 3	
STOP WINCH	No. 3	No. 3
Transfer rip cord	No. 1 R/R	No. 1 R/R
Switch on rip link	No. 1 F/R	No. 1 F/R
Unshackle	No. 1 F/R	No. 1 F/R
Unreeve running line	No. 2 F/R	No. 2 F/R
FLY THE BALLOON		

e. Mooring the balloon.—The balloon is brought down to point of attachment and the rip link is switched off. The running-line snatch-block on the trolley assembly is then locked on the running line, the pyramid is shackled onto the junction strop, and the winch is payed out until the balloon is riding on the pyramid. The rip cord is then transferred and the tensioning strop is reeved through the clevis on the mooring-circle snatch-block, and is tied with a picketing hitch.

f. Flying the balloon.—The balloon is hauled in slightly with the winch to remove tension on the pyramid. The rip cord is then transferred, the rip link is switched on, and the pyramid is unshackled. At this time the snatch-block on the running line is removed and the balloon is ready to fly.

g. Turning the balloon.—The principle involved in turning the balloon at midship mooring and tail-line mooring is the same (see par. 97).

■ 101. STORM PRECAUTIONS.—*a. Bedding down the balloon.*—In high winds or when a gale warning has been issued, the balloon should be bedded down and additional precautions taken. These precautions are discussed below and are illustrated in figure 23.

(1) The handling lines are untied from the spider, unreeved through the bed blocks, and tied off directly to the U-bolts of the mooring-circle anchorages with picketing hitches.

(2) The mooring-line extensions are reefbent to the eye-splices in the mooring lines and are tied off with picketing hitches to the mooring-circle anchorages.

510518°—43——6

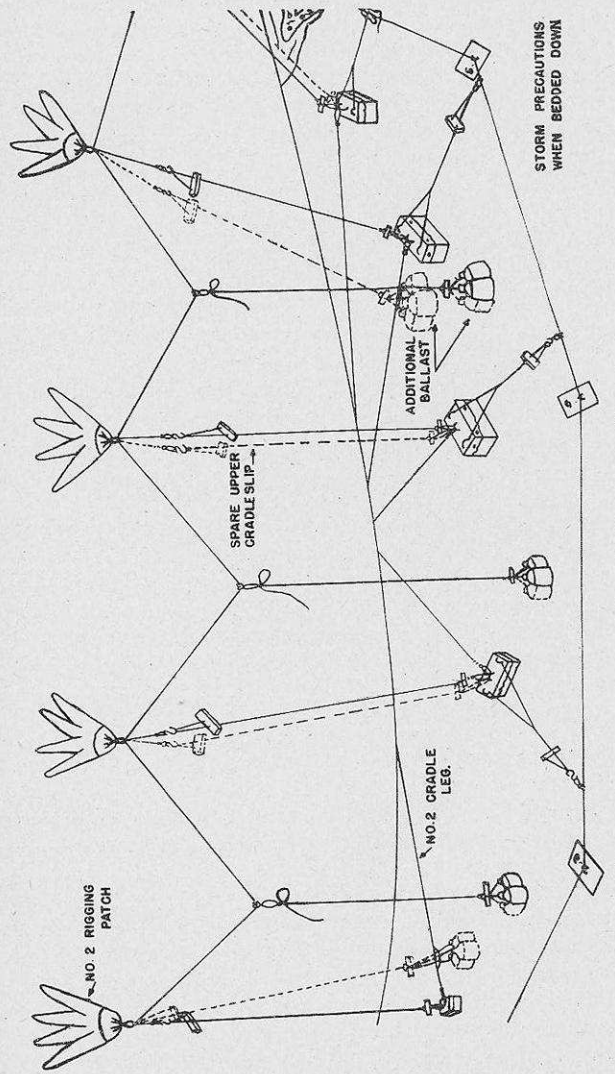


FIGURE 23.—Storm precautions.

(3) Three additional sandbags are attached to the straight cut-splices on Nos. 2 and 5 cradle legs by passing the sandbag suspension lines through the straight cut-splices and over the toggles of spare upper cradle slips.

(4) A second set of upper cradle slips is attached between the ballast blocks on each cradle leg and the corresponding spare bedding strops. On the Nos. 2 and 5 lines, the slips are attached between the additional sandbags and the spare bedding strops.

(5) An additional sandbag is added to each rigging-line sandbag nest.

(6) On the D–8 balloon, additional ballast must be added to the cradle legs, as this balloon has a greater lift and more surface is exposed to the wind.

(7) A third ground cloth is spread over the cradle under the belly of the balloon.

b. Turning the balloon on the bed.—(1) In high winds or when a gale warning has been issued, all members of the crew must be ready at a moment's notice to turn the balloon on the bed. Any delay when the wind direction changes rapidly will allow the wind to come around and hit the balloon broadside, making the turning more difficult and hazardous.

(2) During the operation of turning, if the concrete ballast blocks show any tendency to be lifted off the bed, the lower cradle slips should not be transferred from the octagon to the rigging patches or bedding strops, but should be moved along the octagon as necessary, using additional grommets.

(3) In high winds, it will be easier and safer to leave each handling line tied off to the mooring-circle anchorage while the corresponding mooring slip is being moved to the next point. The mooring slip can then be tensioned while the handling-line or mooring-line extension is untied and made fast to the new point. This is particularly true of the front handling and mooring lines on the windward side, where the greatest tension occurs.

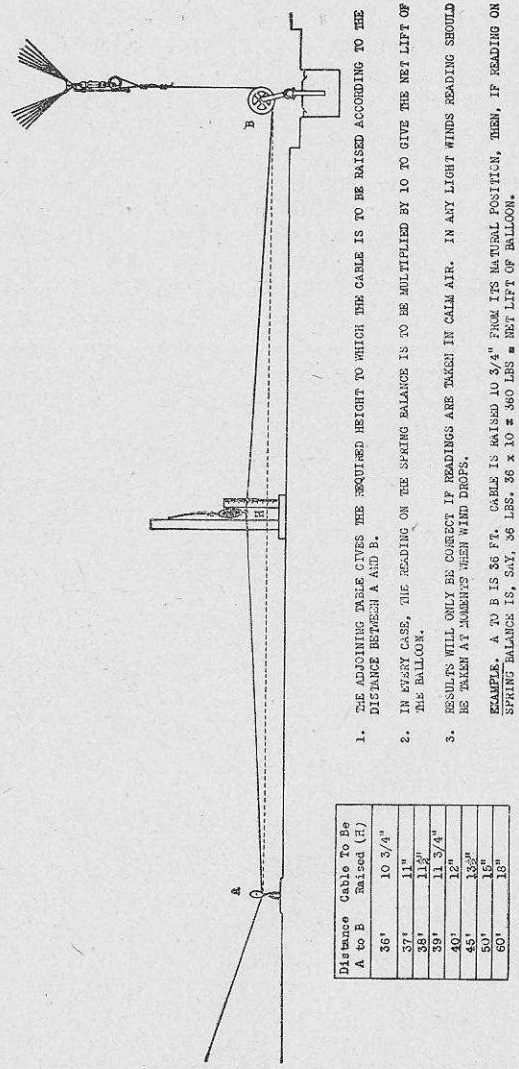
c. Tail-line mooring.—Strong, gusty surface winds, which shift suddenly in direction (usually accompanying a thunderstorm) may endanger a balloon at tail-line mooring, since the strops holding the tail-line mooring cable cannot be

shifted rapidly enough to meet the changing wind conditions. If it is not desired to bed down the balloon, the tail line should be untoggled and manned by several crew members. Men holding the tail line will prevent too great a strain being placed on the balloon, and will permit flexibility in maneuvering the nose of the balloon into the wind. Additional ground cloths should be laid on the bed where the rudder might sweep the ground and on either side of the bed where the balloon might hit the ground in rolling.

d. Mooring-circle close-haul and midship mooring.— Strong, gusty surface winds which shift suddenly in direction will endanger a balloon at mooring-circle close-haul, or midship mooring, and under these conditions the balloon should be bedded down immediately.

■ 102. WEIGHING OFF.—It is desirable that weigh-off be taken before mooring the balloon after a flight. If the balloon is to be weighed off from a bedded-down position or close-haul position, the balloon is released as prescribed in the drills for flying from these positions and is allowed to rise to a height of 25 feet. At this height, the balloon is free from ground disturbances. As soon as the balloon starts to ascend, No. 2 F/R or some other designated crewman obtains the weigh-off stand and places it at the designated mark along the flying cable. No. 1 R/R or some other designated crewman secures the flying cable to the stake. The balloon chief, assisted by No. 2 F/R, takes the scale reading. When the weigh-off is completed, No. 2 F/R replaces the weigh-off stand, and No. 1 R/R releases the flying cable from the stake. See figure 24 for method of obtaining weigh-off.

■ 103. TOPPING-UP.—*a. General.* — Ordinarily, the balloon will be bedded down daily for inspection and may be topped up most conveniently while bedded down. If it is not desired to bed down the balloon for topping-up, the balloon may be hauled down mechanically or manually with the handling lines (as if to bed down) until the topping-up orifice is within reach, and then may be topped up while held in this position with the handling lines. The procedure for topping-up by this method with mechanical handling is given in *b* below.



Distance A to B	Cable To Be Raised (H)
36'	10 3/4"
37'	11"
38'	11 3/4"
39'	11 3/4"
40'	12"
45'	13 3/8"
50'	15"
60'	18"

FIGURE 24.—Method of obtaining weigh-off.

b. Procedure for forming crew.—Balloon chief and ten men are needed:

Balloon chief commands:

1. BALLOON CREW, 2. FALL IN.
COUNT OFF.

Balloon chief tells off:

Front rank, left side.
Rear rank, right side.
No. 1 front rank, side chief, point of attachment, and front handling line.
No. 1 rear rank, side chief and rip cord.
No. 2 front rank, front handling line and gipsy-head.
No. 2 rear rank, front handling line and spider.
No. 3 both ranks, center handling lines and gas cylinders.
No. 4 both ranks, rear handling lines and rudder.
No. 5 front rank, winch operator.
No. 5 rear rank, gas worker.

Balloon chief commands:

1. LEFT, 2. FACE.
1. DETAILS, 2. POSTS.

To haul down and top up.

Commands	*Carried out by—*	*Reported by—*
STOP WINCH	No. 5 F/R	No. 5 F/R
Switch off rip link	No. 1 F/R	No. 1 F/R
Reeve and tie handling lines	No. 1 F/R, No. 2 R/R Nos. 3 and 4	Nos. 1
Disengage winch, engage gipsy-head	No. 5 F/R	No. 5 F/R
Man central snatch-block, spider, and rudder	No. 1 F/R, No. 2 R/R Nos. 4	Nos. 1
Unfasten rip cord	No. 1 R/R	No. 1 R/R
HAUL IN ON GIPSY-HEAD	No. 5 F/R	
WATCH BLOCKS	All crewmen	
STOP HAULING	No. 5 F/R	
ADD (NUMBER) CYLINDERS OF GAS	No. 5 R/R, Nos. 3	No. 5 R/R

NOTE.—At the command REEVE AND TIE HANDLING LINES, No. 2 F/R brings his line in to the main point, at which place No. 1 F/R takes the line and does the reeving and tying. No. 2 F/R goes on to the gipsy-head. Immediately after reeving and tying handling lines, Nos. 3 go to the cylinder stack, obtain the required number of full cylinders of gas, and carry them to the vicinity of the topping-up orifice. No. 5 R/R has obtained the topping-up tube and is prepared to attach it to the cylinder and the balloon. As soon as the gas is added, Nos. 3 and No. 5 R/R remove the cylinders and topping-up tube.

To fly and weigh-off.

Commands	*Carried out by—*	*Reported by—*
MAN CENTRAL SNATCH-BLOCK, SPIDER, AND RUDDER	No. 1 F/R, No. 2 R/R, Nos. 4	No. 1 F/R
PAY OUT GIPSY-HEAD	No. 5 F/R	
WATCH BLOCKS	All crewmen	
Fasten rip cord	No. 1 R/R	No. 1 R/R
Switch on rip link	No. 1 F/R	No. 1 F/R
Untie and unreeve handling lines	Nos. 1, 2, and 4	Nos. 1
Disengage gipsy-head, engage winch	No. 5 F/R	No. 5 F/R

(NOTE.—Now the balloon is ready to fly.)

■ 104. CABLE AND CABLE ARMAMENT.—*a. Maintaining flying cable.*—The flying cable is attached to the balloon at all times. Each time the balloon is hauled down any grit or dirt should be wiped off the cable, and once daily a light protective coating of oil applied to the surface of the cable. This may be done either by holding an oil-soaked rag around the cable a few feet from the lead-off gear or by having the cable pass through a specially constructed box, filled with oil-soaked waste. Surplus oil should be wiped from the cable.

b. Attaching upper link and parachute.—The upper link is attached, when the balloon is inflated (drill table I) by Nos. 1 under supervision of the balloon chief. The parachute is attached by Nos. 1 the first time the balloon is brought to point of attachment. The parachute should be attached when the balloon is moored at tail-line mooring, mooring-

circle close-haul, or midship mooring. The procedure for attaching the link and parachute is as follows:

Operations	*Carried out by—*
Set safety pin at SAFE.	No. 1 F/R
Remove terminal pin from cable-terminal assembly.	No. 1 F/R
Insert male end onto cable-terminal assembly and fasten it with cable-terminal pin.	No. 1 R/R
Remove link pin from female end.	No. 1 F/R
Fit female end onto bell-crank coupler and fasten it.	No. 1 F/R
Lift up parachute bag and intermediate cable.	No. 1 R/R
Fasten parachute-bag grip to No. 3 foot-rope on side opposite rip cord.	No. 1 F/R
Fasten open end of parachute bag to No. 2 and No. 5 foot-ropes.	No. 1 F/R
Attach free end of intermediate cable to cable-terminal assembly.	No. 1 R/R

NOTE.—The parachute is taken from the box by No. 1 R/R, who holds it until No. 1 F/R is ready to attach it to the foot ropes. At no time should the bag be laid on the ground or be lifted by the intermediate cable.

c. Attaching lower link and parachute.—When the balloon is within approximately 200 feet of the height at which it has been ordered to fly, the lower link and parachute are attached to the flying cable. For the commands to attach the lower link see drill tables II, IV, VI, VIII, and XII. This operation is carried out by Nos. 1 using the following procedure:

Operations	*Carried out by—*
With wedge housing opposite U-clamp, insert inner wedge into wedge housing about ½ inch.	No. 1 F/R
Place link on the flying cable, insert outer wedge flush with inner wedge.	No. 1 F/R
Push wedge housing down over wedges.	No. 1 F/R
Tighten wedges in wedge with cramp.	No. 1 F/R
Place parachute-bag grip housing around flying cable.	No. 1 R/R

Insert parachute-bag wedge into grip housing and tap it into position.	No. 1 R/R
Remove U-clamp from cutter housing.	No. 1 R/R
Engage flying cable in cable notch on cutter housing and replace U-clamp.	No. 1 R/R
Remove safety clip and put rubber cap in position.	No. 1 R/R

NOTE.—No. 1 F/R removes the link from the box and No. 1 R/R removes the parachute. At no time should the assembly be laid on the ground or lifted by the intermediate cable or link. The link is placed on the flying cable about 4 feet above the lead-off gear or central-anchorage snatch-block. The parachute bag is attached 6 to 12 inches below the link.

d. Removing lower link and parachute.—The lower link and parachute are removed each time the balloon is hauled down. For the commands to remove the lower device, see Drill Tables III, V, VII, IX, and XIII. The operations to remove the link and parachute are carried out by Nos. 1 and are given below:

Operations	*Carried out by—*
Remove rubber cap and put safety clip in place to make link SAFE.	No. 1 R/R
Remove U-clamp, turn cutter housing away from cable, and replace U-clamp.	No. 1 R/R
Remove wedges from wedge housing with cramp; remove link and cramp from flying cable.	No. 1 F/R
Remove parachute-bag grip housing from flying cable.	No. 1 R/R
Replace lethal assembly in box.	Nos. 1

e. Removing upper link and parachute.—The upper link and parachute should be removed weekly for servicing and inspection. This is done when the balloon is moored at tail-line mooring, mooring-circle close-haul, or midship mooring by Nos. 1. The procedure for removing the upper link and parachute is given below:

Operations	*Carried out by—*
Set the safety pin SAFE.	No. 1 F/R
Remove end of intermediate cable from cable-terminal assembly.	No. 1 R/R

Remove parachute bag from foot ropes and hand down to No. 1 R/R.	No. 1 F/R
Remove female end from bell-crank coupler and replace link-pin.	No. 1 F/R
Remove male end from cable-terminal assembly and replace cable-terminal pin.	No. 1 R/R

f. Replacing upper link and parachute.—After the link and parachute have been serviced or repaired, they are replaced while the balloon is moored at tail-line mooring, mooring-circle close-haul, or midship mooring. The link and parachute are attached by Nos. 1, using the same procedure as described previously.

g. Reference concerning lethal devices is made to FM 4–191 (when published).

■ 105. DEFLATION.—*a. Procedure for forming crew.*—Balloon chief and 10 men are needed:

Balloon chief commands:

1. BALLOON CREW, 2. FALL IN.
COUNT OFF.

Balloon chief tells off:

Front rank, left side.
Rear rank, right side.
Nos. 1 both ranks, side chiefs.
Nos. 2 both ranks, mooring and tensioning slips.
No. 3 both ranks, cradle slips and rigging-line sandbags.
No. 4 front rank, gas worker.
No. 4 rear rank, ballonet deflation sleeve.
Nos. 5 both ranks, running nose line.

Balloon chief commands:	*Carried out by—*	*Reported by—*
1. LEFT, 2. FACE	All crewmen	
1. DETAILS, 2. POSTS	All crewmen	
PREPARE FOR DEFLATION	All crewmen	Nos. 1
Haul down on Nos. 4, 5, and 6 upper cradle slips	Nos. 3	Nos. 1

Place slip knot on deflation appendix	No. 4 R/R	No. 4 R/R
Adjust blocks on mooring and tensioning slips	Nos. 2	Nos. 1
Wet down valve area	No. 4 F/R Nos. 5	No. 4 F/R
REMOVE VALVE	No. 4 F/R	No. 4 F/R
Close air scoop	Nos. 5	
Open ballonet appendix	No. 4 R/R	
COMMENCE DEFLATION	All crewmen	

b. Deflation procedure.—(1) The balloon is bedded down with the fins furled, the rudder unfurled, and the fin and rudder deflation appendixes untied. A stepladder is placed at the nose of the balloon with the steps facing the balloon, and the valve box is placed at the tail.

(2) The handling lines are untied, unreeved, and coiled to hang below the looped cut-splices.

(3) The foot ropes are unshackled and drawn out to their fullest extent, and all twists are removed. The end of each foot rope is looped to form a coil about 6 inches in diameter, and each foot rope is coiled just below the rigging patch. The foot ropes are coiled with the lay to prevent twisting and kinking. Each coil is seized at four places and placed in a fabric bag.

(4) The running nose line is reeved through the strop on the nose patch. For this operation the stepladder is used. The free end of the running nose line is tied to the eye-spliced end with a single sheet-bend, and a slip is hooked into the loop thus formed and is attached to the mooring circle.

(5) Ground cloths are spread under the balloon, care being taken to cover the concrete ballast blocks or cradle sandbags as far as the upper cradle slips permit. The ground cloths are folded against the slips in such a manner that the cloths can be unfolded to cover additional area when the slips are removed. Thus the balloon fabric is protected as deflation proceeds and the balloon is spread on the bed.

(6) The tail of the balloon is hauled down by shortening Nos. 4, 5, and 6 upper cradle slips to bring the ballonet deflation appendix and the valve within reach.

(7) The ballonet deflation appendix is untied and tied off again with a quick-release slipknot.

(8) The mooring and tensioning slips are shortened at the adjusting blocks to allow plenty of room for tensioning when deflation commences.

(9) If it is not raining and the ground is dry, the ground cloths around the tail of the balloon are thoroughly wet. The balloon is thoroughly wet around the valve.

(10) The valve is removed and placed in the valve box.

(11) While the valve is being removed, the ballonet air-scoop curtain is unbuckled and allowed to fall, so that no more air will enter the ballonet. At the same time, the slip-knot on the ballonet deflation appendix is released and the appendix is rolled back on itself to help keep it open.

(12) The valve line, which is detached from the valve when the valve is removed, is tied off to the valve-line securing cord and the slack of the line is put back inside the balloon. The gas worker, when removing the valve and tying the valve line, should avoid breathing the escaping gas.

(13) After the valve line is tied off, a cloth soaked in water is placed in the valve aperture so as to hang half inside and half outside the balloon.

(14) As soon as the valve is removed, the crewmen immediately start to haul down on the running nose line and front mooring lines in order to bring the nose of the balloon down to the ground as quickly as they can. The nose must be drawn down to the ground at the earliest possible moment to prevent any wind getting under the balloon. Once on the ground, the nose is held down by two crewmen until sufficient gas is expelled from the balloon to enable the nose to be sandbagged down. The two crewmen hang the sandbags on the nose as soon as possible and then sit on the bags if necessary.

(15) At no time should the tail of the balloon be allowed to rise above its normal bedded-down position. In high winds, the tail should be kept within 3 or 4 feet of the ground. This maneuver may be accomplished by tying off the tail line to the mooring circle.

(16) The gas worker watches the valve aperture to insure that it does not become choked and thus prevent the flow of gas. HE MUST AVOID BREATHING GAS. Another crewman is delegated to watch the ballonet deflation appendix to prevent choking. These men should be relieved at intervals.

(17) As the gas escapes, the upper cradle slips are removed, starting at the nose, and the ground cloths are spread out to their fullest extent.

(18) As the gas escapes, the mooring and tensioning slips are tensioned progressively from nose to tail.

(19) To force out gas remaining in the balloon, the balloon is rolled up from nose to tail. It is not necessary for any member of the crew to walk on the balloon. The gas worker is left at the tail to hold up the valve aperture, and another crewman remains in position to hold open the ballonet deflation appendix.

(20) The moment when rolling should begin depends entirely on the wind. In calm weather, or in gusty weather, if the gas begins to surge, rolling should be started at the earliest possible moment. A strong, steady wind from the nose will do much to help force out the gas, and rolling can be started much later.

(21) The handling and mooring lines and rip cord are freed and thrown into the roll as they are reached. The crew should keep the roll tight and maintain a steady pressure on the remaining gas in the balloon. Any loose fabric is tucked into the roll to prevent any gas being trapped during the rolling operation.

c. Emergency deflation procedure.—If there is danger of losing the balloon due to high winds, the deflation procedure described above may be more effective and less injurious to the balloon than pulling the rip cord, provided that the balloon can be bedded down and that the gas envelope has not been torn. There may not be time to lay ground cloths, to furl the fins, or to detach and coil flying wires, and the deflation may proceed without carrying out these operations. If it is impossible to remove the valve, make two L-shaped incisions with a knife blade in a panel just ahead of the valve, taking care not to cut across seams. (In view of the proximity of these incisions, the order prohibiting two apertures still holds.)

■ 106. PACKING.—*a. General.*—The balloon, if dry, must be packed as soon as possible after deflating to prevent formation of small pockets of air and gas. A wet balloon should

be dried out before packing. If it is necessary to pack a wet balloon, a large label marked WET BALLOON should be attached to the container so that the balloon can be unpacked and dried out at the earliest possible moment.

b. Bed.—Sufficient ground cloths to accommodate completely the spread-out balloon should be laid on the ground. Where possible, these cloths should be laid on a clean piece of ground outside the mooring circle, and not over the blocks of the balloon bed. The balloon, after deflation on the bed, can be rolled in a ground cloth and dragged to the new position.

c. Laying out the balloon.—Walking on the balloon should be avoided as far as possible. The procedure outlined below is followed in laying out the balloon:

(1) Unroll the balloon completely from tail to nose, so that the center seam of the balloon lies on top and along the center of the prepared ground cloths.

(2) Crew members take positions evenly around the balloon, each member taking a handling and rigging patch.

(3) Haul outward and lay the balloon flat with center seam straight along the middle of the packing area.

(4) Lay the rudder out flat on the left side of the balloon and lay the fins out flat on either side.

d. Preparation for packing.—(1) Remove and coil the rip cord, handling and mooring lines, tail-line bridle, and running nose line. (Foot ropes should have been coiled, taped, and placed in fabric bags prior to deflation.)

(2) Remove bedding strops and grommets on bridles.

(3) Assemble valve, dry it if necessary, insert wedge to lift diaphragm off seating, and replace valve in container.

(4) Wrap all buckles and snatch rings with strips of fabric to prevent chafing.

(5) Crew members take positions evenly around balloon. Each member finds the middle seam between handling patches and rigging patches and hauls outward until the balloon is laid out flat to the fullest extent, with the center seam straight along the middle of the packing area.

e. Folding.—(1) The left fin and then the right fin are folded so that both lie flat on top of the balloon. The rudder remains flat on the left side. The deflation appendixes of the fins are laid out beside the valve aperture.

(2) Crew members take positions evenly along the right side. They pick up the outer edge of the envelope at a seam and fold fabric over toward the center of the balloon, so that a longitudinal fold about 2 feet 6 inches in maximum width and parallel to the center seam of the balloon will be made.

(3) Folding is continued evenly until the inner edge of the last fold lies along the center seam of the balloon. The width of the fold will gradually increase until the last fold is approximately 3 feet 6 inches wide. It is essential that each fold should be made straight, even, and flat, the crew working together and taking orders from the balloon chief.

(4) Folding is repeated on the left side of the balloon and is stopped when space for one more fold is left between the last fold made and the center seam of the balloon.

(5) The balloon inflation appendix and the ballonet deflation appendix must lie underneath and in the center of the last fold made on the left side of the balloon.

(6) One more fold is completed from the right side of the balloon so that the left and right folds are lying straight, flat, and edge to edge.

(7) The final fold is made from the left side, this last fold being placed on top of the last fold on the right side. The inflation appendix of the balloon and the ballonet deflation appendix will now lie on top of the folded balloon. The deflation appendixes of the fins will lie flat on top of the valve aperture.

(8) The balloon inflation appendix is untied and the appendix is laid flat toward the tail on top of the folded balloon. The buckles of the inflation appendix cover are taped. The ballonet deflation appendix is unrolled and laid out.

(9) Fold the rudder like an accordion in approximately 3-foot folds so that it lies on top of the folded balloon with its deflation appendix lying on top of the fin-deflation appendixes over the valve aperture.

f. Rolling.—(1) If the balloon is to be packed in a valise (canvas bag), roll the balloon tightly from the nose, keeping the folds straight and edge to edge on the right side. Keep the roll tight and even. During rolling, tuck in the edges and loose fabric to prevent gas or air remaining in the roll. Press heavily on the roll to drive any remaining gas or air to tail and out through the inflation and deflation appendixes.

When the roll is within a few feet of the tail, lift the tail and wrap it tightly over the top of the roll.

(2) If the balloon is to be packed in a box, it need not be rolled as described above unless it is necessary to force out any remaining gas or air.

g. Packing in valise.—(1) Roll up half of the wrapper and place the roll under the balloon.

(2) Roll the balloon onto the wrapper. Avoid unrolling the balloon.

(3) Unroll wrapper, leaving the balloon in center.

(4) Tie opposite corners of the wrapper tightly in pairs diagonally over the top of the rolled balloon, using square knots.

(5) Fit the valise mouth downward over the wrapped balloon.

(6) Roll the bundle over until the valise mouth is uppermost.

(7) Shake the bundle down into the valise and lace up the valise.

h. Packing in box.—(1) The balloon is folded as described above, and if necessary is rolled to force out remaining gas or air. If rolled, the balloon is again unrolled on the ground cloths, but is not unfolded.

(2) The packing box is placed at the edge of the ground cloths on the down wind side of the bed.

(3) Crew members take positions at even intervals on either side of the balloon. Opposite members grasp hands underneath the balloon. They pick up the balloon. The balloon now lies on a cradle formed by the outstretched arms of the crew members.

(4) The balloon is carried to the box and lifted over the edge. It is then carefully folded, accordionlike, into the box, beginning with the tail. THE BALLOON IS NEVER DRAGGED ALONG THE GROUND CLOTHS OR OVER THE EDGE OF THE BOX.

SECTION III

MANEUVERING IN EMERGENCIES

107. EMERGENCY HAUL-DOWN.—*a.* When the winch is out of order, a maneuvering spider (fig. 25) may be used to haul

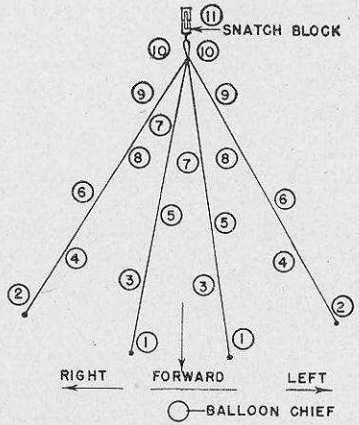


FIGURE 25.—Emergency maneuvering formation and equipment.

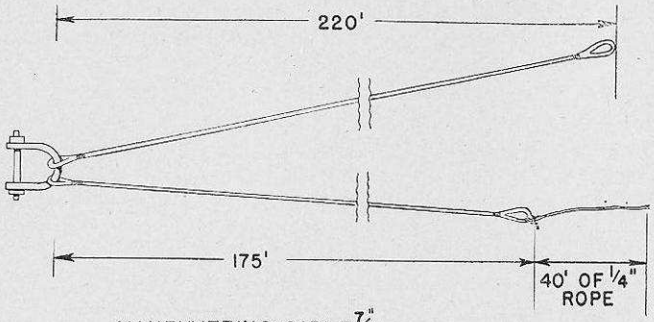


FIGURE 25.—Emergency maneuvering formation and equipment—Continued.

down the balloon. A maneuvering spider also may be used if the cable becomes entangled in surface obstructions. The balloon squad is inadequate to haul a balloon down with a maneuvering spider; therefore it will be necessary to obtain extra men from an adjacent site or some other source. Figure 25 shows the way the emergency crew will form.

b. When the crew is available, the procedure will be:

Balloon chief commands:

1. EMERGENCY CREW, 2. FALL IN.
COUNT OFF.

Balloon chief tells off:

Front rank, left side.
Rear rank, right side.
No. 1 front rank, side chief and inside spider leg.
No. 1 rear rank, side chief, rip cord, and inside spider leg.

Nos. 3, 5, and 7, both ranks, inside spider legs.
Nos. 2, 4, 6, 8, 9, and 10, both ranks, outside spider legs.
No. 11 front rank, winch operator and snatch-block.

Balloon chief commands:

1. LEFT, 2. FACE.
1. MAN THE SPIDER, 2. POSTS.

NOTE.—The balloon chief of the distressed site always will be in command; and Nos. 1 and No. 11 should be personnel of the squad from the distressed site.

Commands	*Carried out by—*	*Reported by—*
ATTACH SNATCH-BLOCK TO CABLE	No. 11	No. 11
TAKE TENSION ON SPIDER	All crewmen	
ATTACH SANDBAGS TO SPIDER	Nos. 10 and 11	No. 11
WALK THE SPIDER FORWARD (OR TO THE RIGHT OR LEFT)	All crewmen	
HOLD IT	All crewmen	
1. BY THE NUMBERS, 2. MAN THE HANDLING LINES	Nos. 2, 4, 6, 8, 9, 3, 5, 7, and 1	
SWITCH OFF RIP LINK	No. 1 F/R	No. 1 F/R
SANDBAGS ON CONCENTRATION FITTING	Nos. 10 and No. 11	
UNFASTEN RIP CORD	No. 1 R/R	No. 1 R/R
UNFASTEN CABLE AND LETHAL DEVICE	No. 1 F/R	No. 1 F/R

c. Procedure.—(1) The winch operator is responsible for obtaining the spider and snatch-block and placing the snatch-block on the cable. Other members of the crew are detailed to obtain sandbags to place on the grommets of the spider.

(2) The crew is formed and at the command, 1. MAN THE SPIDER, 2. POSTS, the crew members take positions at the arms of the spider as shown in figure 24. Nos. 10 and No. 11 hang a sufficient number of sandbags on the spider grommets to equalize the lift of the balloon.

(3) The command for hauling down the balloon is WALK THE SPIDER FORWARD. At the command HOLD IT, the crew halts and holds the spider in position.

(4) When the balloon has been lowered until the handling lines have touched the ground, the crew members are transferred to the handling lines by the command, 1. BY THE NUMBERS, 2. MAN THE HANDLING LINES, 2, 4, 6, 8, 9, 3, 5, 7, and 1. At this command, the crew members designated leave their posts at the spider and assume their posts at the handling lines. Nos. 2, 8, and 5 on the front handling lines, Nos. 4, 9, and 7 on the center handling lines, and Nos. 6 and 3 on the rear handling lines. Nos. 1 act as side chiefs. At the command SANDBAGS ON CONCENTRATION FITTING, Nos. 10 and No. 11 will transfer the sandbags from the spider to the concentration fitting. The cable and lethal device may then be detached from the concentration fitting and the balloon may be walked to the bed, the rip cord being carried by No. 1 R/R. The lethal device should be put in its box immediately after being removed from the concentration fitting.

■ 108. MANEUVERING OVER OBSTACLES.—*a.* When it is desired to transfer an inflated balloon from one site to another and there is a winch at each site and the transfer problem is not complicated, the transfer can be accomplished by using both winches and a double cable as shown in figure 26.

b. However, frequently the situation is more complicated than the one just described, and a different means of accomplishment is desirable. By means of maneuvering cables (fig. 25), maneuvering spider (fig. 25), sandbags, and snatch-block, these obstructions may be crossed. At best, this maneuvering entails risk and should not be attempted except in calm weather. *Any electric lines that are to be crossed should first be switched off.* The crew will consist of a balloon chief and 10 crewmen.

c. To remove the balloon from the bed with the maneuvering cables, snatch-block, and spider, the procedure will be:

Balloon chief commands:

1. BALLOON CREW, 2. FALL IN.
COUNT OFF.

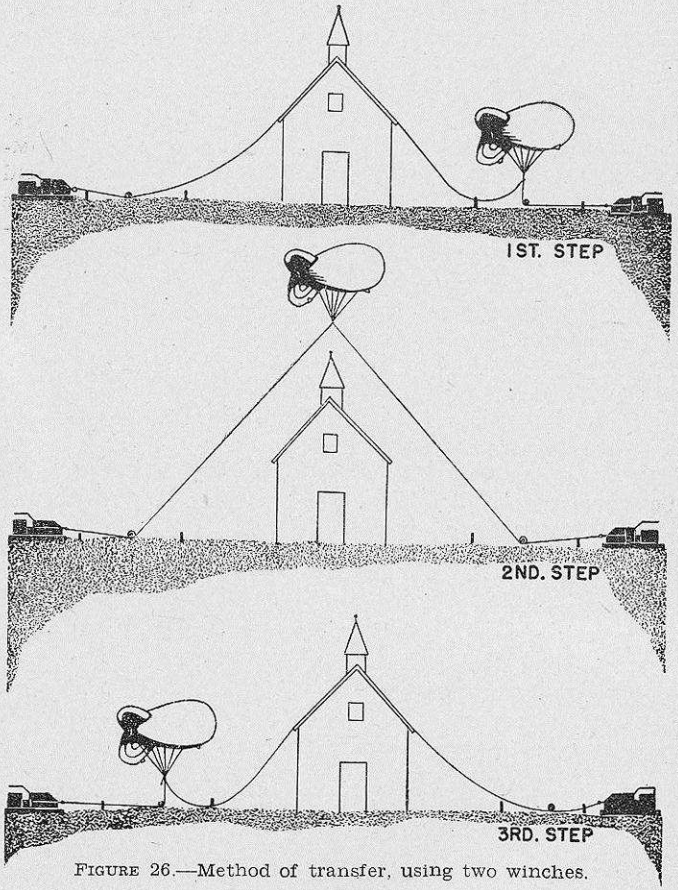


FIGURE 26.—Method of transfer, using two winches.

Balloon chief tells off:

No. 1 front rank, side chief, point of attachment, and inside leg of spider.
No. 1 rear rank, side chief, rip cord, and inside leg of spider.
Nos. 2 both ranks, tail line and inside legs of spider.
Nos. 3 both ranks, long leg and outside legs of spider.
Nos. 4 both ranks, short leg and outside legs of spider.

No. 5 front rank, truck driver.
No. 5 rear rank, assistant truck driver and maneuvering cables.

Commands	*Carried out by—*	*Reported by—*
1. LEFT, 2. FACE		
1. DETAILS, 2. POSTS		
REMOVE FLYING CABLE	Nos. 1	No. 1 F/R
ATTACH MANEUVERING CABLES	Nos. 1	No. 1 F/R
REEVE AND FASTEN LONG LEG TO TRUCK	Nos. 1 and 3	No. 3 F/R
MOVE TRUCK FORWARD SLOWLY	No. 5 F/R	
STOP TRUCK	No. 5 F/R	
TRANSFER RIP CORD	No. 1 R/R	
UNSHACKLE	No. 1 F/R	
UNTOGGLE TAIL LINE	Nos. 2	No. 2 F/R
BACK TRUCK	No. 5 F/R	
STOP TRUCK	No. 5 F/R	
FASTEN SHORT LEG TO TRUCK	Nos. 4	No. 4 F/R
BACK TRUCK	No. 5 F/R	
STOP TRUCK	No. 5 F/R	
UNFASTEN, UNREEVE, AND COIL LONG LEG	No. 1 F/R and Nos. 3	No. 3 F/R

d. To cross a wire, the procedure will be:

Balloon chief commands:	*Carried out by—*	*Reported by—*
FASTEN LONG LEG TO TRUCK	No. 5 R/R	No. 5 R/R
PLACE SNATCH-BLOCK ON LONG LEG	Nos. 1	No. 1 F/R
MAN THE SPIDER	Nos. 1, 2, 3, and 4	Nos. 1
TAKE TENSION ON SPIDER	Nos. 1, 2, 3, and 4	
ATTACH (NUMBER) SANDBAGS TO SPIDER	No. 5 R/R	No. 5 R/R

WALK SPIDER AWAY FROM TRUCK	Nos. 1, 2, 3, and 4	
HOLD IT	Nos. 1, 2, 3, and 4	
UNFASTEN SHORT LEG	No. 5 R/R	No. 5 R/R
PASS SHORT LEG OVER WIRE	No. 5 R/R	No. 5 R/R
MOVE TRUCK FORWARD	No. 5 F/R	
STOP TRUCK	No. 5 F/R	
FASTEN SHORT LEG TO TRUCK	No. 5 R/R	No. 5 R/R
WALK SPIDER TO TRUCK	Nos. 1, 2, 3, and 4	
REMOVE SNATCH-BLOCK FROM LONG LEG	Nos. 1	No. 1 F/R
UNFASTEN LONG LEG	No. 5 R/R	No. 5 R/R
PASS LONG LEG OVER WIRE	No. 5 R/R	No. 5 R/R

e. To put the balloon on another bed, the procedure will be:

Balloon chief commands:	*Carried out by—*	*Reported by—*
BACK TRUCK ONTO BED	No. 5 F/R	
STOP TRUCK	No. 5 F/R	
REEVE AND FASTEN LONG LEG TO TRUCK	No. 1 F/R and Nos. 3	No. 3 F/R
MOVE TRUCK FORWARD	No. 5 F/R	
STOP TRUCK	No. 5 F/R	
UNFASTEN SHORT LEG	Nos. 4	No. 4 F/R
MOVE TRUCK FORWARD	No. 5 F/R	
STOP TRUCK	No. 5 F/R	
TOGGLE AND HOLD TAIL LINE	Nos. 2	No. 2 F/R
SHACKLE ON	No. 1 F/R	No. 1 F/R
BACK UP TRUCK	No. 5 F/R	

STOP TRUCK	No. 5 F/R	
TRANSFER RIP CORD	No. 1 R/R	No. 1 R/R
TENSION AND TIE OFF TAIL LINE	Nos. 2	No. 2 F/R
REMOVE MANEUVERING CABLES	Nos. 1	No. 1 F/R
REEVE AND ATTACH FLYING CABLE	Nos. 1	No. 1 F/R

f. Procedure.—(1) To remove the balloon from the bed, transfer operations should begin with the balloon at tail-line mooring. The truck is placed in position and the transfer equipment, which consists of a maneuvering cable and shackles and ring (see fig. 25), is laid out in preparation for use. The maneuvering cable has two legs, one 220 feet long and the other 175 feet long, attached to a shackle with eye-splices. On the short leg is 40 feet of ¼-inch rope so that crew members can control that leg. The principle governing the use of the maneuvering cable is that with it the balloon can be flown from the apex of a right-angled triangle, the base and hypotenuse of which are formed by the long leg and the vertical side by the short leg. (See fig. 27.) With this equipment laid out, the balloon chief forms the crew and tells off. At the command 1. DETAILS, 2. POSTS, Nos. 1 take posts at the central anchorage, Nos. 2 at the tail line, Nos. 3 at the outer end of the long leg, Nos. 4 at the outer end of the short leg, No. 5 F/R as truck driver, and No. 5 R/R on the left side of truck cab, in position to relay commands to the truck driver. The flying cable is removed. The maneuvering cables are attached to the balloon and the long leg is reeved through the central snatch-block and fastened to the truck. The truck is moved forward to haul down the balloon and is stopped when the load is taken off the pyramid. The rip cord is transferred to the short leg. The balloon is prepared for ascension, and the truck is backed up, allowing the balloon to ascend. During the ascension, Nos. 2 will drop the tail-line mooring cable so as to allow the truck to back onto the bed. At that point where the short leg will reach the truck, the truck is stopped and the short leg is fastened, a second shackle being used for this purpose. The short leg having been secured, the truck is backed toward the central anchorage until the short leg carries the lift of the balloon.

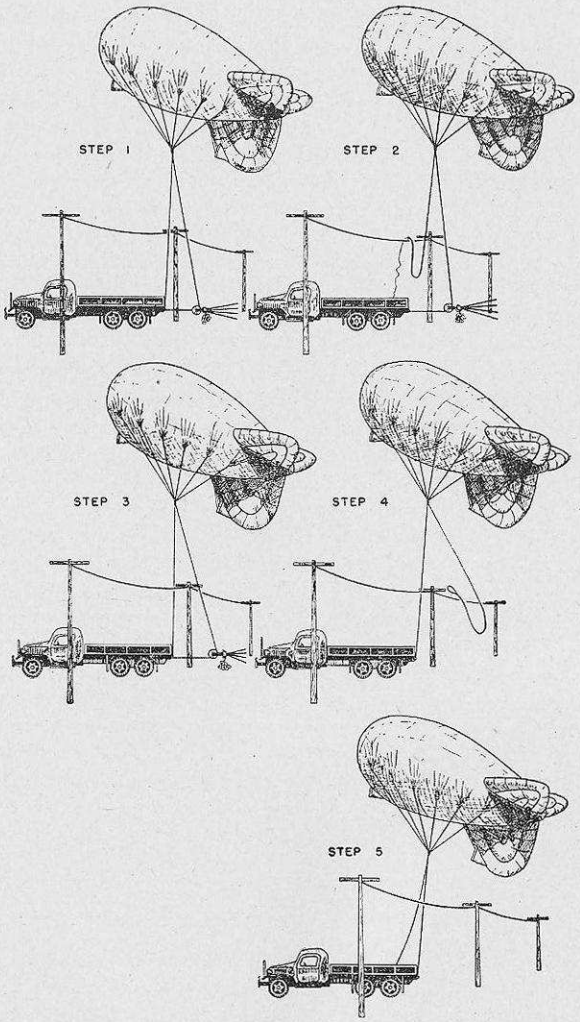


FIGURE 27.—Method of maneuvering over obstacles.

The long leg is then unfastened from the truck, removed from the central snatch-block, and coiled so as to prevent entanglement while en route to the new position. The spider and sandbags normally will have been stored on the truck during the preparation of transfer equipment.

(2) To cross a wire, the truck is stopped as the maneuvering cable approaches the obstruction. The long leg is uncoiled and fastened to the truck. The spider is placed on the long leg and sandbag ballast is added to the spider until the lift of the balloon is counteracted. The spider is walked away from the truck until the short leg can be unfastened. The spider is then held in position. The short leg is unfastened and passed over the wire. The truck is moved forward beyond the obstructing wire and the short leg is refastened. Walking the spider toward the truck will permit the short leg again to take the lift of the balloon. The spider then may be removed from the long leg, and the long leg unfastened from the truck and passed over the wire. The unit then can proceed along the route.

(3) To put the balloon on another bed, Nos. 2 will drop the tail-line mooring-circle cable. The truck will be backed onto the bed and stopped in position so that the long leg may be reeved through the central-anchorage snatch-block and fastened to the truck. The long leg is reeved and fastened. The truck is moved forward and stopped when the long leg has taken the lift of the balloon. The short leg is unfastened from the truck and the truck is again moved forward, hauling the balloon down to the central anchorage. The pyramid is shackled on, and the truck is then backed up, allowing the balloon to be moored at tail-line mooring. When the balloon is at tail-line mooring, the maneuvering cables are removed and the flying cable attached.

Section IV

OPERATING AT MOBILE SITES

109. General.—Defense of airports and certain other installations demands special procedure, consisting of moving the balloon quickly to its site, which might be in the center of an airport runway, and then removing the balloon after the alert has ended. This type of flying, usually achieved

directly from the lead-off gear of a truck-mounted winch, has proved successful.

110. Equipment and Drills.—*a.* Equipment necessary for a mobile site consists of all items necessary for an ordinary site plus a truck-mounted winch.

b. No special drills have been worked out for mobile sites.

111. Procedure.—Detailed procedure must be developed to fit the tactical situation, which will vary. However, the normal circumstances will be—

a. To construct a bed immediately off the airport, but quickly accessible to the landing field.

b. When an alert occurs and the balloon is ordered flown from the landing field runway, to attach the balloon to the mobile winch, flying the balloon as close to the truck as possible, and drive the truck to the runway. Then the balloon can be flown at Operational Height from the winch lead-off gear. The truck will have to carry ballast sufficient to offset the lack of deadmen.

Section V

DRILL TABLES

112. General.—The following drill tables are included in this manual:

Table No.	*Title*
I.	Drill to inflate balloon.
II.	Mechanical drill for flying from bedded-down position.
III.	Mechanical drill for bedding down from flying.
IV.	Manual drill for flying from bedded-down position.
V.	Manual drill for bedding down from flying.
VI.	Drill to fly from tail-line mooring.
VII.	Drill to moor at tail-line mooring.
VIII.	Drill to fly from mooring-circle close-haul.
IX.	Drill to moor at mooring-circle close-haul.
X.	Drill to turn balloon on cradle bed.
XI.	Drill to deflate balloon.
XII.	Drill to fly from midship mooring.
XIII.	Drill to moor at midship mooring.

113. TABLE I—DRILL TO INFLATE BALLOON.—Balloon chief and ten crewmen.

Details	UNPACK THE BALLOON	LAY THE BALLOON ON THE BED	SPREAD THE BALLOON	UNWRAP RIGGING
Balloon chief.	Gives command.	Gives command.	Gives command.	Gives command.
Nos. 1	Grasp fabric and lift balloon from box, working from opposite sides (see note 1).	Place the balloon on the bed with nose headed into the wind.	Spread out fins, rudder, and folded fabric so that balloon lies flat on the bed with ballonet next to the ground.	Supervise operations on respective sides.
Nos. 2	Grasp fabric 10 feet behind Nos. 1 and lift it from box, working from opposite sides.	Place the balloon on the bed with nose headed into the wind.	Assist Nos. 1.	Unwrap all packing and parceling from metal parts on respective sides.

RIG THE BALLOON	PREPARE FOR INFLATION	COMMENCE INFLATION	CEASE INFLATION
Gives command. Checks adjustment of valve-line buckle; ties off valve-line access sleeve; and with assistance of No. 1 R/R installs gas valve.	Gives command. Checks over balloon to see that it is properly rigged.	Gives command. Supervises inflation. Checks gas-valve during inflation and inspects ballonet diaphragm as inflation nears completion.	Gives command when sufficient gas has been injected into balloon. Removes nose line.
No. 1 F/R buckles ballonet air scoop; ties off topping-up sleeve; checks manometer connection; ties off ballonet deflation appendix; and ties off rudder and fin deflation appendixes. No. 1 R/R attaches rip cord to rip panel and ties free end to a point on bed; attaches tail line; adjusts rudder restraining cord; and assists balloon chief with gas valve.	Inspect respective sides to insure that they are properly prepared for inflation.	Supervise adjustment of mooring slips and attachment of upper cradle slips and rigging-line sandbags on respective sides.	Unpack, unroll, and shackle foot ropes to triangular plate of junction assembly and connect upper link (see note 2) and flying cable.
Measure and mark handling lines; attach handling and mooring lines to handling patches; attach grommets to cut-splices in handling and mooring lines; attach grommets to rigging lines and bedding strops to rigging patches; and attach moor-	No duties.	Adjust mooring slips as inflation progresses, working from tail to nose. Attach tensioning slips when final adjustment is made to each mooring slip.	Complete adjustment of mooring and tensioning slips on respective sides to proper angle for bedding down.

Details	UNPACK THE BALLOON	LAY THE BALLOON ON THE BED	SPREAD THE BALLOON	UNWRAP RIGGING
Nos. 3...	Grasp fabric 10 feet behind Nos. 2 and lift it from box, working from opposite sides.	Place the balloon on the bed with nose headed into the wind.	Assist Nos. 1.	Unwrap all packing and parceling from metal parts on respective sides.
No. 4 F/R (gas worker).	Grasps fabric 10 feet behind No. 3 F/R and lifts it from box.	Assists in placing the balloon on the bed with nose headed into the wind.	Assists Nos. 1.	Unpacks gas valve with assistance of No. 4 R/R.
No. 4 R/R (gas party).	Grasps fabric 10 feet behind No. 3 R/R and lifts it from box.	Assists in placing the balloon on the bed with nose headed into the wind.	Assists No. 1.	Assists No. 4 F/R.

RIG THE BALLOON	PREPARE FOR INFLATION	COMMENCE INFLATION	CEASE INFLATION
ing slips to handling and mooring lines.			
Measure and mark handling lines; attach handling and mooring lines to handling patches; attach running nose line; attach grommets to cut-splices in handling and mooring lines; attach grommets to rigging lines and bedding strops to rigging patches; and attach mooring slips to handling and mooring lines.	No duties.	Attach upper cradle slips and rigging-line sandbags on respective sides as inflation progresses, working from tail to nose.	Adjust upper cradle slips and rigging-line sandbags on respective sides so that they assume proper position for bedding down.
Lays out and inspects gas equipment.	Assisted by No. 5 and No. 4 R/R, removes caps from cylinders; connects inflation tube to manifold and grounds manifold; rolls out inflation tube and connects it to inflation appendix. Reports when preparation completed.	Assisted by No. 4 R/R, opens valves on cylinders attached to inflation manifold hoses, marks them MT, and, as cylinders empty, closes them and substitutes full cylinders successively.	Closes all cylinder valves; disconnects inflation manifold hoses and inflation tube from manifold; replaces caps on all cylinders; assisted by No. 4 R/R cleans and replaces all gas equipment.
Assists No. 4 F/R.	Assists No. 4 F/R and Nos. 5 to prepare for inflation.	Assists No. 4 F/R operate gas cylinders during inflation.	Disconnects inflation tube from inflation appendix and rolls it up and away from balloon.

Details	UNPACK THE BALLOON	LAY THE BALLOON ON THE BED	SPREAD THE BALLOON	UNWRAP RIGGING
Nos. 5 (gas party).	Grasp fabric 10 feet behind Nos. 4 and lift it from box.	Place the balloon on the bed with nose headed into the wind.	Assist Nos. 1.	Unwrap all packing and parceling from metal parts on respective sides.

RIG THE BALLOON	PREPARE FOR INFLATION	COMMENCE INFLATION	CEASE INFLATION
			Assists No. 4 F/R to clean and replace gas equipment.
Furl fins.	Assist Nos. 4 prepare for inflation.	No. 5 F/R holds up inflation tube at balloon to prevent choking. No. 5 R/R holds valve in vertical position until out of reach.	When inflation tube is disconnected, tie off inflation appendix, and secure cover over the appendix.

NOTES

1. If balloon is packed in a valise, it is removed from around the balloon, which is rolled onto the bed.
2. The upper parachute is attached the first time the balloon is at point of attachment.

■ 114. TABLE II.—MECHANICAL DRILL FOR FLYING FROM BEDDED-DOWN POSITION.—Balloon chief and ten crewmen.

Details	DETAILS, POSTS	START UP WINCH	HAUL IN ON GIPSY-HEAD	STOP HAULING	PAY OUT GIPSY-HEAD	FLY THE BALLOON
Balloon chief.	Gives command; takes post near nose of balloon.	Gives command. Also commands: REMOVE SLIPS FROM HANDLING LINES; MAN THE SPIDER.	Gives command. Also commands: WATCH BLOCKS.	Gives command. Also commands: UNFURL RUDDER AND FINS, REMOVE CRADLE SLIPS AND RIGGING-LINE SAND-BAGS, REMOVE SLIPS FROM MOORING LINES; MAN CENTRAL SNATCH-BLOCK, SPIDER AND RUDDER; UNFASTEN RIP CORD.	Gives command. Also commands: WATCH BLOCKS; FASTEN RIP CORD; SWITCH ON RIP LINK; UNTIE AND UNREEVE HANDLING LINES; DISENGAGE GIPSY-HEAD, ENGAGE WINCH (see note 1).	Gives command designating height balloon is to fly (see note 2). Also commands: ATTACH LOWER LETHAL DEVICE. After attachment, commands: FLY THE BALLOON, designating height (see note 3).
Nos. 1	No. 1 F/R takes post at central anchorage. No 1 R/R takes post at rip cord.	Supervise operations on respective sides; report upon completion of commands.	Supervise operations on respective sides; assist where needed.	Remove slips from mooring lines. No. 1 F/R mans central snatch-block; No. 1 R/R unfastens rip cord and carries free end; both report upon completion of commands.	No. 1 R/R fastens rip cord. No. 1 F/R switches on rip link. Both report completion of commands.	Supervise operation on respective sides. Attach lower link and parachute. No. 1 F/R reports.
Nos. 2	Take posts at front handling lines.	Remove slips from front handling lines. No. 2 R/R mans the spider.	No. 2 F/R watches blocks. No. 2 R/R holds spider clear of obstructions.	Remove cradle slips and rigging-line sandbags. No. 2 R/R mans spider.	No. 2 R/R holds spider clear of obstructions. Both untie, unreeve, and man front handling lines.	Walk in with handling lines as balloon ascends.
Nos. 3	Take posts at center handling lines.	Remove slips from center handling lines.	Watch blocks.	Remove cradle slips and rigging-line sandbags.	Watch blocks; untie, unreeve, and man center handling lines.	Walk in with handling lines as balloon ascends.
Nos. 4	Take posts at rear handling lines.	Remove slips from rear handling lines.	Watch blocks.	Unfurl rudder and fins.	Watch blocks; untie, unreeve, and man rear handling lines.	Walk in with handling lines as balloon ascends.

Details	DETAILS, POSTS	START UP WINCH	HAUL IN ON GIPSY-HEAD	STOP HAULING	PAY OUT GIPSY-HEAD	FLY THE BALOON
No. 5 F/R (winch operator).	Takes post at winch.	Starts winch; reports when engine is running.	Hauls in on gipsy-head as directed.	Stops hauling.	Disengages gipsy-head, engages winch, and reports. Pays out gipsy-head until balloon takes tension on flying cable.	Pays out as directed, watching ascent of balloon.
No. 5 R/R (gas worker).	Takes post at gipsy-head.	Checks hauling line to see that it is in order.	Sees that hauling line reeves on gipsy-head properly.	Maintains tension on hauling line.	Pays out hauling line from gipsy-head.	Goes to storage drum and keeps watch on cable as it pays out.

NOTES

1. At this point the balloon is flying at point of attachment.
2. From bedded-down position, balloon can be moored at tail-line mooring or mooring-circle close-haul by giving the appropriate commands instead of the command FLY THE BALLOON.
3. Members of the crew without further duties may be dismissed when the balloon starts ascending.

■ 115. TABLE III—MECHANICAL DRILL FOR BEDDI NG DOWN FROM FLYING.—Balloon chief and ten crewmen.

Details	HAUL DOWN BALLOON	HAUL DOWN BALLOON	STOP WINCH	HAUL IN ON GIPSY-HEAD	STOP HAULING	PAY OUT GIPSY-HEAD
Balloon chief.	Gives command. When lower lethal device is at central-anchorage snatch-block, commands: STOP WINCH; REMOVE LOWER LINK AND PARACHUTE.	Gives command when the lower lethal device is removed. Also commands: BALLOON CREW, FALL IN. Tells off crew to their duties, and commands: DETAILS, POST.	Gives command. Also commands: SWITCH OFF RIP LINK; REEVE AND TIE HANDLING LINES; DISENGAGE WINCH, ENGAGE GIPSY-HEAD; MAN CENTRAL SNATCH-BLOCK, SPIDER, AND RUDDER; UNFASTEN RIP CORD.	Gives command. Also commands: WATCH BLOCKS.	Gives command. Also commands: FASTEN RIP CORD; ATTACH SLIPS TO MOORING LINES; ATTACH CRADLE SLIPS AND RIGGING-LINE SANDBAGS; ATTACH SLIPS TO HANDLING LINES.	Gives command. Also commands: OVERHAUL SPIDER; TENSION HANDLING-LINE SLIPS; FURL RUDDER AND FINS.

Details	HAUL DOWN BALLOON	HAUL DOWN BALLOON	STOP WINCH	HAUL IN ON GIPSY-HEAD	STOP HAULING	PAY OUT GIPSY-HEAD
Nos. 1	Remove lower lethal device and parachute. No. 1 F/R reports completion of command.	No. 1 F/R takes post at point of attachment. No. 1 R/R takes post so as to be at rip cord. Both see that crewmen take proper posts.	No. 1 F/R switches off rip link and mans central snatch-block. No. 1 R/R unfastens rip cord. Both report completion of commands.	Supervise operations on respective sides. No. 1 F/R mans central snatch-block. No. 1 R/R continues to carry free end of rip cord.	No. 1 R/R fastens rip cord to point on bed. Both attach slips to mooring lines; report on completion of commands.	Supervise tensioning of slips and furling of rudder and fins.
Nos. 2	No duties.	Take posts so as to be at front handling lines.	Reeve and tie front handling lines to spider. No. 2 R/R mans spider.	No. 2 R/R mans spider and holds it clear of obstructions.	Attach cradle slips and rigging-line sandbags; attach slips to front handling lines.	Tension front handling-line slips. Assist with furling of rudder and fins. No. 2 R/R overhauls spider.
Nos. 3	No duties.	Take posts so as to be at center handling lines.	Reeve and tie center handling lines to spider.	Watch blocks.	Attach cradle slips and rigging-line sandbags; attach slips to center handling lines.	Tension center handling-line slips. Assist with furling of rudder and fins.
Nos. 4	No duties.	Take posts so as to be at rear handling lines.	Reeve and tie rear handling lines to spider.	Man rudder to deflate it when balloon descends.	Keep rudder clear of ground and pull it to one side; attach slips to rear handling lines.	Tension rear handling-line slips; furl and tie off rudder and fins.
No. 5 F/R (winch operator).	Starts winch engine and hauls down balloon, observing descent. Stops winch.	Hauls down balloon as directed, observing descent.	Stops winch. Disengages winch, enages gipsy-head, and reports.	Hauls in on gypsy-head as directed.	Stops hauling.	Pays out gipsy-head; stops winch engine.
No. 5 R/R (gipsy-head).	Takes post at winch and storage drum as cable is reeled in.	Watches storage drum as cable is reeled in.	Checks hauling line to spider and takes up slack on gipsy-head.	Sees that hauling line reeves properly on gipsy-head.	Maintains tension on hauling line.	No duties.

116. Table IV—Manual Drill for Flying From Bedded-Down Position.—Balloon chief and ten crewmen.

Details	DETAILS, POSTS	START UP WINCH	HAUL IN ON TACKLE	STOP HAULING
Balloon chief.	Gives command; takes post near nose of balloon.	Gives command. Also commands: REMOVE SLIPS FROM HANDLING LINES; MAN THE TACKLE.	Gives command and supervises execution.	Gives command. Also commands: TIE OFF; UNFURL RUDDER AND FINS; REMOVE CRADLE SLIPS AND RIGGING-LINE SANDBAGS; REMOVE SLIPS FROM MOORING LINES; UNFASTEN RIP CORD.
Nos. 1	No. 1 F/R takes post at point of attachment. No. 1 R/R takes post at rip cord.	Supervise operations on their respective sides; report upon completion of commands.	Watch blocks to see that they do not foul.	Supervise operations on their respective sides; remove slips from mooring lines. No. 1 R/R unfastens rip cord. Both report completion of duties.
Nos. 2	Take posts at front handling lines.	Remove slips from front handling lines; man the tackle.	Haul in on tackle.	Stop hauling; grasp returns of hauling tackle; remove cradle slips and rigging-line sandbags.

Down Position.—Balloon chief and ten crewmen.

MAN THE TACKLE	EASE OFF TACKLE	HAUL IN ON WINCH	STOP WINCH	FLY THE BALLOON
Gives command. Also commands: UNTIE TACKLE; MAN THE CENTRAL SNATCH-BLOCK.	Gives command.	Gives command.	Gives command. Also commands: FASTEN RIP CORD; SWITCH ON RIP LINK; UNTIE AND UNREEVE HANDLING LINES.	Gives command designating height balloon is to fly. Also commands: ATTACH LOWER DEVICE. After attachment, commands: FLY THE BALLOON, designating height.
No. 1 R/R continues to carry rip cord. No. 1 F/R mans the central snatch-block.	No. 1 R/R continues to carry rip cord.	No. 1 R/R continues to carry rip cord. No. 1 F/R mans central snatch-block to prevent fouling.	No. 1 R/R fastens rip cord to flying cable. No. 1 F/R switches on rip link. Both report completion of commands.	Supervise operations on respective sides. Attach lower link and parachute. No. 1 F/R reports.
Man the tackle.	Ease off on tackle.	Take post at front handling lines.	Untie, unreeve, and man front handling lines.	Walk in with front handling lines as balloon ascends.

Details	DETAILS, POSTS	START UP WINCH	HAUL IN ON TACKLE	STOP HAULING
Nos. 3	Take posts at at center handling lines; man the tackle.	Remove slips from center handling lines; man the tackle.	Haul in on tackle.	Stop hauling; remove cradle slips and rigging-line sandbags.
Nos. 4	Take posts at rear handling lines.	Remove slips from rear handling lines; man the tackle.	Haul in on tackle.	Stop hauling; unfurl rudder and fins.
No. 5 F/R (winch operator).	Takes post at winch.	Starts winch engine; reports when engine is running.	Keeps winch engine running.	Keeps winch engine running.
No. 5 R/R (spider and tackle).	Takes post at hauling tackle.	Insures that tackle is in order. Reports.	Holds spider clear of obstructions.	Ties off tackle; reports when tied off.

MAN THE TACKLE	EASE OFF TACKLE	HAUL IN ON WINCH	STOP WINCH	FLY THE BALLOON
Man the tackle.	Ease off on tackle.	Take posts at center handling lines.	Untie, unreeve, and man center handling lines.	Walk in with center handling lines as balloon ascends.
Man the tackle.	Ease off on tackle.	Take posts at rear handling lines.	Untie, unreeve, and man rear handling lines.	Walk in with rear handling lines as balloon ascends.
Keeps winch engine running.	Keeps winch engine running.	Hauls in on winch.	Stops winch.	Pays out as directed, watching ascent of balloon.
Unties hauling tackle; reports when untied.	Mans spider and holds it clear of obstructions.	No duties.	Mans spider and pulls it away when handling lines are untied.	Goes to storage drum and keeps watch on cable as it pays out.

■ 117. TABLE V.—MANUAL DRILL FOR BEDDING DOWN FROM FLYING.—Balloon chief and ten crewmen.

Details	HAUL DOWN BALLOON	HAUL DOWN BALLOON	STOP WINCH
Balloon chief.	Gives command. When lower lethal devcice is at central-anchorage snatch-block commands: STOP WINCH; REMOVE LOWER LINK AND PARACHUTE.	Gives command when lower lethal device is removed. Also commands: BALLOON CREW, FALL IN. Tells off the crew to their duties and commands: DETAILS, POSTS.	Gives command. Also commands: SWITCH OFF RIP LINK; REEVE AND TIE HANDLING LINES; MAN THE CENTRAL SNATCH-BLOCK AND RUDDER; UNFASTEN RIP CORD; MAN THE TACKLE.
Nos. 1	Remove lower lethal device and parachute. No. 1 F/R reports completion of command.	No. 1 F/R takes post at point of attachment. No. 1 R/R takes post so as to be at rip cord. Both see that crewmen take proper pos s.	No. 1 F/R switches off rip link and mans central snatch-block. No. 1 R/R unfastens rip cord. Both report completion of commands.
Nos. 2	No duties.	Take posts so as to be at front handling lines.	Reeve and tie front handling lines to spider; man the tackle.

PAY OUT WINCH	STOP WINCH	HAUL IN ON TACKLE	STOP HAULING	UNTIE
Gives command.	Gives command.	Gives command. Also commands: WATCH BLOCKS.	Gives command. Also commands: TIE OFF; FASTEN RIP CORD; ATTACH SLIPS TO MOORING LINES; ATTACH CRADLE SLIPS AND RIGGING-LINE SANDBAGS; ATTACH SLIPS TO HANDLING LINES.	Gives command. Also commands: OVERHAUL SPIDER; TENSION HANDLING-LINE SLIPS; FURL RUDDER AND FINS.
No. 1 F/R mans central snatch-block. No. 1 R/R carries free end of rip cord.	No. 1 F/R mans central snatch-block. No. 1 R/R carries free end of rip cord.	No. 1 F/R mans central snatch-block. No. 1 R/R carries free end of rip cord. Both supervise operations on respective sides.	Supervise operations on respective sides. No. 1 R/R fastens rip cord to point on bed. Both attach slips to mooring lines; report completion of commands.	Supervise tensioning slips and furling of rudder and fins.
Continue to man tackle.	Continue to man tackle.	Haul in as directed.	Stop hauling; grasp returns of hauling tackle; attach cradle slips and rigging-line sandbags; attach slips to front handling lines.	Grasp returns of hauling tackle; tension front handling-line slips.

Details	HAUL DOWN BALLOON	HAUL DOWN BALLOON	STOP WINCH
Nos. 3	No duties.	Take posts so as to be at center handling lines.	Reeve and tie center handling lines to spider; man the tackle.
Nos. 4	No duties.	Take posts so as to be at rear handling lines.	Reeve and tie handling lines to spider; man the rudder.
No. 5 F/R (winch operator).	Starts winch engine and hauls down balloon, observing descent; stops winch.	Hauls down balloon as directed, observing descent.	Stops winch.
No. 5 R/R (spider and tackle).	Takes post at winch; watches storage drum as cable is reeled in.	Watches storage drum as cable is reeled in.	Mans the tackle.

PAY OUT WINCH	STOP WINCH	HAUL IN ON TACKLE	STOP HAULING	UNTIE
Continue to man tackle.	Continue to man tackle.	Haul in as directed.	Stop hauling; attach cradle slips and rigging-line sandbags; attach slips to center handling lines.	Ease off on tackle as spider is overhauled; tension center handling lines.
Man the rudder.	Man the rudder.	Keep rudder clear of ground and pull it to one side while deflating it.	Attach slips to rear handling lines.	Tension rear handling-line slips. Furl and tie off rudder and fins.
Pays out winch.	Stops winch.	No duties.	No duties.	Stops winch engine.
Sees that tackle and spider are in order.	Mans the spider.	Holds spider clear of obstructions.	Stops hauling; ties off tackle; reports when tied off.	Unties tackle; reports on completion; overhauls spider.

■ 118. TABLE VI—DRILL TO FLY FROM TAIL-LINE MOORING.—Balloon chief and five crewmen.

Details	DETAILS, POSTS	START UP WINCH	HAUL IN ON WINCH	STOP WINCH	FLY THE BALLOON
Balloon chief.	Gives command.	Gives command.	Gives command.	Gives command. Also commands: TRANSFER RIP CORD; SWITCH ON RIP LINK; UNSHACKLE; UNTOGGLE TAIL LINE	Gives command, designating the height the balloon is to fly. Also commands: ATTACH LOWER LETHAL DEVICE (see note). After attachment, commands: FLY THE BALLOON, designating height.
Nos. 1	No. 1 F/R takes post at point of attachment. No. 1 R/R takes post at rip cord.	See that crew have taken proper posts.	No duties.	No. 1 R/R unfastens rip cord from rip-cord strop and fastens it to cable. No. 1 F/R switches on rip link; unshackles junction strop from pyramid; and releases line attaching handling-line bag to junction assembly. Both report completion of commands.	Supervise operations on respective sides. Attach lower lethal device and parachute. No. 1 F/R reports.
Nos. 2	Take posts at tail line.	No duties.	No duties.	Untoggle tail line and man it. No. 2 F/R reports completion of command.	Walk in with tail line and release it as balloon ascends.
No. 3 (winch operator).	Takes post at winch.	Starts winch engine; reports when engine running.	Hauls in as directed.	Stops hauling in as directed.	Pays out cable as directed, watching ascent of balloon.

NOTE.—Before paying out the flying cable, the bal loon chief details one man to watch the storage drum.

510518°—43——9

■ 119. TABLE VII—DRILL TO MOOR AT TAIL-LINE MOORING.—Balloon chief and five crewmen.

Details	HAUL DOWN BALLOON	HAUL DOWN BALLOON	STOP WINCH	PAY OUT WINCH
Balloon chief.	Gives command. When the lower lethal device is at central-anchorage snatch-block, commands: STOP WINCH; REMOVE LOWER LINK AND PARACHUTE.	Gives command when lower lethal device is removed. Also commands: BALLOON CREW, FALL IN. Tells off the crew to their duties and commands: DETAILS, POSTS.	Gives command. Also commands: TOGGLE AND HOLD TAIL LINE; SWITCH OFF RIP LINK; SHACKLE ON.	Gives command. Also commands: TRANSFER RIP CORD; TENSION AND TIE OFF TAIL LINE.
Nos. 1	Remove lower lethal device and parachute. No. 1 F/R reports completion of command.	No. 1 F/R takes post at point of attachment. No. 1 R/R takes post so as to be at rip cord. Both see that crewmen take proper posts.	No. 1 F/R switches off rip link; shackles junction strop to pyramid. Reports completion.	No. 1 F/R attaches handling-line bag to junction assembly. No. 1 R/R unfastens rip cord from flying cable and fastens it to rip-cord strop. No. 1 R/R reports completion of command.
Nos. 2	No duties.	Take posts so as to be at tail line.	Put toggle in tail line and hold tail line fast. No. 2 F/R reports.	Take tension and tie off tail line. No. 2 F/R reports.
No. 3 (winch operator).	Starts winch engine and hauls down balloon, observing descent. Stops winch.	Hauls down balloon as directed, observing descent.	Stops winch.	Pays out cable until tension is taken off flying cable; stops winch engine.

126

■ 120. TABLE VIII—DRILL TO FLY FROM MOORING-CIRCLE CLOSE-HAUL.—Balloon chief and seven crewmen.

Details	DETAILS, POSTS	START UP WINCH	HAUL IN ON WINCH	STOP WINCH	FLY THE BALLOON
Balloon chief.	Gives command.	Gives command.	Gives command.	Gives command. Also commands: SLACK OFF TENSIONING SLIP; UNFASTEN AND MAN REAR HANDLING LINES; TRANSFER RIP CORD; SWITCH ON RIP LINK; UNSHACKLE; UNFASTEN AND MAN FRONT HANDLING LINES.	Gives command designating height balloon is to fly. Also commands: ATTACH LOWER LETHAL DEVICE. After attachment, commands: FLY THE BALLOON, designating height.
Nos. 1	No. 1 F/R takes post at point of attachment. No. 1 R/R takes post at rip cord.	See that crewmen have taken proper posts.	No duties.	No. 1 R/R slacks off tensioning slip; unfastens and fastens rip cord. No. 1 F/R switches on rip link; unshackles junction strop from safety strop. Both report completion of commands.	Supervise operations on respective sides. Attach lower link and parachute. No. 1 F/R reports.

127

Details	DETAILS, POSTS	START UP WINCH	HAUL IN ON WINCH	STOP WINCH	FLY THE BALLOON
Nos. 2	Take posts at front handling lines.	No duties.	No duties.	Unfasten and man front handling lines. Report completion of command.	Walk in with front handling lines as balloon ascends.
Nos. 3	Take posts at transverse strop and rear handling lines.	No duties.	No duties.	Unfasten and man rear handling lines. Report completion of command.	Walk in with rear handling lines as balloon ascends.
No. 4 F/R (winch operator).	Takes post at winch.	Starts winch engine; reports when engine is running.	Hauls in as directed.	Stops hauling.	Pays out cable as directed, watching ascent of balloon.

121. TABLE IX—DRILL TO MOOR AT MOORING-CIRCLE CLOSE-HAUL.—Balloon chief and seven crewmen.

Details	HAUL DOWN BALLOON	HAUL DOWN BALLOON	STOP WINCH	PAY OUT WINCH
Balloon chief.	Gives command. When the lower lethal device is at central - anchorage snatch - block, commands: STOP WINCH; REMOVE LOWER LINK AND PARACHUTE.	Gives command when the lower lethal device is removed. Also commands: BALLOON CREW, FALL IN. Tells off crew to their duties and commands: DETAILS, POSTS.	Gives command. Also commands: REEVE AND TIE REAR HANDLING LINES; SWITCH OFF RIP LINK; SHACKLE ON.	Gives command. Also commands: TRANSFER RIP CORD; TENSION RUNNING SLIP; FASTEN SANDBAGS AND SNUBBERS TO FRONT HANDLING LINES.
Nos. 1	Remove lower link and parachute. No. 1 F/R reports completion of command.	No. 1 F/R takes post at point of attachment. No. 1 R/R takes post so as to be at rip cord. Both see that crewmen take proper posts.	No. 1 F/R switches off rip link; shackles junction strop. Reports completion. Both assist Nos. 3 to reeve and tie rear handling lines to transverse strop. Both report completion.	No. 1 R/R takes tension on running slip as directed; unfastens rip cord from flying cable and fastens it to the rip cord strop. Reports completion.
Nos. 2	No duties.	Take posts so as to be at front handling lines.	Man front handling lines to help steady balloon.	Fasten sandbags and snubbers to front handling lines. Report completion of command.
Nos. 3	No duties.	Take posts so as to be at rear handling lines.	Man rear handling lines to help steady the balloon; reeve and tie rear handling lines to transverse strop.	Assist Nos. 2 to fasten sandbags and snubbers to front handling lines.
No. 4 F/R (winch operator).	Starts winch engine and hauls down ballon, observing descent. Stops winch.	Hauls down ballon as directed, observing descent.	Stops winch.	Pays out cable until tension is taken off flying cable; stops winch engine.

122. TABLE X—DRILL TO TURN BALLOON ON CRADLE BED.—Balloon chief and eight crewmen.

Details	DETAILS, POSTS	MOVE FIRST PICKET	BED DOWN
Balloon chief.	Gives command. Also commands: UNTIE, UNREEVE, AND COIL HANDLING LINES; TRANSFER LOWER CRADLE SLIPS AND FOOT ROPES.	Gives command. Also commands: MOVE SECOND PICKET; MOVE THIRD PICKET; MOVE FOURTH PICKET; MOVE FIFTH PICKET. Supervises operation of turning.	Gives command. Also commands: TRANSFER RIP CORD; REPLACE LOWER CRADLE SLIPS AND FOOT ROPES; PASS UPPER CRADLE SLIPS UNDER FLYING CABLE; ADJUST MOORING SLIPS; MOVE TACKLE; REEVE AND TIE HANDLING LINES.
Nos. 1	Take posts at cradle slips and foot ropes on leeward side of balloon; transfer lower cradle slips and foot ropes on leeward side; when transfer completed, move to windward side and transfer lower cradle slips and foot ropes. Take posts on respective sides; report completion.	Assisted by Nos. 2, move cradle legs, ballast, and rigging-line sandbags on respective sides in the direction balloon is being turned. This movement progresses with picket movement.	No. 1 R/R transfers rip cord to a more suitable point on the bed. Assisted by Nos. 2 on respective sides, both replace lower cradle slips and foot ropes. No. 1 on flying-cable side passes upper cradle slips under flying cable. Report completion of duties.
Nos. 2	Take posts at cradle slips and foot ropes on leeward side of balloon; transfer lower cradle slips and foot ropes on leeward side; when transfer completed, move to windward side and transfer lower cradle slips and foot ropes. Take posts on respective sides.	Assist Nos. 1 to move cradle legs, ballast, and rigging-line sandbags on respective sides in the direction balloon is being turned. This movement progresses with picket movement.	Nos. 2 assist Nos. 1 on respective sides to replace lower cradle slips and foot ropes. No. 2 on flying cable side assists No. 1 to pass upper cradle slips under flying cable. Both move hauling tackle to proper position.
Nos. 3	Take posts at spider; untie rear, center, and front lines on respective sides; unreeve and coil front handling lines on respective sides.	No. 3 on windward side, assisted by No. 4, moves rear mooring slip one point on mooring circle in direction balloon is to be turned; moves other slips, working toward nose, as ordered, until all on windward side have been moved one point. No. 3 on leeward side, assisted by No. 4, moves front mooring slip one point on mooring circle in direction balloon is to be turned; moves other slips, working toward tail, as ordered until all on leeward side have been moved one point.	Adjust mooring slips on respective sides; reeve and tie front handling lines to spider.
Nos. 4	Take posts at rear handling lines on respective sides; unreeve and coil rear and center handling lines.	Assist Nos. 3 in moving mooring slips. Report when each picket movement is completed.	Adjust mooring slips on respective sides; reeve and tie center and rear handling lines to spider.

132

123. TABLE XI—DRILL FOR DEFLATING THE BALLOON.—Balloon chief and ten crewmen.

Details	DETAILS, POSTS	PREPARATION FOR DEFLATION	REMOVE VALVE	COMMENCE DEFLATION
Balloon chief.	Gives command.	Gives command. Also commands: HAUL DOWN NOS. 4, 5, AND 6 UPPER CRADLE SLIPS; PLACE SLIP KNOT ON DEFLATION APPENDIX; ADJUST BLOCKS ON MOORING AND TENSIONING SLIPS; WET DOWN VALVE AREA.	Gives command. Also commands: CLOSE AIR SCOOP; OPEN BALLONET APPENDIX.	Gives command as soon as No. 4 F/R sounds off, "Valve out."
Nos. 1	Take posts as for flying balloon from bedded-down position.	Remove foot ropes from concentration fitting, coil and bag foot ropes. Report.	Supervise operations.	Supervise operations. No. 1 R/R unfastens rip cord when necessary.
Nos. 2	Take posts as for flying balloon from bedded-down position.	Untie, unreeve, and coil handling lines. Adjust blocks.	Take positions at front mooring lines.	Take up on mooring and tensioning slips as required. Assist Nos. 5 as required in rolling balloon.
Nos. 3	Take posts as for flying balloon from bedded-down position.	Place ground cloths under balloon. Haul down on Nos. 4, 5, and 6 upper cradle slips.	Take positions at Nos. 1 cradle slips.	Remove cradle slips and unfold ground cloths as required. Assist Nos. 5 as required in rolling balloon.
No. 4 F/R	Takes post as for flyingballoon from bedded-down position.	Assists Nos. 3 to place ground cloths. Wets down valve area, prepares wet cloth for placing in valve aperture; obtains valve box and places it near tail of balloon. Reports.	Removes valve; reports "Valve out." Places water-soaked cloth in valve aperture.	Keeps valve aperture open.
No. 4 R/R	Takes post as for flying balloon from bedded-down position.	Assists Nos. 3 to place ground cloths. Puts on quick-release slip knot. Reports.	Opens ballonet appendix.	Keeps ballonet deflation appendix open.
Nos. 5	Go to nose of balloon.	Obtain stepladder, attach running nose line; assist No. 4 F/R.	Close air scoop.	Haul down on running nose line and control nose of balloon with sandbags. Begin rolling balloon when necessary.

133

■ 125. TABLE XIII.—DRILL TO MOOR AT MIDSHIP MOORING.—Balloon chief and five crewmen.

Details	DETAILS, POSTS	START UP WINCH	HAUL IN ON WINCH	STOP WINCH	FLY THE BALLOON
Balloon chief.	Gives command.	Gives command.	Give command.	Gives command. Also commands: TRANSFER RIP CORD, SWITCH ON RIP LINK, UNSHACKLE, UNREEVE RUNNING LINE.	Commands: ATTACH LOWER LETHAL DEVICE. After attachment, commands: FLY THE BALLOON, designating height.
Nos. 1	No. 1 F/R takes post at central anchorage. No. 1 R/R takes post at rip cord.	See that crewmen have taken proper posts.	No duties.	No. 1 R/R unfastens rip cord from rip-cord strop and fastens rip cord to flying cable. No. 1 F/R switches on rip link; then unshackles junction strop from safety strop. Both report completion of commands.	Attack lower link and parachute. No. 1 F/R reports. (See note.)
Nos. 2	No. 2 F/R takes post at running line. No. 2 R/R takes post at tail line.	No. 2 R/R mans tail line.	No duties.	No. 2 F/R unreeves running line from running-line snatch-block and reports. No. 2 R/R continues to man tail line.	No. 2 R/R releases tail line as the balloon goes aloft.
No. 3 (winch operator).	Takes post at winch.	Starts winch engine; reports when engine is running.	Hauls in as directed.	Stops hauling.	Pays out cable as directed, watching ascent of balloon.

NOTE.—Before paying out the flying cable, the balloon chief details one man to watch the storage drum if required.

■ 125. TABLE XIII—DRILL TO MOOR AT MIDSHIP MOORING.—Balloon chief and five crewmen.

Details	HAUL DOWN BALLOON	HAUL DOWN BALLOON	STOP WINCH	PAY OUT WINCH	STOP WINCH
Balloon chief.	Gives command. When the lower lethal device is at central-anchorage snatch-block, commands: STOP WINCH; REMOVE LOWER LINK AND PARACHUTE.	Gives command when the lower lethyl device is removed. Also commands: BALLOON CREW, FALL IN. Tells off crew to their duties and commands: DETAILS, POSTS.	Gives command. Also commands: SWITCH OFF RIP LINK, REEVE RUNNING LINE, SHACKLE ON.	Gives command.	Gives command. Also commands: TRANSFER RIP CORD, TENSION AND TIE OFF RUNNING LINE.
Nos. 1	Remove lower link and parachute. No. 1 F/R reports completion of command.	Nos. 1 take posts at central anchorage. Both see that crewmen take proper posts.	No. 1 F/R switches off rip link; shackles pyramid to junction strop. Reports completion.	No duties.	No. 1 F/R attaches handling-line bag to junction assembly. No. 1 R/R unfastens rip cord from flying cable and fastens it to rip-cord strop. No. 1 R/R reports completion of command.
Nos. 2	No duties.	No. 2 F/R takes post to reeve running line. No. 2 R/R takes post to man tail line.	No. 2 F/R reeves running line. Reports completion. No 2 R/R mans tail line.	No. 2 R/R mans tail line.	No. 2 F/R tensions and ties off running line. Reports completion. No. 2 R/R mans tail line.
No. 3 (winch operator).	Starts winch engine and hauls down balloon, observing descent. Stops winch.	Hauls down balloon as directed, observing descent.	Stops winch.	Pays out winch until tension is taken on flying cable.	Stops winch engine.

CHAPTER 9

OPERATING AND MANEUVERING AT WATERBORNE SITES

		Paragraphs
SECTION I.	General	126–132
II.	Personnel	133
III.	Equipment	134–143
IV.	Operating and maneuvering	144–148

SECTION I

GENERAL

126. SCOPE.—This chapter covers the operation of the standard low-altitude barrage balloon over water as part of a fixed defense. The balloon usually is serviced at a nearby land site and is transferred to the waterborne site by use of a service boat and a transfer strop.

127. PURPOSES.—The purposes of overwater operations are to—

a. Maintain balance, density, and probability in a land-sited barrage.

b. Close harbors, channels, and other bodies of water to enemy low-altitude aircraft operations of all sorts, including torpedo-launching, mine-laying, and reconnaissance.

128. TYPES OF OPERATIONS.—Overwater low-altitude barrage balloon operations are of several types:

a. From mobile craft:

(1) Power boats.

(2) Barges.

b. From buoy anchorages.

c. From platforms—

(1) Built entirely over water.

(2) Built with one end on the shore.

d. From a double cable, or a cable and strop, forming a triangle over a channel or other body of water.

129. EQUIPMENT.—Equipment needed for overwater operations includes—

a. A completely equipped land site as a base.

b. Transfer equipment, consisting usually of a power boat.

c. A waterborne anchorage.

d. Safety and other equipment necessary to satisfy local regulations and to insure that personnel and matériel are not subjected to unnecessary risks. Information concerning any waters may be obtained from the port captain of those waters.

130. HAZARDS.—Operating barrage balloons over water presents special hazards not normally encountered when operating from conventional land sites. Tide and surf must be reckoned with on seas; the current, on rivers; and the depth of the water, in every instance. In cold climates, icing must be watched.

131. RELATED OPERATIONS.—The operation of M1 (*very* low altitude) barrage balloons under all of the above described circumstances, and with convoys, is discussed in FM 4–188 (when published) and will not be taken up here. However, the general information herein set forth may prove of value to the operator of an M1 balloon, and vice versa. Therefore personnel concerned with overwater flying of balloons, particularly in cases where low-altitude and very low-altitude barrage balloons are used in the same area, should consult both manuals.

132. REFERENCE DATA.—Reference is made to chapter 8, since all the material pertinent to land operating and maneuvering *must be understood thoroughly* before waterborne operations can be undertaken safely. (See also FM 4–181, 4–182, 4–184, and 4–198 (when published).)

SECTION II

PERSONNEL

133. CARE IN SELECTING.—*a.* Every care should be given to the selection of personnel to man overwater sites. The organization commander should bear in mind the following circumstances in assigning men to this duty:

(1) Special hazards are involved.

(2) The problem of morale, because of long periods of isolation, may be great.

b. Resourcefulness, ingenuity, stability, good physique, and general adaptability to circumstances are virtues desirable in personnel who must live for weeks cramped into the comparatively narrow confines of the average waterborne site. No soldier should be selected for waterborne site operations if he cannot swim or if he is subject to fear or physical sickness on floating equipment.

c. Waterborne site personnel should include not only the balloon squad, but a pilot with a license for the waters in which the equipment must be navigated. In some instances a civilian crew for handling floating equipment may be desirable, leaving the balloon squad free to maneuver and operate the balloon.

SECTION III

EQUIPMENT

134. GENERAL.—Local conditions will dictate modifications in equipment when necessary. A careful analysis of conditions at the site should be made and craft designed to operate under these conditions must be selected.

135. LAND SITE.—The land site which is used in conjunction with waterborne operations will serve one or more water sites. In case more than one water site is served, equipment, particularly extra gas cylinders, should be provided in sufficient quantities so that service can continue uninterrupted during the operation of the barrage. The balloon is bedded down on the land site and frequently is repaired there.

136. BARGE.—*a.* The barge may be one of two types—double-end or catamaran—and will be moved with a power boat when necessary.

(1) *Double-end.*—This is the common type of barge, either steel or wood. The standard river and harbor barge is satisfactory.

(2) *Catamaran.*—The catamaran barge consists of a superstructure built on two or more pontons. It is designed primarily for operations on quiet waters.

b. Regardless of type, the barge must have a main or flight deck with minimum dimensions of 16 by 52 feet, free of obstructions or projections which might endanger men or

equipment. This deck, on the double-end barge, should be at least 5 feet above water level, that is, the barge should have a freeboard of 5 feet. The flight deck may be the deck of the barge itself, or it may be placed atop the superstructure, with crew quarters on the barge deck proper.

c. The main deck fittings should be demountable and will include block and tackle, davits, flagstaffs, anchor winches and cables, ventilators, gas cylinder racks, entry and operations hatches, railings, bits and chocks, and other equipment, either all or in part, as needed.

d. Operations quarters must be provided. These should include—

(1) Crew space.
(2) Machinery space.
(3) Storage space.
(4) Servicing space for the barge.

e. Crew space should provide sleeping, messing, sanitary, and living quarters for at least five men.

f. Machinery space should be provided for the winch, a work bench where repairs can be made to the balloon and equipment, heating equipment (unless such has been put in the crew quarters), and the electrical system.

g. Storage space should provide for gasoline, fuel oil, and water storage tanks, and such other items as it may be expedient to store, NOT INCLUDING HYDROGEN CYLINDERS, WHICH ARE STORED IN RACKS ON THE MAIN DECK.

h. Servicing space should provide for barge-servicing tools and equipment.

137. POWER BOAT.—*a.* A service boat capable of towing the barge to and from its dock and its anchorage must be provided. A 40-horsepower boat is satisfactory in calm water, but in rough water a more powerful one will be necessary. Circumstances may arise where it will be necessary to equip the power boat with a balloon winch in order to accomplish the transfer of the balloon from land to the waterborne site.

b. If the power boat also is to be used for flying a balloon, it should meet the following general requirements:

(1) Motor—150 horsepower.
(2) Hull—50 feet long.

(3) Draft—5 to 6 feet.
(4) Beam—10 to 12 feet.
(5) Deck prepared so as to permit the placing of balloon winch and gas cylinders.
(6) Bow winch; aft tow bit located about one-third of length from stern.
(7) Same general equipment as for barge.

■ 138. ROWBOATS.—Each waterborne site must be equipped with rowboats.

■ 139. ELECTRICAL SYSTEM.—*a. General.*—Lighting equipment must comply with navigation regulations for the waters in which the craft will be operated. IN NO CASE IS AN OPEN FLAME TO BE USED NEAR THE BALLOON OR HYDROGEN CYLINDERS.

b. Generator.—If electricity is used, a generator capable of furnishing 500 watts at 110 volts is likely to be required. If the boat or barge to be employed contains a generator, and if a radio or equipment other than lights is to be connected with it, the generator should be checked as to the type of current it supplies and the voltage, since much electrical equipment must conform to the source of power.

c. Outlets.—A minimum of two double electrical outlets, one at each end of the barge, should be provided if electricity is used. Additional outlets should be provided in accordance with local needs.

d. Lighting.—Requirements for properly lighting a waterborne site with electricity are—

(1) Regular equipment:
(*a*) Two 25-watt riding lights.
(*b*) One 150-watt spot light.
(*c*) One 150-watt flood light.
(*d*) Interior lights as required.
(2) Auxiliary equipment:
(*a*) Two heavy-duty, lantern-type flashlights, each containing two 1½-volt dry cell batteries.
(*b*) Two riding lights, each powered by two 1½-volt dry cell batteries.
(*c*) Such other flashlights, electric lanterns, or other types of lanterns as may be necessary.

■ 140. PLATFORMS.—Platforms should be placed only after a thorough study of tides, currents, nature of bottom, and the tactical necessity of placing the balloon. The most satisfactory platform is the dock type. In marshy areas or where the water is very shallow, platforms may be placed entirely over water on piling. Piling should be firm and planking should be heavy. Lift and horizontal force must be considered. The platform should be able to withstand 12,000 pounds vertical pull. Bracing must be provided to prevent sideway and shifting of the deck on the platform.

■ 141. BUOYS.—*a.* Flying balloons from buoys should be avoided if possible. Balloons flown from buoys cannot be readily serviced, nor can their altitudes be altered easily to meet changing clouds or other conditions. Heavy loss of balloons thus flown has been attributed to inability to haul down quickly on the approach of a storm. If flying from buoys is found necessary, the use of extra-strength flying cable may reduce balloon casualties. Types of buoys are shown in figure 28.

b. When a balloon is flown from a buoy, the cable should be attached as close to the water line as possible, since the swaying of a tall buoy jerks the cable, increasing the likelihood of a break-away.

c. It is advisable to anchor the barrage balloon to a buoy that can adapt its behavior in water to any variability of lift of the balloon due to erratic kiting. This will serve as a shock absorber on the flying cable when the maximum lift is exerted by the balloon. The buoy may be lifted nearly out of the water when reducing the jerking action on the flying cable. The anchor of the buoy needs to hold little, if any, of the lift of the balloon at any time.

■ 142. ANCHORS.—*a.* Under most circumstances a square anchor, sufficient to withstand the probable vertical pull, is best for buoys and barges. Several small anchors in most cases are preferable to a single large one. Types of anchors and their characteristics are shown in figure 28.

b. The kedge anchor is made of steel and is desirable for use on a sandy or clay bottom, since about two-thirds of it will be buried. It is only fair anchorage for a gravel or rocky bottom.

510518°—43——10

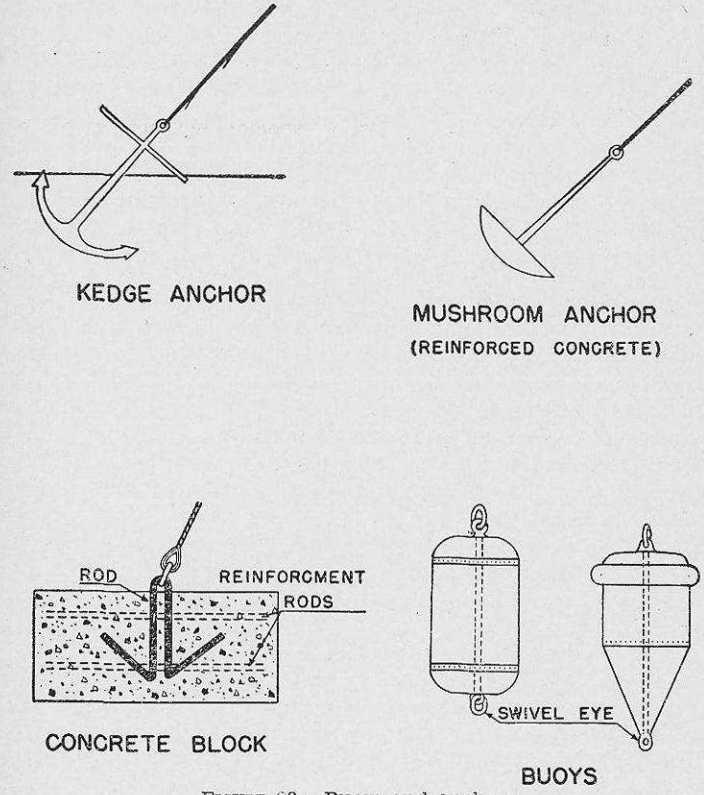


FIGURE 28.—Buoys and anchors.

c. The mushroom anchor is made of reinforced concrete. On a soft bottom it will bury itself completely. It is more desirable for anchorage than the kedge, except for rocky bottom.

d. The concrete block is a block of concrete reinforced with steel rods. It is a good type of anchor for any type of bottom.

e. To provide satisfactory mooring for the barge, the length of the anchor line should be from five to seven times the depth of the water. When the barge is anchored from only one end, the barge can swing with the wind and the tide.

Anchoring from both ends limits the movement of the barge. Where the tide is strong and the water rough, anchorages of barges must be secure, and greater movement of the barge to ride with the tide and wind must be provided.

■ 143. MISCELLANEOUS.—*a.* Other special equipment at a waterborne site includes—

(1) *Topping-up hose.*—The topping-up hose is attached to the manometer fitting and flies with the balloon. It can be made from air or garden hose and couplings.

(2) *Transfer strop.*—The transfer strop, eye-spliced at one end, should be about 200 feet long, though the balloon may be transferred with a shorter strop.

(3) *Safety strop.*—The safety strop should be about 100 feet long. There will be instances where both a safety strop and a transfer strop will not be necessary. However, both should be available.

b. The length of the topping-up hose, transfer strop, and safety strop will be determined by operating conditions at the site.

SECTION IV

OPERATING AND MANEUVERING

■ 144. GENERAL.—The following general rules apply, as modifications of normal land procedure, at overwater sites:

a. The balloon will not be bedded down on the barge.

b. Close-haul at waterborne sites may be expanded to include flying the balloon from a strop used in transferring to the water site. When the balloon is close-hauled close to the deck of the barge, it may be advisable to provide some form of water drag or snubber on the tail line.

c. Transfers from shore to boat and vice versa should be accomplished with as much dispatch as possible.

d. Inspections and repairs will be done ashore.

■ 145. FLYING OVER CHANNELS.—Flying over channels is accomplished by the following operations (see fig. 29):

a. Place an auxiliary anchorage on the shore opposite the land site from which the balloon is flown.

b. From the auxiliary anchorage, extend cable sufficient to lie slack on the bottom of the channel and reach the central anchorage of the site.

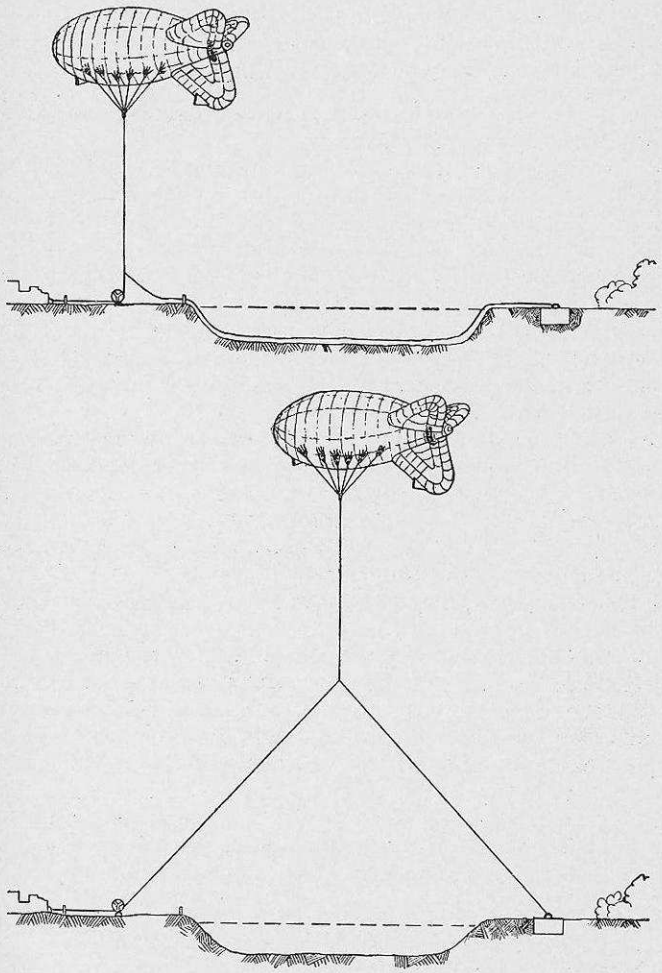


FIGURE 29.—Method of flying over channels.

c. Fly the balloon at the required height.

d. Attach the auxiliary cable to the flying cable.

e. Pay out flying cable until the balloon is in position over the channel. The auxiliary anchorage, the junction of the auxiliary cable and the flying cable, and the central anchorage at the bed now form the points of a triangle. The altitude of this triangle, subtracted from the ruling operational height of the balloon, will determine the height at which the balloon is flown when the auxiliary cable is fastened to the flying cable.

■ 146. TRANSFER, SHORE TO POWER BOAT.—*a.* To transfer from shore to power boat, the balloon is laid out and inflated on the land site near the water. Both the 200-foot and the 100-foot strops are attached to the junction assembly. The 200-foot strop is passed through the snatch-block in the center of the bed and then is looped onto the gipsy-head of the winch. The end of the 100-foot strop is made fast to a cleat on the deck of the power boat by means of a strop and clevis. Then the balloon is released from the bed and the 200-foot strop is paid out until the 100-foot strop takes the tension. The 200-foot strop is taken off the gipsy-head and coiled on the deck of the power boat. A small hand reel can be used for this purpose. (See fig. 30.)

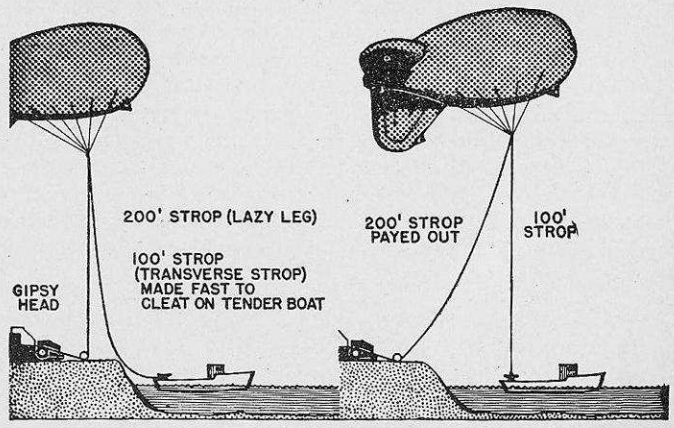


FIGURE 30.—Method of transfer, shore to power boat.

b. Where transfer cannot be made directly from the bed to the power boat, the balloon may be transferred to a truck by using methods similar to those outlined in section III, chapter 8, the transfer from truck to service boat being accomplished at the dock.

147. TRANSFER, POWER BOAT TO BARGE.—The power boat, with the balloon flying from the 100-foot strop, proceeds to the barge. The power boat comes alongside the barge. The 200-foot strop is taken onto the barge and looped onto the gipsy-head of the barge winch. The balloon is hauled in until the tension is taken off the 100-foot strop. When the flying cable is to be connected to the junction assembly, the balloon will be hauled in to the point of attachment, the flying cable will be attached, tension will be taken on the flying cable, and the strop will be removed. When the balloon is operated with the flying cable attached at the lower end of the short strop, the short strop is unfastened from the power boat and connected to the flying cable as soon as the 200-foot strop is carrying the lift of the balloon. The long strop is payed out and tension is taken by the flying cable. The long strop is allowed to hang free, or the lower end is lashed to the flying cable so that it will not swing and wrap around the flying cable, except when the lethal device is attached at the lower end of the short strop. In the latter instance, the junction assembly would be attached to the strop, the parachute bag being secured to the strop with a grip housing. Thus the danger of the parachute's fouling the strops would be minimized, the lethal device could be serviced readily, and the likelihood of the lethal device being fired accidentally would be decreased. When it is necessary to take the balloon ashore, the process is reversed. In case the winches do not have gipsy-heads, hand winches will be required. Transfers to overwater platforms can be accomplished in a similar manner. (See fig. 31.)

148. SAFETY EQUIPMENT.—Such safety equipment, including life preservers, running lights, bells, etc., as local conditions may require, must be placed at each water site and the crew must be instructed in use of the equipment. Some of the things which will be required are:

a. One life jacket per crew member.

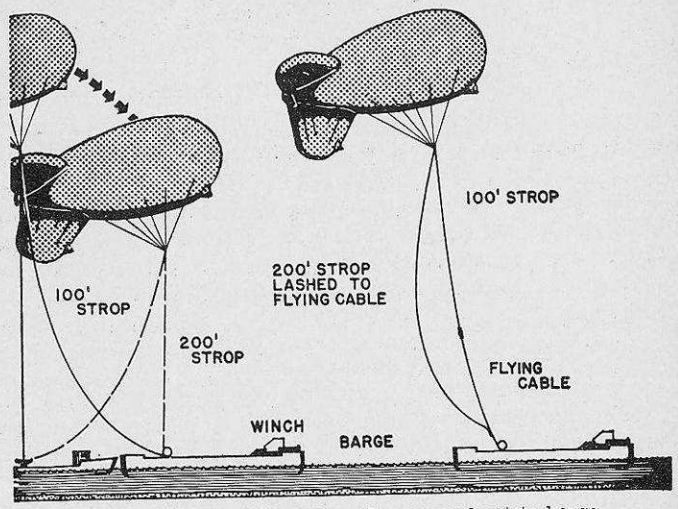


FIGURE 31.—Method of transfer, power boat to barge.

b. Two life rings on power boat and on barge.

c. Fire extinguishers on power boat and barge.

d. First-aid kits on power boat and barge.

e. Good tow line on power boat at least 200 feet long with a bridle having 50 feet of rope on each leg.

f. Ax handy near tow line to cut bridle in emergency.

g. Other items such as the port captain may advise or direct.

CHAPTER 10

RIGGING AND FABRIC REPAIR

149. GENERAL.—Methods of repairing rigging and fabric are described in detail in FM 4–196 (when published).

150. RIGGING REPAIRS.—Repairs to rigging and fabric will be made under the supervision of the platoon rigger. Repairs to rigging by personnel at the site will be limited to the replacing of worn ropes, renewing of rope servings, and rope splicing.

151. FABRIC REPAIRS.—Repairs to fabric by personnel at the site will be limited to the patching of small holes with repair fabric and cement. Large holes or tears may be patched with repair fabric and cement temporarily to prevent loss of gas until proper repairs can be made.

CHAPTER 11

RECORDS AND REPORTS

152. GENERAL.—Records of tactical operations, messages, maintenance of equipment, and repairs are kept at the site. If forms are available they will be used, the prescribed number of copies being forwarded in accordance with directions issued by proper authority. If forms are not available, records still will be kept at the site so that pertinent information concerning the balloon, the site, and the equipment will be available to higher echelons.

153. BALLOON SERVICE RECORD.—The balloon service record will be opened at the factory by the duly appointed authority, and will accompany the balloon throughout its life. All data pertinent to the life of the balloon will be incorporated into the balloon service record.

154. CASUALTY REPORTS.—*a.* Reports of balloon casualties must be made as directed by higher authority. The location of the barrage, the type of equipment, and the topography, industry, commerce, and military operations of the surrounding area will determine the details of these reports and the agencies which must be notified.

b. Military and civilian personnel must be cautioned against touching a balloon cable found on the ground, as the cable may be resting across an electrical transmission line. In that event, as in other potentially dangerous situations, guards should be posted to warn persons away pending removal of the cable.

155. UNSATISFACTORY REPORTS.—*a.* In case any barrage balloon, balloon equipment, or portion of balloon or equipment is unsatisfactory, a report will be made in accordance with Army Regulations.

b. The purpose of the report is to explain how the matériel in question is unsatisfactory. This information will enable corrective action to be taken. Each report will be a complete description of an individual case so as to enable investigation and correction of the difficulties reported without the necessity for further request for information.

c. Exhibits will be forwarded for examination, except when the exhibit is bulky or heavy and photographs are considered satisfactory.

CHAPTER 12

DEMOLITION OF MATÉRIEL IN EVENT CAPTURE APPEARS IMMINENT

	Paragraphs
SECTION I. Reasons, policies, and materials	156–157
II. Methods	158–168

SECTION I

REASONS, POLICIES, AND MATERIALS

■ 156. SITUATIONS REQUIRING DEMOLITION.—*a.* There are two general situations where demolition of matériel will become necessary:

(1) In withdrawal, where limitation on time or transportation makes it impossible to evacuate all equipment.

(2) Where withdrawal cannot be accomplished and capture of personnel and equipment by the enemy is certain.

b. In either situation demolition of matériel will be undertaken only when in the judgment of the military commander concerned such action is necessary.

c. Plans for demolition should be thorough. They should include the preparation of demolition equipment and equipment to be destroyed, as well as the manufacture and storage of special demolition devices. The troops must be thoroughly acquainted with their duties and assignments under the plans. Plans should be flexible. Demolition should be as complete as available time, equipment, and personnel permit. When unlimited time is available, demolition of armament is not difficult. In combat, however, time is always limited. Often there is no more than a final moment in which equipment can be rendered unfit for subsequent use against friendly troops. For this reason priority in evacuation or demolition of equipment must be established. Often, however, the decision to surrender is made under conditions which allow ample time for demolition, though evacuation is impossible. Under these circumstances the most thorough measures of demolition should be employed. Coordination of effort will be necessary to insure that friendly personnel

are not endangered and that destruction of some items at the site does not interfere with destruction of others.

■ 157. PRIORITY.—The following order of priority applies to the various types of demolition, in terms of the time available:

a. Destruction of secret features of armament.

b. Destruction or removal of parts essential to the operation of the equipment. (The same part must be destroyed in each like item to prevent construction of one complete item out of several damaged ones.)

c. Thorough destruction and dispersion of all parts (for example, by fire and explosion) to make salvage impossible.

SECTION II

METHODS

■ 158. MATÉRIEL.—Matérial to be destroyed in event capture appears imminent includes (not in order of priority).

a. Balloons.
b. Gas cylinders.
c. Winches.
d. Cable and bedding-down equipment.
e. Sites, site structures, and site access roads.
f. Hydrogen generators.
g. Motor transportation equipment.
h. Weather station instruments.
i. Arms.
j. Supplies.

■ 159. BALLOONS.—*a. When the balloon is moored.*—After all other steps necessary to destroy site equipment have been begun, pull the balloon as close to the bed as possible, throw gasoline on the lower part of the envelope, and ignite the gasoline.

b. When the balloon is flying.—The balloon may be cut loose (which will cause the lethal device to fire) and ignited with a burst of tracer ammunition if a machine gun is available at the site. Balloon fabric is inflammable, and therefore a hydrogen-filled balloon may be destroyed in this manner.

Helium-filled balloons, however, can rarely be ignited by tracer ammunition.

■ 160. GAS CYLINDERS.—For gas cylinders filled with either hydrogen or helium, and located either at the hydrogen generation plant or at the site, the recommended procedure is to LET ALL THE GAS ESCAPE and smash the valves. Release of gas is recommended because its presence would hamper demolition and endanger personnel. Deformation of valves would prevent use of the cylinders except as scrap.

■ 161. WINCHES.—*a. Method No. 1.*—Puncture the fuel tank. Place TNT charges as follows: 2 pounds on top of the clutch housing, 2 pounds underneath the gypsy head, and 3 pounds under the storage drum. Insert tetryl nonelectric caps with at least 5 feet of safety fuze in each charge. Ignite the fuzes and take cover.

b. Method No. 2.—Puncture the fuel tank. Smash all vital elements (such as distributor, carburetor, radiator, engine block, generator, control levers, crankcase, gears, and clutch) with a heavy ax, pick, or sledge. Pour spare gasoline on winch and ignite.

■ 162. CABLE AND BEDDING-DOWN EQUIPMENT.—If the cable is spooled, it will be adequately destroyed if the demolition in paragraph 161*a* is used. If it is unspooled, destruction will be difficult and only partial at the best. Unspooled cable can best be destroyed by cutting in relatively short lengths with an ax. Bedding-down equipment should be placed on the deflated balloon and destroyed at the same time the balloon is destroyed, or atop some other material which is to be burned.

■ 163. SITES, STRUCTURES.—Slow explosives can be used for sites and site structures. Gasoline and other inflammable materials can be utilized on structures. FM 5–25 should be consulted for size and placing of charges and inflammables.

■ 164. HYDROGEN GENERATORS.—*a.* Smash gases on generators, moisture separators, and drying bottle, and gage glasses on caustic tank.

b. Cut belt drives and chain drives and mutilate latter with sledge hammer. Also destroy with sledge hammer the cooling radiator, water pump, air compressor, gasoline engine, caustic pumps, and sludge valves. *Any damage which did not include the generating cylinders themselves, sludge and moisture separators, and the drying bottle probably could be repaired in a comparatively short time.* Demolition of these parts presents a special problem, since they are made of a fine grade of steel and will withstand high pressures. TNT or other high explosives should be used to destroy these parts.

c. See paragraph 165*b* for destruction of tires. Pour gasoline on the wooden trailer floor and ignite it.

■ 165. MOTOR TRANSPORTATION EQUIPMENT.—*a. Vehicles.*—(1) *Method No. 1.*—Remove and empty portable fire extinguishers. Puncture the fuel tanks. Place a 2-pound TNT charge on top of the clutch housing (the hood must be opened to do this properly). If time is available, place another 2-pound TNT charge on the left side of the engine as low as possible. Insert tetryl nonelectric caps with at least 5 feet of safety fuze in each charge. Ignite the fuzes and take cover.

(2) *Method No. 2.*—Remove and empty the portable fire extinguishers. Puncture the fuel tanks, if readily accessible. Smash all vital elements (such as distributor, carburetor, radiator, engine block, air and oil cleaners, generator, control levers, crankcase, and transmission) with a heavy ax, pick, or sledge. Pour spare gasoline, oil, or distillate over entire unit and ignite.

b. Pneumatic tires.—(1) *Method No. 1.*—Ignite an incendiary grenade under each tire. Be certain that the incendiary fires are well started before detonating the TNT in *a* (1) above if that method is used.

(2) *Method No. 2.*—Damage the tires with an ax, pick, or heavy machine-gun fire (deflate them before doing this, if possible). Pour gasoline on tires and ignite.

■ 166. WEATHER STATION EQUIPMENT.—Smash instruments, place in weather station, saturate station with gasoline, and burn. Slow explosives may be used to assist the demolition process.

167. SAFETY PRECAUTIONS.—Demolition, to be accomplished safely, requires a close following of fundamental rules for the handling of explosives and incendiary material. FM 5–25 sets forth these rules fully and barrage balloon personnel are again referred to it.

168. BOOBY TRAPS.—If time and materials permit, booby traps and antipersonnel mines may be placed at balloon sites, particularly near equipment which it is not possible to destroy. FM 5–25 discusses placing of mines.

APPENDIX

LIST OF REFERENCES

Service of the Balloon and Balloon Equipment (Dilatable)	FM 4–108
Organization and Tactics	4–181 (when published).
Site Installations	4–184 (when published).
Service of the Balloon and Balloon Equipment, Very Low Altitude	4–188 (when published).
Service of Cable Armament	4–191 (when published).
Gas Generation, Use, Purification, and Service of the Hydrogen Generator	4–193 (when published).
Rigging and Fabric Repair	4–196 (when published).
Reference Data	4–198 (when published).
Explosives and Demolitions	5–25

INDEX

	Paragraph	Page
Airports, defense of	109	102
Air-relief valve	14	11
Air scoop:		
Ballonet	14	11
Rudder	21	14
Air valve, plastic	5, 17	2, 12
Anchorage, auxiliary, use of	145	143
Anchorages, winch, regular and emergency	39	24
Anchors, for waterborne sites	142	141
Angle of trim	12	9
Appendix:		
Ballonet deflation	14	11
Inflation	20	14
Connecting method	92	50
Appendixes, stabilizer deflation	93	55
Armorer, duties of	79	43
Armorer equipment, BB, LA	33	19
Ascent, speed of	42	25
Attachment, point of, definition	88	48
Ballonet:		
Nomenclature and functioning	14	11
Spider patch	16	12
Balloon, D–8:		
Air valve	5	2
Angle of trim	12	9
Assemblies	5	2
Characteristics	7–12	3
Concentration fitting	5, 23	2, 16
Dimensions of	8	8
Drills for	112–125	103
Envelope	5	2
Folding	106	89
Gas valve	5	2
Lift	11	9
Maintenance equipment	33	19
Method of shipping	6	2
Name plate on	3	2
Nomenclature	2	2
Packing of	31, 106	19, 89
Replacement, modification of rigging	26	18
Rigging of	92	50
Rolling of	106	89
Safety during high winds	95	65
Sides	4	2
Unpacking of	92	50
Volumes of compartments	10	9
Weight	9	9
Balloons:		
Demolition of	159	151
Low altitude, types	1	1

	Paragraph	Page
Balloon case	6	2
Balloon chief:		
Duties of	78	43
Position of	83	47
Rank	78	43
Balloon crew:		
Definition of	71	42
Formation of	80–81	45
Balloon service record	153	149
Balloon site equipment, BB, LA	33	19
Balloon squad	70	41
Barges, types	136	138
Bed, balloon:		
As component of site	65	39
Preparing of	91	49
Bedding down:		
After turning	95	65
During mechanical handling	93	55
For storm	101	77
Manual drill for	117	120
Mechanical drill for	115	113
Bedding-down equipment, demolition of	162	152
Block anchor, concrete	142	141
Boat, power	137	139
Booby traps	168	154
Box, packing balloon in	106	89
Buoys, flying balloons from	141	141
Cable:		
Auxiliary, use of	145	143
Flying:		
Broken wires in	47	28
Corrosion of	47	28
Defects in	47	28
Demolition of	162	152
Description of	46	28
Expected life of	50	30
Inspection of	48	29
Kinks in	47	28
Limited standard	46	28
Loops in	47	28
Lubrication of	49	29
Maintenance of	49, 104	29, 83
Margin of safety	47	28
Reversals	50	30
Spooling on winch	49	29
Standard (M2)	46	28
Touching during storm	45	27
Wear, abrasive and fatiguing	47	28
Cable, tail-line mooring-circle, adjustment of	97	71
Cables, maneuvering	108	96
Cap valve-protecting, treatment of	55	35
Case, balloon	6	2
Casualty reports	154	149
Catamaran barge	136	138
Channels, flying balloons over, method of	145	143

	Paragraph	Page
Chief:		
Balloon	78	43
Platoon	74	42
Side	79	43
Chief gas worker	75	43
Civilians, use of at waterborne site	133	137
Close-haul:		
Definition of	88	48
Mooring-circle:		
Drill to fly from	120	127
Drill to moor at	121	128
Procedure for	98	71
Turning balloon at	99	74
Clamp, six-bolt, on cable	48	29
Clothing, crew	63	38
Commander, platoon	72	42
Communication corporal	77	43
Concentration fitting	5, 23	2, 16
Cords, spacer	21	14
Corporal, communication	77	43
Corrosion, cable	47	28
Cradle bed:		
Drill to turn balloon on	122	130
Turning balloon on	95	65
Cranking winch, method of	43	26
Crew, balloon:		
Definition of	71	42
Emergency, formation of	107	92
Formation of	80–81	45
Crew, civilian, use at waterborne site	133	137
Crewmen:		
Duties of	79	43
Positions of	85	48
Crew quarters, at site	65	39
Crew quarters, on barge	136	138
Curtains, spacer	21	14
Cylinders, gas:		
Color code	54	34
Defective, labeling of	55, 56, 57	35, 36
Demolition of	160	152
Dunnage for	55	35
Empty, labeling of	55	35
Exposure to heat or fire	55	35
Grounding	55	35
Handling of	55	35
Helium, color code	54	34
Hydrogen, color code	54	34
Identification of	54	34
Stacking at site, rules for	55	35
Storing on barge	136	138
Deflation:		
Emergency procedure	105	86
Normal procedure	105	86
Precautions during	64	38
Deflation appendix, ballonet	14	11
Deflation system, emergency	15	12
Demolition of matériel if capture appears near	156–168	150

Demolitions:	Paragraph	Page
Balloons	159	151
Bedding-down equipment	162	152
Cable	162	152
Gas cylinders	160	152
Hydrogen generators	164	152
Matériel to be destroyed	158	151
Motor transportation equipment	165	153
Plans for	156	150
Priority for	157	151
Safety precautions	167	154
Sites	163	152
Situations requiring	156	150
Structures	163	152
Weather station equipment	166	153
Winches	161	152
Descent, speed of	42	25
Direct flying	38	23
Diving balloons, method of handling	41	24
Double-end barge	136	138
Drain holes, ballonet	14	11
Drill Tables:		
For bedding down from flying:		
Manual	117	120
Mechanical	115	113
For flying from bedded-down position:		
Manual	116	116
Mechanical	114	110
To deflate balloon	123	132
To fly from mooring-circle close-haul	120	127
To fly from tail-line mooring	118	124
To inflate balloon	113	104
To moor at mooring-circle close-haul	121	128
To moor at tail-line mooring	119	126
To turn balloon on cradle bed	122	130
Drills, purpose	90	49
Drill with D–8 balloon	82–106	45
Dunnage, for gas cylinders	55	35
Electrical precautions	44	27
Electrical system, for waterborne sites	139	140
Emergencies, maneuvering in	107–108	92
Emergency crew, formation of	107	92
Emergency deflation procedure	105	86
Emergency haul-down	107	92
Emergency repair equipment, BB, LA	33	19
Emergency winch anchorage	39	24
Envelope:		
D–8 balloon	5, 8, 13	2, 8, 10
Fabric	13	10
Gores	13	10
Length	8	8
Panels	13	10
Rings	13	10
Seams	13	10
Equipment:		
Bedding-down, demolition of	162	152
Gas	51	31

Equipment—Continued.	Paragraph	Page
Maintenance of	33	19
Motor transportation, demolition of	165	153
Weather station, demolition of	166	153
Executive, platoon	73	42
Exhibits, use of with unsatisfactory reports	155	149
Fabric, envelope, construction and servicing	13	10
Fabric repairs	151	148
Fins:		
Description of	21	14
Deflation and furling	93	55
Fire:		
Action in case of, at site	53	31
Precautions concerning	53	31
Flight deck, dimensions of, on barge	136	138
Flying, direct and indirect	38	23
Flying cable:		
Description and functioning	46–49	28
Maintenance	104	83
Folding D–8 balloon	106	89
Foot-ropes:		
Length	8	8
Method of attachment	26	18
Number and location	26	18
Freeboard, on barge	136	138
Gas, handling, transporting, and storing	52–59	31
Gas equipment, nomenclature	51	31
Gas safety precautions:		
Clothing of crew	63	38
During deflation	64	38
During inflation	62	37
General	60	37
Inspection	61	37
Gas valve, interior line-operated:		
Assembly	5	2
Description and functioning	16	12
Gas valves, on gas cylinders, direction of threads	54	34
Gas worker:		
Chief	75	43
Duties of	79	43
Gas workers' equipment, BB, LA	33	19
Generator, electrical, at waterborne site	139	140
Generators, hydrogen, demolition of	164	152
Gipsy-head, use of	93	55
Ground cloths, use during inflation	92	50
Grounding rod or mat, winch	44	27
Handling:		
Manual	94	62
Mechanical	93	55
Principles of	92	50
Handling lines	8, 27	8, 18
Handy-billy, use of	97	71
Haul-down, emergency	107	92
Helium:		
Cylinder color code	54	34
Rules governing use	52	31

	Paragraph	Page
Hose, topping-up, for waterborne site	143	143
Hydrogen:		
Cylinder color code	54	34
Danger of impurities in	52	31
Use	52	31
Hydrogen generators, demolition of	164	152
Indirect flying	38	23
Inflation:		
Appendix location, size, and use	20	14
Arranging of equipment	92	50
Commencing	92	50
Completing	92	50
Manifold hose, trench for connecting	55	35
Nomenclature of equipment	51	31
Precautions during	62	37
Procedure	92	50
Tube, method of connecting	92	50
Inspection of cable	48	29
Inspection windows	19	12
Junction assembly, method of attaching	40	24
Kedge anchor	142	141
Land sites:		
As auxiliaries to waterborne sites	129, 135	136, 138
Lubrication of cable at	49	29
Maneuvering and operating at	80–123	45
Lethal devices:		
Attachment and detachment of	104	83
Maintenance equipment for	33	19
Lift, of D–8 balloon	11	9
Lighting, requirements at waterborne site	139	140
Line:		
Nose	30	19
Tail	8, 29	8, 18
Lines:		
Handling:		
Length	8	8
Location and number	27	18
Splicing	27	18
Mooring	8, 28	8, 18
Rigging	8	8
Machinery space, on barge	136	138
Maintenance equipment, D–8 balloon	33	19
Maintenance of flying cable	104	83
Maneuvering area, balloon site	65	39
Maneuvering in emergencies	107, 108	92, 96
Manifold assembly, attachment of	92	50
Manual drill:		
For bedding down from flying	117	120
For flying from bedded-down position	116	116
Manometer connection	18	12
Master orders	90	49
Matériel:		
Captured, disposition of	168	154
Demolition of if capture appears near	156–168	150

	Paragraph	Page
Mechanical drill:		
For bedding down from flying	115	113
For flying from bedded-down position	114	110
Mechanical handling	93	55
Midship mooring	100	74
Mobile sites, operating at	109	102
Mooring-circle close-haul:		
Drill to fly from	120	127
Drill to moor at	121	128
Procedure	98	71
Storm precautions	101	77
Turning balloon at	99	74
Mooring lines	8, 28	8, 18
Mooring:		
Midship	100	74
Tail-line:		
Procedure	96	69
Turning balloon at	99	74
Motor transportation equipment, demolition of	165	153
Mushroom anchor	142	141
Name plate, on D–8 balloon	3	2
Nicopress sleeve, use of on rigging	26	18
Nose cupping, cause of	42	25
Nose line	30	19
Obstacles, maneuvering over	108	96
Operations hut, at site	65	39
Operator, winch, responsibilities of	79	43
Orders:		
Master	90	49
Repeated	87	48
Organization	67–79	41
Over watersites	126–148	136
Packing of D–8 balloon	31, 106	19, 89
Patches, spider	16	12
Personnel:		
Duties of	72–79	42
For waterborne sites	133	137
Photographs, use of with unsatisfactory reports	155	149
Pilot at waterborne site	133	137
Platforms, flying balloons from	140	141
Platoon:		
Composition	69	41
Task of	68	41
Platoon chief, rank and duties	74	42
Platoon commander, rank and duties	72	42
Platoon executive, rank and duties	73	42
Point of attachment, definition of	88	48
Power boat, type and equipment	137	139
Precautions during demolition	167	154
Record, Balloon Service	153	149
Records and reports	152–155	149
References, list of	App.	155
Repairs:		
Fabric	151	148
Rigging	150	148

	Paragraph	Page
Repeated orders	87	48
Replacement balloon, rigging modification	26	18
Reporting, by side chiefs	86	48
Reports:		
Casualty	154	149
Unsatisfactory	155	149
Winch, made out by	40	24
Rigger, platoon	75	43
Rigging:		
Concentration fitting	23	16
Description	22	16
Dimensions	8	8
Lines	8, 25	8, 16
Patches	24	16
Repairs	150	149
Rigging and fabric repair equipment, BB, LA	33	19
Rip cord	15, 92	12, 50
Rip panel	15	12
Rolling D–8 balloon	106	89
Ropes, foot	8, 26	8, 18
Rowboats, need for at waterborne sites	138	140
Rudder, nomenclature and functioning	21	14
Rudder-protection sheet, use of	93	55
Safety equipment for waterborne sites	145	143
Safety precautions:		
During demolitions	167	154
During drill	89	49
Sandbags:		
Additional as storm precaution	101	77
Preparation of	92	50
Sentry, duties of regarding fire prevention	53	31
Servicing space, on barge	136	138
Sheet, rudder-protection, use of	93	55
Shipping D–8 balloon, method of	6	2
Side chief:		
Duties of	79	43
Reporting by	86	48
Signs, at site	53	31
Site:		
Abandonment of, in case of fire	53	31
Components	65	39
Definition	65	39
Demolition of	163	152
Equipment, placing for inflation	92	50
Preparation of, for inflation	92	50
Records, responsibility for keeping	78	43
Skin irritation, neoprene cause of	60	37
Slips:		
Cradle, attachment of	92	50
Mooring and tensioning	92	50
Smoking area, nearness to site	53	31
Solvent, use on cable forbidden	49	29
Spacer cords, rudder	21	14
Spacer curtains, fin	21	14
Spider, maneuvering	107	92
Squad, balloon	70	41

	Paragraph	Page
Stabilizers	21	14
Static electricity, danger from animals	53	31
Storage space, on barge	136	138
Storm precautions	101	77
Strops, for waterborne sites	143	143
Structures, demolition of	163	152
Tail line:		
Attachment of	29	18
Length	8	8
Tail-line mooring:		
Drill to fly from	118	124
Drill to moor at	119	126
Procedure	96	69
Storm precautions at	101	77
Turning balloon at	97	71
Technicians, duties of	79	43
Telling off	84	47
Thimble, inflation tube	92	50
Thunderstorm, procedure during close approach	45	27
Tie-off, of inflation tube and appendix	92	50
Topping-up	103	80
Transfer:		
Method of, using two winches	108	96
Power boat to barge	147	146
Shore to power boat	146	145
Trim, angle of	12	9
Tube, inflation, method of connecting	92	50
Turning balloon:		
At mooring-circle close-haul	99	74
At tail-line mooring	97	71
During storm	101	77
On cradle bed	95	65
Unsatisfactory reports	155	149
Valise, packing balloon in	106	89
Valve, air-relief	14	11
Valve, gas, interior line-operated:		
Installation of	92	50
Nomenclature and functioning	16	12
Removal during inflation	105	86
Valve line	16	12
Valve, nonreturn flap, balloonet	14	11
Valves, gas cylinder, thread direction	54	34
Waterborne sites:		
Equipment needed	129	136
Hazards of	130	137
Lubrication of cable at	49	29
Maneuvering and operating at	126–148	136
Personnel for	133	137
Purposes of	127	136
Related operations	131	137
Safety equipment for	148	146
Types of operations at	128	136
Wear, cable, kinds	47	28
Weather station equipment, demolition of	166	153

	Paragraph	Page
Weather station maintenance equipment, BB	33	19
Weigh-off, how taken	102	80
Winch, M1:		
Anchorages for	39	24
Assemblies	37	21
Clutch and transmission	37	21
Cranking	43	26
Definition	34	21
Demolition of	161	152
Dimensions	36	21
Electrical precautions	44	27
Frame	37	21
Grounding	39, 44	24, 27
Method of getting on and off during storm	45	27
Nomenclature	35	21
Operator's responsibilities	40, 79	24, 43
Power plant	37	21
Purpose	34	21
Repairs, log of	40	24
Safety precautions	43	26
Winch maintenance equipment, BB, LA (second echelon)	33	19
Windows, inspection	19	12
Wire, method of crossing	108	96
Wires, broken, effect of in cable	47	28