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AC 150/5200-13

REMOVAL OF DISABLED AIRCRAFT

AUGUST 1970

DEPARTMENT OF TRANSPORTATION

FEDERAL AVIATION ADMINISTRATION

AC NO: AC 150/5200-13

DATE: 8/27/70

ADVISORY CIRCULAR

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

SUBJECT: REMOVAL OF DISABLED AIRCRAFT

1. PURPOSE. This circular discusses the responsibility for disabled aircraft removal and emphasizes the need for prearranged agreements, plans, equipment, and improved coordination for the expeditious removal of disabled aircraft from airport operating areas. It also illustrates some of the various methods used, equipment employed, equipment available, and concepts for aircraft recovery.

2. REFERENCES.

   a. National Transportation Safety Board Regulations, Part 430, Rules Pertaining to Aircraft Accidents, Incidents, Overdue Aircraft, and Safety Investigations, dated 1 January 1968, published in Title 14 of the Code of Federal Regulations, may be obtained from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, for five cents.

   b. Advisory Circular 150/5200-10, Airport Emergency Operations Planning.

   c. Advisory Circular 150/5200-12, Fire Department Responsibility in Protecting Evidence at the Scene of an Aircraft Accident.

3. HOW TO OBTAIN THIS PUBLICATION AND REFERENCED PUBLICATIONS. Obtain copies of this advisory circular, AC 150/5200-13, Removal of Disabled Aircraft, and the referenced advisory circulars from the Department of Transportation, Distribution Unit, TAD-484.3, Washington, D.C. 20590.

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Initiated by: AS-570

TABLE OF CONTENTS

1. BACKGROUND.

a. An aircraft may occasionally suffer damage or a malfunction while on or near a runway or taxiway, causing it to become a temporary obstruction or hazard. If a disabled aircraft hinders movement of other aircraft, or will interfere with the operation of navigational aids it can result in traffic delays, scheduling problems, and inconvenience to travelers and other airport users.

b. For the most part, only negligible damage occurs during present day removal of commercial aircraft from the operational areas of air carrier airports. However, efforts to preclude damage have not been matched with improved plans and coordination which can reduce the time it takes to remove such aircraft.

c. The most frequent causes of runway closures involve situations where tire, wheel, or brake failures occur and changes or repairs are made while the aircraft is on the runway. The records also show that the elapsed time for such changes in many instances closely approaches the time estimated by industry as a goal for the actual lifting and removal of disabled aircraft (approximately three hours, not including defueling time) However, in the latter case, it should be explained that this timing is based on the operations to be done after all removal equipment is on the scene.

d. The removal of small aircraft is often done by makeshift means, leaving a lot to be desired in the interest of recovery value. It is also significant to note that, in many cases, runway closure times for removing small aircraft closely approach the times being experienced in removing large aircraft.

e. Significant efforts have been made by the FAA regions in developing programs for handling the removal of both large and small aircraft.

f. With regard to work in industry on this subject, the Air Transport Association sponsored development of performance specifications for disabled aircraft recovery equipment based on the concept for a system with compatible components. The Airport Operators Council International (AOCI) made a survey on REMOVAL OF DISABLED AIRCRAFT FROM ACTIVE RUNWAYS. As a result of this survey, the AOCI issued a

report of their findings which outlined problem areas, ideas for improvement and the availability of recovery equipment. Current work is also being done by industry on special dollies for moving jumbo jets; conveying aircraft by the air cushion principle, and a technique for horizontal movement of an aircraft while it is suspended on pneumatic lifting bags.

2. TYPES OF OCCURRENCES AND INVESTIGATIVE PROCEDURES. Aircraft can become immobilized on airport surfaces for a variety of reasons. Uncomplicated problems, such as an engine failure, a blown tire, or a brake malfunction should be handled with little delay. If the aircraft is substantially damaged in a landing, takeoff, or taxiing accident, an investigation will be required. In these instances, the aircraft or its parts should not be moved until released by the authorized representatives of the cognizant investigative agency. The National Transportation Safety Board (NTSB) has the basic responsibility for investigating aircraft accidents and incidents, but has delegated the investigation of certain small aircraft accidents to the Federal Aviation Administration (FAA).

3. ACCIDENT INVESTIGATIONS.

a. The rules pertaining to release of aircraft in Title 14, Code of Federal Regulations Part 430, paragraph 430.10 read as follows:

"Subpart C-Preservation, Access to and Release of Aircraft Wreckage, Mail, Cargo, and Records

430.10 Preservation of aircraft wreckage, mail, cargo, and records.

"(a) The operator of an aircraft is responsible for preserving to the extent possible any aircraft wreckage, cargo, and mail aboard the aircraft, and all records, including those of flight recorders, pertaining to the operation and maintenance of the aircraft and to airmen involved in an accident or incident for which notification must be given until the Board takes custody thereof or a release is granted pursuant to §§ 430.11.

"(b) Prior to the time the Board or its authorized representative takes custody of aircraft wreckage, mail, or cargo, such wreckage, mail and cargo may be disturbed or moved only to the extent necessary:

"(1) To remove persons injured or trapped;

"(2) To protect the wreckage from further damage, or

"(3) To protect the public from injury.

"(c) Where it is necessary to disturb or move aircraft wreckage, mail or cargo, sketches, descriptive notes, and photographs shall be made, if possible, of the accident locale including original position and condition of the wreckage and any significant impact marks."

b. On 1 April 1968, a dispatch was forwarded to FAA and NTSB field personnel which clarified the intent of paragraph 430.11(b) of Part 430 of the NTSB Regulations. The dispatch stated, in part, that paragraph 430.11(b) "...confers authority to FAA to release wreckage for accidents delegated to FAA to investigate for NTSB /fixed-wing aircraft with a maximum takeoff weight of 12,500 pounds or less except accidents in which fatal injuries have occurred to an occupant of such aircraft/. This authority enables the investigator to grant temporary conditional release to a third party for the purpose of clearing an obstructed landing area.

"If upon initial notification involving an accident delegated to FAA by NTSB, it is known that the wreckage is or is likely to impede airport operations, the FAA official receiving notification shall promptly advise authorities concerned that the wreckage may be moved to the extent necessary to permit resumption of operations provided that the original position, significant impact marks, and condition of wreckage are recorded as practicable. Following removal of wreckage from runway, the wreckage shall then be preserved pending further disposition by the FAA investigator.

"Prompt notification of accidents to NTSB and FAA facility directly concerned is essential to timely and responsive implementation of this policy."

As a last resort, if wreckage is an immediate detriment to safety, and neither the NTSB nor FAA can be contacted, the airport management should record all available evidence and take steps to have the aircraft removed.

4. RESPONSIBILITY.

a. Responsibility of Airport Owner

(1) The owner of an airport which has been developed in part with Federal aid, has assumed certain obligations, including a commitment to operate and maintain the airport in a safe and usable condition for the use and benefit of the public. Although not always expressly stated in its agreement with the United States, there is an implied duty to keep aeronautical facilities available for use by having obstructions removed or by making plans to lessen the effects of obstructions that jeopardize the safety of flight operations. The presence of an immobilized aircraft could constitute such an obstruction. Prudence dictates that an airport owner should thoroughly explore his authority so as to clearly understand his rights and responsibilities with respect to an immobilized aircraft, as well as the rights and responsibilities of the aircraft owner.

(2) If the disabled aircraft, because of its location, jeopardizes the safety of other flights, all or part of the airport should be closed. It is the responsibility of airport management to make this determination. Among the circumstances to be considered are:

(a) Can positive control of vehicles and personnel be maintained?

(b) Is an alternate runway available, and will it accommodate all aircraft?

(c) What is the existing weather condition?

(d) Is a suitable alternate airport available?

(3) If there is to be an appreciable delay in removing the disabled aircraft, airport management should light and mark it clearly and designate all areas of the movement surfaces which are closed. In addition, during removal operations it is sometimes necessary to install temporary lights on removal equipment such as those that were put on the crane booms shown in Figure 11, Page 9, Appendix 2, because of their proximity to the airport operational area.

(4) The first notification of any temporary restrictions should be to the controlling IFR authority such as the FAA control tower or air route traffic control center so that they can relay the information as rapidly as possible, and issue Notices to Airmen (NOTAM) or air advisories as appropriate. It is essential that air traffic control personnel be informed of plans for moving aircraft removal equipment onto the airport and that they be kept informed of the progress of removal operations. Further, it is important that the local air carrier office, or aircraft owner/operator/representatives be notified immediately, in the interest of getting assistance on the scene as quickly as possible.

b. Responsibility of Aircraft Operator.

(1) The responsibility for removing disabled aircraft, as well as providing or arranging for equipment and crews necessary for its removal, and the determination of the extent of damage prior to removal rests with the aircraft owner or operator. If the registered owner or operator cannot remove the aircraft or is dilatory in doing so, the airport management should have authority to act for him with minimum delay. However, to assure that secondary damage does not occur, it is important that such authoritative provisions do not imply that other than proper salvage procedures be used for removal of disabled aircraft. The method of establishing such authority will depend on the makeup and legal capabilities of the body responsible for managing the airport.

(2) The following is an example of enabling ordinances used in some locations pertaining to authority for aircraft removal:

"The pilot or operator thereof /any aircraft involved in any accident/ shall be responsible for the prompt disposal of aircraft wrecked or disabled at an air terminal and parts of such aircraft as directed by the Manager; in the event of his failure to comply with such directions such wrecked or disabled aircraft and parts may be removed by the airport owner at the operator's expense and without liability for damage which may result in the course of such removal."

5. ADVANCE PLANNING. More often than not, actual removal of a disabled aircraft is beyond the technical capability of the average airport owner. Some thoughtful advance planning is called for to assure that

the necessary equipment and skills will be furnished and can be quickly put to use when needed. Consider the following:

a. Prepare a detailed "Aircraft Recovery Plan" for each airport, ready to be put into motion as soon as an accident occurs or as soon as any required investigation permits. Contemplate the necessary emergency actions and assign specific responsibilities for carrying them out. THE COMPLEXITIES AND RESPONSIBILITIES INVOLVED IN REMOVING DISABLED AIRCRAFT MAKE IT IMPERATIVE THAT SOMEONE BE DESIGNATED TO TAKE CHARGE OF THE OVERALL OPERATION. Inform all major users of the airport of the airport management's preparations and capabilities, as well as policies regarding disabled aircraft removal. Applicable portions of this circular should be included in the airport plan. It is suggested that a copy of this circular be used as a part of the airport's "Aircraft Recovery Plan."

b. Local airline representatives should have a clear definition of their responsibility and authority to enter into contracts for removal services; and airport authorities should be made aware of these arrangements.

c. Among other things, include in the plan:

(1) The type and location of heavy equipment or special units needed and the average time it will take to get cranes, etc., to the airport.

(2) Access routes to all parts of the airport and any special routes needed for cranes in the vicinity of overhead power lines.

(3) Grid maps, of the type referred to in AC 150/5200-10, for use during aircraft recovery operations.

(4) Means of maintaining security for such operations.

(5) Manufacturers' data pertaining to aircraft recovery for the various types of aircraft which normally use the airport.

(6) The economic reasons to plan for the quick removal of disabled aircraft from airport operational areas in order to maintain uninterrupted flight operations.

d. Make advance plans to obtain the services of aircraft removal equipment and crews, through agreements with other airport sponsors, with military airfields, or with aeronautical industries in the vicinity of civil airports. An inventory of locally available salvage equipment should be kept current. This would include, in addition to equipment located on the airport, that which construction contractors and other operators of heavy machinery have in the vicinity and agree to make available. In this connection, the heavy demand for cranes, tractor-trailers, etc., in their primary use, indicates that a retainer fee may be necessary to assure availability on short notice. When arranging for equipment, anticipate that a primary source of equipment or operators may not be available, and that a second or even a third source for these services must be considered in the plans. Mere plans to call for heavy equipment are insufficient. An airport must have arrangements with equipment companies, and a commitment from the company to provide the services when they are needed.

e. Airport regulations should establish the owner's right to close all or part of the airport as necessary, his limits of liability, and penalties for violations. Particular attention should be given to the airport owner's authority to move disabled aircraft as discussed in paragraph 4.

f. Contractual arrangements between air carriers and fixed base operators should provide for a capability to move the types of aircraft normally used or serviced with minimum risk of secondary damage to either the aircraft or the airport. The plans may include those of an individual airline, a cooperative plan with the airport authorities, or a joint plan of a number of air carriers at a particular airport. An informal agreement between several air carriers for recovery operations is contained in Appendix 4, Page 1. The pooling of removal equipment by the airlines appears to have considerable merit because of:

(1) Logistic and time advantages of more widely distributed kits.

(2) Economic advantages as individual airlines would need fewer kits.

(3) Overall improvements that should result by gaining additional equipment from participation by a larger number of airlines.

g. Arrangements and agreements should take into account the air carrier and fixed base operators' plans and ability to expeditiously perform nonroutine aircraft repairs on runways.

h. Mutually supporting plans and agreements are needed on airports that are used jointly by civil aviation and the military forces.

i. In planning for recovery equipment, pay particular attention to:

(1) The furnishing and availability of a complete system for lifting or hoisting, and transport of aircraft.

(2) The compatibility of recovery system components and the necessity of support equipment such as materials handling equipment, cranes, dollies, flat bed trucks, etc.

(3) The availability of heavy winching equipment, due to the frequent use of this method of recovery.

j. Analysis of data on current recovery equipment indicates that the type of recovery equipment used does not make a big difference in the actual removal time. This is because of the time-consuming complex job of maintaining aircraft stability while lifting, jacking or raising the aircraft by various means. This time-consuming job is also related to the problems involved in arranging and using recovery equipment so as to prevent damage to the aircraft skin or structure. In view of these factors, the most significant time advantages can be gained by having agreements for recovery, having someone to take charge of the overall operation and having adequate recovery equipment on hand, or available for fly-in on short notice. It is, further, advisable for airports with only one runway to have recovery equipment either on the airport, or within the vicinity of the airport.

6. PROCEDURES AND TECHNIQUES. The basic aims for recovery operations are to minimize removal time and to avoid secondary damage so that aircraft which have retained structural integrity may be returned to service.

a. The sequence of events surrounding disabled aircraft occurrences includes removal of passengers; securing release of the aircraft from the NTSB, or when delegated, the FAA; unloading cargo, baggage, and defueling; lifting the aircraft; and removal of the aircraft from the airport operating area.

b. The sequence of events surrounding occurrences where special removal equipment is not required, includes removal of passengers; determining the extent of damage to components, i.e., tires and wheels; making repairs; and towing or taxiing the aircraft from the runway.

c. From a time saving standpoint, it will be advantageous to start defueling, or transferring of fuel (to shift the center of gravity), prior to official release of the aircraft, at the discretion of the NTSB/FAA investigator. The purpose of this arrangement is to reduce the overall time it takes to remove disabled aircraft where the weight has to be shifted or reduced. Determine the quantity of fuel removed from each aircraft tank so that accident investigating teams can have this vital information.

d. The functions of aircraft removal should be done with primary consideration being given to the safety of all personnel working on the job; all reasonable assurance that secondary damage does not occur to the aircraft; and with dispatch, to insure that runway closure time will be held to a minimum. Overall removal time can be reduced by doing things concurrently, such as getting removal equipment into place, while the aircraft is being unloaded or readied for removal.

e. The amount and variety of equipment needed to remove disabled aircraft necessitates that airport resources be considered by the airport owner to complement items available through the air carriers and fixed-base operators. It is also desirable that cross-training be accomplished for the various mechanics and crews available to work on these type jobs, to make sure that special skill requirements are met.

f. Aircraft maintenance organizations, or the firms that specialize in removal of disabled aircraft, are best qualified to do these jobs properly.

7. GENERAL DATA ON METHODS.

a. The information below regarding the more common types of occurrences is intended to help airport personnel understand the scope and nature of work involved in removing disabled aircraft. (These and other related principles are covered in detail in aircraft maintenance manuals and in manufacturers' data.) A knowledge of these

principles will aid untrained personnel who may be assigned to help designated and trained crews in this work.

b. It must be recognized that these are complex, mechanical problems, especially regarding hull inspection, planning the operation, and in determining what method to use in lifting and removal operations. The assistance of certificated mechanics should be solicited.

c. The condition of the aircraft must be determined, as most of the work associated with removal will be dependent upon these findings. Other major considerations include weather, terrain, and the type of special removal equipment (e.g., cranes and winches) available on the airport or through local rental companies and contractors.

d. Some of the more common situations that occur which result in an aircraft becoming disabled are outlined below, along with typical methods of removal. In addition, appendices are included. These appendices show some actual removal operations, methods used for removal, and information on removal equipment.

CONDITIONS	TYPICAL METHODS OF REMOVAL
Collapsed nose gear.	Jacking and use of pneumatic lifting bags; hoisting with cranes and the use of specially designed slings; or by pulling down on tail tie-down fitting.
Collapsed or retracted main gear, but nose gear intact and extended.	Jacks, pneumatic lifting bags, or cranes.
Collapsed main gear, one side only.	Jacks, pneumatic lifting bags, or cranes.
Collapse of all landing gears.	Jacks, pneumatic lifting bags, and cranes.
One or more main gear off pavement, no aircraft damage.	Assuming that the aircraft will have the gear bogged down in soft soil or mud, extra towing or winching equipment or use of pneumatic lifting bags will usually suffice for this type removal. It may be necessary to construct a temporary ramp from timbers, matting, etc.

Nose gear failure and one side of main gear failure.	Jacks, pneumatic lifting bags, or cranes.
Tire failures and/or damaged wheels.	Jacks and parts replacement.

(1) In addition to lifting an aircraft, plans are required for equipment to remove the aircraft from the scene if gear cannot be lowered. Equipment which has been most frequently used for this purpose includes flatbed trailers and various types of dollies.

(2) Other equipment or systems, such as that offered by companies who specialize in this business are also available. While these companies employ special equipment for conveying an aircraft, they also complement conventional equipment, such as jacks or cranes.

e. Some of the most likely places to obtain support equipment needed for aircraft recovery are:

Boatyards and shipyards	Machine shops
Bus company garages	Military establishments
Construction firms	Oil company shops
Crane rental companies	Quarries
Dock areas	Railroad shops and yards
Foundries	Rigging companies
Junkyards	Sugar Mills
Large farms	Telephone companies
Lumberyards	Trucking firms

(1) In investigation of recovery procedures, aircraft manufacturers have found that dollies, wooden and steel beams, towing equipment and procedures used by house moving contractors can be adapted for use in damaged aircraft recovery operations.

(2) Field representatives of aviation insurance underwriting companies are in a position to furnish information regarding firms or individuals that are experienced in this work, assuming that insurance firms will be notified of such occurrences promptly.

(3) It is necessary that arrangements be made to obtain fuel handling equipment, as aircraft with a portion or all of the gear off the runway will most likely require defueling prior to other operations.

(4) It is also apparent that plans and arrangements will be required to obtain bulldozers, etc., for those exceptional cases where aircraft have broken up and are determined to be beyond salvage value. This, of course, would involve emergency situations where secondary damage is not a limiting consideration. The plans of one aircraft manufacturer show methods for dragging an aircraft off a runway in an emergency situation by the use of cables and towing equipment.

(5) The infrequent use of removal equipment, such as pneumatic lifting bags, presents special problems associated with storage, inventory, periodic inspection, and tests. Adequate maintenance and storage are essential to assure serviceability and availability of removal equipment.

8. ACCESS AND REMOVAL ROUTES IN SOFT TERRAIN

a. As previously noted, it is advantageous to start defueling operations as soon as possible after passenger evacuation. It should save time and should expedite defueling and unloading operations if consideration is given to maintaining material, such as fiber glass matting, the various available types of airfield landing mat, or other ramp construction materials to make a temporary vehicle roadway to the aircraft. Also, consider using material that can be reused, rather than constructing a temporary roadway which can prove to be costly. Plans for a single means of access to the aircraft and to bring the aircraft out has obvious advantages. Materials which can be used for this purpose are illustrated in Appendix 2, Figures 18 through 22, pages 16 through 20.

b. The engineering staff on airports can analyze soil conditions adjacent to runway surfaces and plan for temporary treatments for the removal of aircraft. Under various weather conditions, the civil engineer can determine that a certain thickness of crushed stone, or that other stabilizing materials will support aircraft with certain gear loads.

9. SAFETY CONSIDERATIONS.

a. Establish a standby with aircraft fire fighting and rescue vehicles.

b. Take measures to eliminate or reduce the hazards of spilled fuel by the use of blanketing type fire extinguishing agents or by flushing with water.

c. Separate the aircraft at any points of major fracture prior to movement.

d. Stay clear of aircraft surfaces during actual lifting, i.e., between shoring and plane surfaces. Also, stay clear of tow cables.

e. Move the aircraft to a point where it can remain for an extended period during the first move.

f. Clean up the area after removal operations are completed.

g. Prior to reopening operational areas, make a safety inspection to determine that no hazardous pavement or shoulder conditions exist and that lights operate.

APPENDIX 1. REMOVAL AND TRANSPORT OF SMALL AIRCRAFT

Several problems have been associated with removal of small aircraft, including:

(1) Delay in removal from airport operating areas;

(2) Additional damage caused by improper methods;

(3) Lack of equipment for removal;

(4) Lack of information on proper methods of removal;

(5) Recovery by inexperienced persons; and

(6) Lack of plans for removal operations.

While these problems have been largely related to operations on airports, similar problems have been experienced in removing small aircraft from crash locations off airports. This appendix deals briefly with both of these situations. The equipment illustrated in this appendix should be adaptable for use both on and off airports. However, the scope of this circular is primarily limited to airport and industry programs for assuring the prompt removal of disabled aircraft from airport operational areas. In addition, advance planning as outlined in paragraph 5 of the circular is of utmost importance to assure the efficient handling of both small and large aircraft.

Experience shows that both small mobile cranes and automotive towing trucks have been used effectively to remove small aircraft. The removal of this type aircraft can be handled safely and efficiently without having elaborate equipment. The main things to consider are: arrangements to get special mobile units on the scene promptly; the availability of slings, jacks, air bags and dollies; and the supervision of experienced personnel. The illustrations in this appendix show improvisation in methods for removing small aircraft.

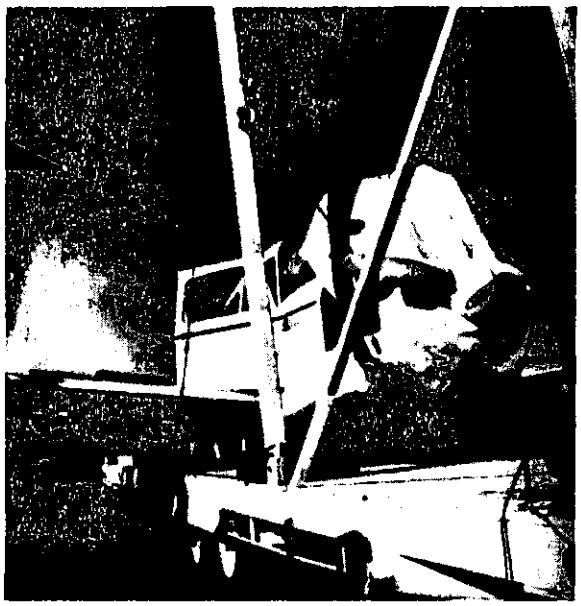
The following details pertain to the construction and operation of the trailer shown in Figures 1 and 2, Pages 3 and 4.

a. The trailer is 36 feet long, of steel construction, with a hinged boom that extends 10 feet beyond the trailer edge. Screw type jacks are used to level the trailer for loading. Two winches are used--one to lift the boom and the other to operate the steel lifting cable. Power is furnished by a 110 volt generator. The band that is used to lift the plane was woven of nylon webbing material. However, when lift points are provided on aircraft engines, steel sling-cables are used for the lifting.

b. These aircraft are defueled as a matter of routine in preparation for lifting, partial disassembly, and for moving. Then, the trailer is positioned for lifting the aircraft onto the edge of the trailer. While the aircraft is in this position, the wings and horizontal stabilizers are removed, and the fuel and hydraulic lines are disconnected. The aircraft is then pulled forward on the trailer and secured for transport.

Another method used to remove small aircraft is shown in Figure 3, Page 5.

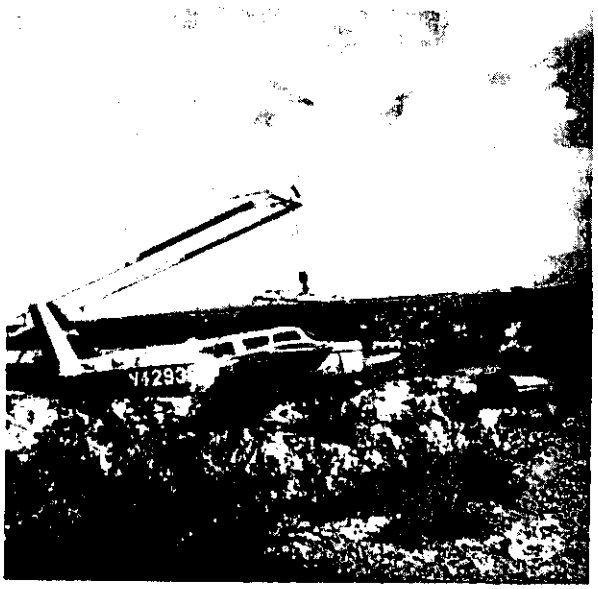
Figure 4, Page 6, shows a new concept developed by Sikorsky Aircraft Division, United Aircraft Corporation for the U.S. Army Aviation Materiel Command, for lifting small aircraft in areas which are inaccessible to surface vehicles. Pneumatic lifting bags of the type shown in Figure 13, Page 11, Appendix 2, are also adaptable for use with small aircraft.



← NOTE HINGED BOOM ARRANGEMENT ON FLAT BED TRAILER

LIFTING BAND MADE OF NYLON WEBBING MATERIAL →

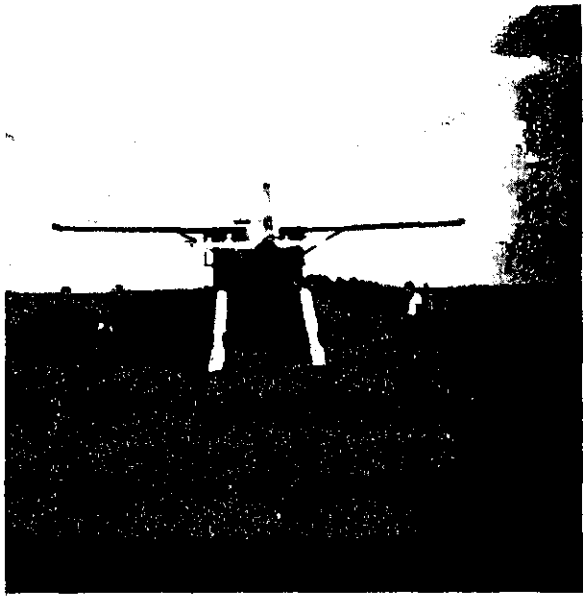
FIGURE 1. SPECIAL LIFTING EQUIPMENT FOR REMOVAL OF SMALL AIRCRAFT



← START OF LIFT OF AIRCRAFT

LOADING OF AIRCRAFT COMPLETED →
NOTE THAT WINGS WERE REMOVED
FOR TRANSPORT.

FIGURE 2. PROCEDURES IN REMOVAL OF SMALL AIRCRAFT



THIS AIRCRAFT WHICH HAD COME TO REST IN AN INVERTED POSITION WAS LOADED ON A "HALF TRACK" TYPE VEHICLE BY THE USE OF WOOD BEAMS.

THE AIRCRAFT WAS PLACED ON A SMALL PLATFORM AREA AND SECURED IN A LEVEL ATTITUDE FOR HAULING.

FIGURE 3. RECOVERY AND TRANSPORT OF AN AIRCRAFT FROM THE EVERGLADES

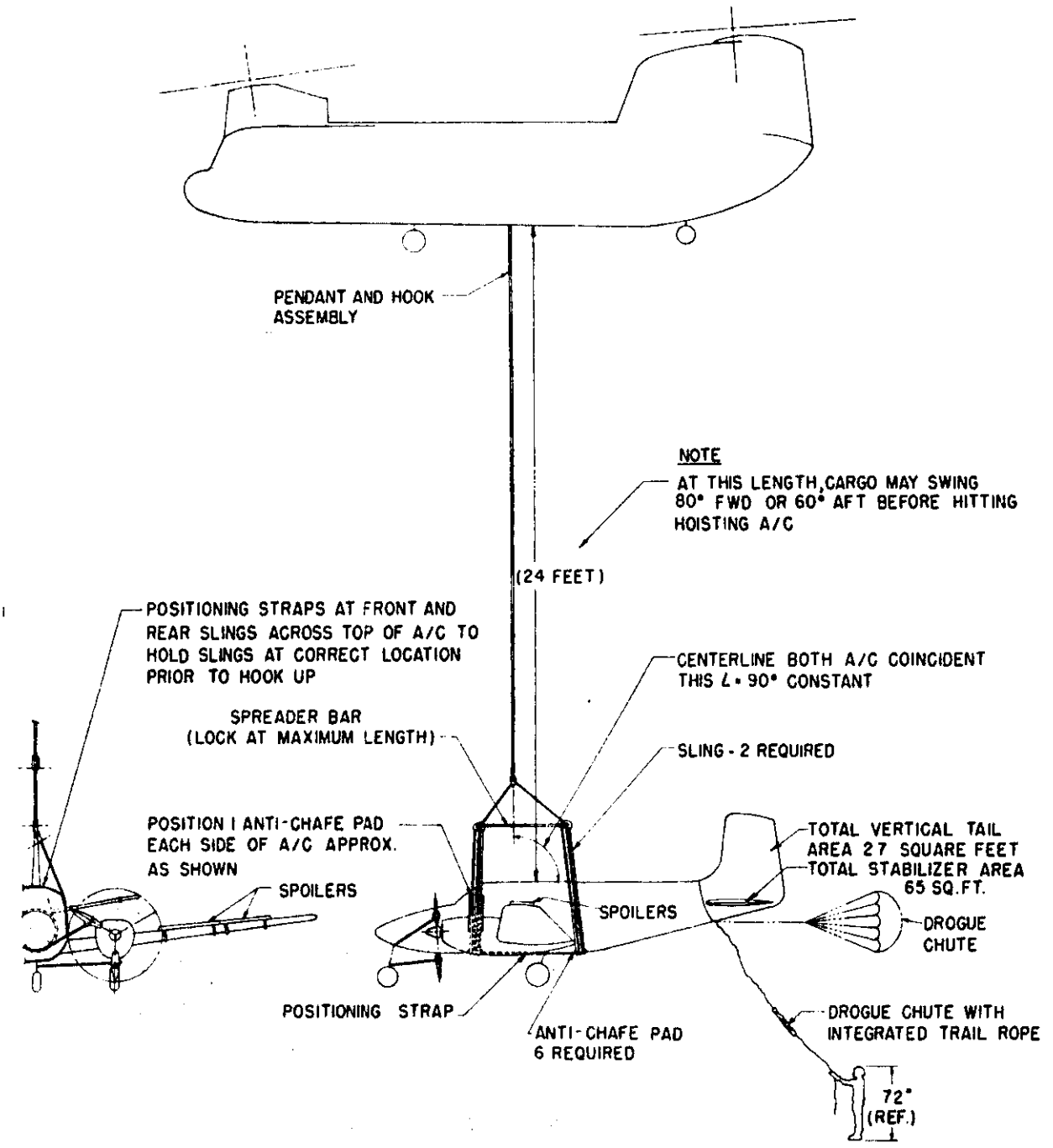


FIGURE 1. AERIAL RECOVERY KIT

APPENDIX 2. REMOVAL OF LARGE AIRCRAFT

The illustrations in this appendix show some of the available equipment, proposals, and methods used for removal of these aircraft. To some extent, these illustrations are also indicative of the scope of operations in removal of large aircraft. This material is intended as an aid in planning and coordinating efforts to take advantage of available assets to do these jobs. Detailed instructions on removal procedures are contained in Chapter 7, Lifting and Shoring, of the aircraft maintenance manuals. In addition, aircraft manufacturers are developing recovery documents for new aircraft that are now intended for use by airport and aircraft operators. Such documents include the BOEING 747 DAMAGED AIRPLANE RECOVERY, D6-30114 AND THE DC-10 AIRCRAFT RETRIEVAL. It is significant that these new type documents are more informative than the data previously included in service bulletins on this subject.

Another important approach is being pursued by industry planners for the design of complete recovery systems. This approach not only lends itself to developing equipment that will be adaptable to various aircraft, but it takes into account that the parts of the system will be compatible. In the past, recovery equipment development has generally involved lifting and hoisting devices which depended upon the availability of support units such as flatbed trucks or cranes, even in remote areas. However, the problems of obtaining large support units such as cranes and flatbed trucks have resulted in planning for kits that can be transported by air. This includes the use of "dummy" gears, dollies with adjustable contour frames, and "trolley" trailers that have features corresponding to those of jacks. The use of mobile cranes for this purpose is increasing where they are available near airports. This is especially true for aircraft such as the B-707, the DC-8, the B-727, and smaller types of aircraft.

As pointed out in BOEING 747 DAMAGED AIRPLANE RECOVERY, D6-30114, the "Use of crane hoists is an excellent means of lifting a damaged airplane. With hoists a continuous lift is possible because it is not necessary to provide intermediate support between lifts as in the case of lifting with jacks or air bags. However, due to the weight of the Boeing 747 and the probable unavailability of cranes of the required lifting capacity and reach, use of this method in recovering a damaged B-747 is limited.

"Using a large number of cranes to lift the B-747 does not appear to be feasible due to the difficulties in coordinating the cranes such that the proper load will be taken by each hoist.

"However, use of a single crane should prove valuable in the initial leveling of the airplane. Lifting the nose by hoisting on a four foot wide heavy duty mesh sling passed under the fuselage should prove expeditious."

Figures 5 through 26, Pages 3 through 24, show various available equipment and methods used to lift and to remove disabled aircraft. They show procedures for the use of pneumatic aircraft lifting bags, the use of jacks, the use of mobile cranes and for winching aircraft.

Figures 27 and 28, Pages 25 and 26 show equipment being developed by industry for aircraft recovery.

FIGURE 5. JACKING OPERATION IN PREPARATION FOR REPLACEMENT OF TIRES

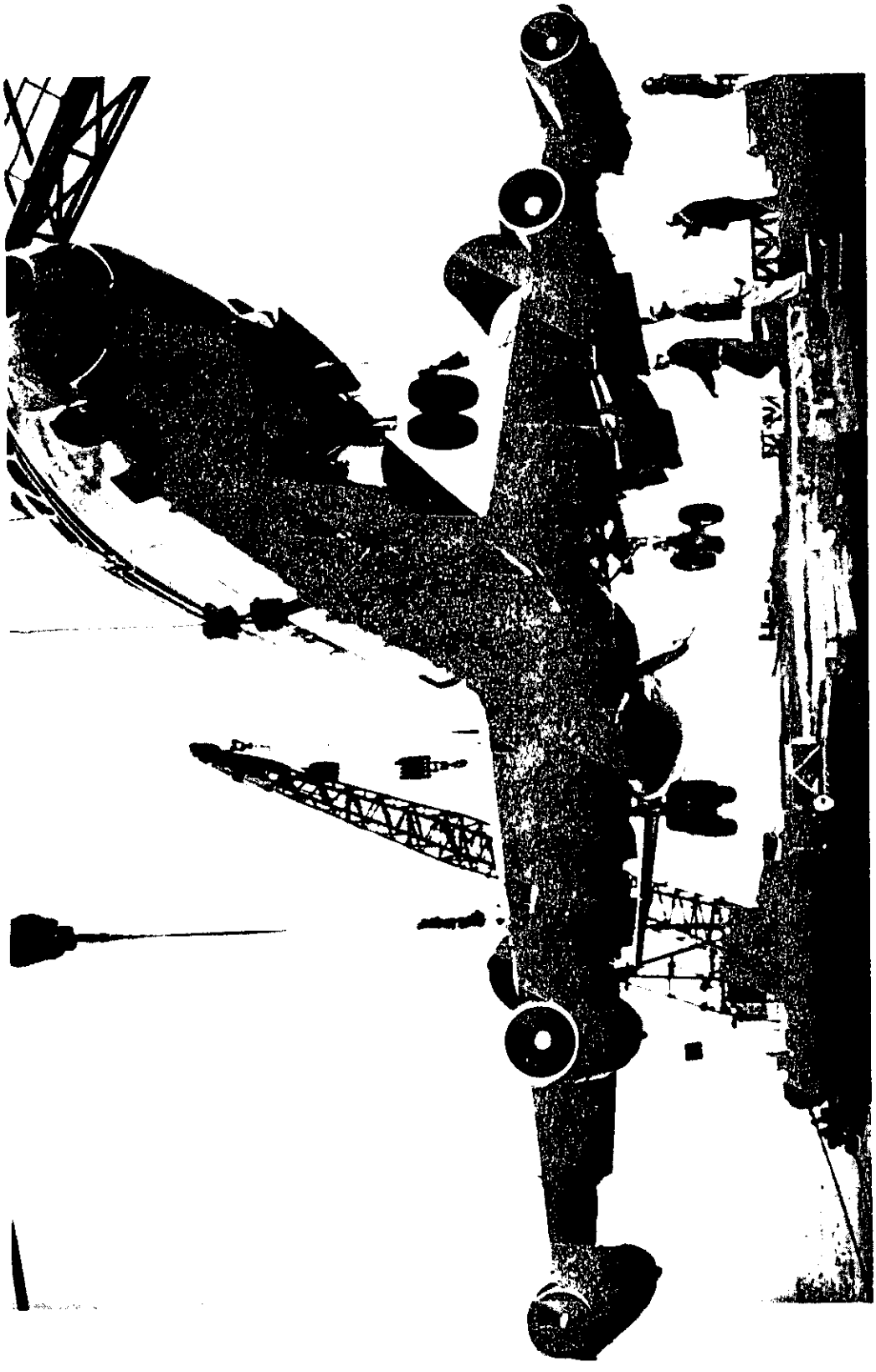


FIGURE 6. BARGE CRANES AND SPECIAL REMOVAL METHOD USED TO LIFT AIRCRAFT FROM BAY ONTO BARGE

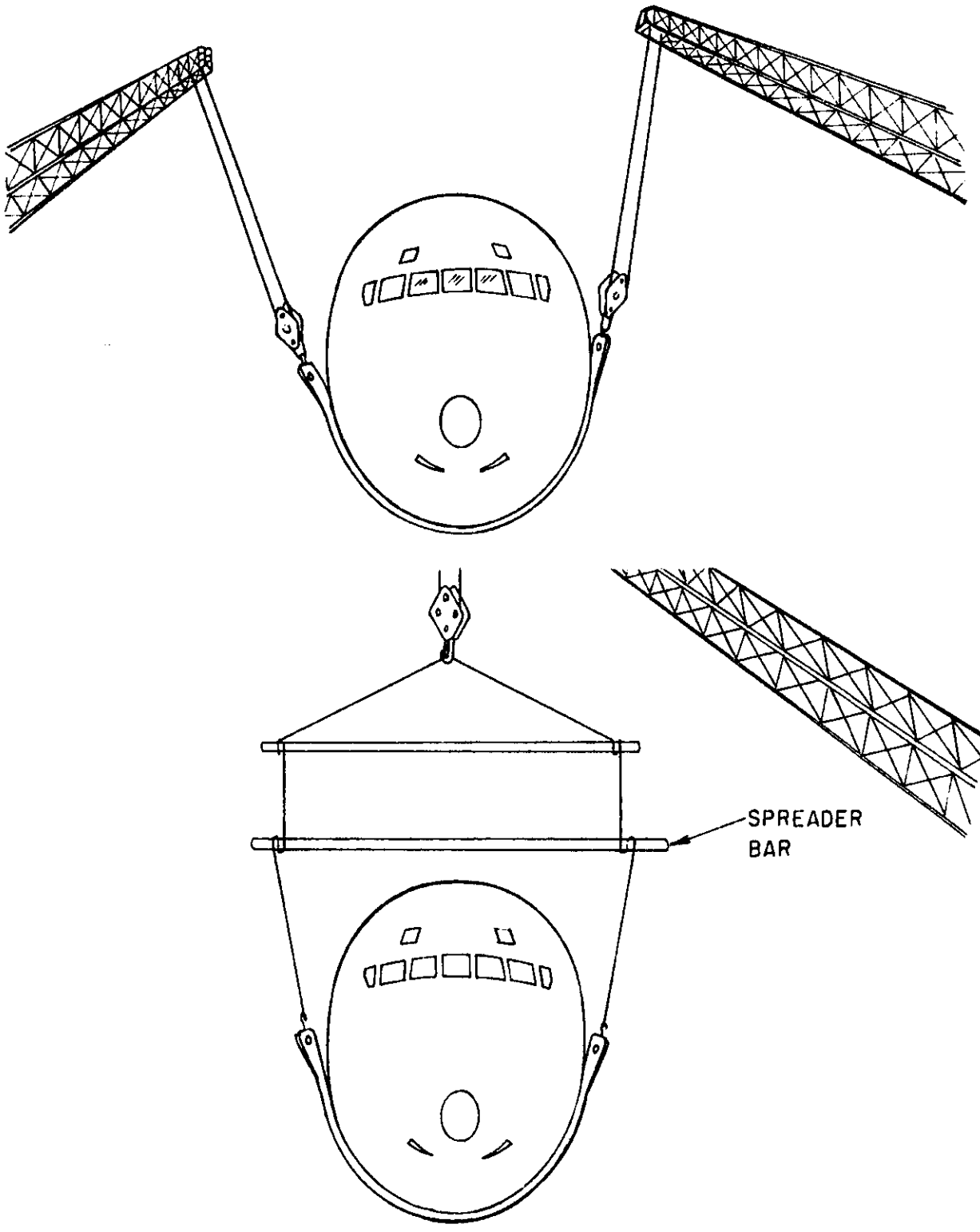
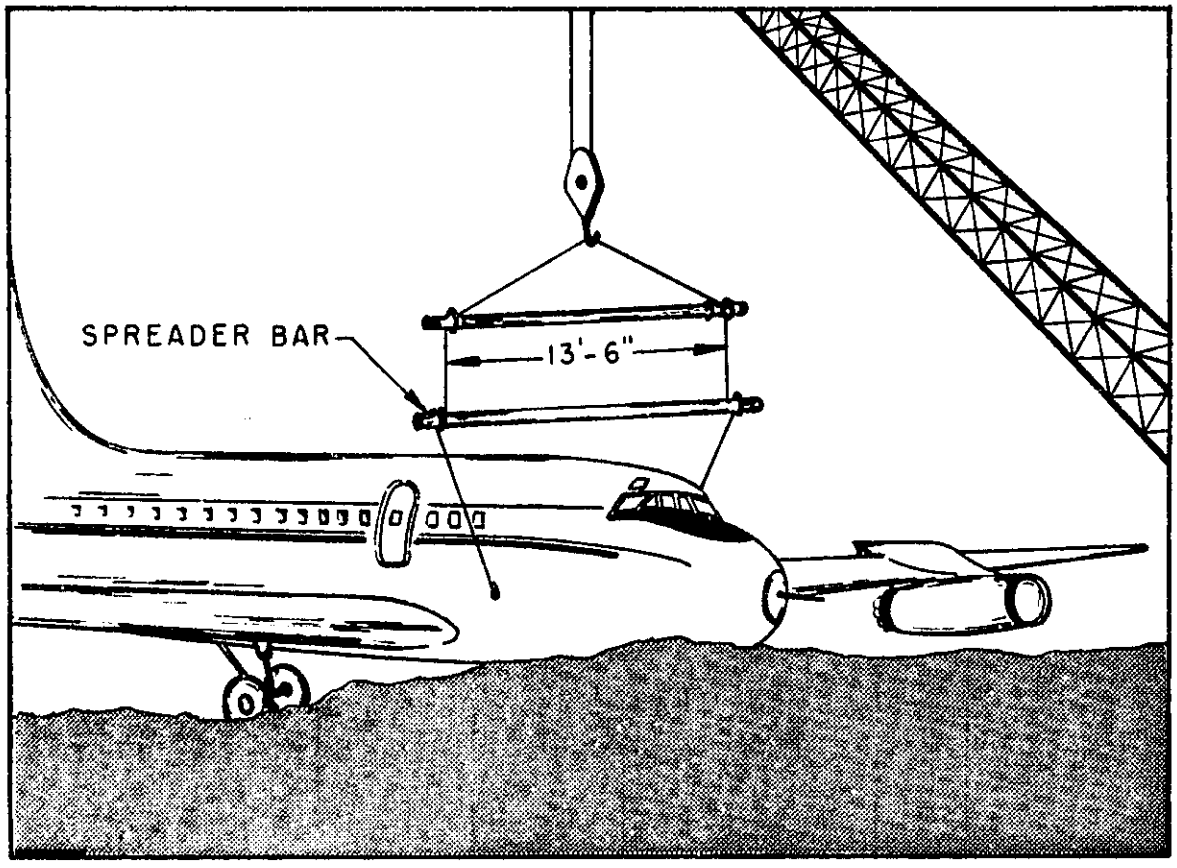
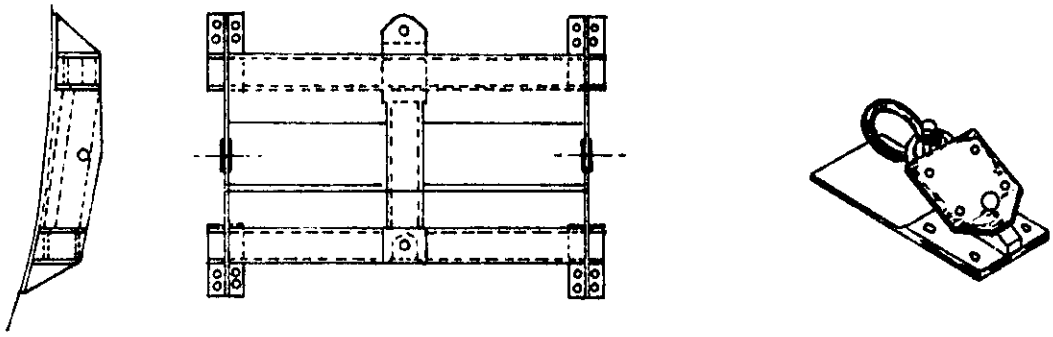


FIGURE 7. METHODS OF LIFTING NOSE OF AIRCRAFT USING LOOP - TYPE SLING



LIFTING WITH SIDE FITTINGS AND CRANE



TYPICAL SIDE FITTINGS

FIGURE 8. LIFTING AN AIRCRAFT WITH SLING THAT REQUIRES SPECIAL SIDE FITTINGS

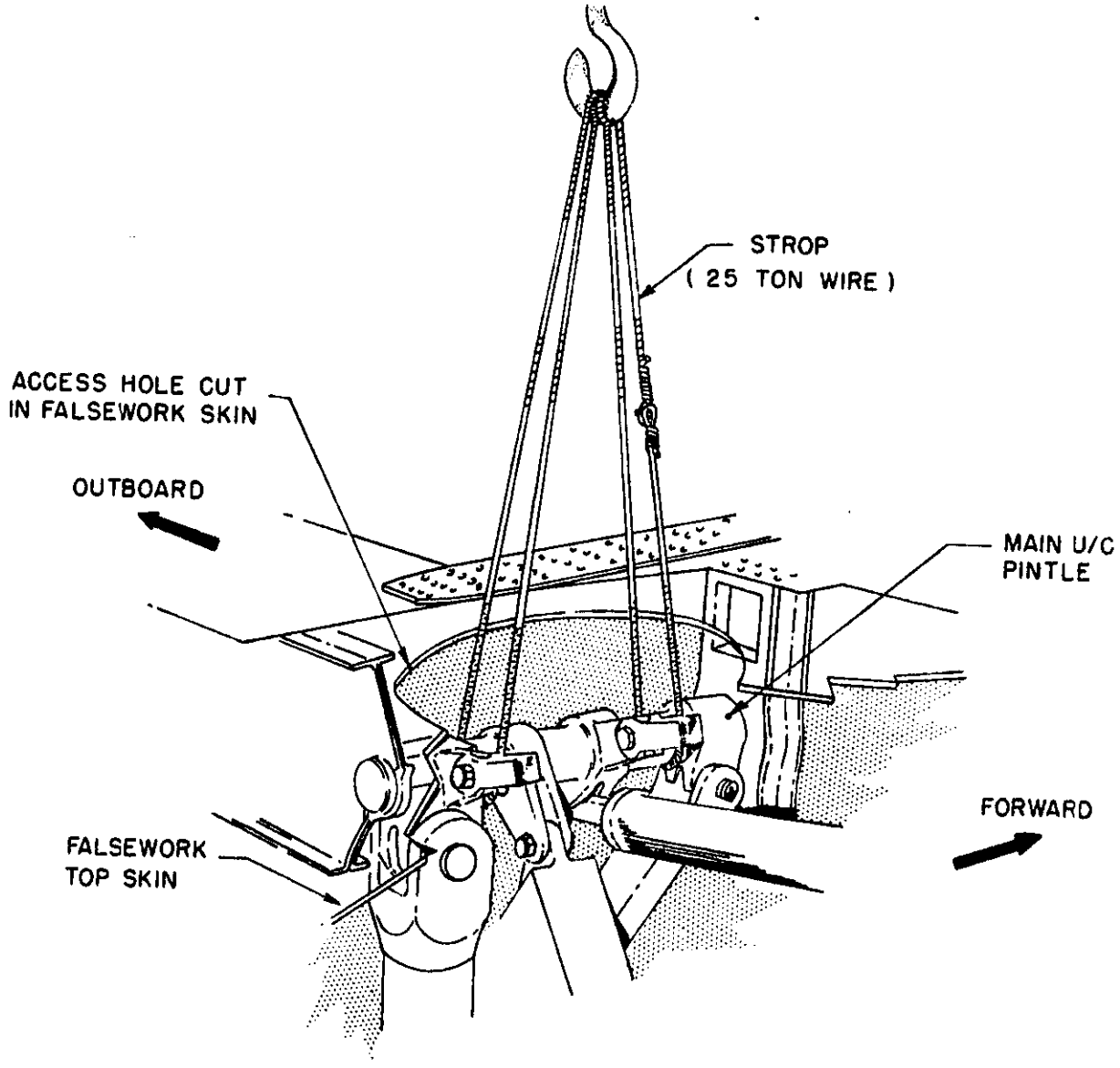


FIGURE 9. DETAIL OF EMERGENCY LIFT POINT ON BAC ONE-ELEVEN FOR ATTACHMENT TO CRANE

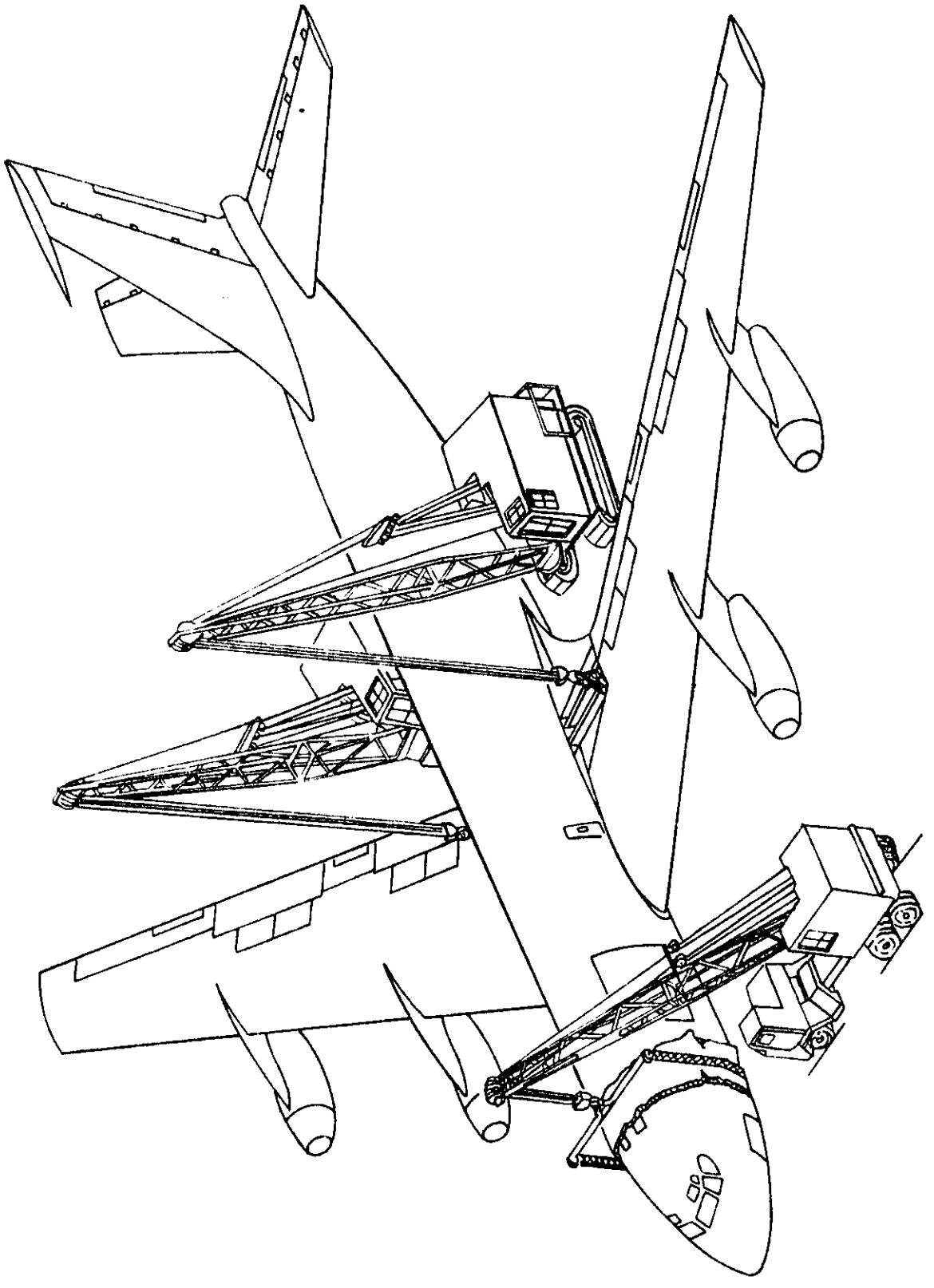


FIGURE 10. ILLUSTRATED METHOD OF LIFTING AN AIRCRAFT WITH MOBILE CRANES

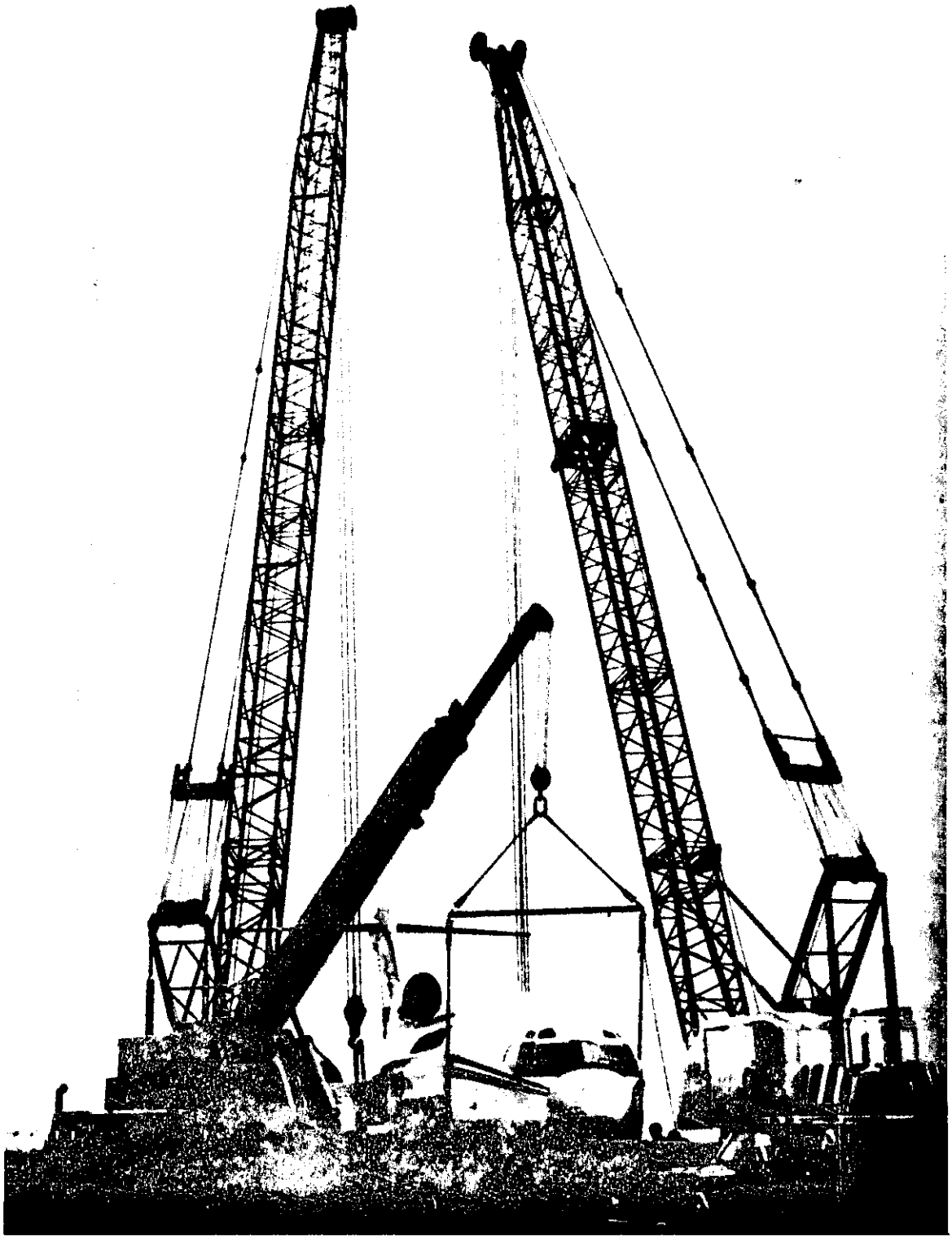


FIGURE 11. MOBILE CRANES BEING USED TO LIFT A DISABLED AIRCRAFT

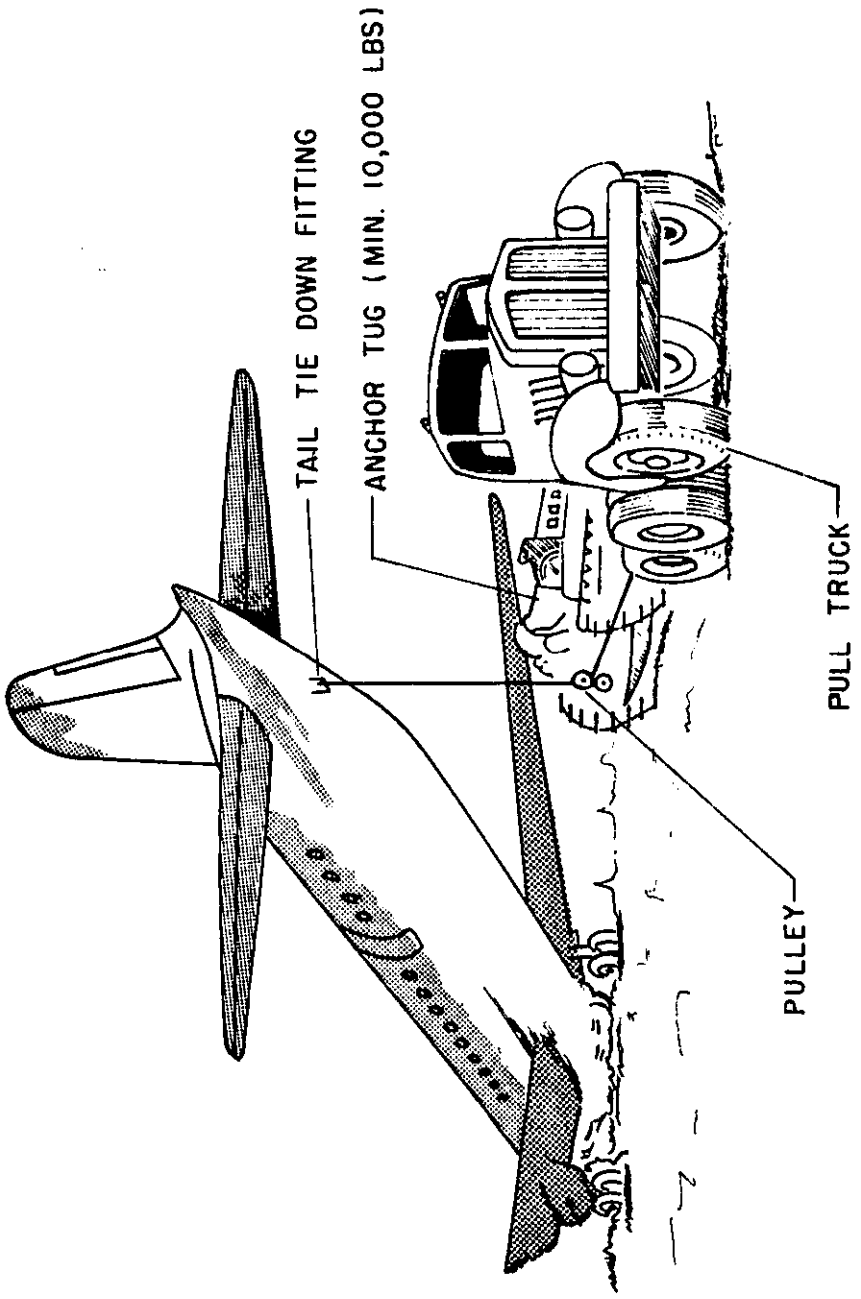
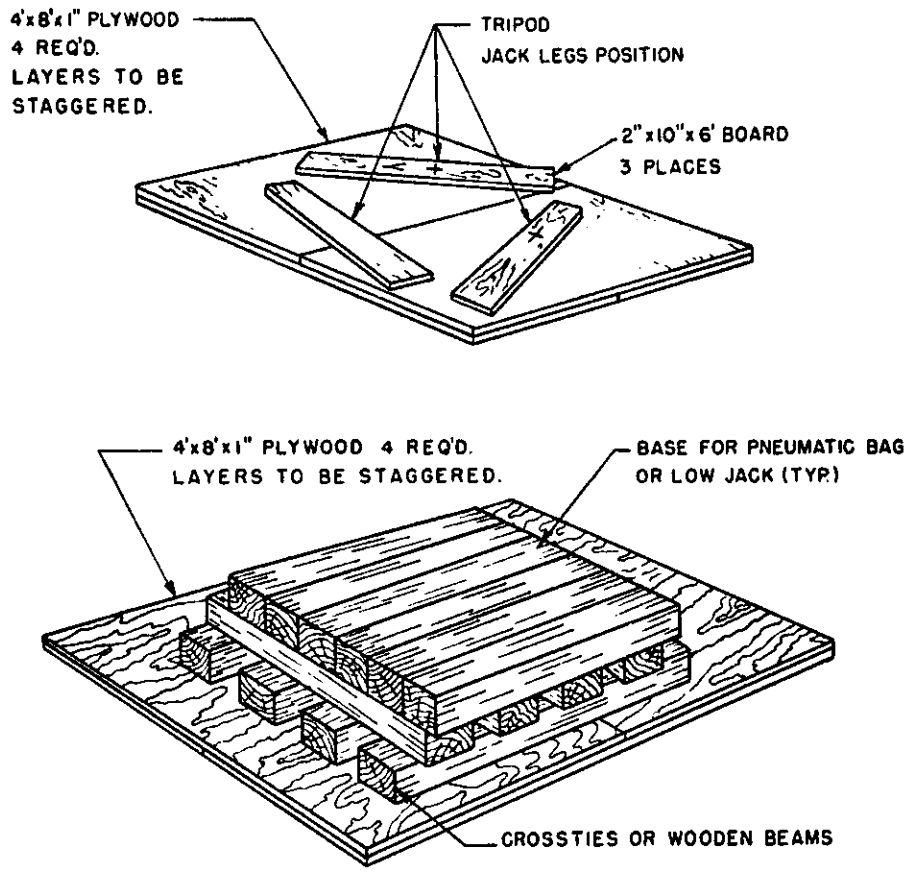


FIGURE 12. METHOD OF RAISING NOSE OF AIRCRAFT BY PULLING DOWN ON TAIL

FIGURE 13. LIFTING BAGS OF THE TYPE HAVING THREE INDEPENDENT INFLATION COMPARTMENTS IN USE

FIGURE 14. HIGH STABILITY TYPE AIRCRAFT PNEUMATIC LIFTING BAGS IN USE



NOTE: 3/4" THICK PLYWOOD MAY BE USED WHEN 1" IS NOT AVIALABLE

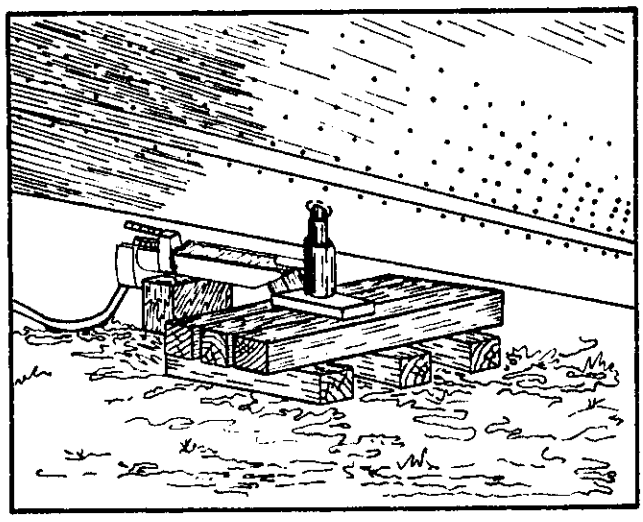


FIGURE 15. LIFTING BASES FOR JACKS AND AIR BAGS IN SOFT MUD

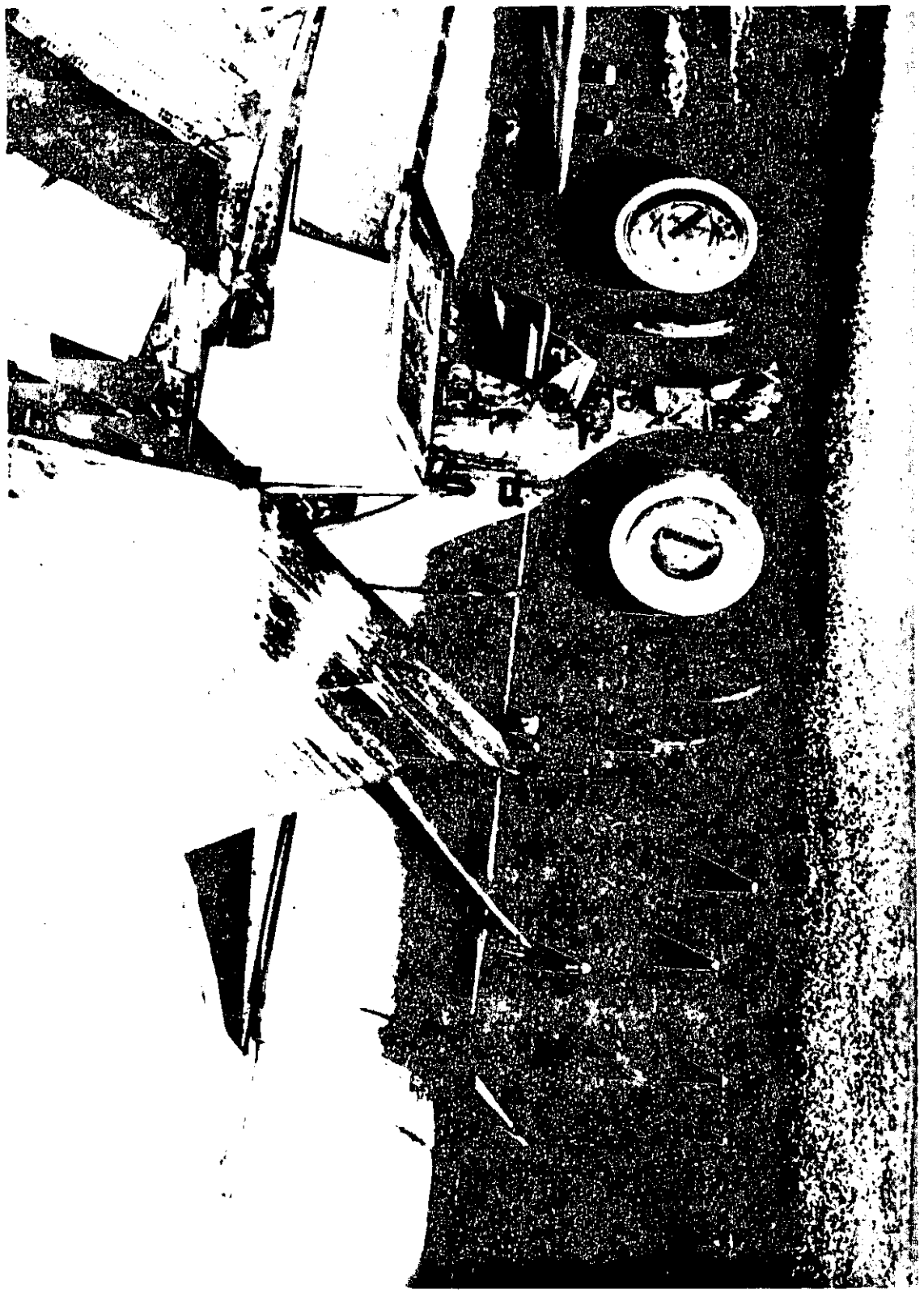


FIGURE 16. PICTURE OF AIRCRAFT WHICH CAME TO REST PARTIALLY OFF THE RUNWAY

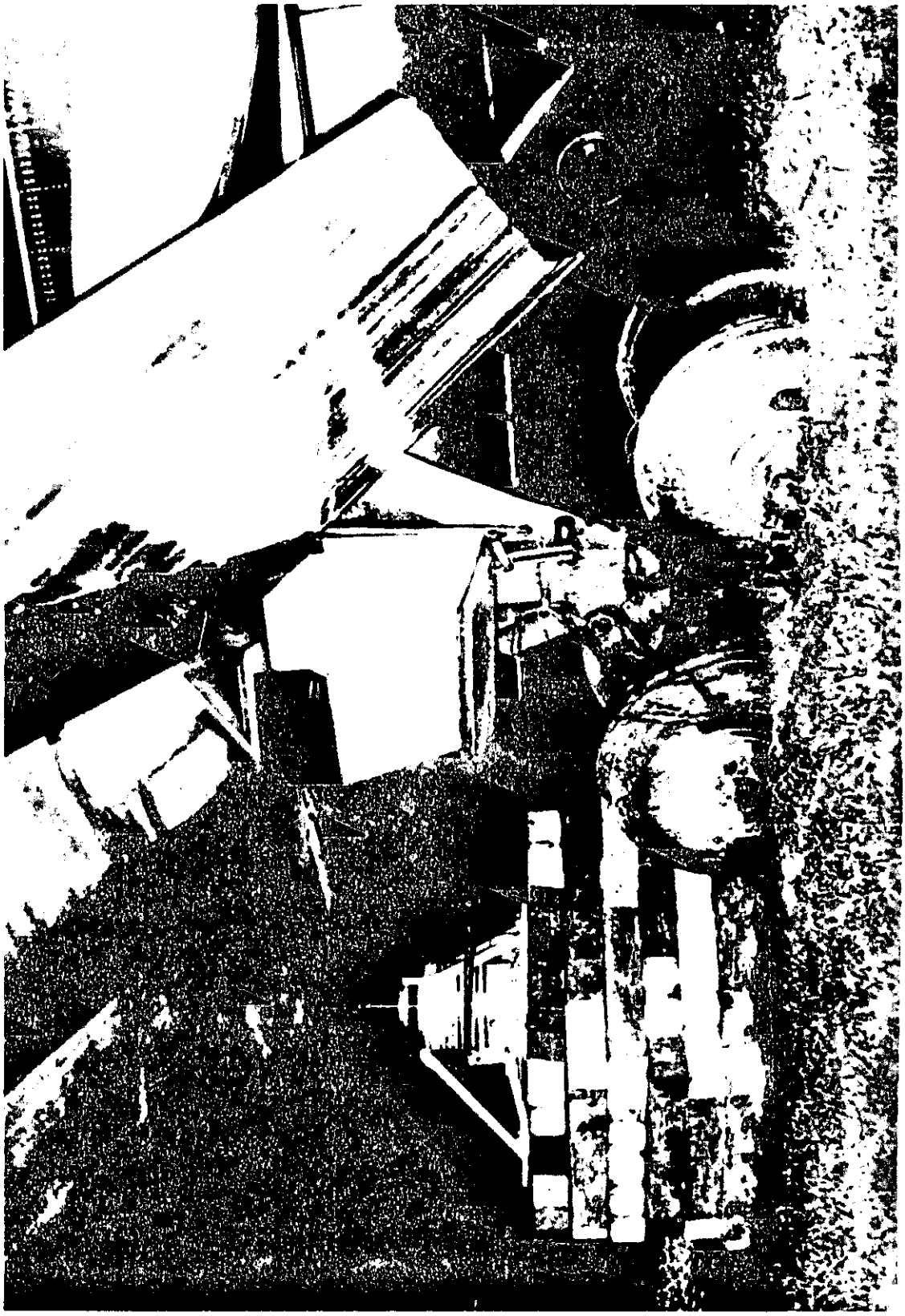


FIGURE 17. METHOD OF LIFTING AIRCRAFT SHOWN ON OPPOSITE PAGE

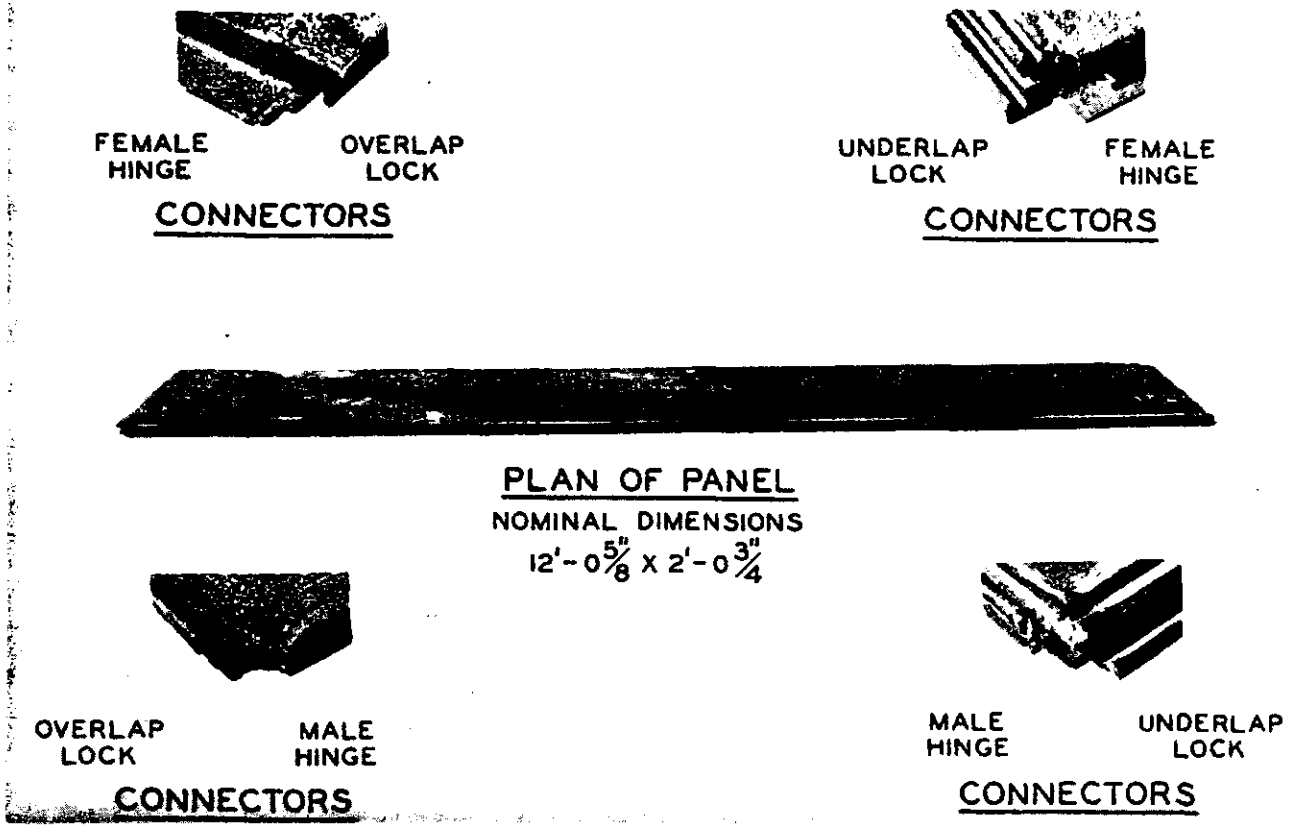


FIGURE 18. COMPOSITE VIEW OF AM2 ALUMINUM LANDING MAT

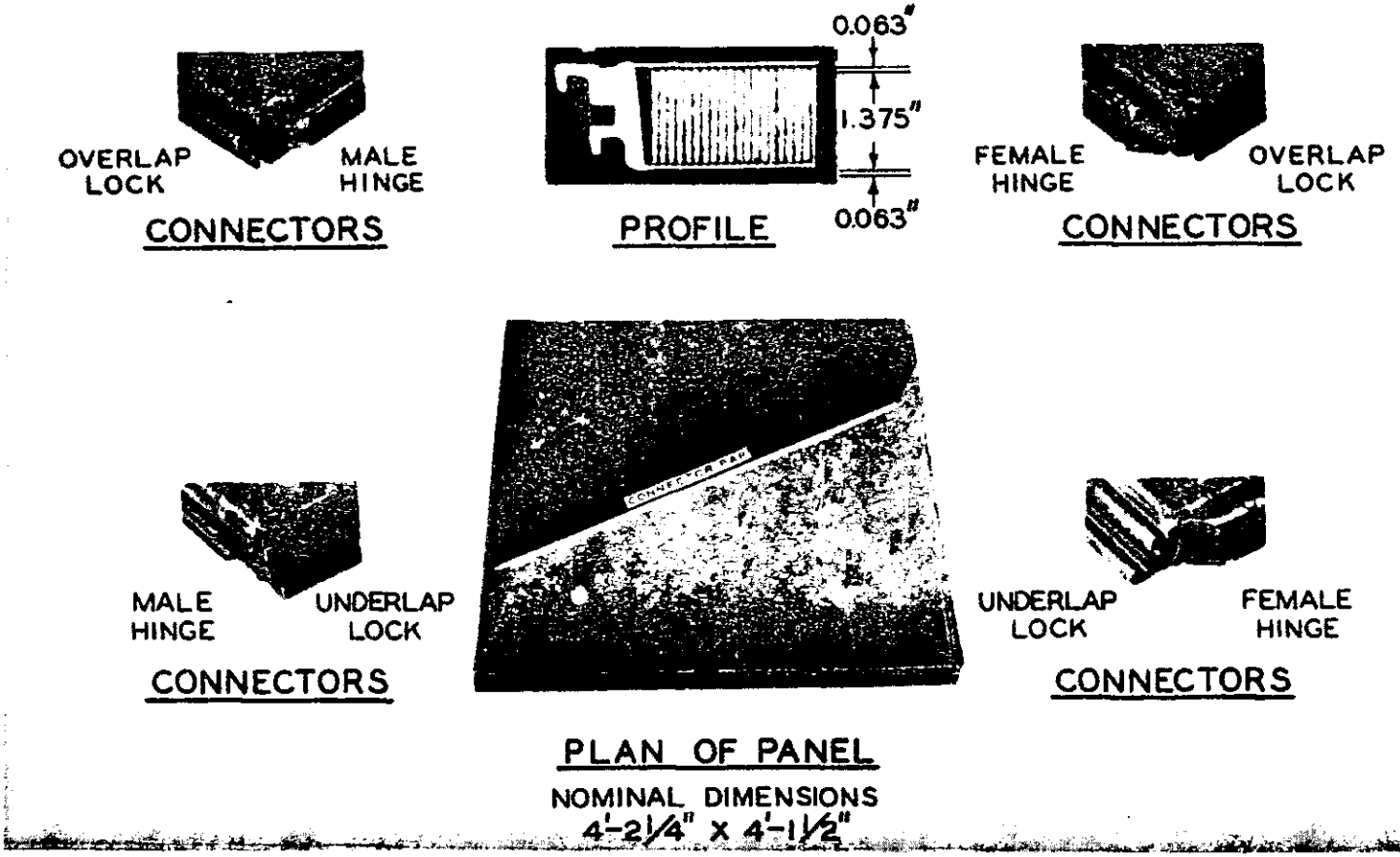
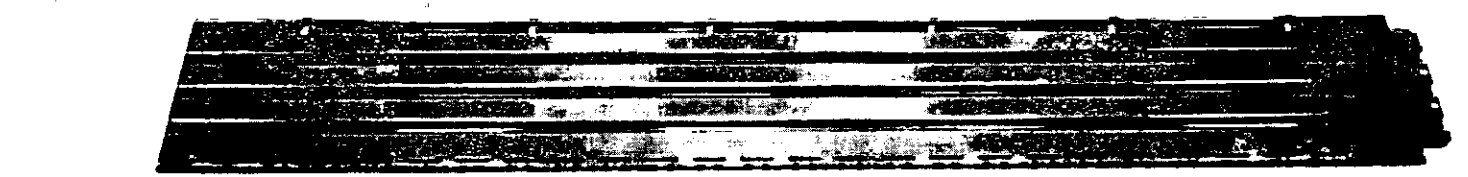


FIGURE 19. COMPOSITE VIEW OF XM19 ALUMINUM LANDING MAT

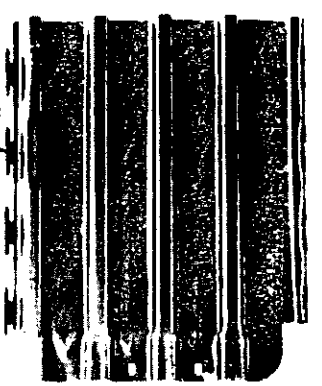


PLAN VIEW OF PANEL

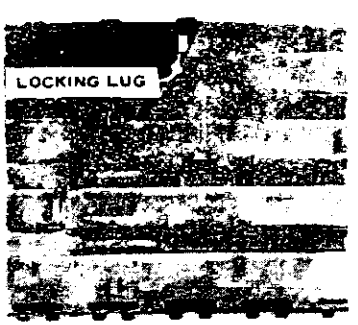
NOMINAL DIMENSIONS
1'-7¾ × 11'-9¾"

VIEW OF LEFT END

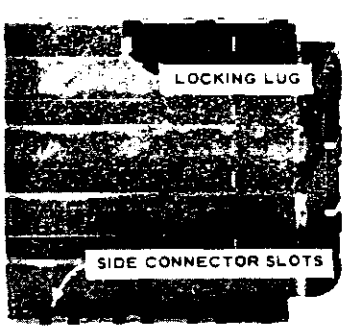
VIEW OF RIGHT END



BOTTOM VIEW RIGHT END



DETAILS LEFT END



DETAILS RIGHT END

FIGURE 20. COMPOSITE VIEW OF M8A1 STEEL LANDING MAT

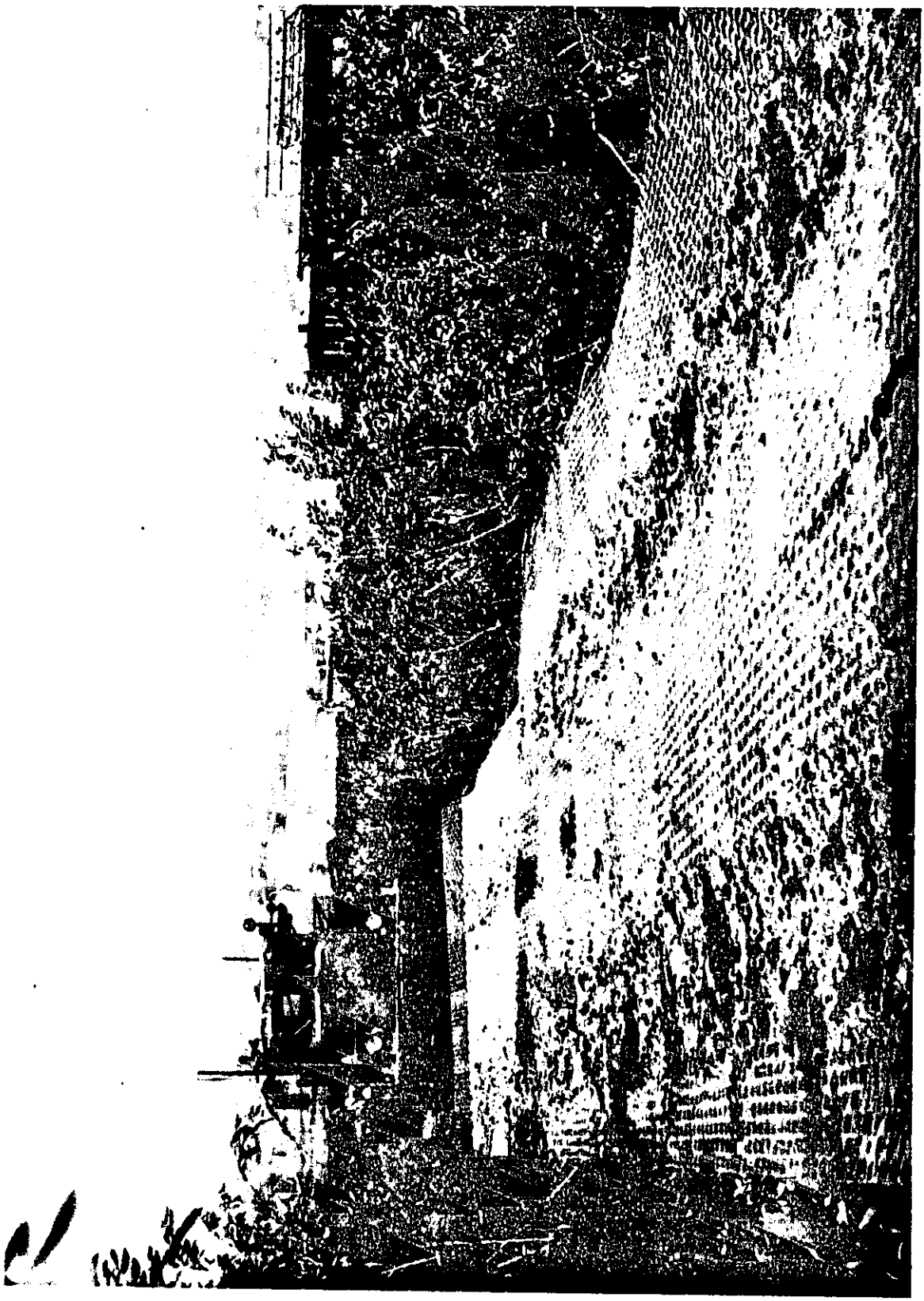


FIGURE 21. FIBER GLASS MATTING (AVAILABLE IN ROLLS OR PANELS)

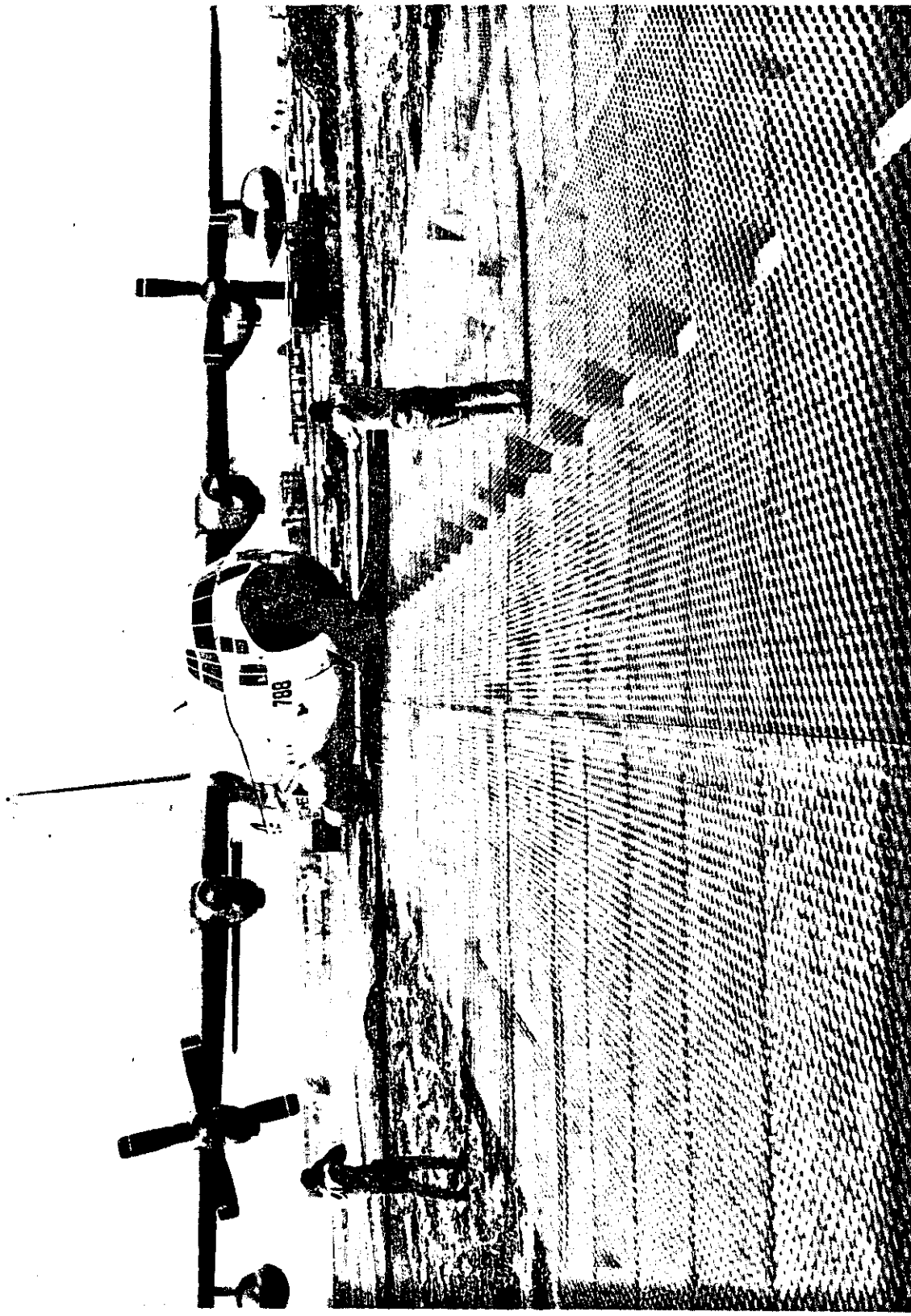
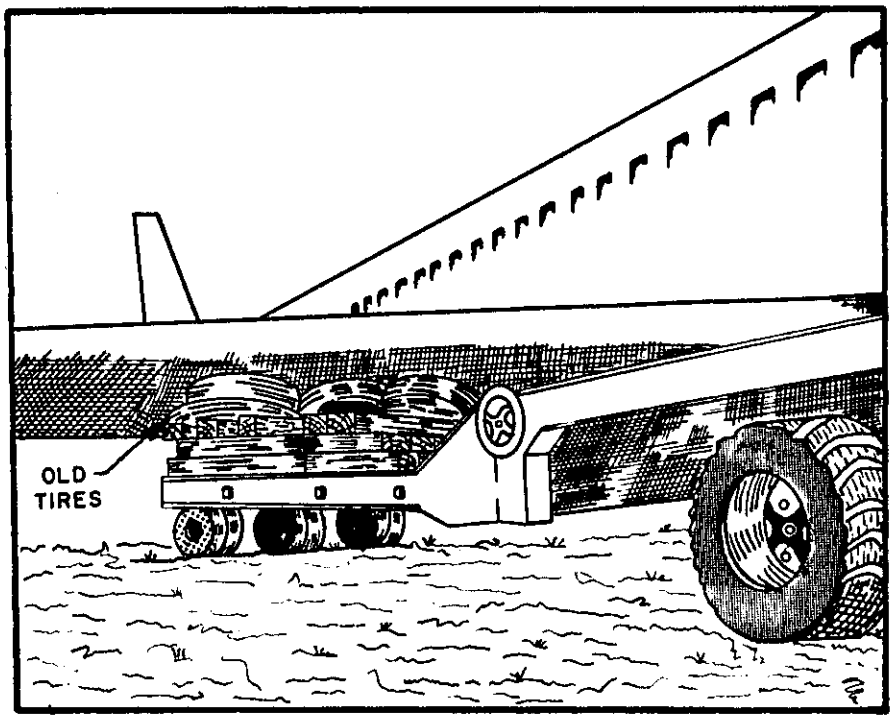
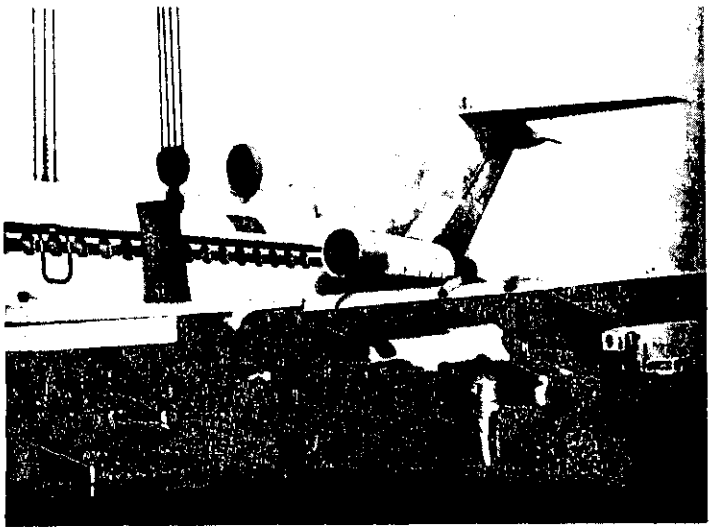


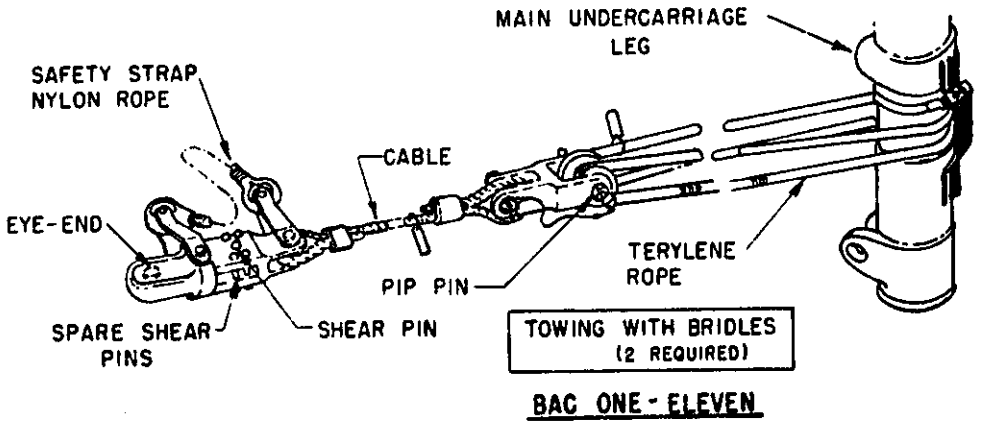
FIGURE 22. FIBER GLASS MATTING





SAND BAGS WERE USED AS A CUSHION ON THIS FLATBED

FIGURE 23. METHODS OF PROTECTING AIRCRAFT SKIN DURING REMOVAL ON FLATBED TRUCKS



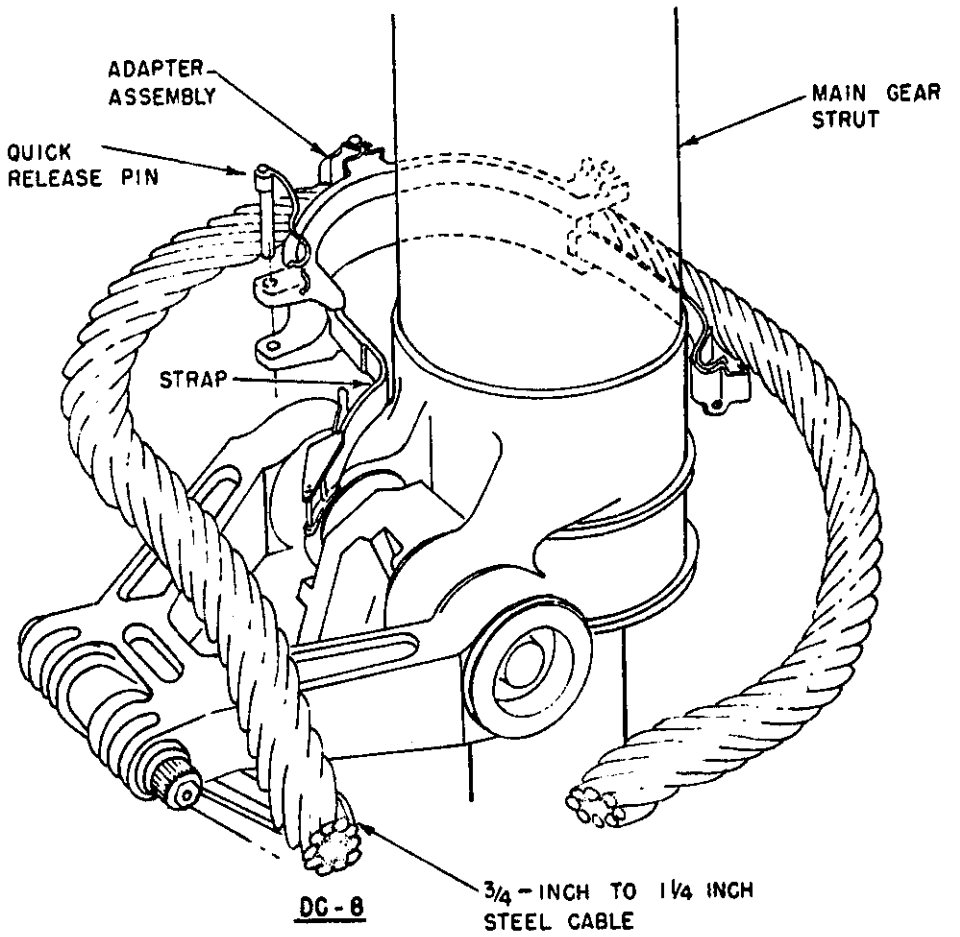
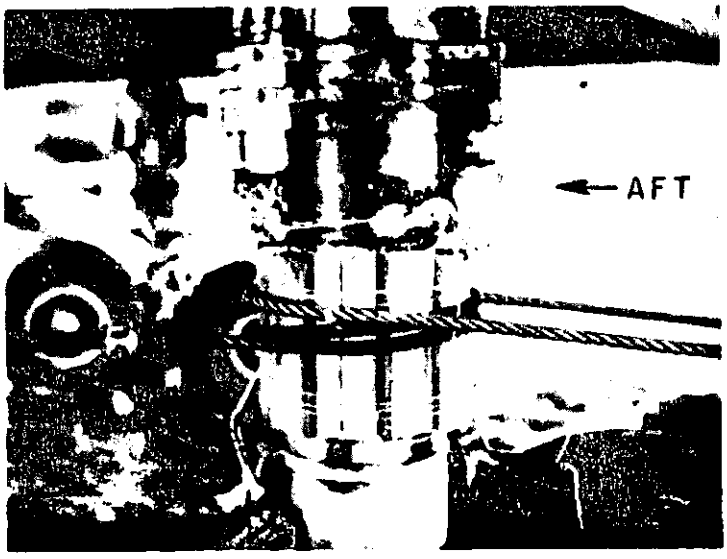
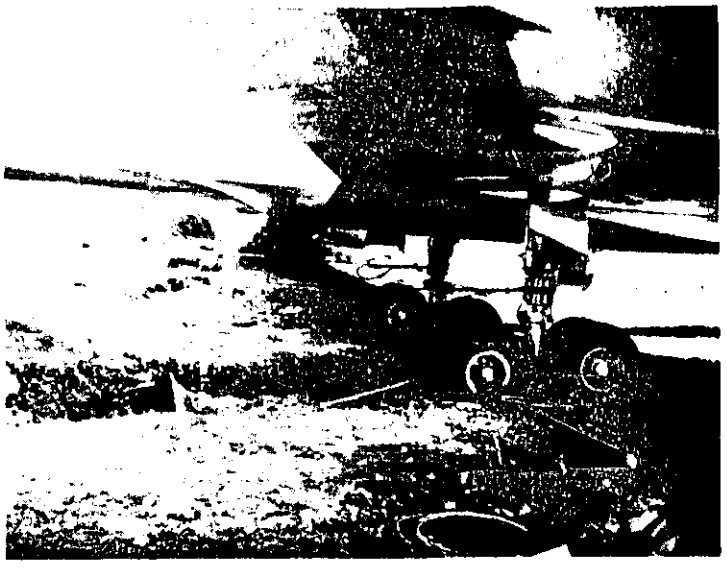


FIGURE 24. ADAPTERS USED TO PROTECT GEAR FITTINGS FOR EMERGENCY TOWING OPERATIONS



SNUBBING & PULLING CABLES RIGHT HAND



GEAR BLOCKED AND CABLES SNUGGED

FIGURE 25. PREPARATION FOR WINCHING AN AIRCRAFT BACK ONTO RUNWAY

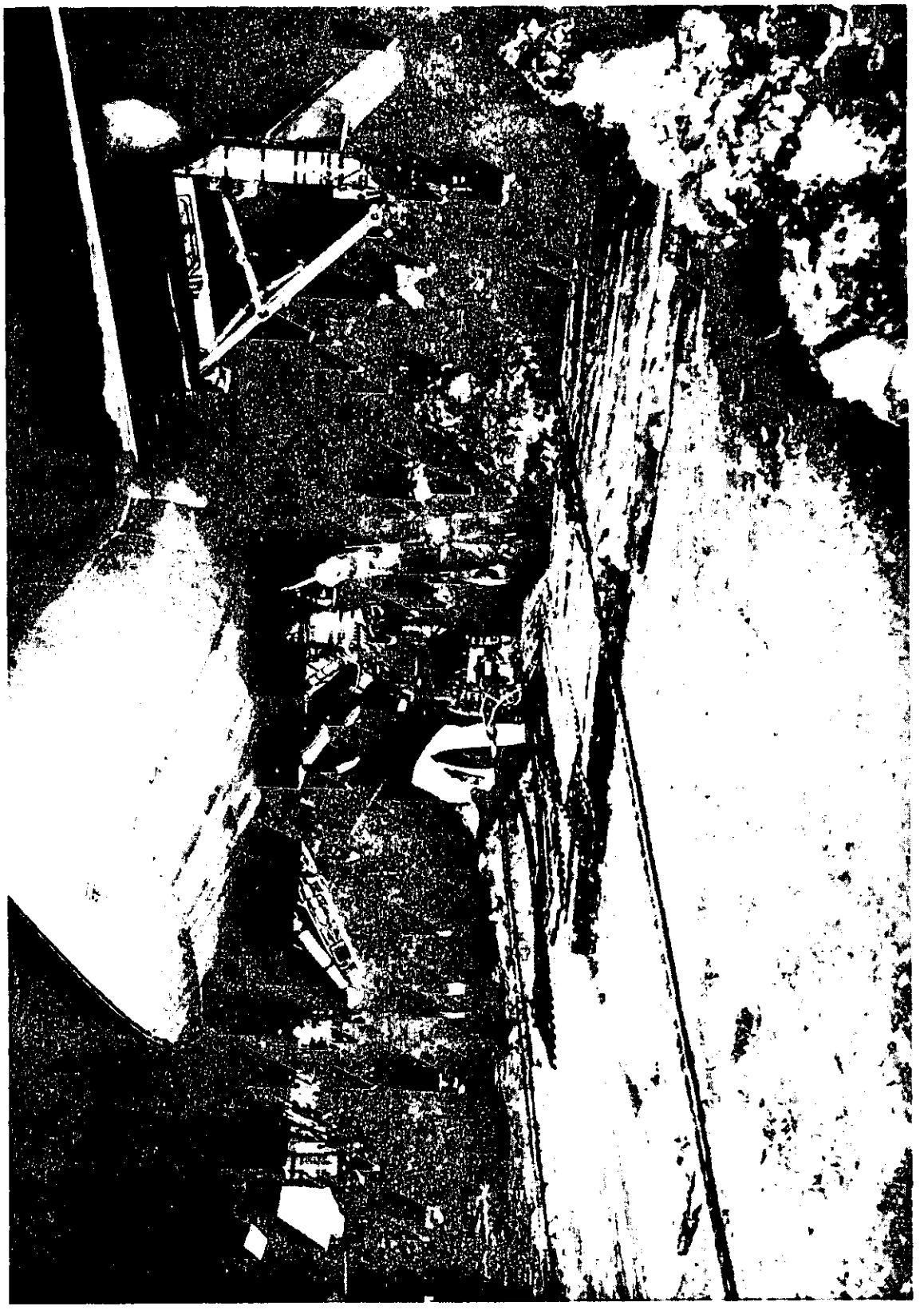


FIGURE 26. USE OF RAILROAD TIES AND STEEL CABLES FOR WINCHING A BOEING 747 ONTO A TAXIWAY

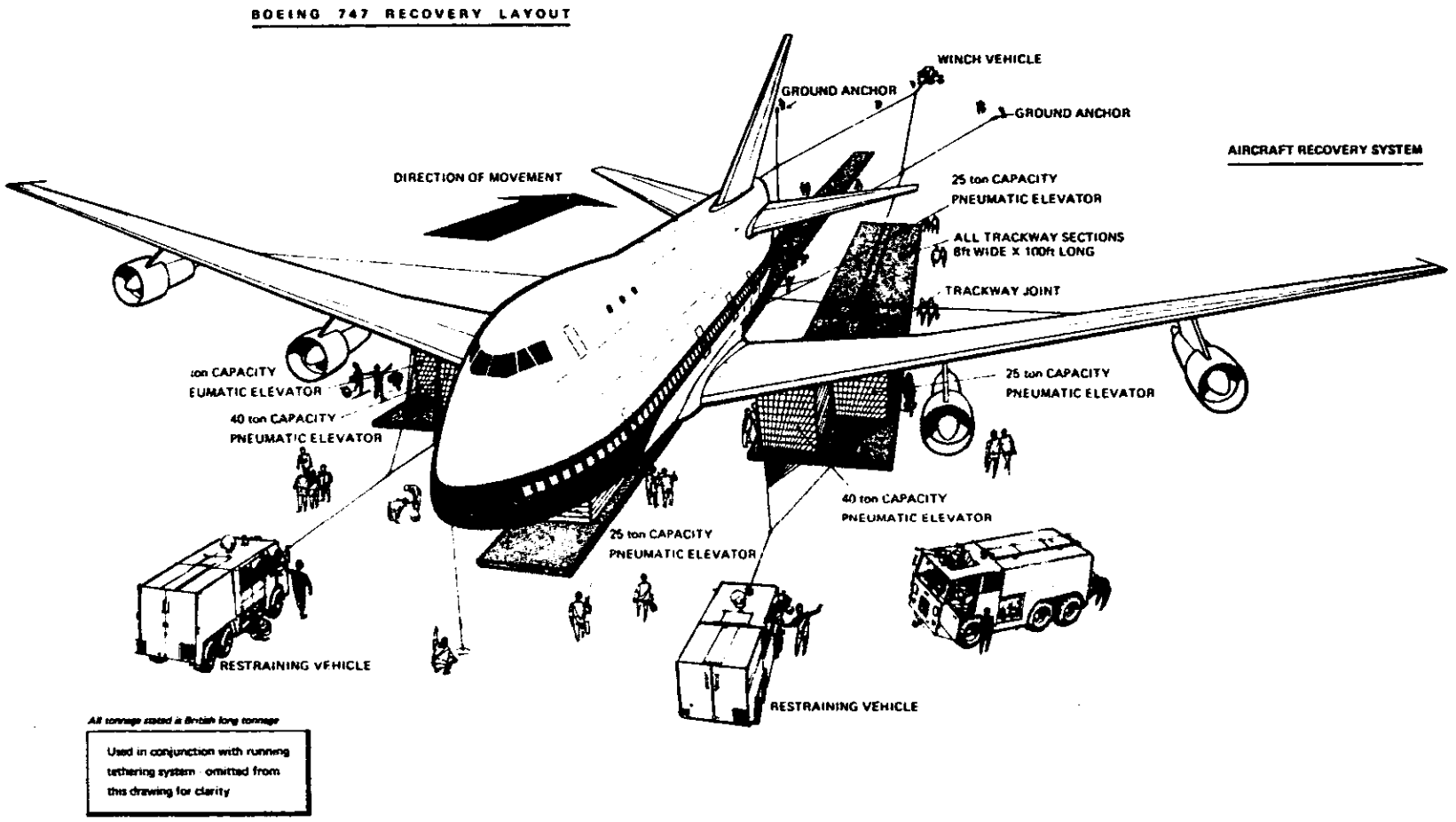


FIGURE 27. PROPOSED SYSTEM OF "PNEUMATIC ELEVATORS" AND INFLATED TRACKS FOR AIRCRAFT RECOVERY

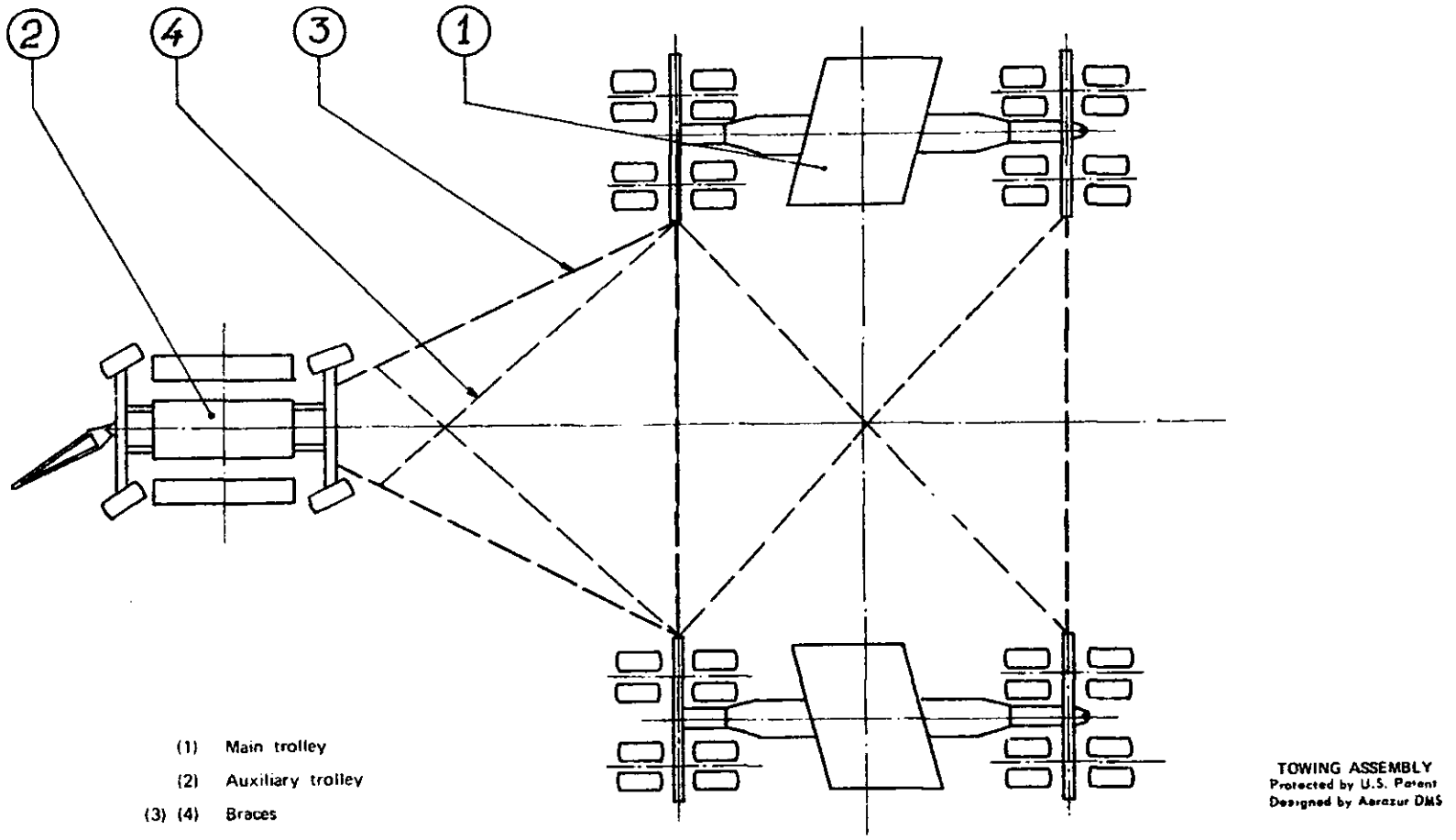


FIGURE 28. PROPOSED TROLLEYS HAVING JACKING CHARACTERISTICS TO LIFT AND TOW AIRCRAFT (CERTAIN CRASH ATTITUDES REQUIRE PRE-LIFTING WITH BAGS OR JACKS)

APPENDIX 3. RECOVERY EQUIPMENT AND A RECOVERY METHOD FOR THE BOEING 747 AIRCRAFT

DAMAGED AIRPLANE RECOVERY

LIST OF TOOLS AND EQUIPMENT

(The Boeing Company has anticipated that most of this equipment will be available at the airport, at airline facilities, and from local contractors. Most of the equipment can be transported by air and it is also adaptable to other types of large aircraft.)

ITEM	DESCRIPTION	NUMBER REQUIRED
1.	Air Bags, 12 to 25 Ton, (and Repair Kit)	10 ea.
2.	Air Compressor, 50 cfm, 1 to 7 psi, with manifolds and hoses	3 ea.
3.	Earth screw anchors	16 ea.
4.	Mattresses or similar padding	20 ea.
5.	Plywood, 4' x 8' x 1/4" 4' x 8' x 1"	24 shts. 40 shts.
6.	Rope, 2" 1"	1,000 ft. 1,000 ft.
7.	Hoists, 3 ton	4 ea.
8.	Steel Plates 1/2" thick, 2' x 2' 8' x 4'	16 ea. 24 ea.
9.	Ladders, 20' - 30' long	4 ea.
10.	Jacks, low level 70 - 100 T, 36" lift 80 T, 30" with 78" lift 1/	3 ea. 2 ea.

1/Special jacks developed for B-747 recovery operations

ITEM	DESCRIPTION	NUMBER REQUIRED
11	Jacks, Tripod 80 T, 100" with 69" lift	2 ea.
	20 T, 96" with 72" lift	1 ea.
	15 T, 156" with 77" lift	2 ea.
	46.5 T, 233" with 69" lift	1 ea.
	50 T, 60" - 134" with 44" lift	4 ea.
	30 T, 55" - 145" with 40" lift	4 ea.
12.	Emergency power unit for lighting, 10 KW	1 ea.
13.	Floodlights, lamp stands, leads, junction boxes and 50 ft. extension cords	8 ea.
14.	Engine hoist or dolly	2-4 ea.
15.	Railway ties	500 ea.
16.	Planking 2" x 8" x 8'	200 pcs.
17.	Hand winches or block and fall for rope tightening	
	(a) Hand winch - ratchet hoist with at least 10' chain, 3 T capacity	1 ea.
	(b) Pulley blocks with double sheaves of 1" rope	16 ea.
18.	Tow tractor, 50,000 lbs. drawbar pull	2 ea.
19.	Bulldozer, large	2 ea.
	small	1 ea.
20.	Flat Bed truck, 10 Ton	1 ea.
21.	Bulk Cargo Van/Conveyor Loader	1 ea.

ITEM	DESCRIPTION	NUMBER REQUIRED
22.	Transporter loader for Baggage/Cargo Removal	1 ea.
23.	5,000 gal. collapsible fuel storage tank	2 ea.
24.	Crane, 30 T, 70' lift, with personnel bucket	2 ea.
25.	Lifting slings, 48" wide, 50' long, 30 T capacity with 20' spreader beam	2 ea.
26.	Used rubber tires	30 ea.
27.	Ballast, in bags	20 ton
28.	Crushed rock or gravel	24 cu. yds.
29.	Steel runway mats	1,000 pcs.
30.	Fork lift, 2-5 ton	3 ea.
31.	Hand tools - hammers, shovels, sledges, pick axes, chain saws, levels, plumb bobs	
32.	Steel spikes for securing railway ties	200
33.	Workshop tent or trailer	
34.	On site communications	
35.	Main landing gear assembly	1 ea.
36.	Oleo lock, nose gear part No. 5ME65B01202-1	1 ea.
37.	Oleo lock, wing gear part No. 9ME65B00161-1	1 ea.

ITEM	DESCRIPTION	NUMBER REQUIRED
38.	Oleo lock, body gear part No. 4ME65B00163-1	1 ea.
39.	Bolt cutter, several sizes	1 ea.
40.	Sheet metal shears, large	1 ea.
41.	Air powered rotary saw	1 ea.
42.	Air Compressor, 100 psi, 30 to 40 CFM (for operating air tools)	1 ea.
43.	Rubber sheets, 8' x 8' x 1/8" (for use underneath and on top of air bags)	20 ea.
44.	Pieces of foam rubber padding, 6' x 5' x 4"	12 ea.

747

Damaged Airplane Recovery

NOTES:

1. MAX. ALLOWABLE BAG PRESS. 3.6 PSI, TOTAL ALLOWABLE LOAD, 100,000 LBS.
2. MAX. ALLOWABLE BAG PRESS. 7PSI, TOTAL ALLOWABLE LOAD, 130,000 LBS.
3. MAX. ALLOWABLE BAG PRESS. 5.5 PSI, NO LIMIT ON MAX. TOTAL LOAD.

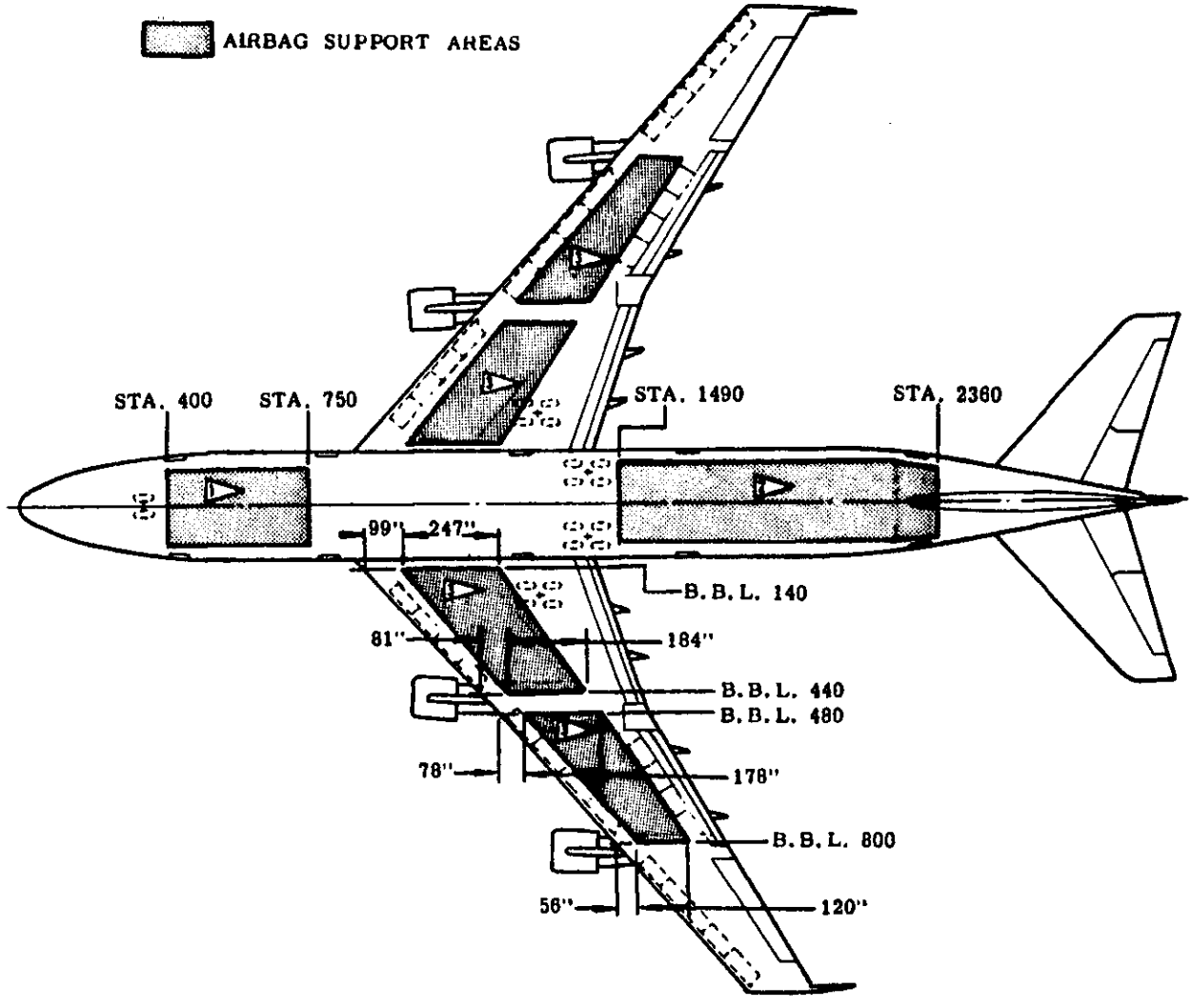


FIGURE 29. LIFT BY USE OF AIR BAGS

APPENDIX 4. LIST OF EQUIPMENT AND INFORMAL AGREEMENT BETWEEN PAN AMERICAN WORLD AIRWAYS, INC., AND SEVEN OTHER AIRLINES FOR AIRCRAFT RECOVERY

AIRLINE MANUALS SYSTEM

ADMINISTRATIVE MANUAL

90.00.30 EMERGENCY - AIRCRAFT RECOVERY TOOLS AND EQUIPMENT

I. PURPOSE.

This publication lists the tools and equipment which may be required to recover an aircraft involved in an accident or operational incident and the sources from which this equipment is available.

II. RESPONSIBILITY FOR SUPPLYING TOOLS AND EQUIPMENT.

A. In the event an aircraft is disabled, the designated Maintenance Representative shall appraise the damage and notify the Line Maintenance Controller (NYCMJ)1/ of the tools and equipment required to recover the aircraft.

B. The Line Maintenance Controller shall:

1. Forward the required Pan Am owned tools and equipment to the Station, and

2. Coordinate with the designated Maintenance Representative and Airport Manager at the Supplying Station to have other necessary tools and equipment loaned, rented, or purchased from other carriers and agencies routed to the aircraft site.

III. PAN AM SOURCES OF SUPPLY - TOOLS AND EQUIPMENT.

A. The Line Maintenance Manager maintains tools and ground equipment available at various Line Stations.

B. This information is listed in the General Maintenance Manual publication 1-50-1. The locations at which Tools and Equipment are available for each aircraft type are as follows:

1/ New York City Line Station Maintenance Administrative

III. B. (continued)

Aircraft Type	Tools and Equipment Available At
B707-300 (all)	London, England; San Francisco International Airport; John F. Kennedy International Airport; Miami International Airport
B720B	Miami International Airport
B707-100B	John F. Kennedy International Airport; Miami International Airport
B727	John F. Kennedy International Airport; Miami International Airport; Frankfurt, Germany
DC8	London, England; John F. Kennedy International Airport
All Aircraft	John F. Kennedy International Airport; London, England; San Francisco International Airport; Miami International Airport and other stations per individual station allocations listed in MYCMJPA 1/ office inventory.

IV. OUTSIDE SOURCES OF SUPPLY - TOOLS AND EQUIPMENT

A. In accordance with an existing informal agreement, the carriers listed in Paragraph B. below will provide the following items on an "as available" basis:

1/ Teletype Designation for line Maintenance

IV. A. (continued)

1. Eight 12-ton air bags and repair kit
2. Three 50 CFM/1 to 4 PSI Compressor, manifolds and hoses
3. 8 mattresses (or similar material for padding)
4. 10 earth or picketting screws
5. 24 sheets 1/4" x 4' x 8' plywood
6. 500 ft. 1" diameter rope
7. Four 2-ton come-along or ratchet hoists
8. 3 short stroke aircraft axle or screw type jacks (30 to 50-ton)
9. 6 each 1/2" x 2' x 2' steel plates
10. 1 light alloy access ladder - 15'
11. 1 electrical power unit for emergency lighting, 5 kilowatt or larger
12. 4 floodlights, lamp stands, leads and junction boxes and 50' ext.
13. Jacks - a) 1 nose 15-ton
    b) 1 tail 15-ton
    c) 2 main 50-ton
    d) 2 outboard wing steadies

IV. B. The designated area coverage is allocated to the following carriers:

Owner	Station	Area Coverage
American Airlines, Inc.	John F. Kennedy International Airport	Canada and USA as far west to include the Mountain Time Zone. East to Keflavik, Iceland and Santa Maria, Azores Islands.
American Airlines, Inc.	O'Hare International Airport	Continental USA and Canada.
Pan American World Airways, Inc.	Miami International Airport	Southern and Eastern USA. South America, Caribbean, Central America and Mexico.
Trans World Airlines, Inc.	Los Angeles International Airport	Alaska. Western USA to the Central Time Zone. South to Mexico and west to Honolulu.
Qantas Airways, Ltd.	Sydney, Australia	North to Nandi. Northwest as far as Singapore.
Royal Dutch Airlines	Amsterdam, The Netherlands	All of Europe as far east as Beirut. As far west as Keflavik, Iceland and Santa Maria, Azores Islands.
British Overseas Airways Corporation	London, England	Same as above.
South African Airways	Johannesburg	Republic of South Africa.

NOTE: Airport authorities maintain lift bags and other emergency equipment at certain airports. In addition, this equipment is sometimes available from military sources. The most convenient source of supply should therefore be determined before contacting the carrier covering the geographic area in which the aircraft is located.

V. AUXILIARY EQUIPMENT

A. The following list constitutes heavy equipment, materials, and other items that may be required in the recovery operation. The list is a guide and quantities indicated are estimates only. In the event any of the following items are required, it will be necessary to borrow, rent, or purchase them locally. This activity shall also be coordinated with the Line Maintenance Controller.

B. Heavy Equipment, Tools, and Work Materials:

1. Engine hoist or engine lifting equipment

2. Steel plates 8' x 4' x 1/2" - minimum of twelve

3. Railway ties - in quantity (up to 1,500)

4. Additional coils of rope for fuselage lashing - 300' x 1/2"

5. Additional hand winches or block and fall for rope tightening

   a) Hand winch - ratchet hoist 2-ton with at least 10' chain coffing or equivalent

   b) Pulley blocks - 4 each with double sheaves of 1/2" rope

6. Crane for fin removal

7. Tractive power min. 60,000 lb. draw bar pull

8. Hawsers for tractors. 2 1/2" rope or 1" cable made up in 4-50' lengths with clevis or thimble - both ends

9. Ladders - light weight and high access (allow for fin fitting reach)

10. Facilities for defueling and storage of suspected contaminated fuel

11. Buildozer (can also be used for towing)

V. B. (continued)

12. Low bed flat bottom trailers for local movement of damaged aircraft

13. Ballast

14. Crushed rock or equivalent 12 cubic yards

15. Planking - 500 pieces 2" x 8" x 8' or steel runway mats

16. 50 pieces construction grade plywood 4' x 8' x 3/4"

17. Steel I beam or rolled steel joists 14" x 8" - 20 each in 30' length

18. Felt packing for protecting aircraft skin

19. Available cranes and fork lifts

20. Hand tools - hammers, shovels, pick axe, sledges, chain saws

21. Workshop tent or trailer

22. Onsight communication

23. Availability of quick-set concrete

24. Condition of site and surveyors plot showing underground bearing conditions, e.g., water lines, drainage systems,etc., which may not take the planned load

APPENDIX 5. BIBLIOGRAPHY OF ILLUSTRATIONS AND TECHNICAL MATERIAL

Credits for illustrations and technical material used to develop the appendices are indicated below:

FIGURE/MATERIAL	SOURCE/COURTESY OF
Paragraphs a and b, Pages 1 and 2, Appendix 1, and Figures 1 and 2, Pages 3 and 4, Appendix 1	Mr. T. Fisher, Mesa, Arizona
Figure 3, Page 5, Appendix 1	Henning Industries, Inc., Hialeah, Florida
Figure 4, Page 6, Appendix 1	Sikorsky Aircraft Division United Aircraft Company Washington, D.C.
Figure 6, Page 4, Appendix 2	Air International Recovery San Jose, California
Figures 7 and 8, Pages 5 and 6 Appendix 2; Figure 12, Page 10 Appendix 2; Figure 23 (sketch) Page 21, Appendix 2; DC-8 adapter sketch in Figure 24, Page 22, Appendix 2; and Appendix 4	Pan American World Airways, Inc. New York, N.Y.
Figure 9, Page 7, Appendix 2; BAC One-Eleven Adapter in Figure 24, Page 22 Appendix 2	British Aircraft Corporation (USA) Inc. Arlington, Virginia
Figure 11, Page 9, Appendix 2; (picture) Figure 23, Page 21, Appendix 2	Lapadula & Villani, Inc. Brooklyn, N.Y.
Figure 13, Page 11, Appendix 2	Rubber Fabricators, Inc. Richwood, West Virginia
Figure 14, Page 12, Appendix 2 and Figure 27, Page 25, Appendix 2	R.F.D. Ltd. Godalming, Surrey, England
Figures 18 thru 20, Pages 16 thru 18, Appendix 2	U.S. Army Corps of Engineers Washington, D.C.

FIGURE/MATERIAL	SOURCE/COURTESY OF
Figures 21 and 22, Pages 19 and 20 Appendix 2	Air Logistics Corporation Washington, D.C.
Figure 25, Page 23, Appendix 2	Douglas Aircraft Company Long Beach, California
The material quoted on Pages 1 and 2 Appendix 2, and all of the material in Appendix 3	The Boeing Company Seattle, Washington
Figure 28, Page 26, Appendix 2	Societe Aerazur Paris, France

GPO 919-404