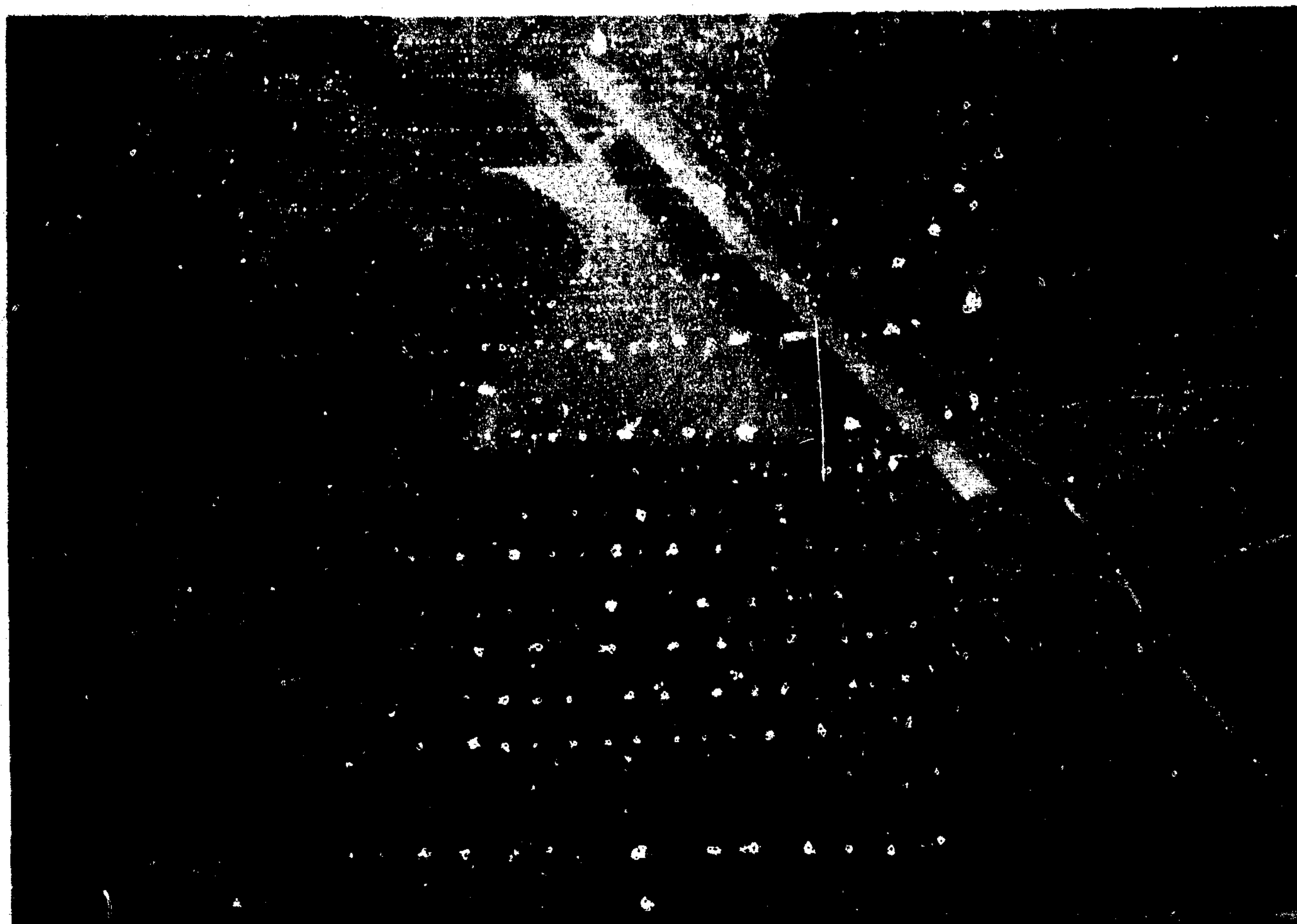
BARE BASE DEVELOPMENT CONCEPTS



BARE BASE DEVELOPMENT CONCEPTS

A collaborative design project
accomplished by Junior Architecture
and Industrial Design students,
College of Design, Architecture, and Art
University of Cincinnati
in cooperation with Tactical Air Command

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Sponsored by: Support Techniques Branch
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Preface

The Air Force Aero Propulsion Laboratory, RTD, wishes to extend its sincere appreciation to College of Industrial Design, Architecture and Art of the University of Cincinnati for their organization of the Limited War project. Special appreciation is given to J. Alexander, G. Born, and K. Merkel who were mainly responsible for the undertaking of this effort. Finally, appreciation is extended to Headquarters, Tactical Air Command for their technical briefing on TAC and their interest in this project.

This report has been published to stimulate further research in this area and to disseminate the information contained in the report; however, publication of this report does not necessarily represent Air Force approval of these concepts.

TABLE OF CONTENTS

INTRODUCTION

On the following pages are the results of an exercise in creative problem solving recording the efforts of nineteen Juniors of the College of Design, Architecture, and Art, University of Cincinnati. The complex and timely problem of Bare Base development was the subject of their efforts.

These students were organized into five teams (four teams of four members and one of three). Nine represented the department of Industrial Design and the remaining ten were Architectural students. Participation on each team was equally divided between Architecture and Industrial Design with the exception of the three-man team (No. 5) which included only one student representing the latter.

The students were introduced to the problem on June 8, 1964, when they received the "Bare Base Development Program" as presented on pages . to 8. Two days later, they were briefed by Headquarters TAC on the mission of TAC and, on the relative success and/or failure of recent Bare Base and limited war exercises. To serve as a vehicle for its proposal, each team was given a site map chosen from a selection of SAC and TAC airfields in various parts of the world. These site plans were altered to eliminate all existing structures and equipment. Only basic airfield pavement, roads and indications of terrain conditions were left on the map. The site, however, was to be incidental to the equipment which had to be adaptable and flexible to suit any conditions or climate in the temperate zone.

With this information and with the assistance of various TAC manuals on the subject of bare bases, these five teams researched the problem and prepared design proposals in four major areas: 1) site development, 2) shelter system, 3) transportation system and 4) miscellaneous equipment. They then organized their concepts into 20-minute slide presentations and presented these at Wright Patterson Air Force Base on Thursday, July 23, 1964, only six and one-half weeks from their initial introduction to the project. Included in the reports as presented here, are a resume' and illustrative excerpts from each team's proposal.

BARE BASE DEVELOPMENT PROGRAM

BACKGROUND

The ability of TAC to conduct tactical air combat operations, both nuclear and non-nuclear, anywhere in the world, is dependent on the availability of suitable operating bases. TAC forces have been fashioned into packages designed to include all weapons systems appropriate to meet a particular threat. The packages include aircraft, flying and maintenance personnel, and a command staff. They are commonly called "strike" forces and are capable of conducting limited war activities from remote base sites known as bare bases.

There are many such sites in all parts of the world. Their locations are known and, depending upon strategic requirements, any one may be suitable for remote TAC operations on very short notice.

A bare base is defined as an airfield having one or more runways, taxiways, and a ramp, but no support facilities. In most cases, the bare base is a commercial airport or an abandoned airfield. Extensive inspection and evaluation are normally required prior to operational use. It is assumed that facilities such as maintenance, housing or administrative buildings, etc. are not available. However, any existing facilities are used to whatever extent possible.

Bare base operations are planned for a minimum of 30-day occupancy, with personnel on temporary duty status. Each bare base has a rear main operating base (MOB). It is defined as a fully operational base having all support capabilities and facilities normally associated with established USAF bases.

After recognition for the need and selection of a bare base, a survey team visits the site to determine the adequacy of the facilities and program airlift and erection priorities for rapid development. At this point, a Combat Control Team (CCT) representing TAC and an advanced unit of the Combat Support Group (CSG) representing the MOB arrive for the purpose of supervising the bare base development. Then, addition CSG personnel are airlifted to the site. To accomplish this phase efficiently, the Combat Support Group is organized into preplanned packages of personnel and equipment. Once at the bare base site, these CSG units accomplish the development and ready the airfield for the arrival of the tactical forces and remain to manage base support functions throughout the duration of occupancy. Upon the arrival of the tactical forces, however, the overall command responsibility is assumed by the TAC unit commander.

The sequence of events in the development of a bare base operation is as follows:

1. Recognition of the need for and selection of a bare base.
2. Initial survey of the proposed BB by operation planners, engineers and maintenance personnel if possible.
3. Arrival of Combat Control Team (CCT) and advanced Combat Support Group (CSG) Unit.
4. Establish air lift operations.
5. Air landing of additional CSG units according to priority.
6. Preparation of base for arrival of tactical aircraft.
7. Arrival of TAC Command element.
8. Arrival of TAC aircraft.
9. Improvement of base as required.

PROBLEM

Develop a battery of equipment into transportable units with an accompanying plan of mobility and erection to effect efficient and rapid utilization of a bare base site. The equipment and its utilization are to be applicable in varying quantities and configurations to any bare base site in the temperate zone. Its sequential arrival, erection and use are to be given extensive consideration based upon an initial study of the site and criteria. The growth of the total base is to be presented in successive stages. Design proposals should be accomplished with sufficient detail to indicate realistic consideration of the following:

1. Loading and unloading of equipment and personnel.
2. Unforeseen terrain and weather conditions.
3. Air and ground transportation for equipment and personnel.
4. Temporary repair measures.
5. Temporary utilities.
6. Emergency requirements.
7. Security vigilance.
8. Possible air drop requirements.
9. Darkness, heat, cold and minimum personnel comfort.
10. Supervision.
11. Safety.

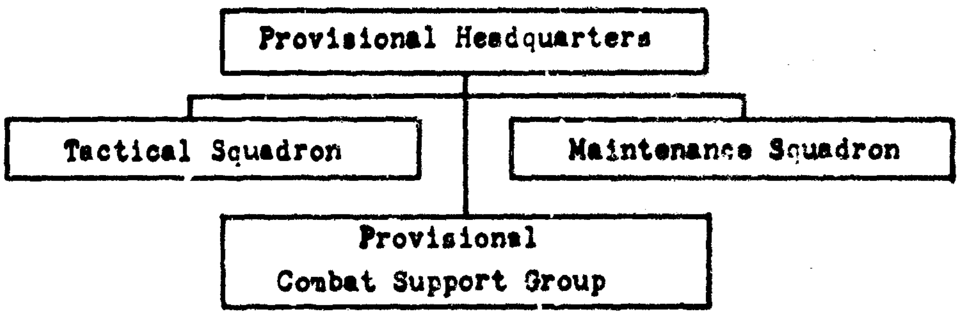
ASSUMPTIONS

1. Friendly land forces are in general control of the area, although minimum guerrilla penetration has to be anticipated.
2. The site is in relatively good condition but airstrips are in need of quick surfacing and spot repair.
3. There are no utilities or usable buildings.
4. No heavy overgrowth is anticipated but minor clearing equipment will be necessary.

5. Army will provide and locate 8 to 10 pieces of anti-aircraft equipment. Billeting, messing, storage, etc., are under the Army jurisdiction, and are not to be included in this project.
6. C-130 Aircraft is to be the transport carrier.
7. All personnel are to be male and military.

REQUIREMENTS

1. Provide for a total complement of 1100 men to include two Tactical Squadrons (110 men), one Maintenance Squadron (500 men), and one provisional Combat Support Group (470 men), all under a provisional headquarters (20 men). The administrative organization looks like this:



2. Provide for 36 F4C jet fighter aircraft:
   a. provide an aircraft parking plan
   b. provide towing capability
   c. provide refueling capability (by vehicle)
   d. provide fuel storage
   e. provide one engine run-up area
   f. provide maintenance hangar and facilities for 1 or 2.
   g. provide aircraft washing facilities for 1 or 2.
3. Provide billeting and messing to accommodate 1100 men (162 officers, 938 airmen)
4. Provide airfield lighting.
5. Provide for a full complement of support facilities. A check list of support functions and the number of personnel involved in each is attached.
6. Provide for development of the base to the point of operational effectiveness within a time schedule not to exceed 96 hours.

DEVELOPMENT PRIORITIES

Establish priorities for air lift items and erection of operational and support facilities according to the following:

1. 1st priority: operational support - minimum armament and security, minimum fuel storage, minimum essential utilities.
2. 2nd priority: provide for increased capacity and efficiency of operational facilities.
3. 3rd priority: further improve operations and provide special facilities, i.e. hospital, administrative structures, special housing.
4. 4th priority: erect remainder of camp.
5. 5th priority: improvements based on projected length of tenancy.

DESIGN SOLUTIONS

1. Site development: In scale model form, using movable components of shelters, vehicles and equipment, make a photographic record of the sequential development of the base recorded at meaningful stages and calibrated to a time schedule.
2. Shelter system(s): Present basic components demonstrating erection and demounting procedures. Project the system(s) into a variety of sizes and applications using models, graphic presentation and/or photography to effectively present design thinking.
3. Transportation system: Develop a multipurpose land vehicle (or vehicles) to accomplish equipment and personnel transportation and additional workaday functions. Present a comprehensive scale model and be able to demonstrate flexibility.
4. Equipment: Survey equipment needs (other than shelter and transportation) and present new equipment ideas in sketch form, e.g. airstrip lighting, fuel storage, personal equipment, etc.

Check List of Support Functions for a Bare Base Operation of 1100 Men:

	support function	No. of TDY Personnel		
		Off	Amn	total
1	CSG Commander and Deputy	2	0	2
2	Administrative Staff	0	4	4
3	Chaplain Services	2	2	4
4	Personnel	1	2	3
5	Personal Services	1	3	4
6	AF Exchange	0	2	2
7	Accounting and Finance	1	1	2
8	Materiel Services	2	2	4
9	Civil Engineering	3	55	58
10	Fire Protection and Rescue	0	18	18
11	Procurement (Government Contracts)	1	2	3
12	Supply	1	21	22
13	Munitions	1	18	19
14	POL (fuels)	1	24	25
15	Cyrogenic Fluid Production	0	12	12
16	Terminal Services (transportation)	1	41	42
17	Administrative Services	1	10	11
18	Legal Services	1	1	2
19	Security and Law Enforcement	1	30	31
20	Information Services	1	2	3
21	Medical Services	7	24	31
22	Graphical Services	0	2	2
23	Weather and Meteorolgoy	1	4	5
24	Aircraft Operations	3	7	10
25	Transient Aircraft Maintenance	0	6	6
26	Photo Mapping and Charting	1	3	4
27	Motors, Ground Equipment	1	2	3
28	Motors, Vehicle Maintenance	0	13	13
29	Motor Vehicle operators	0	27	27
30	Food Services	1	71	72
31	Housing Services	0	5	5
32				
33				
34				

Class schedule and calendar of events:

	Monday	Wednesday	Friday
1st week	JUNE 8: Introduction of problem and formation of teams.	JUNE 10: Orientation by Headquarters TAC.	JUNE 12: Site assignments to teams.
2nd week	JUNE 15:	JUNE 17: Preliminary site survey presentations.	JUNE 19:
3rd week	JUNE 22:	JUNE 24:	JUNE 26: Interim design critique.
4th week	JUNE 29:	JULY 1:	JULY 3: HOLIDAY
5th week	JULY 6:	JULY 8:	JULY 10:
6th week	JULY 13:	JULY 15:	JULY 17: Final design critique.
7th week	JULY 20:	JULY 23 (Thursday): Presentation of final design solutions at Wright Patterson Air Force Base, Dayton, Ohio	

TEAM 1

Duane A. Gordon	Architecture '66
Dale C. Harris	Industrial Design '65
John R. McKnight	Architecture '66
John Plut	Industrial Design '65

TEAM PHILOSOPHY OF BARE BASE APPROACH

Development of the bare base must be accomplished with a minimum of both total and man-hour time, maximum efficiency, and minimum weight. In order to accomplish this, modern technology should be utilized to replace outdated concepts of design and use.

The development of a light weight polyurethane, nylon, and mylar lamination greatly reduces the weight of the skin of the shelter and at the same time increases durability, provides insulation, and increases living comfort. By using suspension and tension members for structural elements, weight, bulk, and erection time are reduced.

A new type of free-piston engine, invented by Harold Kosoff of Philadelphia, Pennsylvania, provides a compact, efficient power source for all phases of the base complex including lighting, heating, generating and vehicle power, while reducing maintenance time and complexity. Hydraulic drives and fluid couplings also eliminate most maintenance time, reduce weight, and improve efficiency. The single power source will reduce the need for most spare parts storage, reduce maintenance time, and lessen the need for some specialized tasks.

Electronic ovens can be utilized for the preparation of pre-packaged foods.

The use of these developments reduces the overall complexity of the bare base. There are fewer items, and these items can be applied to more separate functions. One basic shelter unit can be grouped in a variety of ways in order to serve for storage, command areas, housing, messing, or hospital. A second, larger tension structure is used for the hangar and provides for more efficient use of the floor area.

Shelters of contemporary design and materials will seem less temporary and provide more pleasant living conditions while actually being quicker to erect and dismantle than the present tentage. Better living conditions will increase the efficiency of the men and provide for better morale. Better functional use of space provides more useable space per man yet cuts down on overall area.

The entire base can be set up or dismantled within seventy-two (72) hours by a crew of approximately four hundred (400) men, with a minimum of experience and preparation time.

ADAPTABILITY OF DESIGN CONCEPTS TO SITES

Our shelter design can be adapted to any particular terrain since the center supporting cable can be raised or lowered independently of the other unit on the same pylon. This makes it possible for any of the units to sit on a different level from the other units in the cluster.

Due to the insulation quality of the shelter skin, the concept is adaptable for all temperate zone conditions.

The structures are completely enclosed through the use of a poly-zipper for sealing which provides for complete protection from the elements of nature.

Due to the shape, the structures can be grouped to form any number of units and adapted to any number of functions, such as housing, messing, medical and storage.

VEHICLE

The vehicle can be adapted to any type of terrain because of the hydraulic lifts which can raise or lower the vehicle. There is also the provision for a 90 degree turning to maneuver on tight or hilly terrain.

SITE

In adapting our concepts to our site (Fig. 1) we positioned our facilities according to the existing runway and roadway layout in order to have them function at their best.

Our site, which is located in England, has both hot and cold weather for which the insulated material will compensate. The base is planned (Fig. 2) to be completely independent from the surrounding area in the event that the vicinity has been devastated, the land is desolute, or the inhabitants are unable to give aid or support. All food, water, fuel, and shelter are to be flown to the site.

SHELTER CONCEPT

The shelter concept used by our team was designed with the basic idea of simpler and easier erection in mind.

This idea is conveyed through the use of a suspended structure which makes it possible to suspend as many as three basic units from a single fiberglass member in the center of a three-cluster unit (Fig. 3). The erection of this shelter (Fig. 4 thru 9) is accomplished by a team of six men.

Time required to erect this thirty-man shelter is forty (40) minutes, which is less than the present time of one (1) hour taken by six (6) men to erect three tents housing a total of thirty (30) men.

Each separate housing unit is in the form of a hexagon making it possible for these units to be completely modular and able to be used for any number of functions, such as housing units (Figs. 11,12), messing unit (Fig. 13), hospital, storage, motor pool, operational functions, and recreational units.

The exterior skin of the structure is fabricated from ¼ inch polyurethane foam of the flexible type. Laminated on both sides of the polyurethane foam will be a layer of mylar and woven nylon fiber. The nylon is necessary to increase the tear strength of the material, and the mylar is used to improve durability and to waterproof the polyurethane foam.

From the research our team has done on the shelter, skin it was found that the "K" (insulating) factor of this material was as low as .22 thus demonstrating the ability of this shelter material to be used in a variety of climates. It is also worth-while to note that the tent skin weighs approximately 0.1 pound per square foot.

One tent unit can be folded down and rolled into a package of thirteen (13) feet long by eighteen (18) inches in diameter with its mylar flooring rolled around the outside to protect the unit in shipping.

A conservative estimate of the weight per one ten man unit is approximately four hundred and fifty (450) pounds as compared to a five hundred and eighty (580) pound tent made of canvas to house ten (10) men.

The supporting members are fabricated from a fiberglass material which gives them increased strength and durability and cuts the weight down considerably.

By having a wall area of thirteen (13) feet by eight (8) feet, it is possible to bunk as many as 12 men per unit which is two men more than can be bunked in the present canvas tent.

The shelter concept we have used has flooring, and complete enclosure from the elements makes it possible for better living conditions including heating, lighting, ventilation, insulation, and cleanliness.

In summary, our shelter is simple to erect, is lighter in weight, has increased space making it possible to house more men, and makes provisions for better living conditions.

HANGAR

Our objectives in designing a hangar were to lighten the weight, simplify erection, and provide a functional and efficient working space (Fig. 14).

In order to lighten the weight of the hangar, we did away with any structural members that would have to span the width of the hangar. A truss or beam would have to be built out of steel or wood to achieve the span needed.

We decided that the most efficient way to support a hangar structure is to suspend the enclosing material with relatively light tension cables. The hexagonal form we used is highly adaptable to a tension structure since all walls are the same length and the distance to the center of the hangar is the same length as the walls. It is a very simple process to locate, without surveying, all the points where the structure is secured to the ground. With one string forty-five (45) feet long the six points could be quickly located on the site by triangulation.

The structure consists of six pylons and six tensions cables from which is suspended the wall and roof of the hangar (Figs. 15,16,17). The pylons would be made from high strength fiberglass which has a very high yield point. Pylons of this material would lighten the pylon weight considerably.

The material of the walls and ceiling is formed from ¼ inch flexible polyurethane foam reinforced with nylon and has a skin of mylar plastic laminated to each side. This provides a strong material that is tear-resistant, has a smooth surface for easy cleaning, has a weight of approximately 0.1 pound per square foot, and has a "K" factor of 0.22 for excellent insulation.

Ventilation is provided at the six corners of the hangars with screened windows that are two feet and six inches wide and eighteen feet high. Each of these tall windows will have flexible doors at the ground for easy access from any side. These window units can be closed from the elements by rolling down a panel that zippers closed with a poly-zipper which does not allow wind to blow through.

This hangar has six sides forty-five (45) feet long. It will completely accommodate two F-4-C jet fighters (Fig. 18) that are completely closed off from the elements, or three planes (one completely and two partially enclosed) may be accommodated.

Another reason for using the hexagonal form for the hangar is that more square-footage of floor area is provided per square-footage of wall and ceiling, as compared with a rectangular building. The space provided for two fighter planes is quite adequate. Both planes have plenty of room for work access on all sides.

The hangar has two doors for plane access located on opposite sides of the hangar. These doors are made of the same material as the walls and ceiling. They fold (on overhead rollers) to the sides giving a forty-five (45) foot clear opening.

Since this design provides an easy-to-erect hangar from a relatively light package as well as a functional hangar for two fighter planes, we believe this hangar would be an excellent addition to the Air Force Bare Base concept.

UTILITY VEHICLE SURVEY

In order to raise the overall efficiency of the bare base, there is a need to reduce the number of vehicles required to perform the tasks too large to be done with manpower. A look at the list of vehicles provided for the base will show many vehicles which are by their design, limited to one or two jobs and, since the particular jobs are not done constantly, there is inefficiency in having vehicles sitting idle when they might possibly be doubling up on other functions to get the jobs done faster.

According to TAC Manual 400-12 there are eighty-eight (88) vehicles alloted in the average bare base support group. These vehicles may be broken down into three catagories: light, medium, and heavy duty in accordance with their own specific weight and the functions they perform. Out of the total of 88 vehicles, 55 may be classed as light and medium duty vehicles with the following specific functions: (1) hauling in one form or another (this group includes trucks and trailers) (2) light bulldozing (3) ditch digging and other functions associated with a farm tractor, and (4) lifting (forklift). It is felt by the team that the light and medium duty function could be performed by a single vehicle type located somewhere between the two classes.

Since the TACM 400-12 did not catalogue any of the ground support vehicles for the Tactical fighter air craft, the trip to Wright-Patterson Air Force Base brought to light another group of vehicular functions which may also be included in the class of vehicles the team intends to pursue. The ground support group included towing functions (both for air craft and air craft checking equipment), refueling, and munitions-handling. Although most of these vehicles are physically smaller than the vehicles included in the bare base system, the functions they perform are in the same catagories.

VEHICULAR CONCEPT

In order to fulfill the required functions, the new vehicle must be flexible to adapt to the various situations which would include variations in terrain and climate (Fig. 19). A vehicle which would perform well on the hard, even surface of the runway system would not do well if the off-runway terrain was sand or mud. The vehicle would not need the same weather protection in mild climates as it would in the extreme cold or hot areas. Viewed in this light, the weather-protection facilities become a separate item to be included in the package only if the site survey deems them necessary.

The first consideration given to the vehicle was that of the operational, or cab area (Fig. 20). Since the vehicle will be used for taxi service in transporting personnel, we decided upon a two-place cab to carry the driver and one passenger. There would also be rear box attachment to allow seating for four additional persons. The second consideration was that of a suitable drive train which would require a minimum of maintenance, reduce the overall weight, yet allow the vehicle adequate power, traction, and flexibility. After considering many possibilities, a fluid-drive system was settled upon due to the lack of moving and complex parts and the idea of transmitting the power from the engine to the wheels through flexible tubes rather than rigid drive shafts, universal joints, gear boxes, differentials, etc. As an end result, the fluid drive will allow driver control through a single "tiller" which will control speed and breaking as well as direction. Now that there are no rigid connections to the wheels, they can be made to rotate 360 degrees to allow the vehicle more flexibility (Figs. 21,22,23). All four wheels are to use a standard drive, suspension, and steering mechanism thereby allowing an interchange ability and allowing a reduction in maintenance, inventory and personnel training.

The third consideration was that of a power source. The engine needed to be light for its power output, efficient in terms of fuel input, easy to maintain, and reliable. An engine has been developed which is particularly well suited to our fluid drive concept. The engine (Fig. 24) was designed by Harold Kosoff and consists of a tube with two pistons which come together in the center of the tube to form the combustion chamber. The compression ratio of the engine is 16 to 1, which puts it in the diesel fuel range and means it will fire without a spark plug. There are no valves in the combustion chamber since the engine works like any two-cycle engine and draws its air through ports which are alternately covered and uncovered by the piston movement. Fuel is inducted to the combustion chamber via an injector nozzle and the exhaust gas escapes through ports in the same manner that the air is taken in. In order to increase the efficiency of the engine, Mr. Kosoff has included an exhaust-driven turbo-charger to increase the oxygen input. Once the pistons have come together and fired, they fly out toward the outer ends of the tube at which point air and oil are trapped in a chamber. As the piston nears the end of the tube, it will compress the air trapped there, force the fluid out of the chamber, then bounce off the compressed air and return to the center of the tube to fire again. The engine as it has been designed is a thirty inch long tube and is five inches in diameter. Engine weight is light at thirty pounds with a twenty horsepower output. Also, with modifications, the same power plant can be used as an air-compressor or a generator.

In applying the engine to our vehicle we intend to use six such engines (Fig. 25). Three of these engines are to power the vehicle, two engines will power accessory hydraulic equipment, and the remaining engine will be a generator to supply electrical power for lighting on the vehicle and its other electrical systems as well as providing a power supply for electrical power tools.

A means for tying all of the first three considerations into a workable package made the fourth consideration that of building a functional frame. In order to conserve weight, the frame should be a working part of the vehicle. Our concept involves making the frame from hydraulic cylinders (Figs 26,27). The cab and engine-housing part of the vehicle is to be attached to two parallel cylinders which are six feet long and six inches in diameter. Both of the cylinders will be solid at the center to allow each end to become a separate unit, thus allowing two hydraulic cylinders per side. The two forward wheel assemblies would also be attached to the outer ends of these cylinders. The rear frame also consists of hydraulic cylinders, but of a shorter length. There are two cylinders per side running parallel (one over the other). These attach to the transverse frame cylinders to form a "U" shape. The rear driving wheel assemblies attach to these rear members. This arrangement allows the back of the vehicle to be completely open to the attachment of various working units (Fig. 28). This mounting position brings the attachments up close to the operator and, in effect, makes any attachments an integral part of the vehicle. The vehicle could also straddle heavy objects to pick them up with the weight concentrated in the center of the chassis within the perimeter of the wheels.

Since the vehicle has the ability to raise or lower itself on its own suspension (Fig. 29), the ground equipment for the fighter aircraft could be designed to allow the vehicle to back under the equipment, raise itself and the load, and carry the equipment to the job.

The vehicle has the ability to operate at the same speed and with the same amount of maneuverability in any direction. This concept necessitates giving the driver seating and controlling facilities which will accommodate the multi-directional movements. It is our contention that the driver should be given a high vantage point when the vehicle is being used to perform the heavier work functions such as scraping and trenching. To accomplish this function, the passenger seat is made to fold upon itself allowing it to assume a higher position (Fig. 30). The driver will now be seated on the reverse side of what had been the seat back in the lower position. The former head-rest now becomes a back-rest. A console containing the working levers can be raised and rotated ninety degrees to position the controls in front of the elevated operator. The directional tiller mentioned before has been placed to allow its operation from both the normal and the elevated driving positions.

SUMMARY

The vehicle we have designed can be utilized not only for the development of the Bare Base; it will also become an effective part of the fighter aircraft ground equipment. We also feel that the same basic concept of the vehicle could be applied to a larger vehicle which could fulfill the functions now performed by a variety of heavy-duty vehicles. In combination, the new vehicles would reduce the number of vehicles required. Since the vehicles are light-weight in themselves, the overall weight of the vehicle portion of the Bare Base package would be greatly reduced.

SURVEY OF SPECIAL EQUIPMENT

POWER PLANTS

This team recommends that the Air Force adopt for use as Power Plants the Kosoff engine described in the VEHICULAR CONCEPT section of this report. This engine is said to be eighty per cent efficient and provides twenty (20) horse power. These engines can be grouped together into a very small unit, compared to conventional engines, to provide the horse power needed for any power function. Mr. Kosoff has designed a fluid power converter that would give efficient power conversion to all wheels of a vehicle. He has also designed a means for incorporating into his engine a generator which puts out five kilowatts per hour. This adds very little to the weight of the engine. The engines can be grouped together to provide the required kilowatts at a very low weight. For example twelve of the Kosoff engines would generate sixty (60) KWH with an estimated weight of four hundred (400) pounds for the engines themselves, and an additional one hundred (100) pounds for necessary packaging and controls for a total weight of five hundred (500) pounds. This is a very great savings in weight over the existing conventional generators. This engine can be used individually to provide very small and light-weight packages for sources of power.

TENT HEATING AND LIGHTING

Mr. Kosoff's engine can be packaged with each tent to provide heating and electrical lighting. Wiring can be incorporated in the tent material to power wall recepticles for individual lights, fans, and radios.

RUNWAY LIGHTING

Runway lighting can be a series of packages on each side of the runway. Each of these packages would have its own power source and light source. Mr. Kosoff's engine, which provides this power, can be started by radio signal which eliminates all need for stringing wire over the base.

SHOWERS

The rigid support members in the shelter ceiling which laterally support the structure can be replaced by tubing used as piping to supply water to the shower heads.

Heating the water and the pressure necessary to supply the showers can be achieved by using the Kosoff engine described elsewhere in this paper.

Individual shower heads, which airiate the water supply, are suspended from the water supply tubing so that the showers can be used by many people or by only one person at a time.

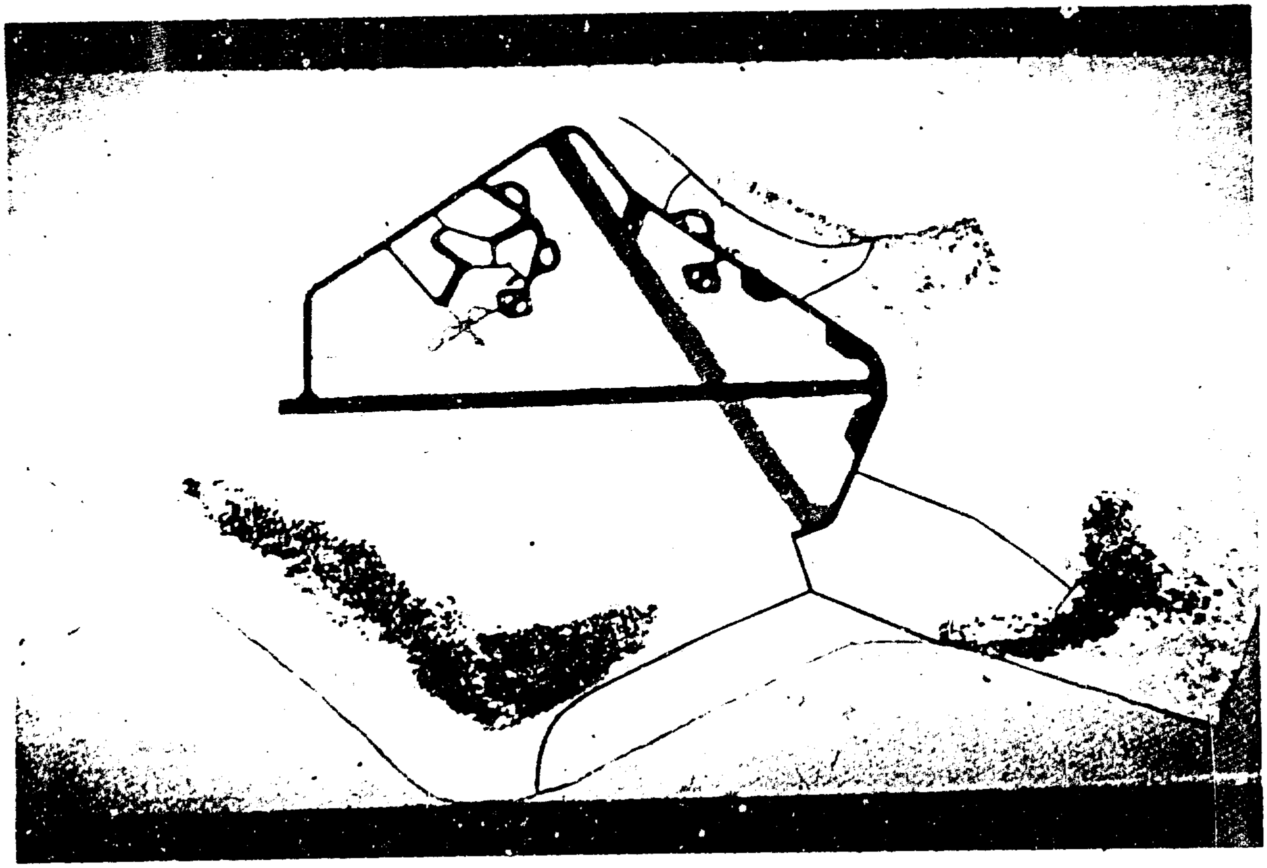


Fig. 1: Site for Bare Base.

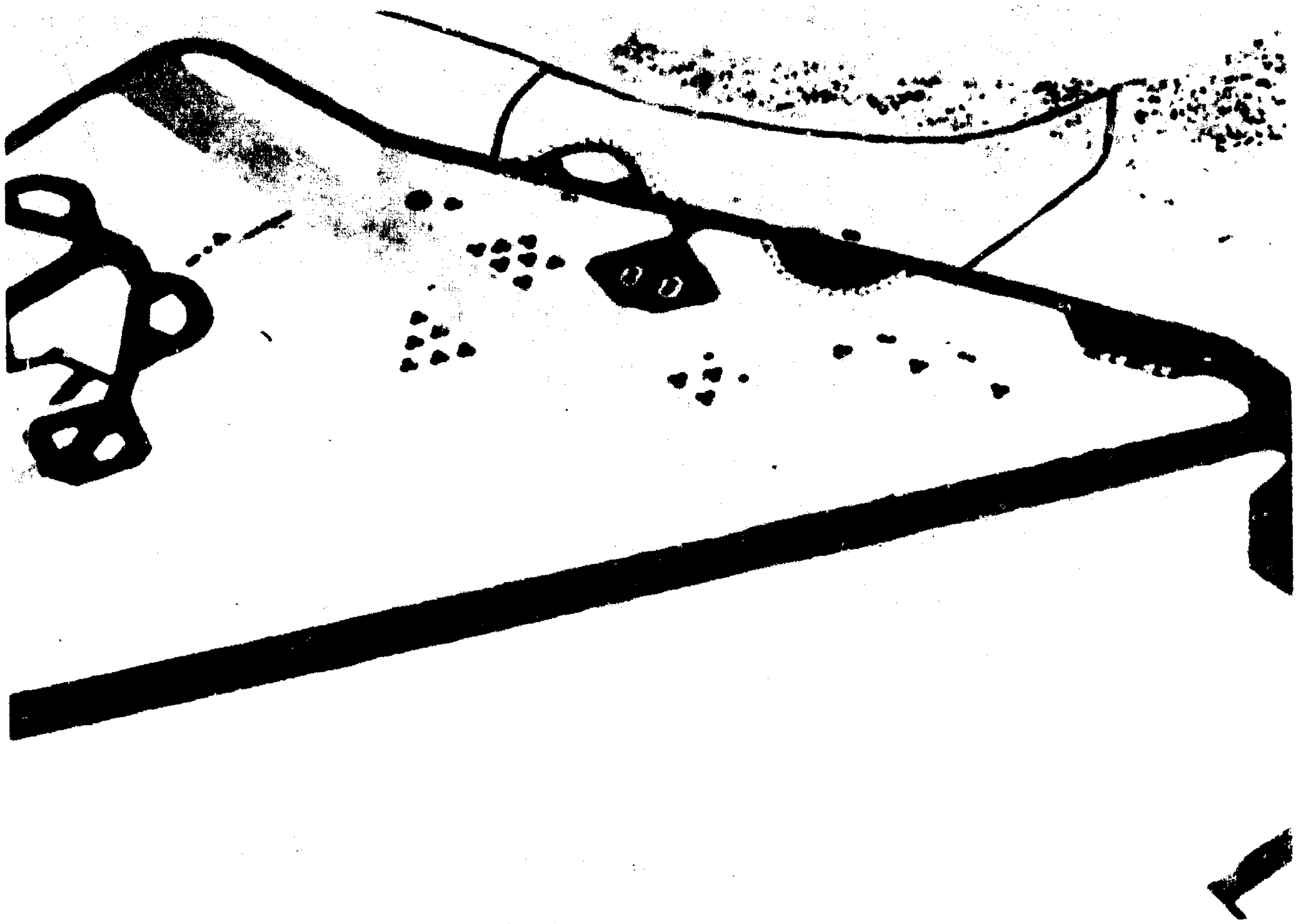


Fig. 2: Fully developed site.

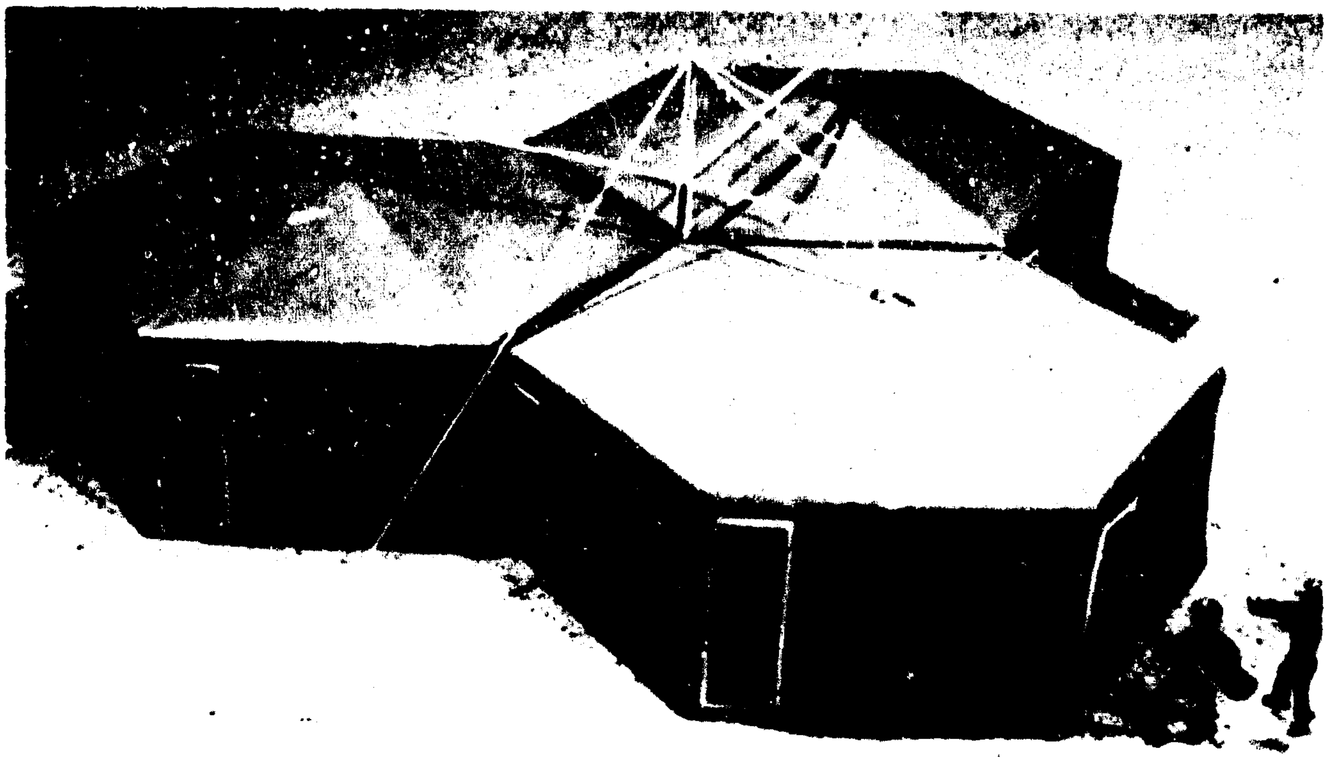


Fig. 3: Aerial view of shelter.

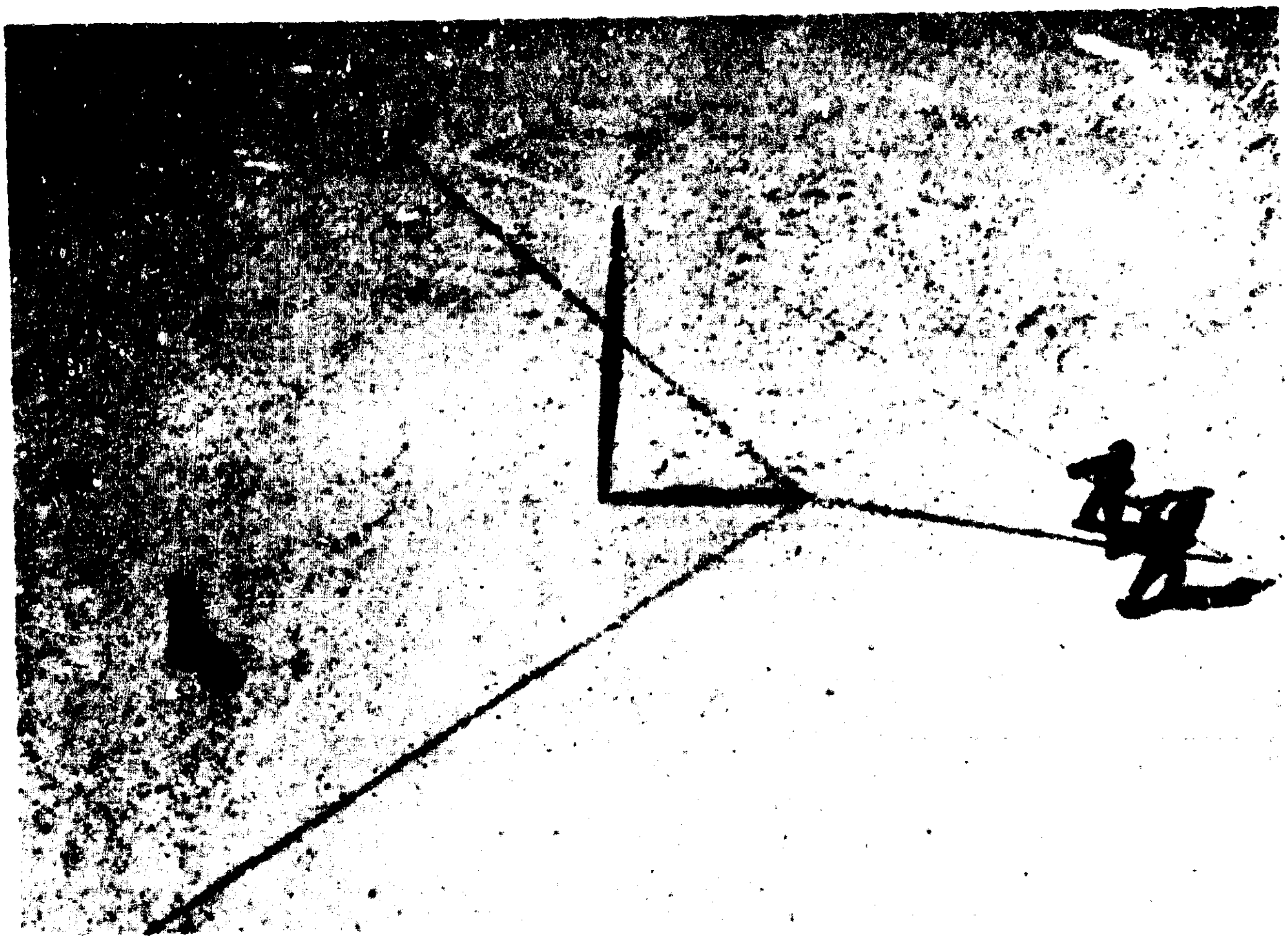


Fig. 4: Erection sequence: 1. Erect pylon.

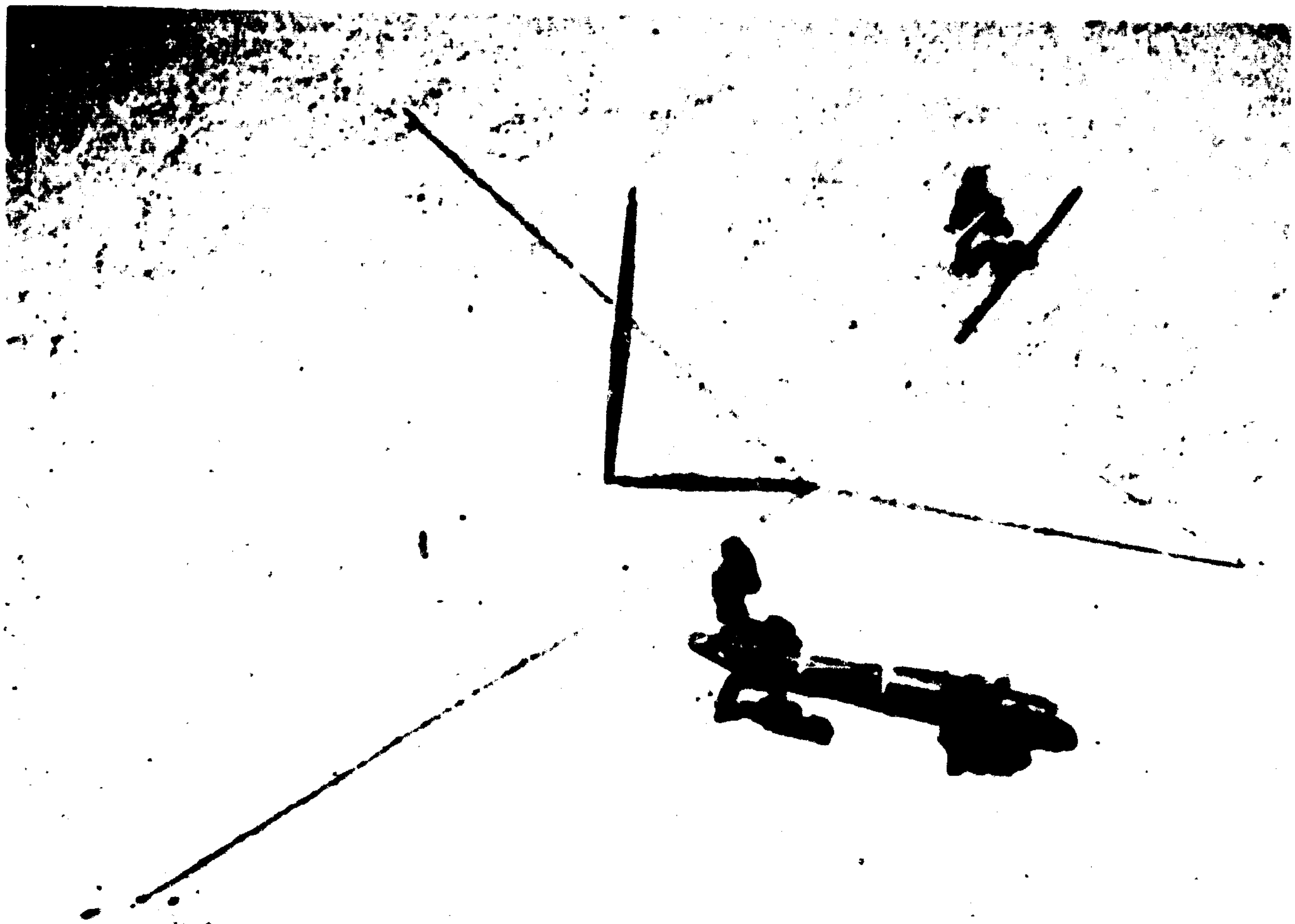


Fig. 5: Erection sequence: 2. Position flooring package.

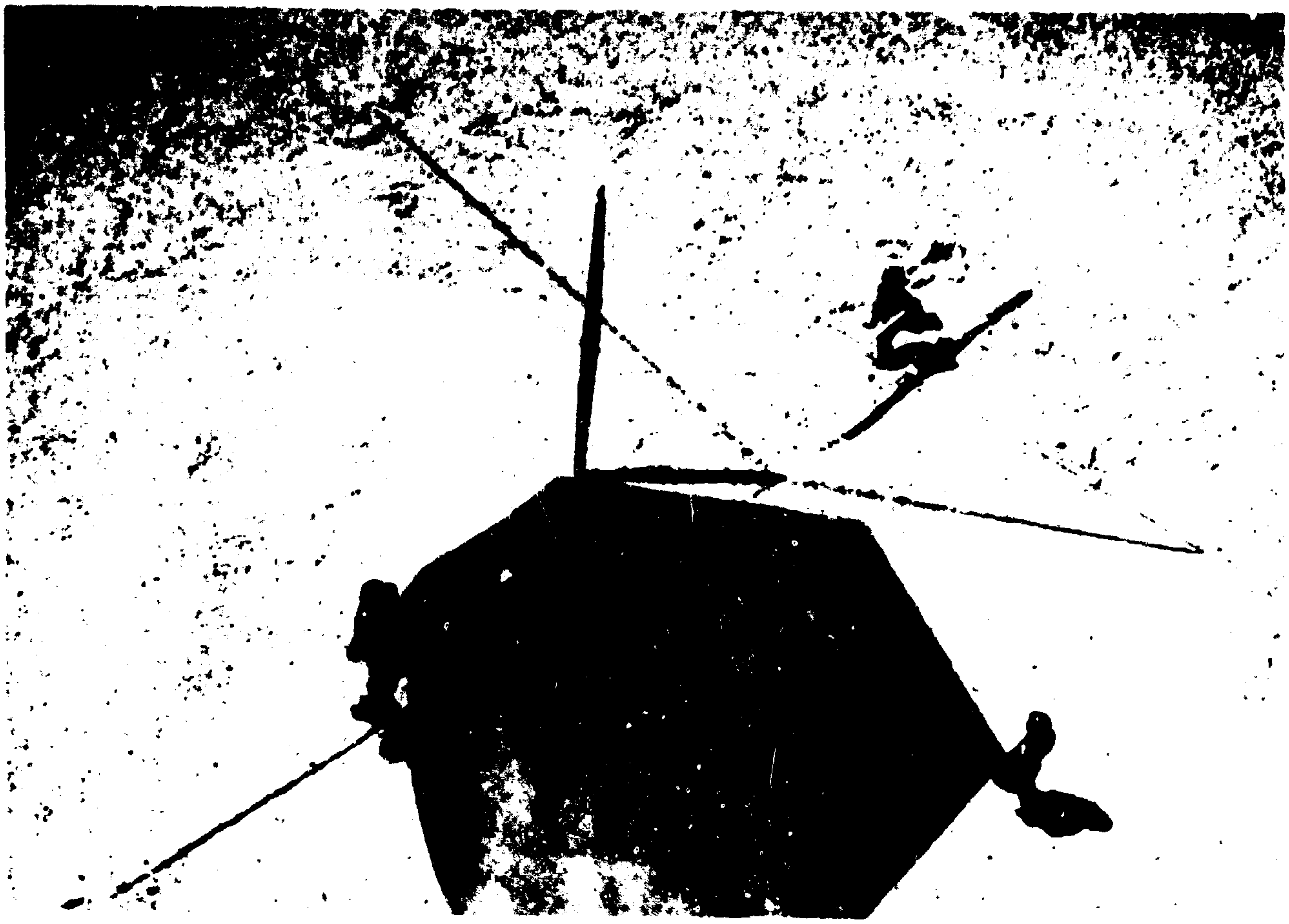


Fig. 6: Erection sequence: 3. Unroll flexible flooring.

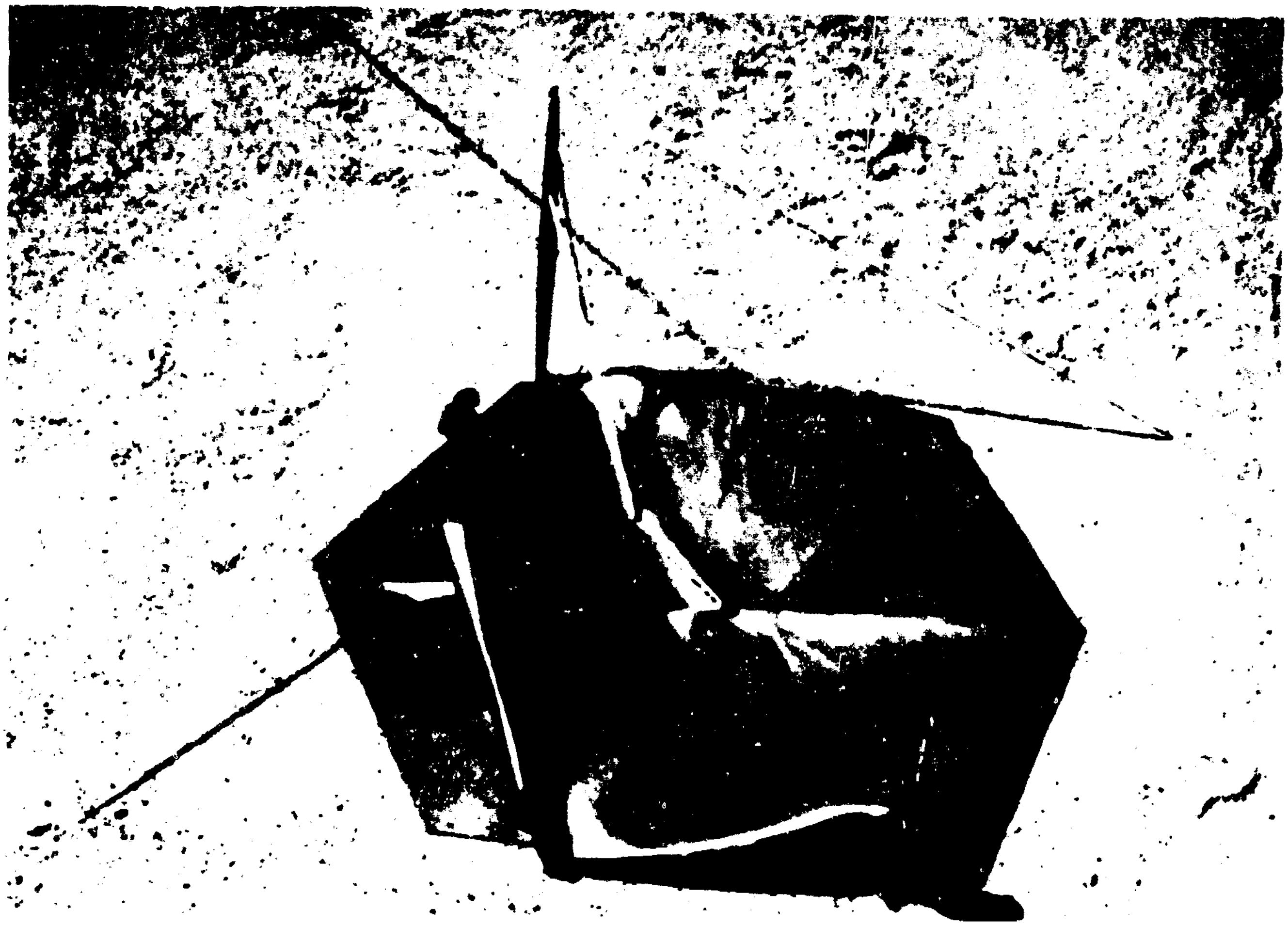


Fig. 7: Erection sequence: 4. Placing enclosure package.

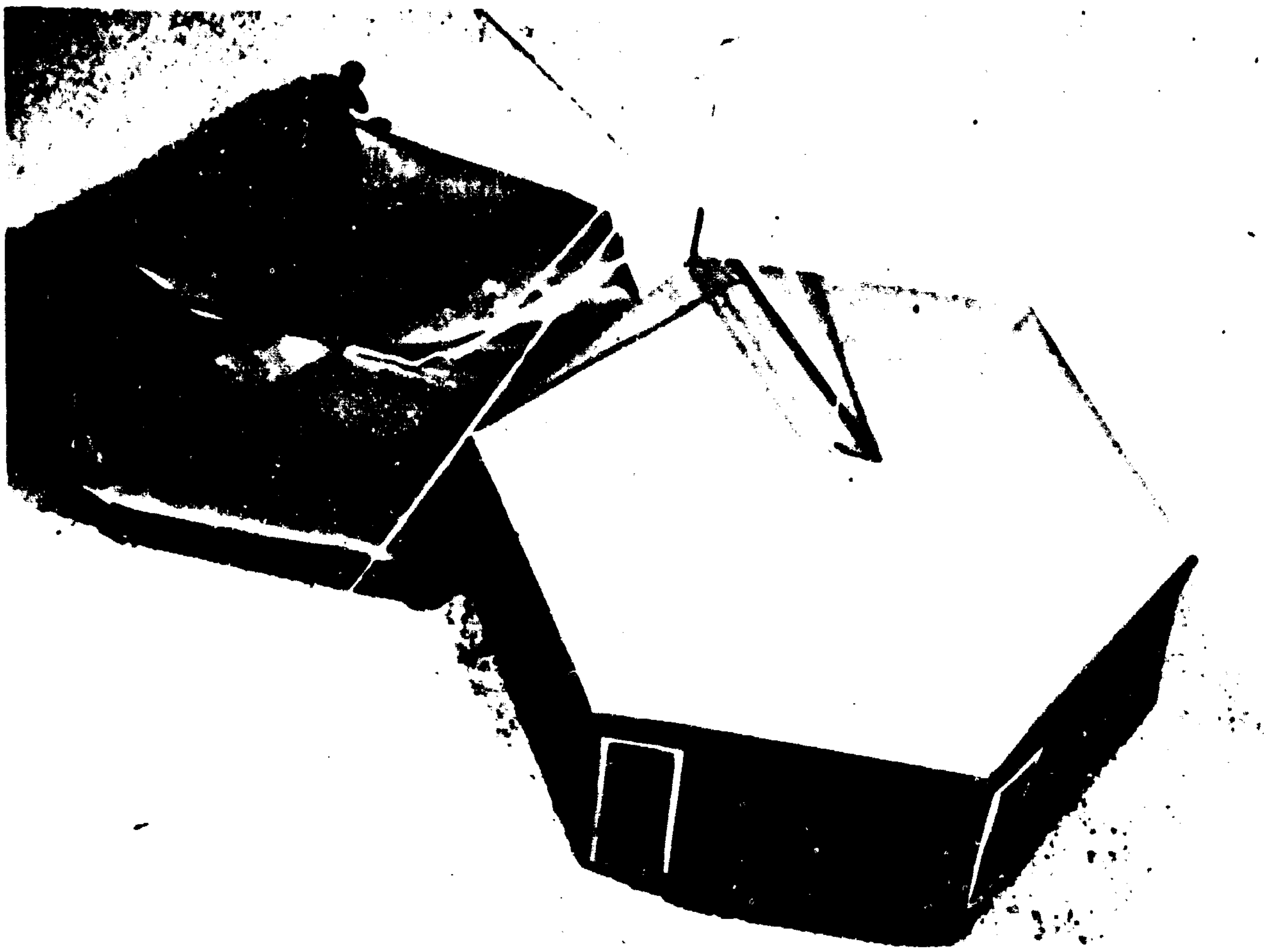


Fig. 8: Erection sequence: 5. First element hoisted into place; second element positioned.

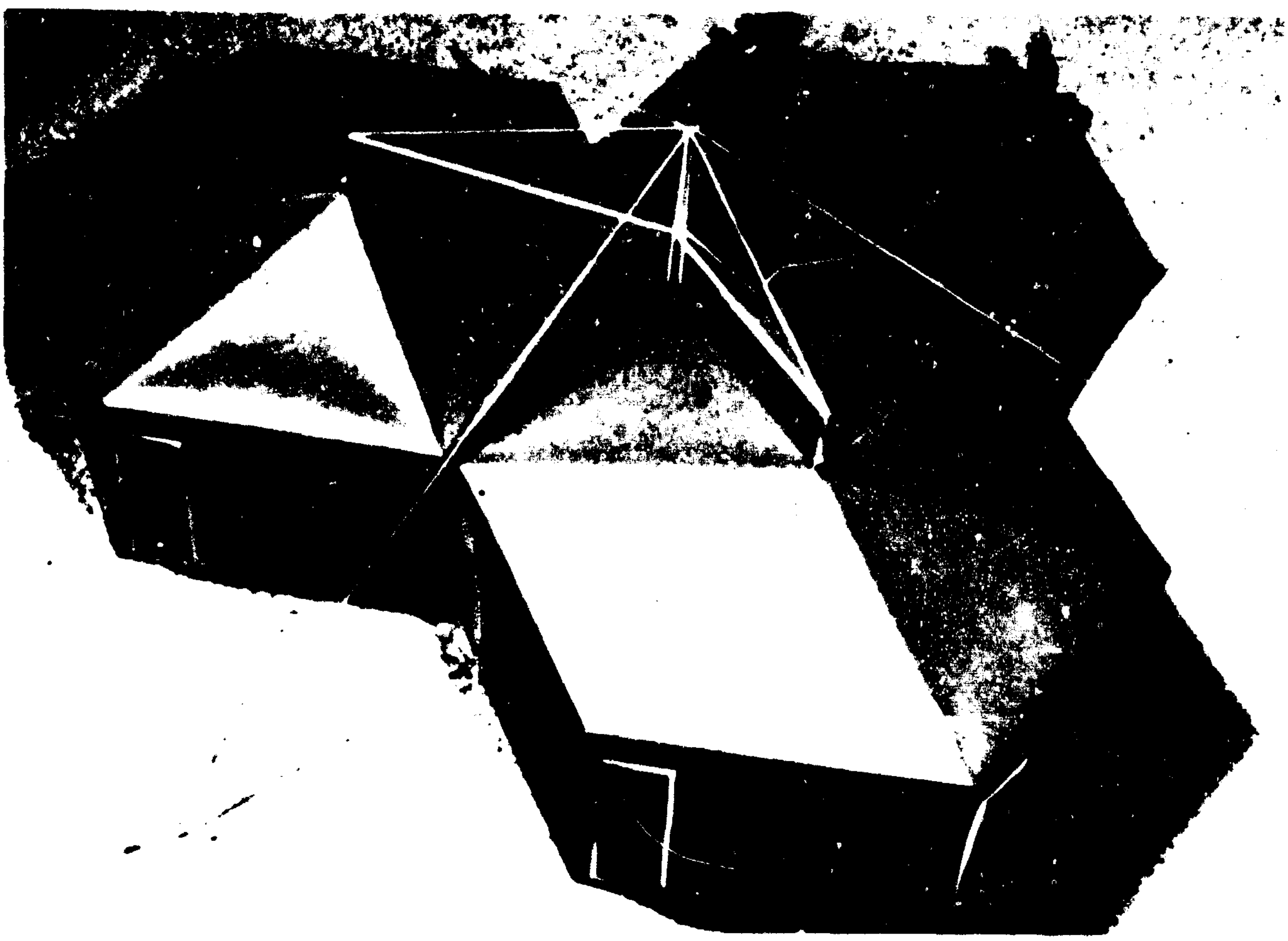


Fig. 9: Erection sequence: 6. Placement of final element.

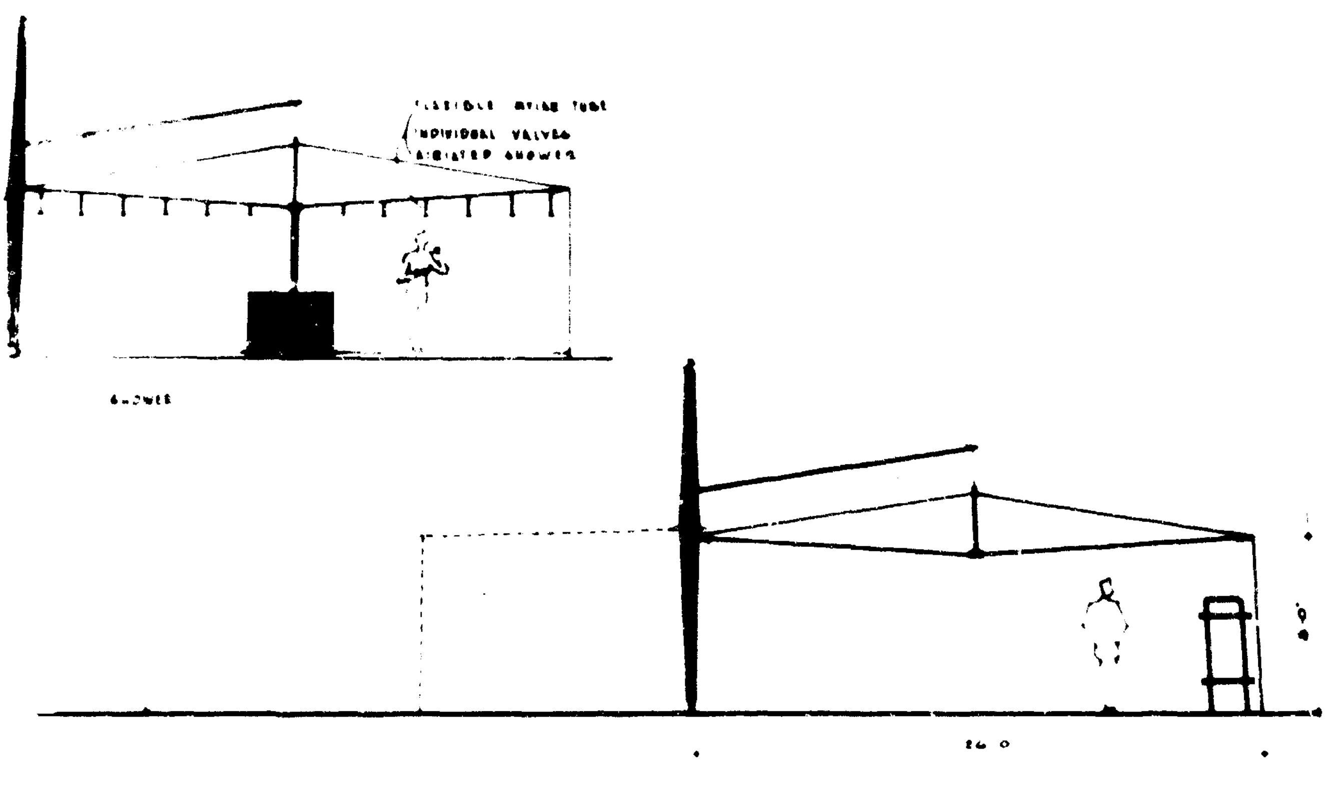


Fig. 10: Basic section and detail showing adaptation for shower.

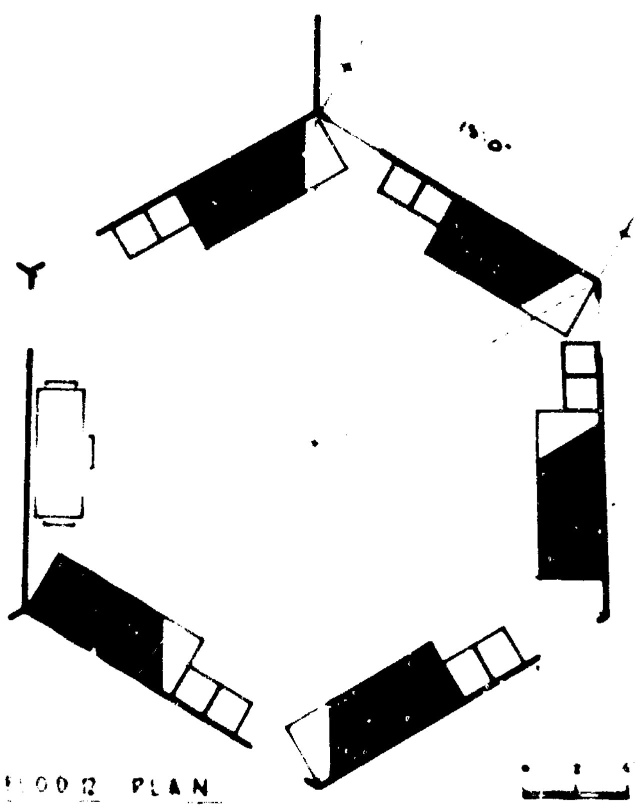


Fig. 11: Floor plan ('ypical ten-man unit.

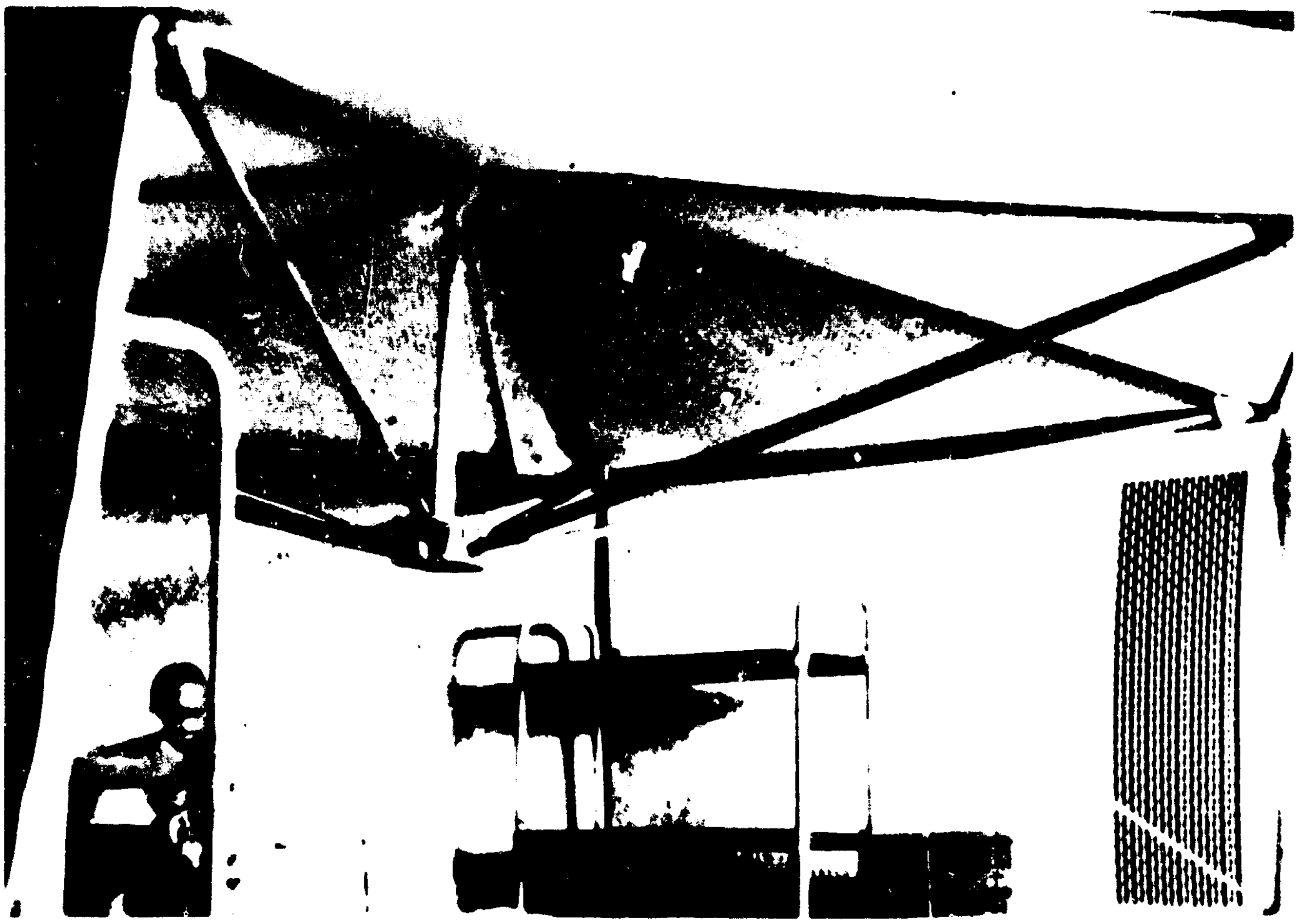


Fig. 12: Interior of housing unit.

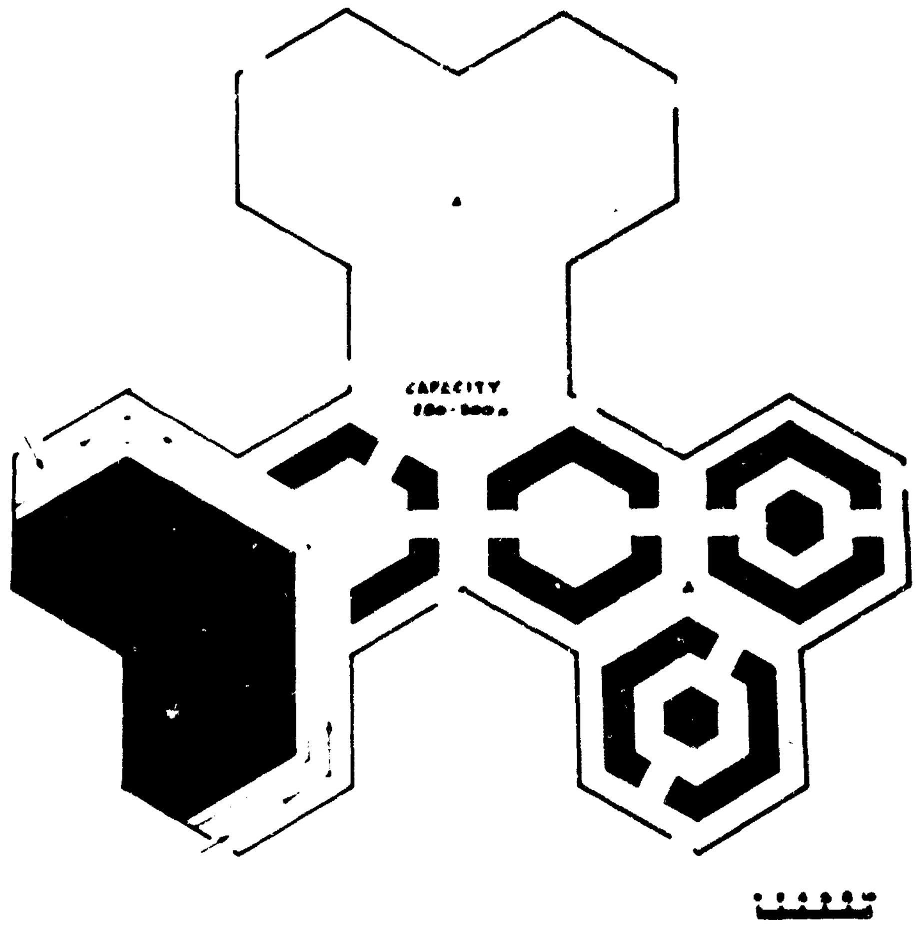


Fig. 13: Floor plan (typical messing complex).

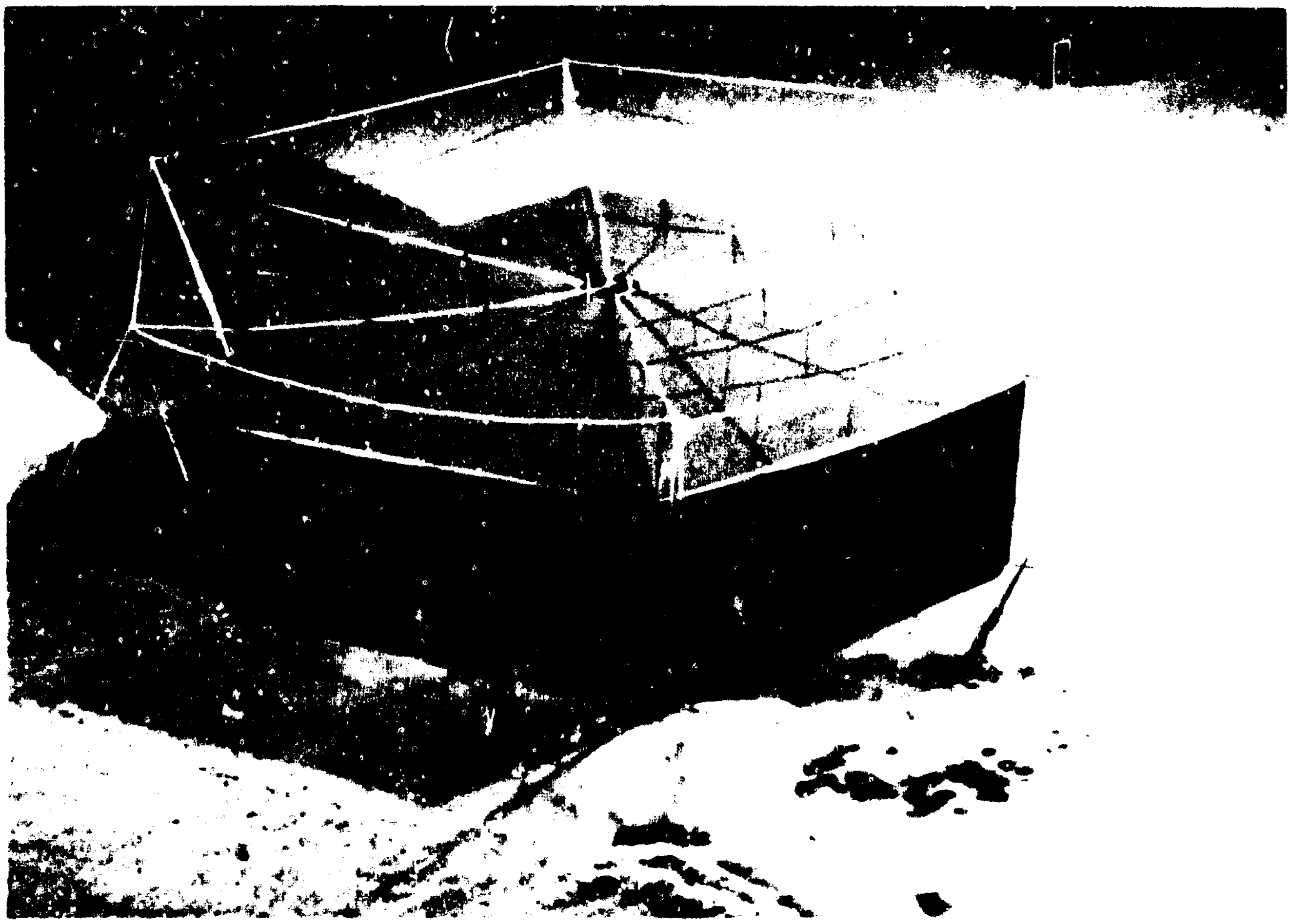


Fig. 14: Aerial view of hangar.

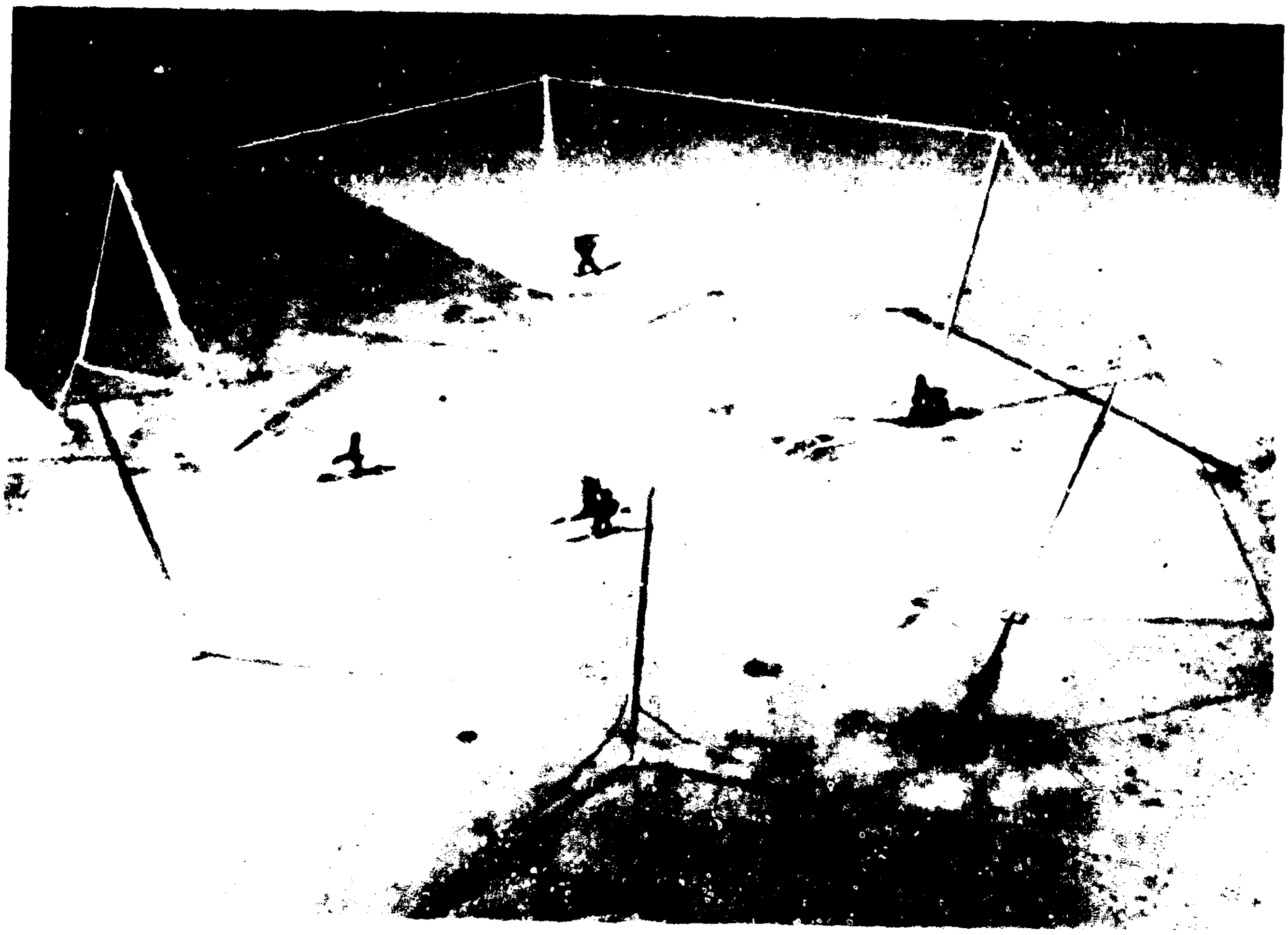


Fig. 15: Erection sequence: 1. Pylons and tension lines installed.

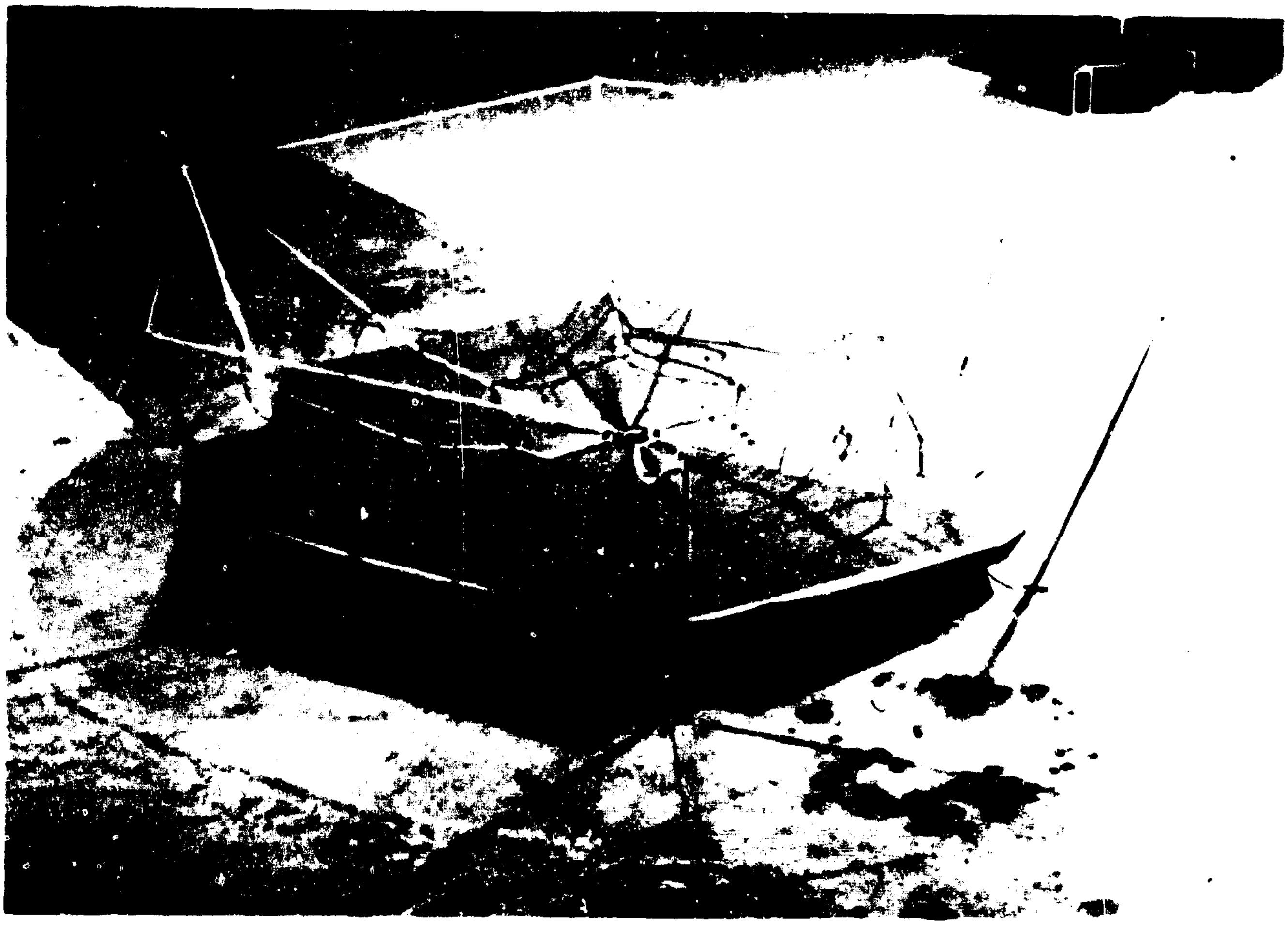


Fig. 16: Erection sequence: 2. Shelter enclosure in place.

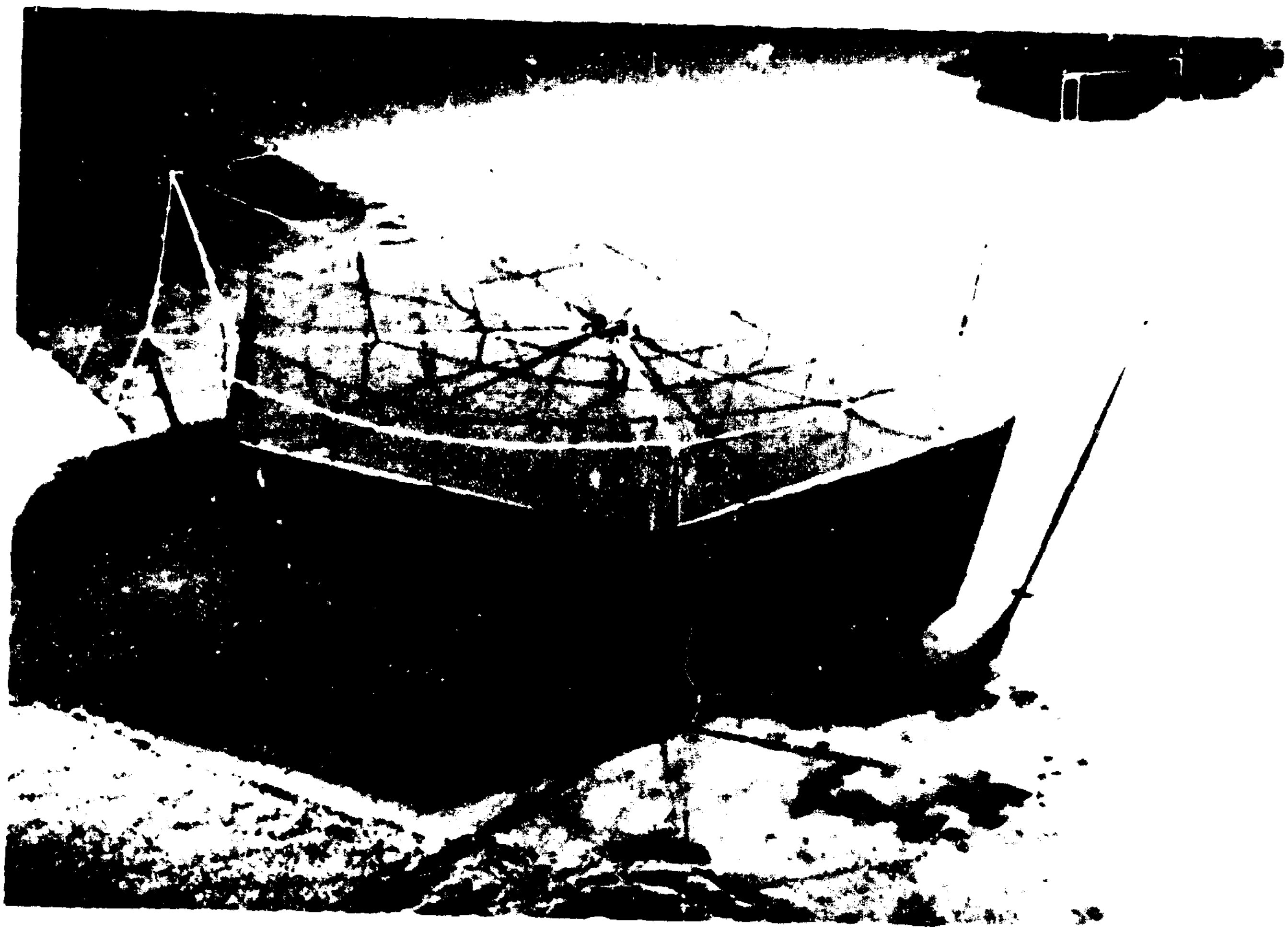


Fig. 17: Erection sequence: 3. Shelter hoisted toward final position.

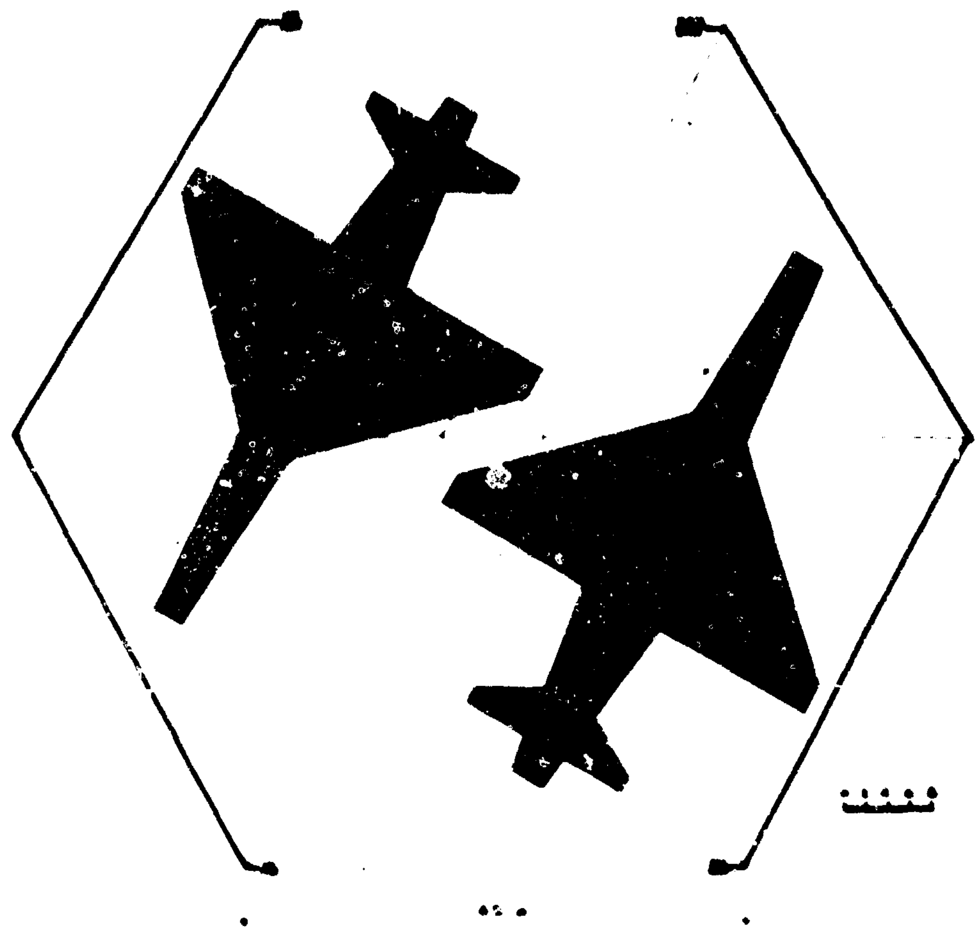


Fig. 18: Floor plan housing two F4C Fighter aircraft.

Fig. 9: All-purpose vehicle.

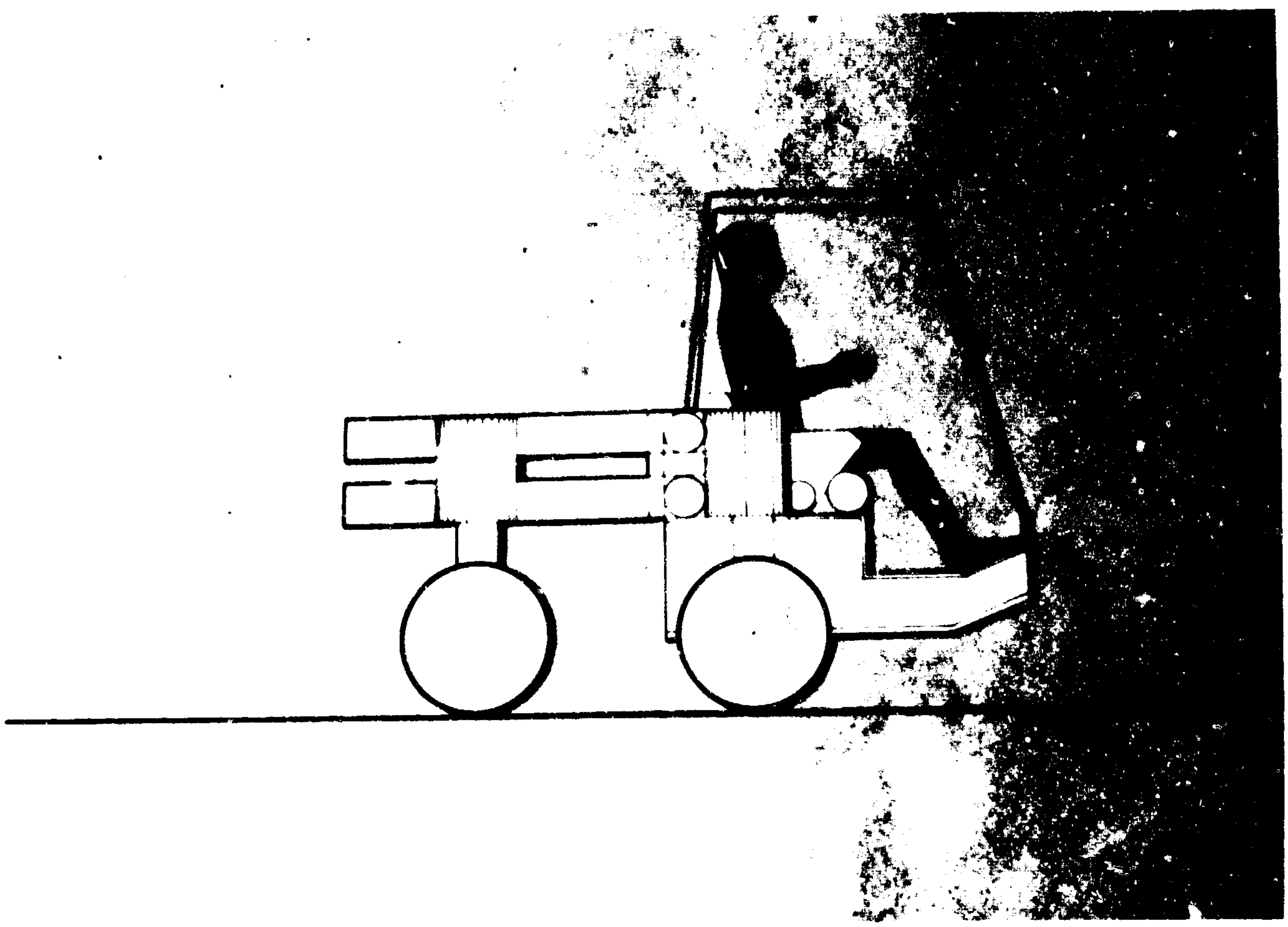


Fig. 20: Canopy attached to vehicle cab.

Fig. 21: Vehicle showing wheel rotation (inboard to outboard).

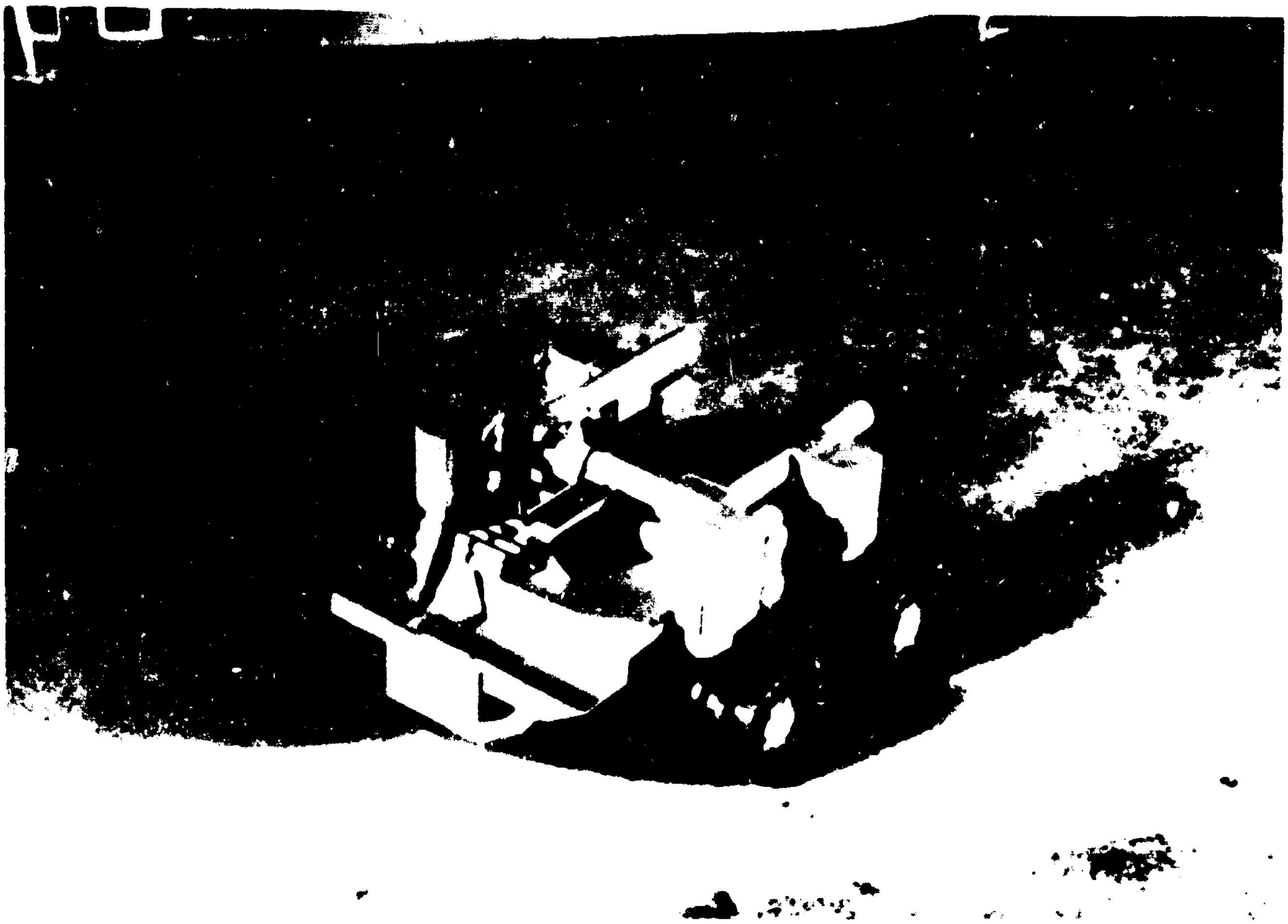


Fig. 22: Vehicle showing wheel rotation (outboard).

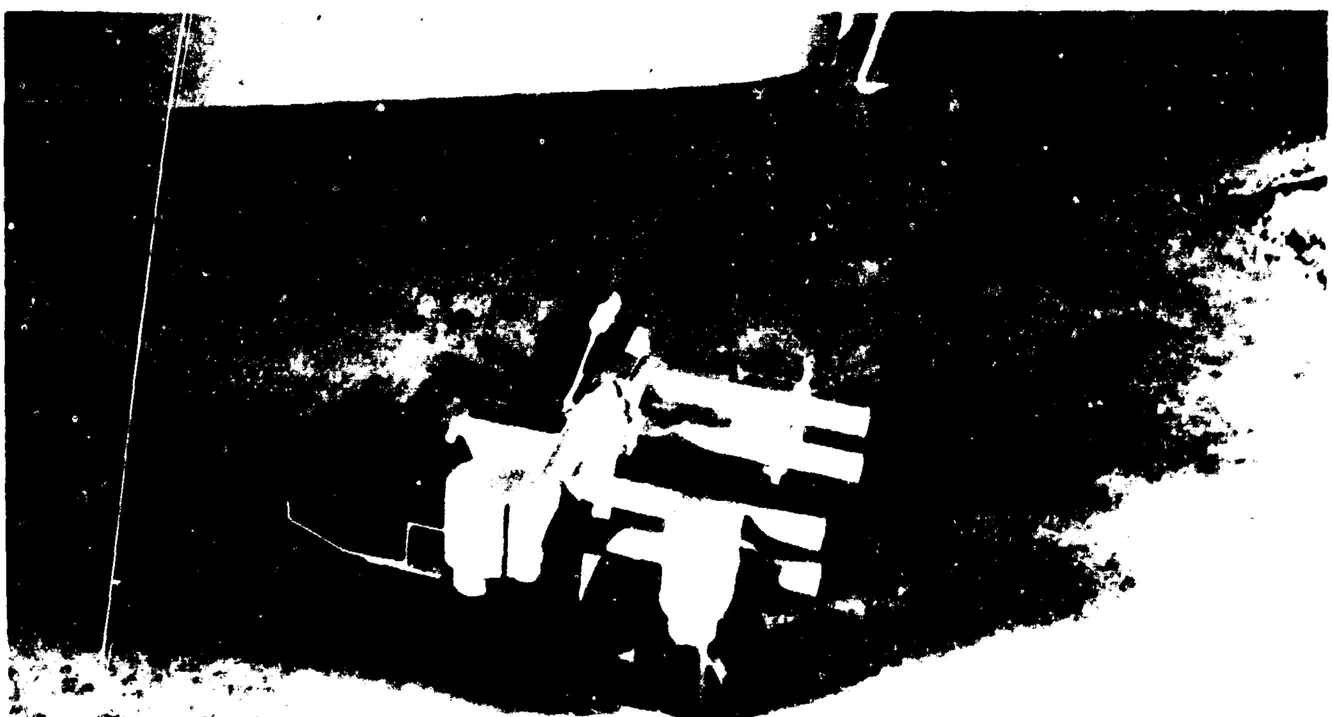


Fig. 23: Vehicle showing wheel rotation (inboard).

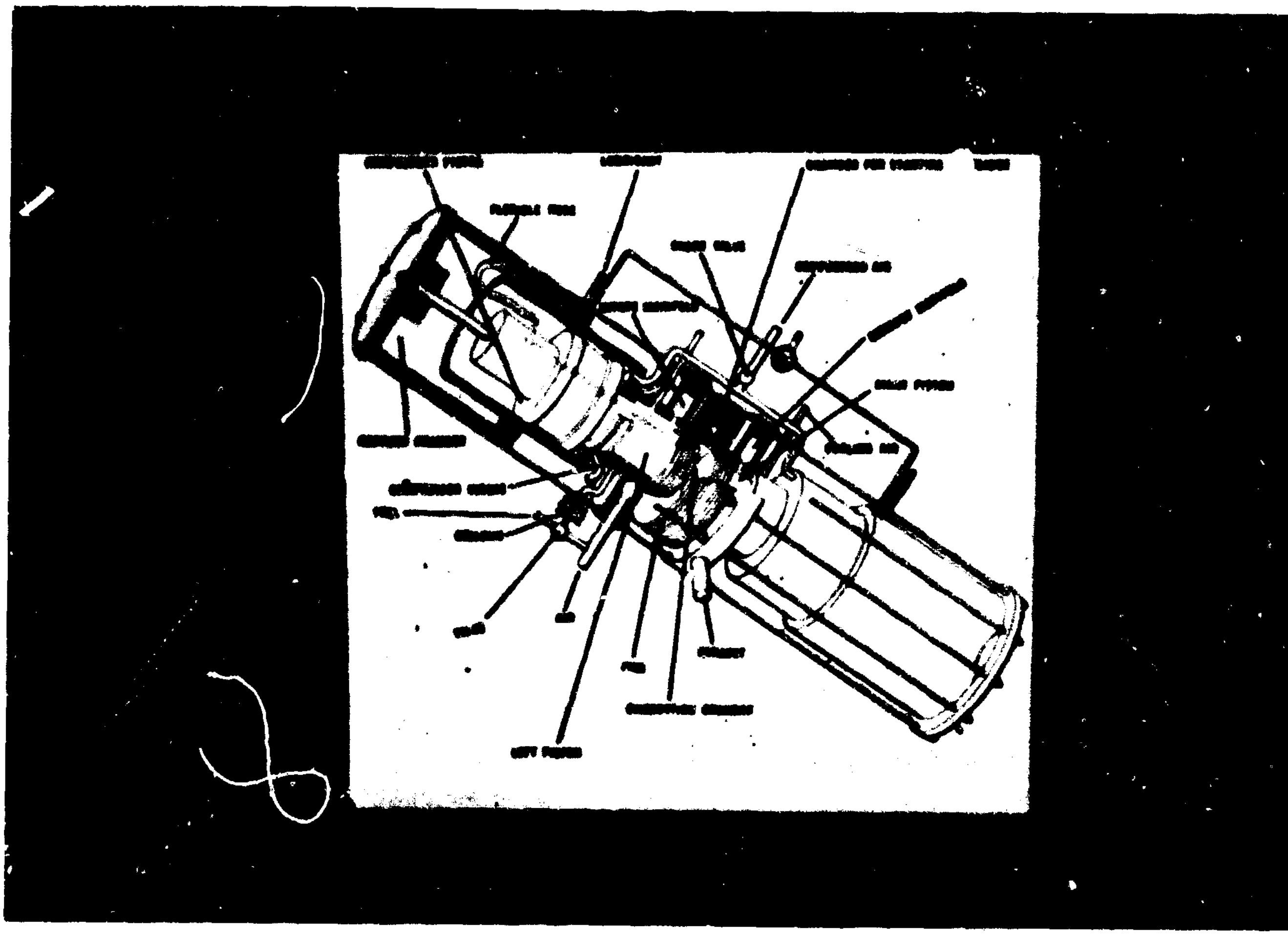


Fig. 24: Technical drawing of Kosloff engine.

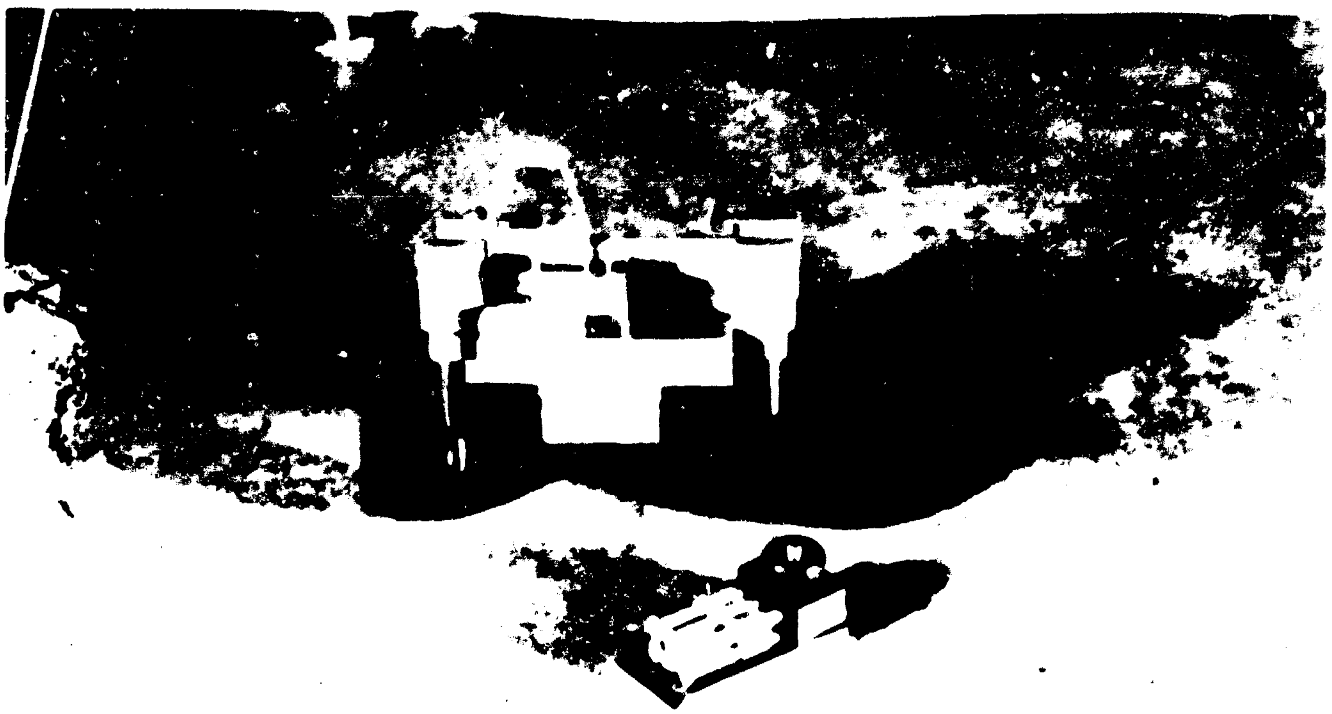


Fig. 25: Vehicle showing six-engine power pack.

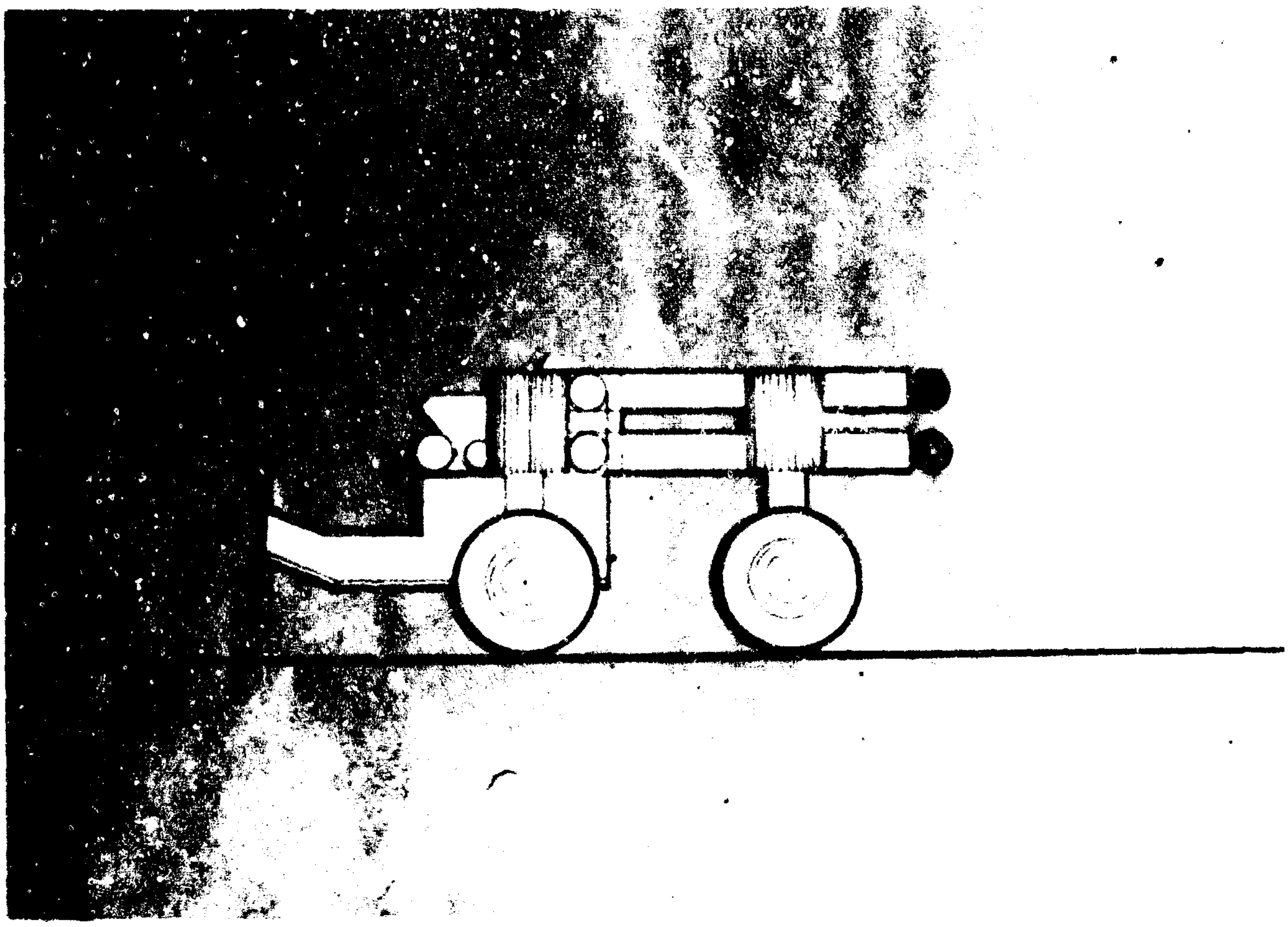


Fig. 26: Hydraulic cylinders retracted.

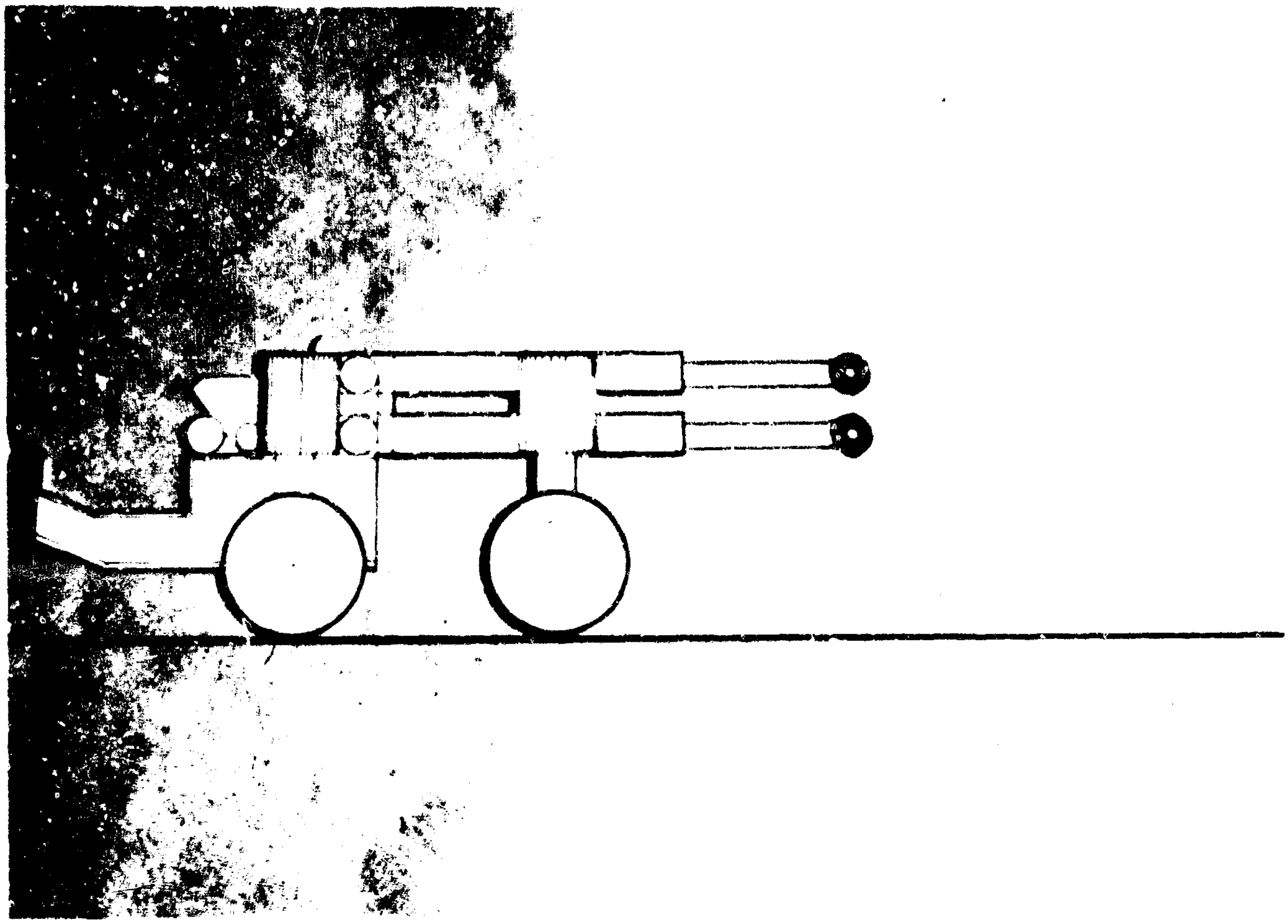


Fig. 27: Hydraulic cylinders extended.

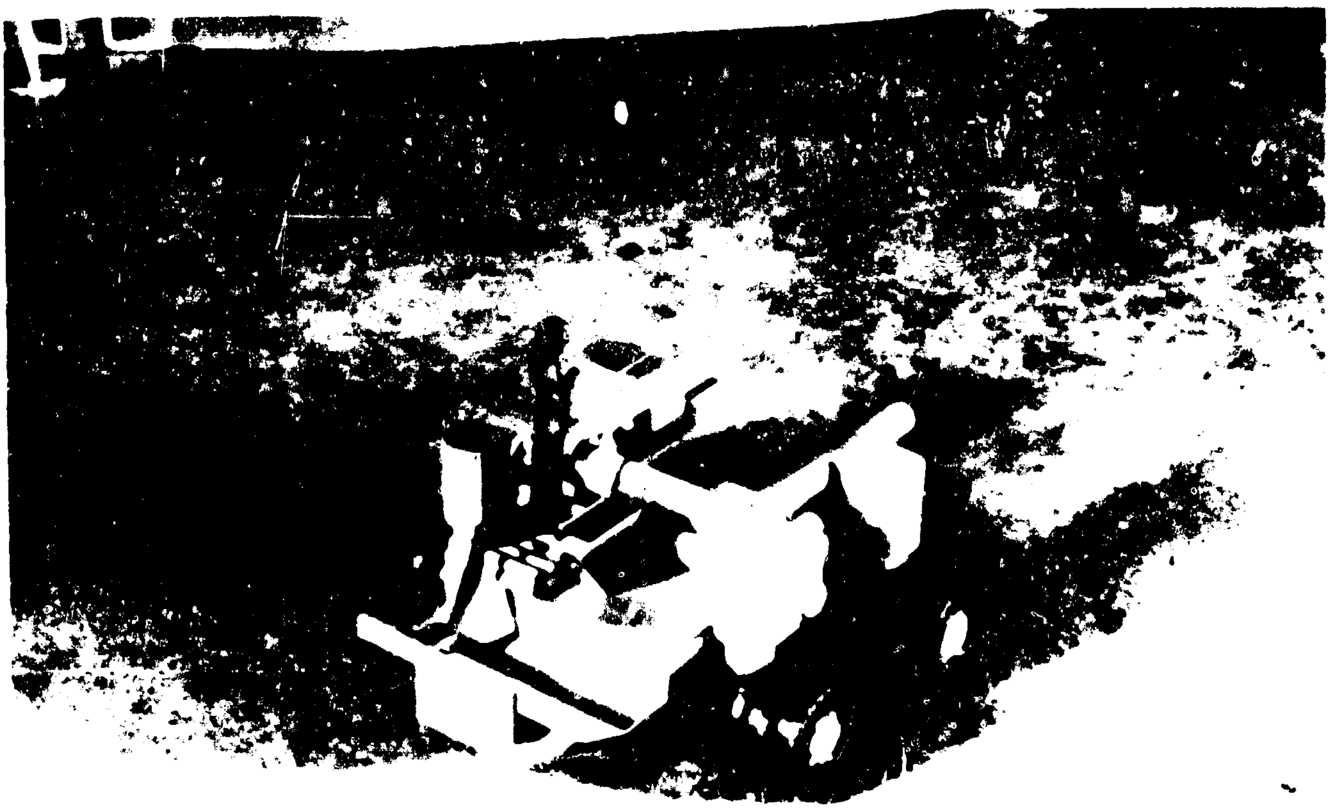


Fig. 28: Vehicle showing view of U-shaped open frame.

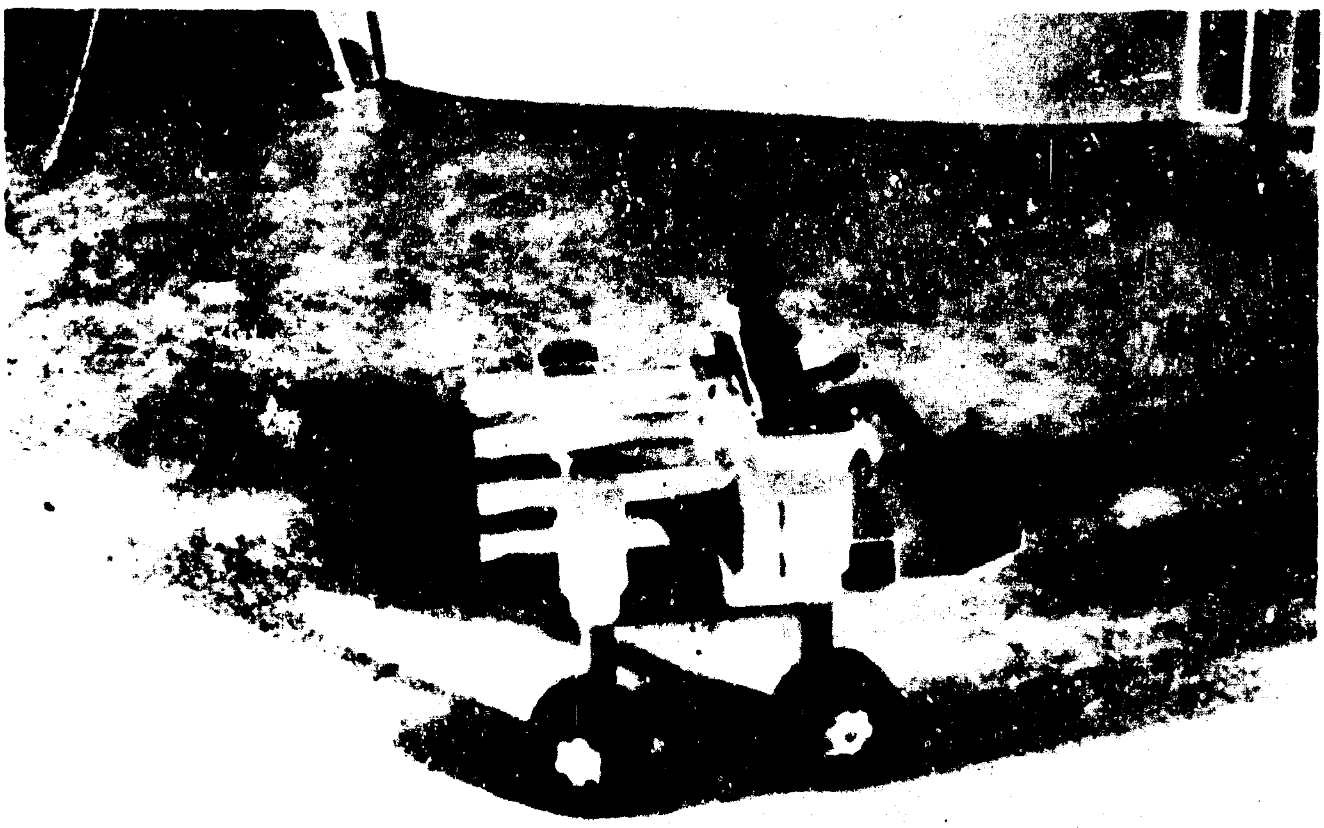


Fig. 29: Vehicle in raised position.

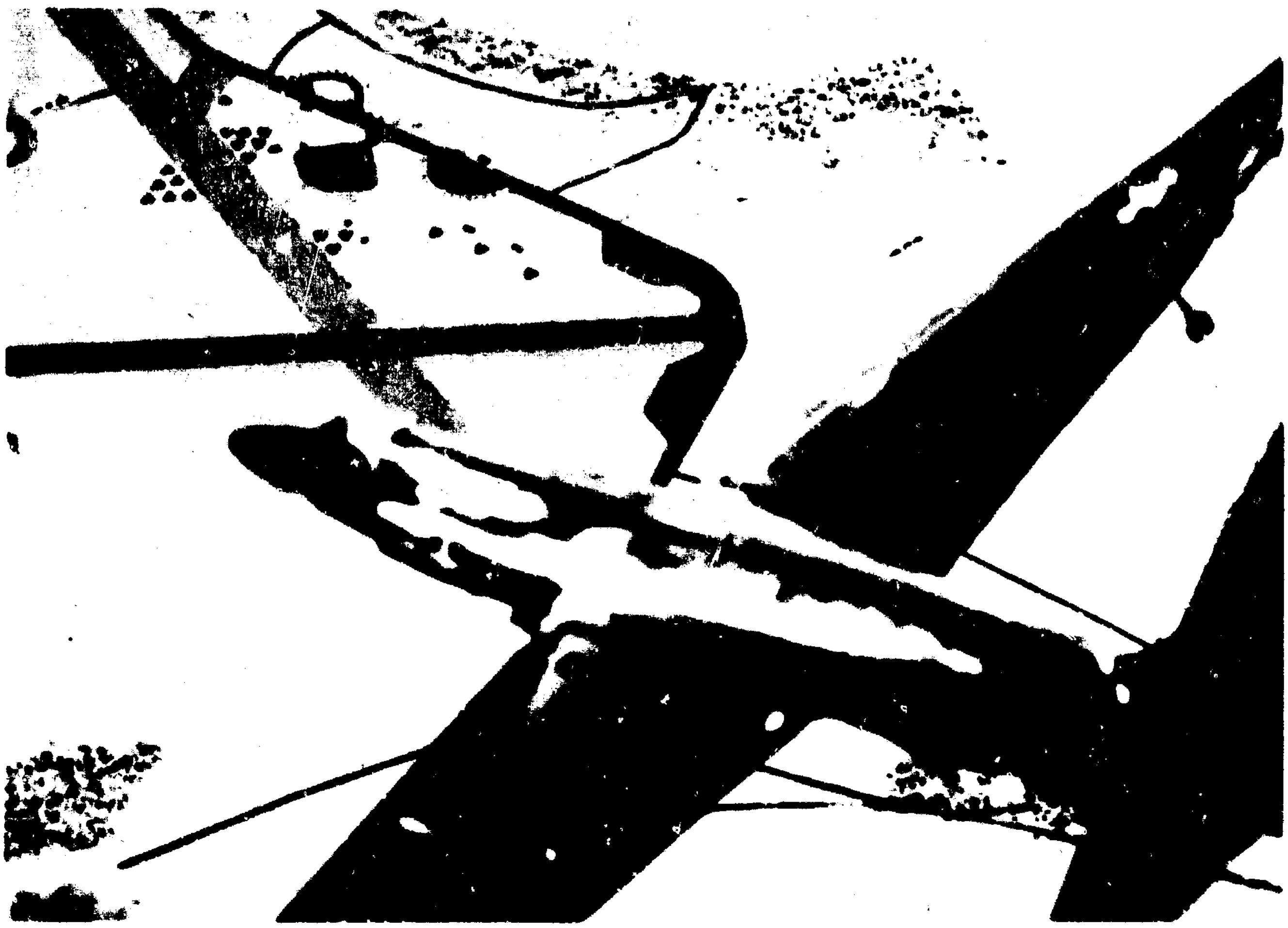


Fig. 32: Bare Base fully operational.

TEAM 2

Ruth H. Grad	Industrial Design '65
Thomas C. McMullen	Architecture '66
David R. Oldham	Architecture '66
John W. Wissinger	Industrial Design '65

PHILOSOPHY

Our philosophy regarding the Bare Base Development followed along the lines of the problem as it was assigned. In our designs we hoped not only to cut the weight and therefore the number of trips by C-130's but also to increase the efficiency in setting up this base and operating it.

We naturally approached this mainly through the designs of our structures and vehicles. As the following report shows, we did this to the best of our ability, although at times we had to sacrifice one thing to accomplish another.

In this manner we tried to develop a battery of equipment to be transported into a Bare Base and to be erected there with as much ease and efficiency as possible. We planned through our scheme of vehicles, shelters and other special equipment to have an operating base set up in four priorities.

In the following pages we will try to show how we have used this philosophy in our Bare Base Development.

ADAPTABILITY

The base which we were given for our Bare Base Development is on one of the Bermuda islands. The island is fairly level, the highest elevation being not more than two hundred feet. The major part is three miles long and three-fourths of a mile wide with several peninsulas jutting out at each end. Therefore, our site would be very similar to many other sites (Figs. 1,2,3).

Our plan for the establishment of a Bare Base would be easily adaptable to most other sites that the Air Force uses for these bases. Throughout our discussions we geared our thinking to the Bare Base itself and not to the fact that our particular site was fairly level or had mostly mild weather or any other particular idea. We kept in mind that this just happened to be our site and that what we were designing should be applicable to any given base or set of conditions. The only thing that might be changed in another situation would be the layout of the base areas, depending upon the airstrip layout and the terrain.

Keeping in mind that the Air Force did not want a number of concepts, each usable at certain bases and not at others, we chose a scheme by which the Air Force could take the same component parts anywhere in the temperate zone.

Our inflatible structures are insulated and ventilated to provide comfortable living or working quarters in any climatic situation, barring the severe cold of the Artic or extreme heat at the Equator. The expanded Royalite floors can be used on any ground and will certainly add to the living ease.

The vehicles that we have designed are also of a nature that can be used anywhere they might be sent. Regardless of the weather or terrain, these vehicles will be able to perform the same tasks they would on our Bermuda Island.

Thus we have a Bare Base Concept that can be adapted to any Bare Base, and any base should be able to be set up with the same ease with which we developed ours.

SHELTER CONCEPT

Our major idea for our shelter structures is an inflatable structure with an expanded Royalite floor. These are packaged in sections and fastened together to acquire the desired size. Basically all our buildings on the Bare Base would be of very similar nature.

TENTS

The billeting structures are sixteen by thirty-two foot inflatables each of which houses twelve men (Fig. 4). This tent is made up of four individual sections which are combined to make the one large one. The individual package is eight inches by four and one-half feet by eight feet and contains one-fourth of the twelve-man tent plus one-half of its end panel. The package itself is the Royalite floor with the inflatable part of the structure already attached to it.

In shipping, four of these packages are strapped together to make a larger package two feet by four and one-half feet by eight feet (Fig. 5). When the structure is being erected, these same straps fit on the same snaps to hold the floor sections together. The inflatiable parts are zipped together, and the end panels are then zipped in.

A three-man team would most likely be used to erect this structure, and four of these teams could erect billeting for eleven hundred men in five hours. The first two men of a team would carry the package to the area and unfold it (Fig. 6). The third man would then begin to inflate it as the other two are unfolding the second section and strapping it to the first (Fig. 7). The third man zips them together and begins to inflate the second section. This process is repeated until the entire structure is erected (Figs. 8,9).

The units have plastic sections in the end panels which allow for ventilation and also for the heater hook-up. We figure that the weight of this type of structure is sixty-six pounds per man, but in many ways it is a great improvement over the existing tent. By using a special square inflated groin vault center section, tent complexes with 2,3, and 4 wings can be erected (Figs. 10,11,12,13).

MESSING & HOSPITAL

The messing structure and hospital (Figs. 14,15) are the same type of unit as our billeting structures. The main difference is that the erected units are twenty-four feet by forty feet because of the need for extra space in both.

In conjunction with these structures is a square inflatable, twenty-four feet to a side, which allows for a crossing pattern to be set up without the necessity of going out-of-doors to get to another part of the structure. Either of these can be erected completely in two hours time.

HANGAR

Our hangar structure is also made of inflatable material but, due to its larger size, it is constructed in a somewhat different manner. It consists of a double layer of tubes with double zippers so that its three vaults can be supported properly.

The three vaults are twenty-five feet across and are twenty-eight feet above ground level at the highest point. The sides have sixteen foot vaulted openings to which can be attached smaller tents for utility or for light or ventilation (Figs. 16,17,18). The end panels are not inflated but are flat and roll up and down in a manner similar to a window shade.

These hangars would have to be anchored to the runway and would have no floor of their own. Not including the time it would take to anchor, the hangar could be inflated in an hour.

VEHICULAR CONCEPT

We came to the conclusion, in looking over the vehicles that are now in use on the Bare Base development plan, that the standard trucks now in use have too much dead weight. These trucks were designed for road use and are too general for this specific project. Also, the cabs have much unused space.

In designing our vehicle we assumed that it should be specifically for a Bare Base. We chose to cut down on the unusable weight and have a cab to carry only the driver. Since the engine and drive train are the heaviest part and are in use only when the vehicle is moving, we decided to detach the unit when it is stationary and other parts are being used such as the tank, generator, etc.

The two cabs we plan to use attach to a basic trailer with a posi-lock to allow the truck to be driven as one unit for ease of handling and maneuverability (Figs. 19,20,21).

Both the cab and trailer use lightweight materials in ther construction to lighten their shipping weight. The trailer has an expanded Royalite base floor over molded ribs to give it additional strength. The frame is made of lightweight aluminum alloy. The tires under the trailer are of the "air-sack" type and required very low pressure (7 psi). These provide an easy ride without regular suspension (Fig. 22).

The larger of the two trailer sizes is eight feet by twenty feet and weighs somewhat less than one thousand pounds. The smaller one is the same width with a thirteen foot length and weighs in the neighborhood of five hundred pounds. The larger cab is eight feet by nine feet and weighs about three tons while the smaller is six feet by seven feet and weighs one-half that amount. Both cabs stand six feet high.

Our overall Bare Base scheme calls for the shipping in or six of the larger cabs and eighteen of the smaller ones. With these would arrive nine of the long trailers and sixteen shorter ones. Of course the cabs can be used interchangeably with the two size trailers.

The cabs not only combine with the various size trailers but have a number of other independent tasks. One of the main one of these in the opening days of the Bare Base erection is that of a Fork Lift (Figs. 2, 24). The cab was designed with this in mind for the engine, tank and mechanical equipment are in the rear to counterbalance the fork lift load.

In the initial support we would ship in three or four of these along with trailers, and these cabs would then be able to drive loaded trailers to their destinations and unload them there. They could then come back to pick up other trailers whose fork lifts had just loaded them from the plane. This would set up somewhat of a chain reaction for unloading the planes and setting up the base.

A power take off at both front and rear operates many of the other attachments for the cab. A crane attachment on the front utilizes this as well as the same weight counter-balance that the fork lift uses. Other parts that can be worked in this manner include: grader blade (Fig. 25), runway sweeper (Fig. 26), ditch digger, crane (Fig. 27) and jerry-type weed cutter.

The cab has rear wheel drive and rear wheel steering. As the trailer is locked on, the front wheels raise. When the cab is operating separately, the steering is in the rear unit. Automatic controls change it over to reversed steering. Steering is hydraulic. A master control changes the steering and locks the cab to its trailer.

Each trailer also contains jacks which lower when the cab is detaching. They hydraulically raise when cab is being attached. If the trailer is loaded, the jacks raise and level so that it can sit level when not in use.

Our reasoning behind the two sizes of cabs was that no one vehicle can do all the jobs on the base, but that the two sizes with their variety of combinations could accomplish this. Both have the same basic properties and same lift on front. In the smaller cab the engine is along side the driver rather than in the rear.

The trailer's basic units can be fitted with special parts to change them to specific uses. We designed a refrigeration unit (Fig. 28) to fit on the trailer to transport food to our messing area. The runway sweeper has its vacuum and dirt tank attached to this same basic trailor. We also can attach seats to make the trailer into a personnel carrier (Fig. 29) and this can be covered with a canvas top. By folding up the seats, this personnel carrier becomes a covered transport for inclement weather.

Three of the large cabs become the cab part of the fire truck (Fig. 30) because we feel these must be on constant call. Our fire truck includes stationary foam guns and a flood light and is basically like the presently used models.

This is how we solved our vehicle problem. It also tells how we approached it because our final concept is not too far removed from our initial sketches.

OTHER CONCEPTS

RUNWAY LIGHTING

Our concept of Runway Lighting is to have radio operated lights which will eliminate the necessary generator and the wires along the side of the airstrip. This latter factor also makes the setup of the runway lighting an easier job.

The individual light is a gas cylinder in a tubular housing which is glass at the top and lightweight metal alloy around the cylinder itself. The unit contains a pilot light and a radio control box. When the radio control receives its signal, the valve is opened to emit the gas which is then lighted by the pilot light (Fig. 31).

The top of the container has directional mirrors which receive the light from the parabolic mirror around the light itself. These directional mirrors cause the light to be at its strongest when looking directly down the runway but able to be seen from any direction.

The entire Runway Light unit would stand twenty inches high with tripod legs that would anchor it into the ground. Its weight would be twenty pounds and its fuel would last approximately thirty hours. This is based on the theory that the lights are on for only about one hour per night. Thus, a unit would be a thirty day lighting supply. At one hundred fifty to two hundred foot spacing, the runway should be sufficiently illuminated.

FUEL

Our plan for storing and transporting fuel is a semi-rigid plastic tank in a frame on wheels (Fig. 32). The tank has a thirty-six hundred gallon capacity. This enables it to fuel three F4C's.

The fuel storage spot on our site is located away from the base with a natural protection of hilly terrain but has roads built right to it to give it easy access to the airfield. These tanks would be stored here until needed and then, with the same posi-lock our other vehicles have, would be driven by one of the cabs.

The tank would be filled at a distant point and shipped into the Bare Base. As the fuel is used, the semi-rigid plastic tank begins to deflate down into the frame structure which is braced with steel ribs to hold the tank.

When the entire tank is emptied, it lies on this steel base. The side pieces, which are made of telescoping tubular metal, are then collapsed so as to make a compact unit to ship back to the starting base to receive more fuel.

HEATER

The heating unit we have designed was done so to work specifically with a tent pattern that we are using in our base setup. We chose to set our billeting structures in a cross pattern of four, leaving the center of the cross open to contain this heating unit. The one unit then would produce the heat for four twelve-man tents (Fig. 33).

The heating unit is approximately three feet square and also contains the electrical supply for the tents it services. It operated on a jet fuel in the fire box and employs a centrifugal fan. Baffles are used to slow down the air for a greater transfer of heat.

The square unit contains four nozzeled hoses, one coming from each corner. These are recessed with a cap until ready to be used and then are pulled out and attached to a prepared opening in the end panel of the tent.

These are the main innovations we worked on along with our shelter and vehicular concepts which we have already discussed.

CONCLUSION

In the preceeding pages we have tried to show how our philosophy affected our thoughts in the planning of a Bare Base Development and what the results of these thoughts were. We feel that our scheme will enable the base to be erected at a much faster rate and with a good deal more ease. Also, once the base has achieved operating capacity, we believe that with the equipment we have designed, the operation will be a smoother and more efficient one.

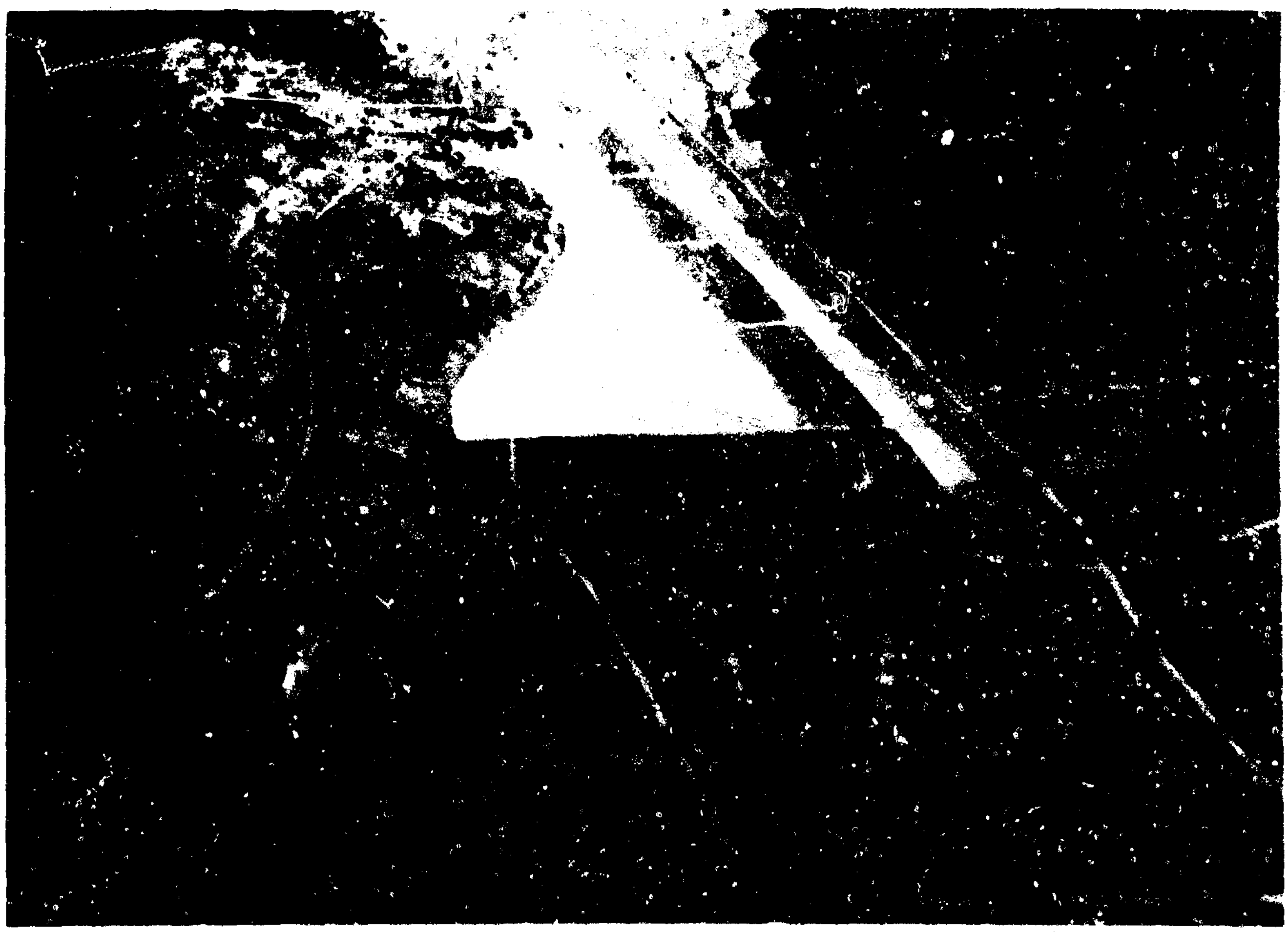


Fig. 1: Air approach to Bare Base site.

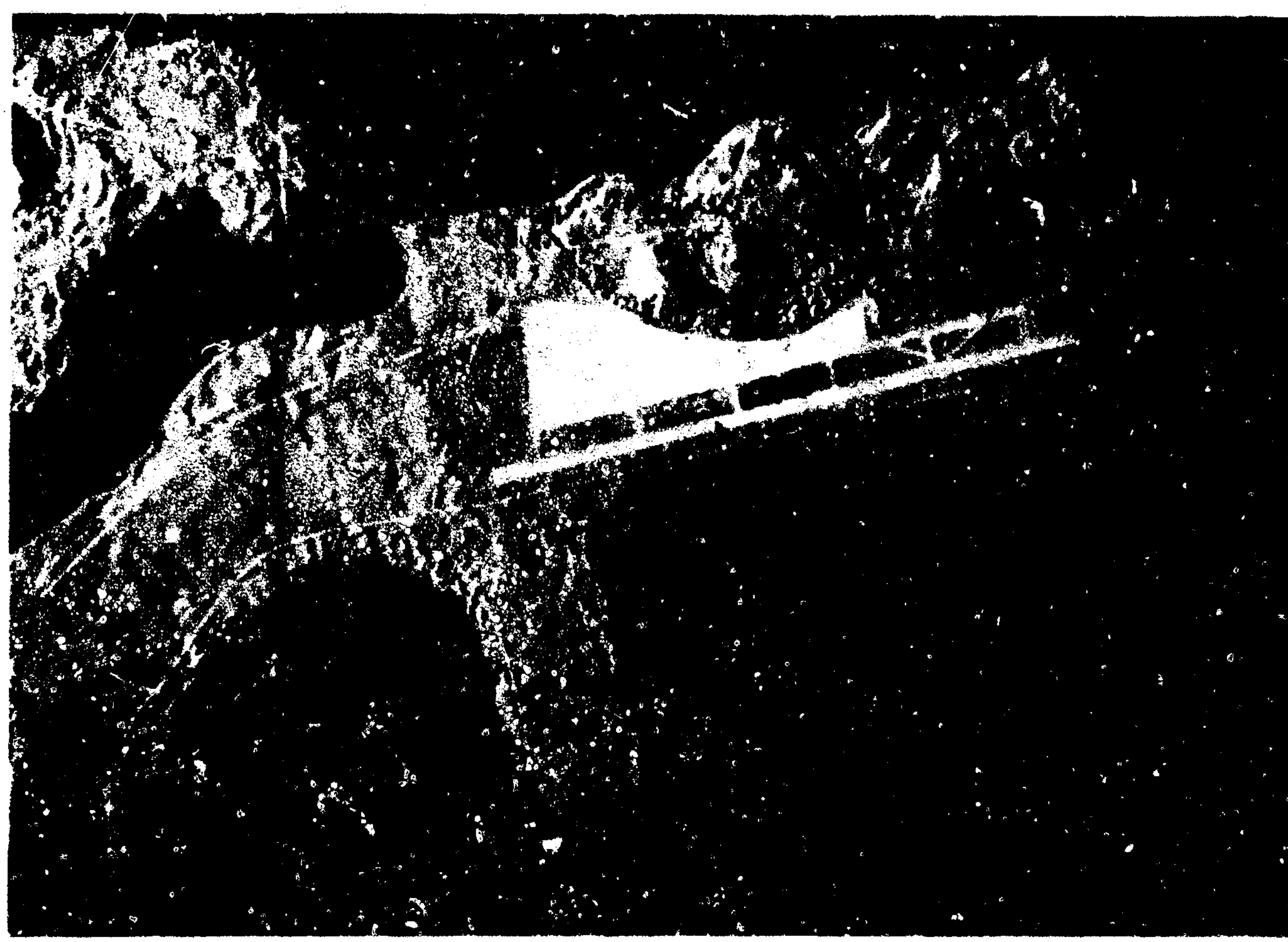


Fig. 2: Aerial view of site prior to development.

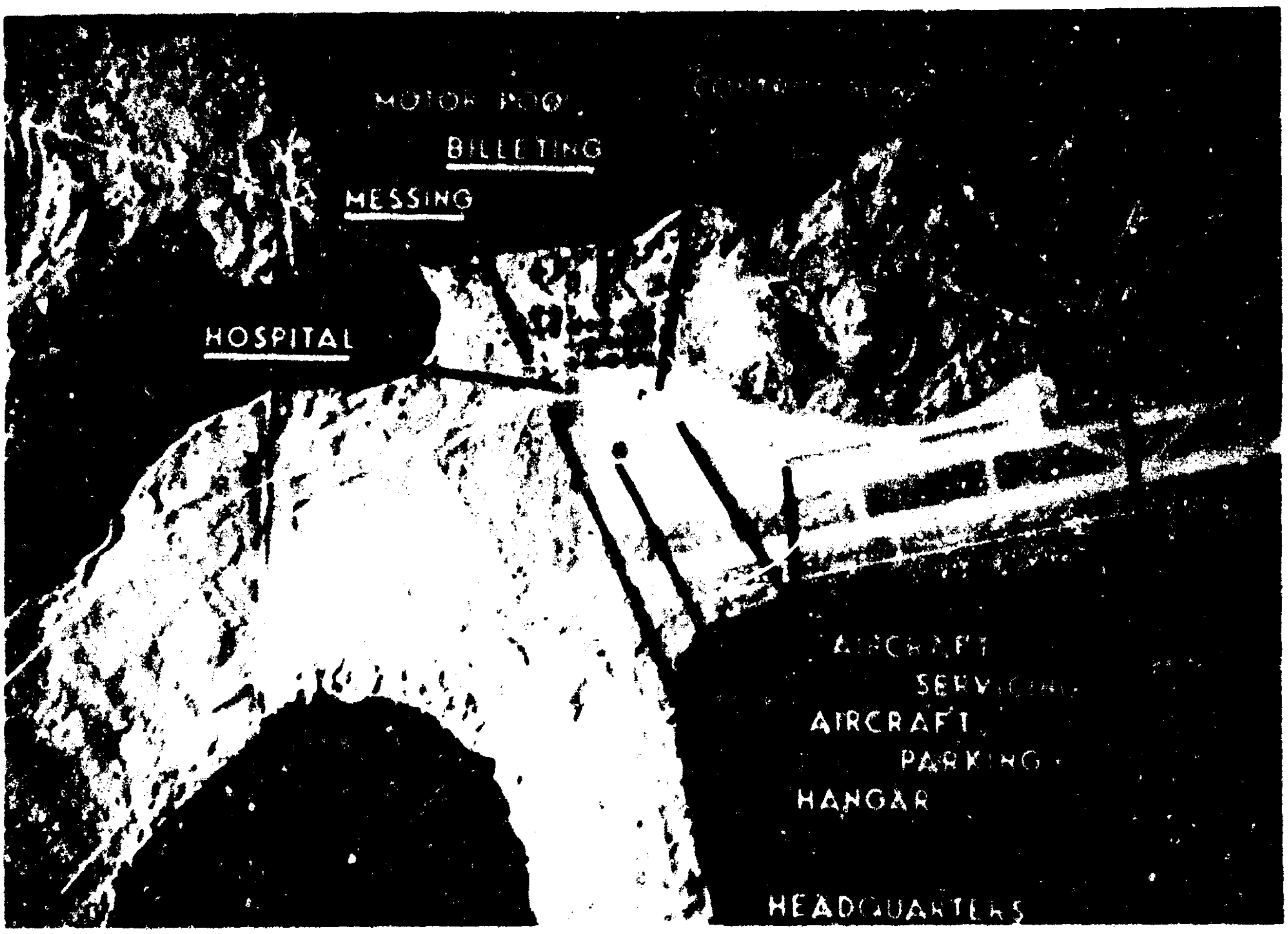


Fig. 3: Aerial view of site fully developed.

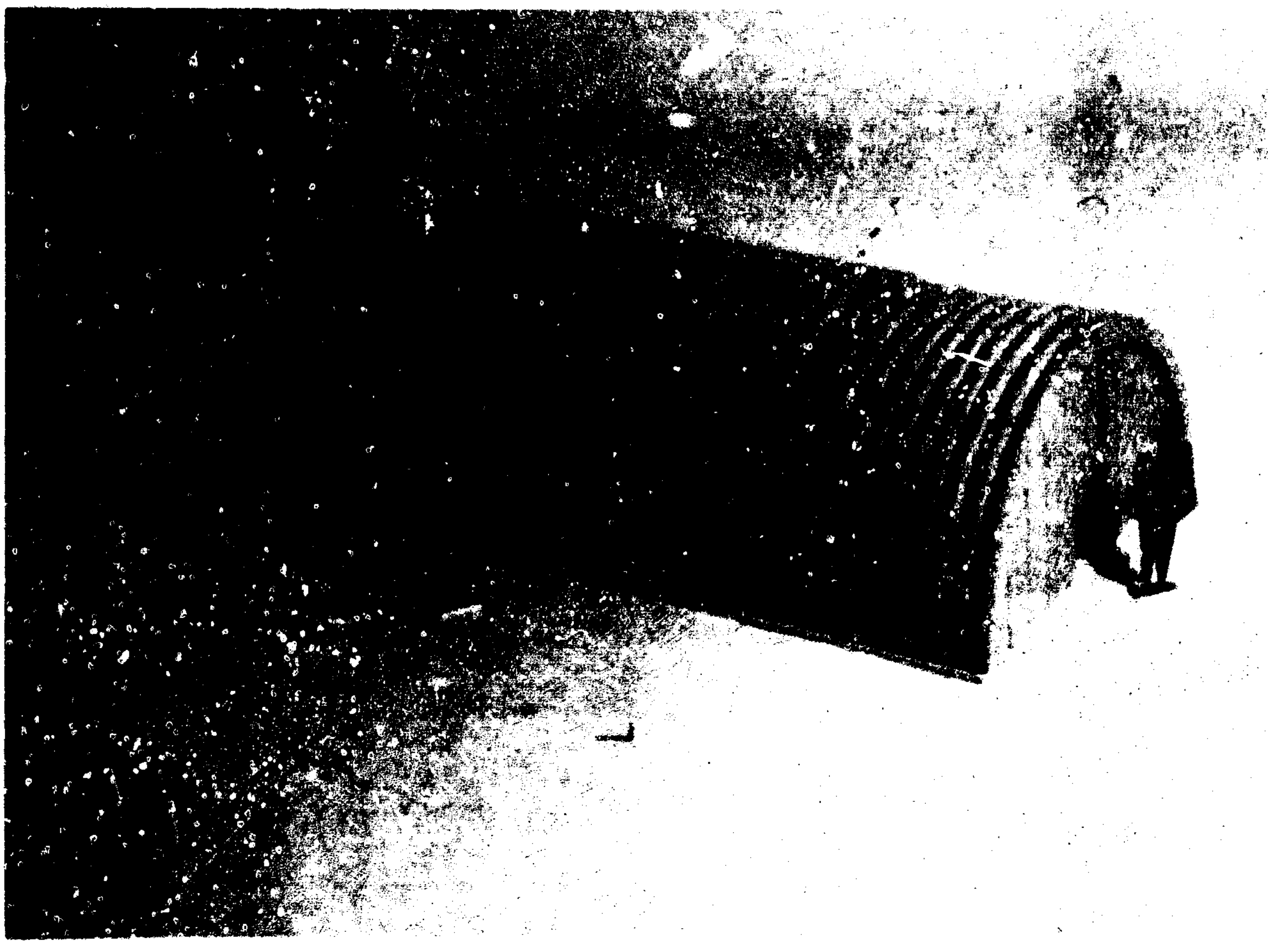


Fig. 4: Overall view of twelve-man billeting tent.

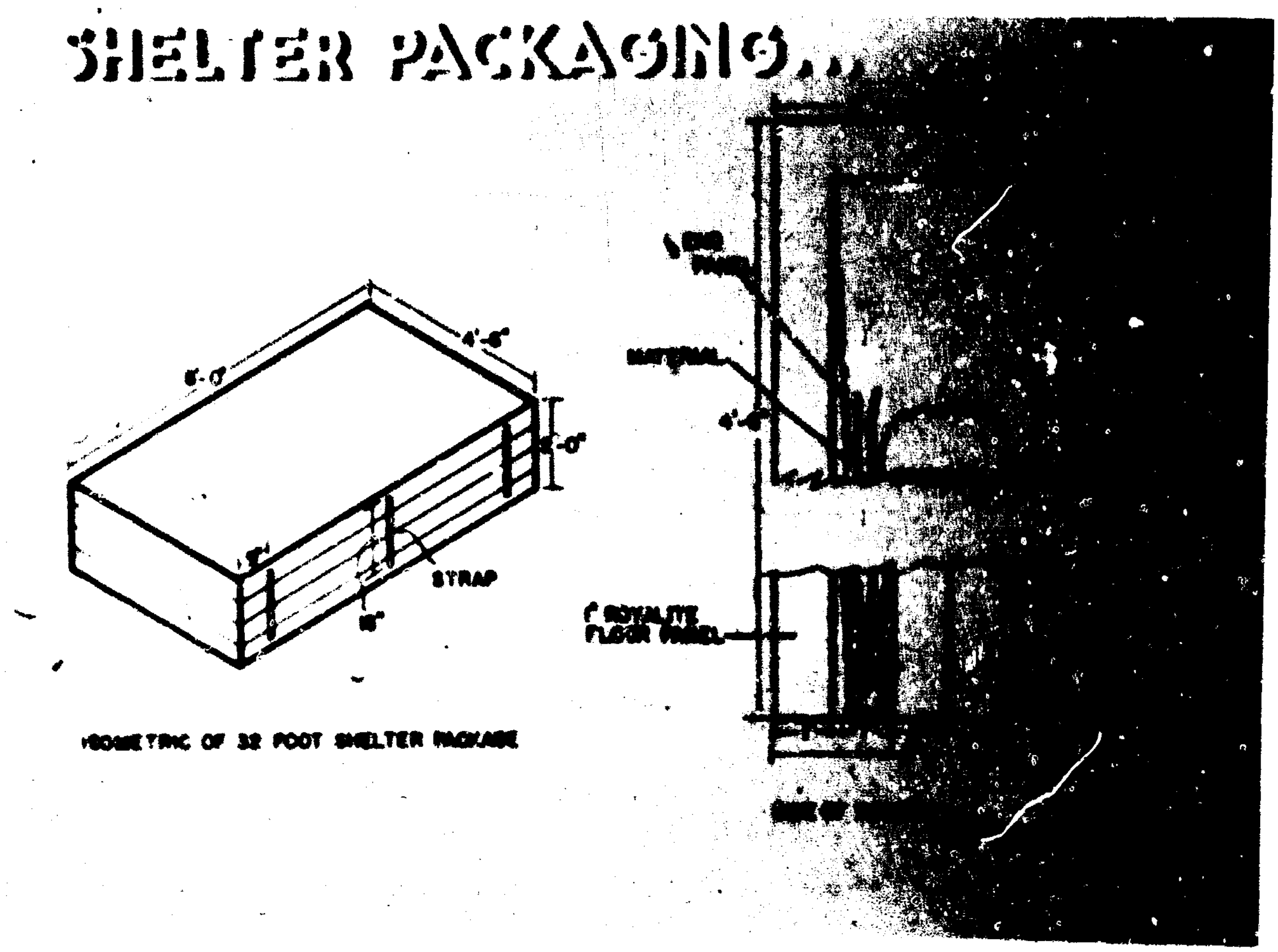


Fig. 5: Twelve-man tent shelter package.

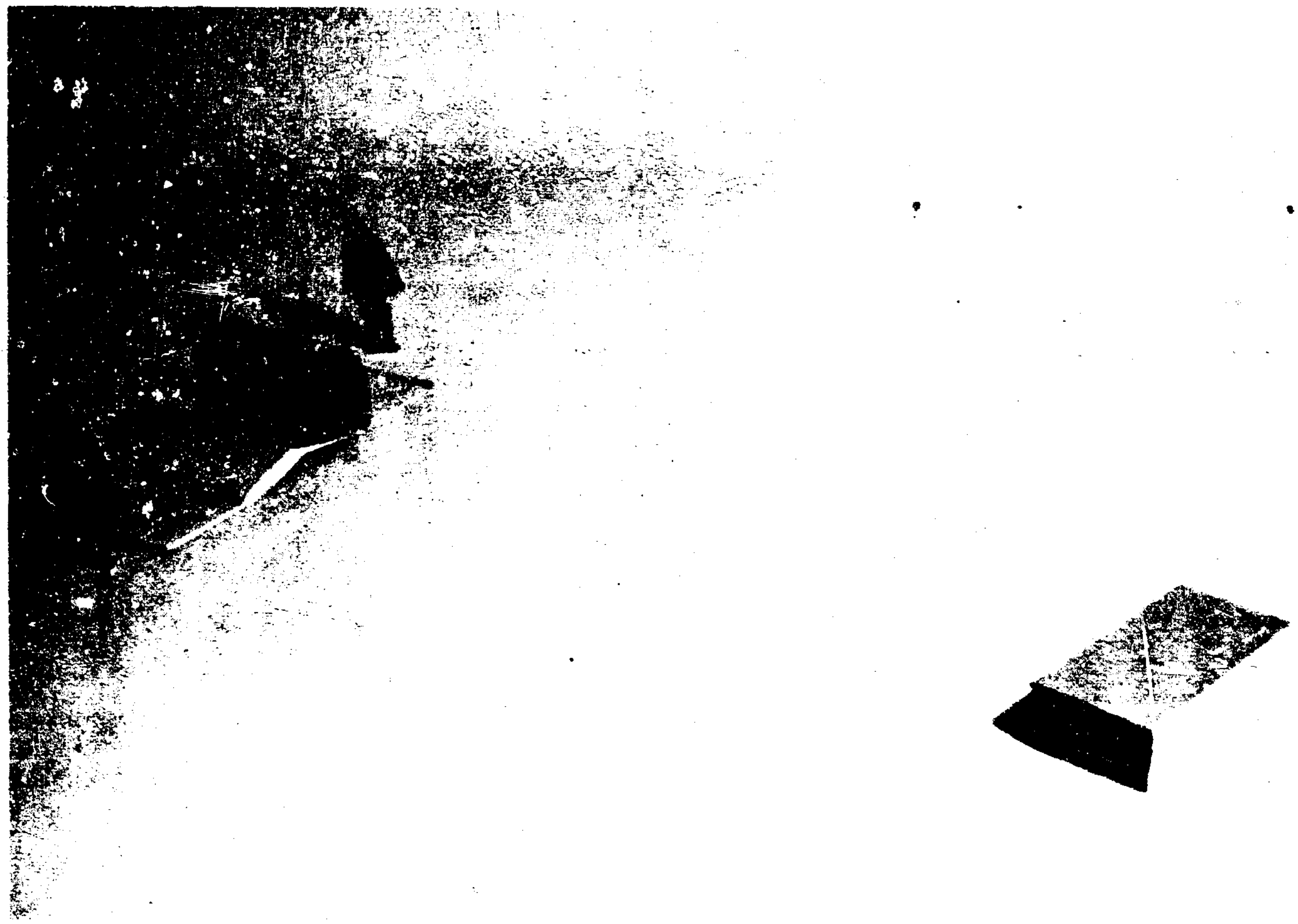


Fig. 6: Erection sequence: 1. Two men unfold first segment.

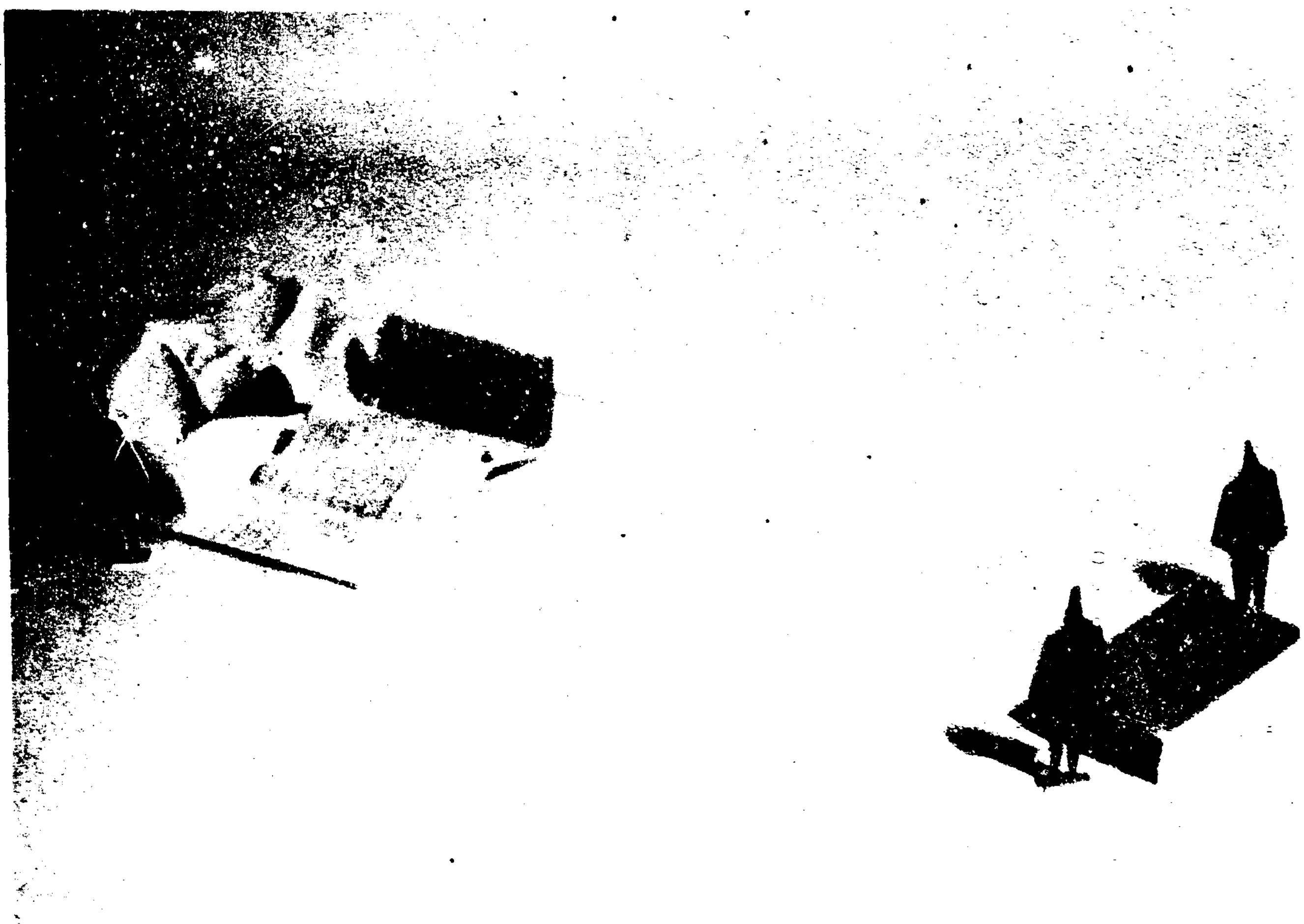


Fig. 7: Erection sequence: 2. Second segment is joined to first; first segment is partially inflated.

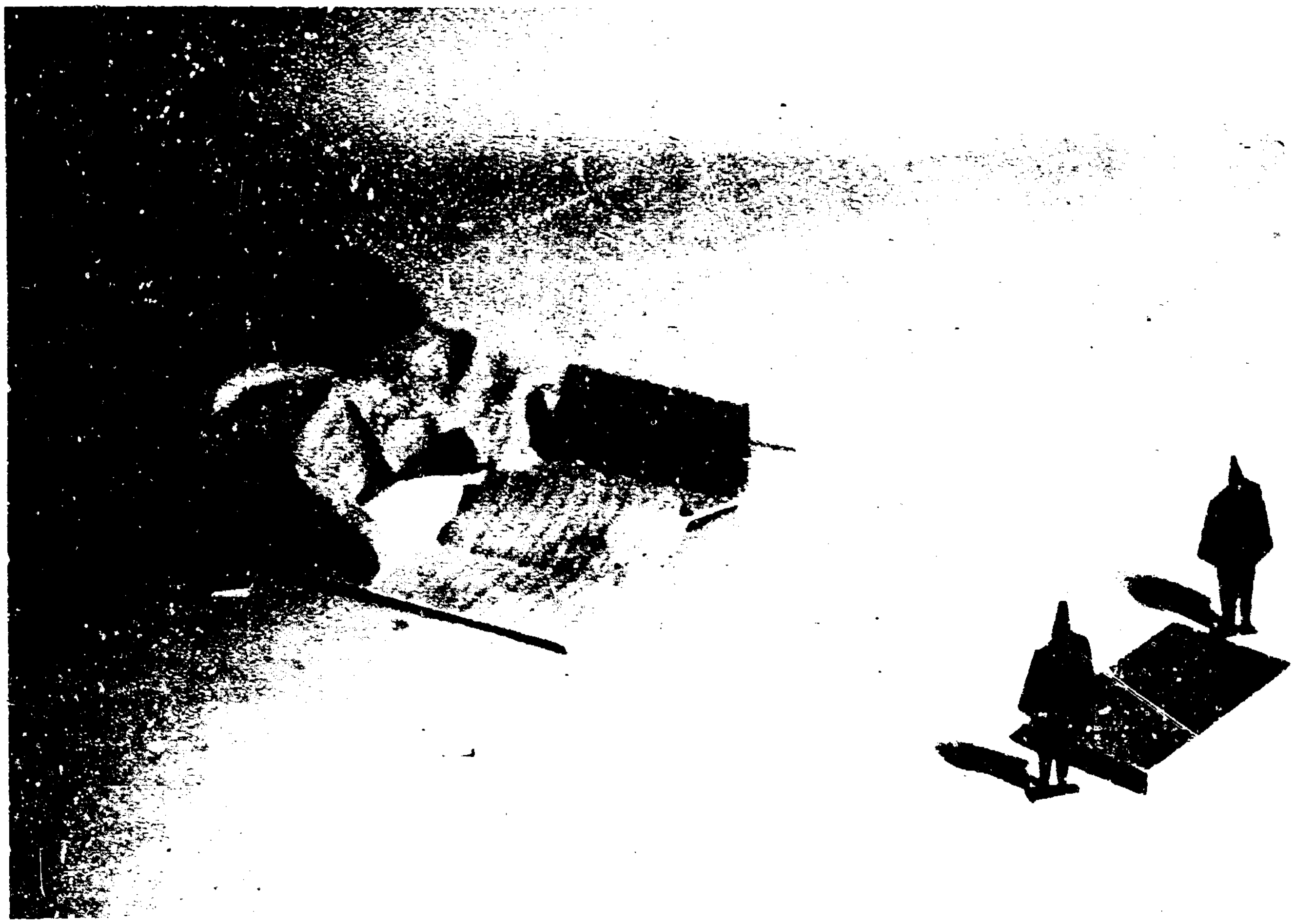


Fig. 8: Erection sequence: 3. Continuation of erection technique.

Fig. 9: Erection sequence: 4. Structure completely inflated but without end panels.

Fig. 10: Expansion of basic components: 1. Basic unit with center section.

Fig. 11: Expansion of basic components: 2. L-shaped plan.

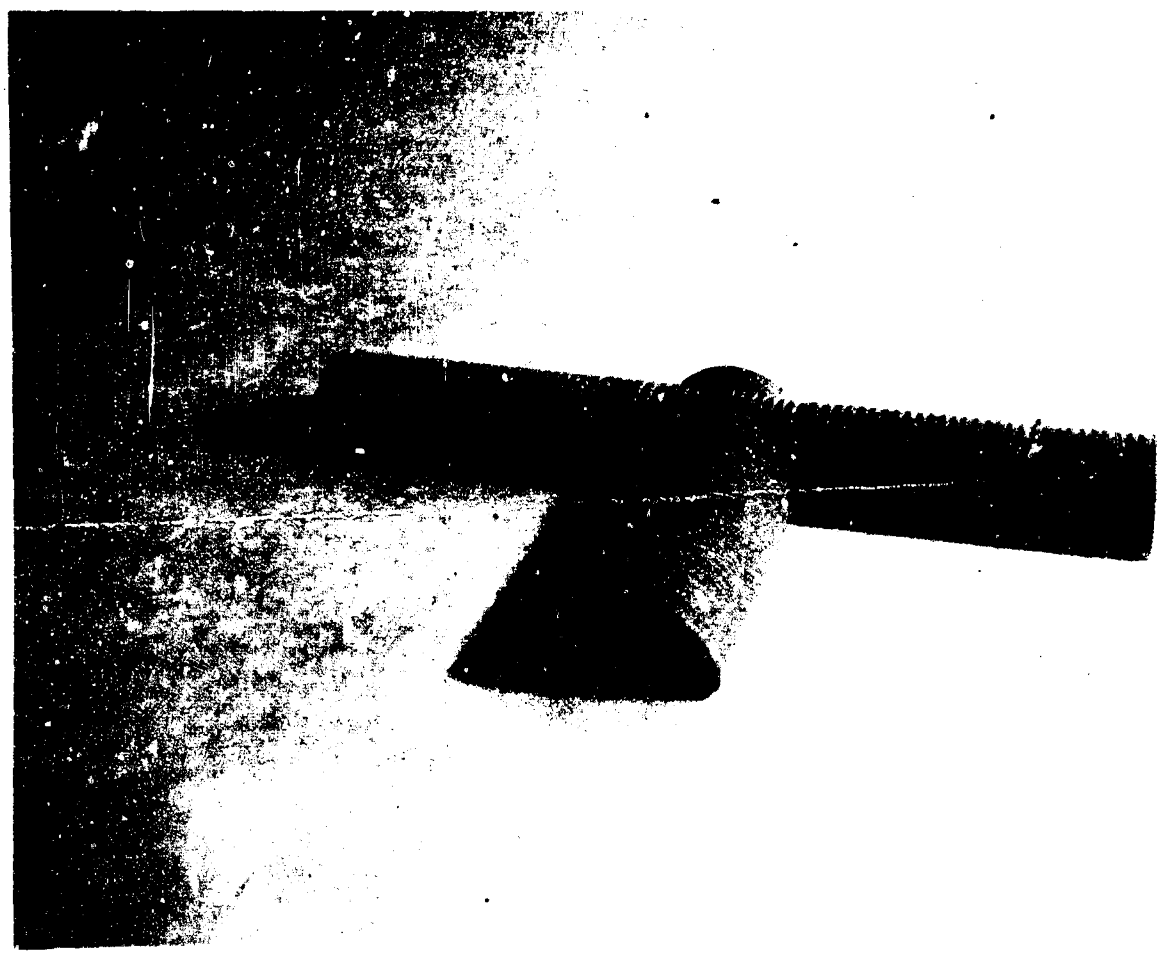


Fig. 12: Expansion of basic components: 3. T-shaped plan.

Fig. 13: Expansion of basic components: 4. X-shaped plan.

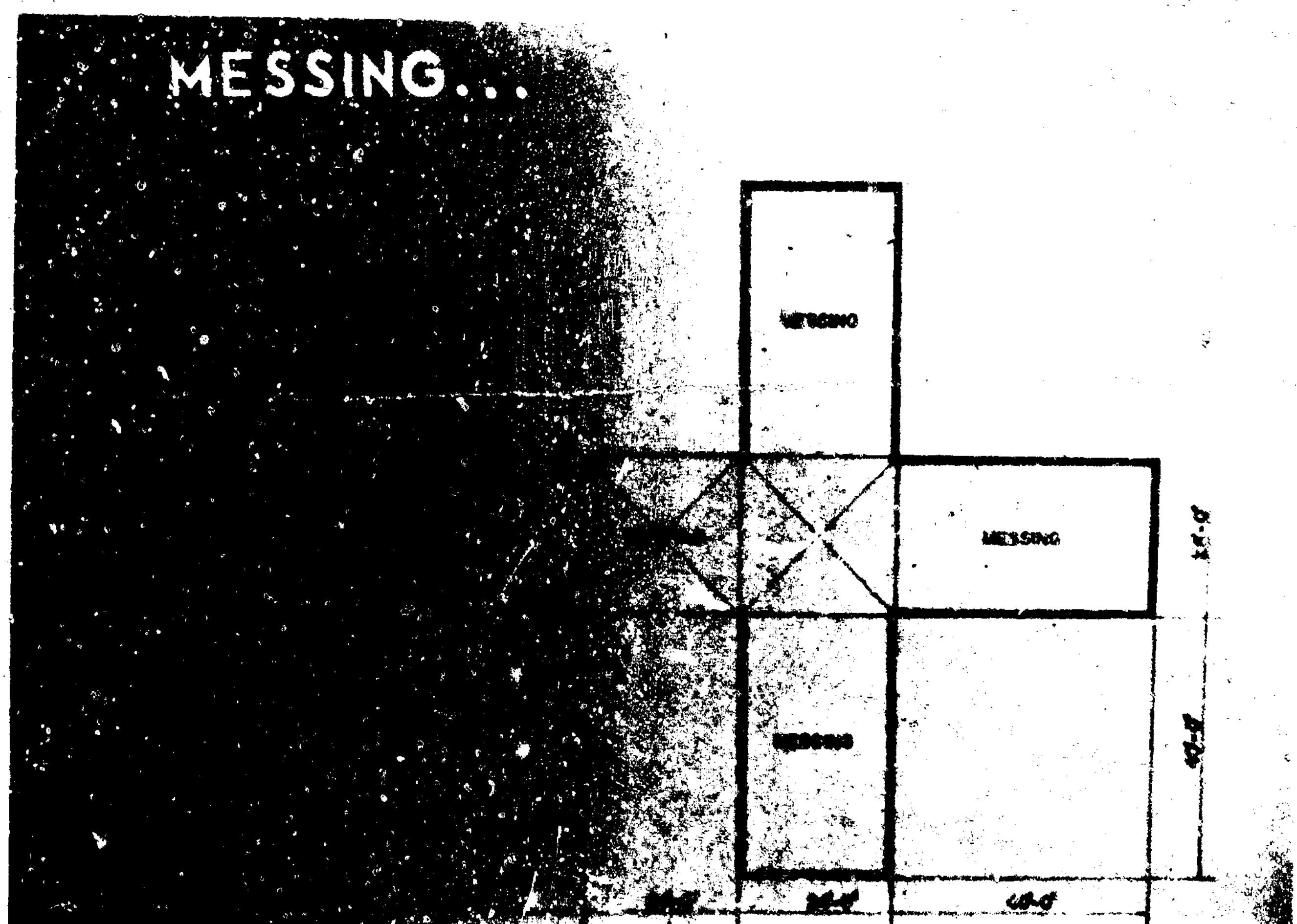


Fig. 14: Floor plan of messing structure,

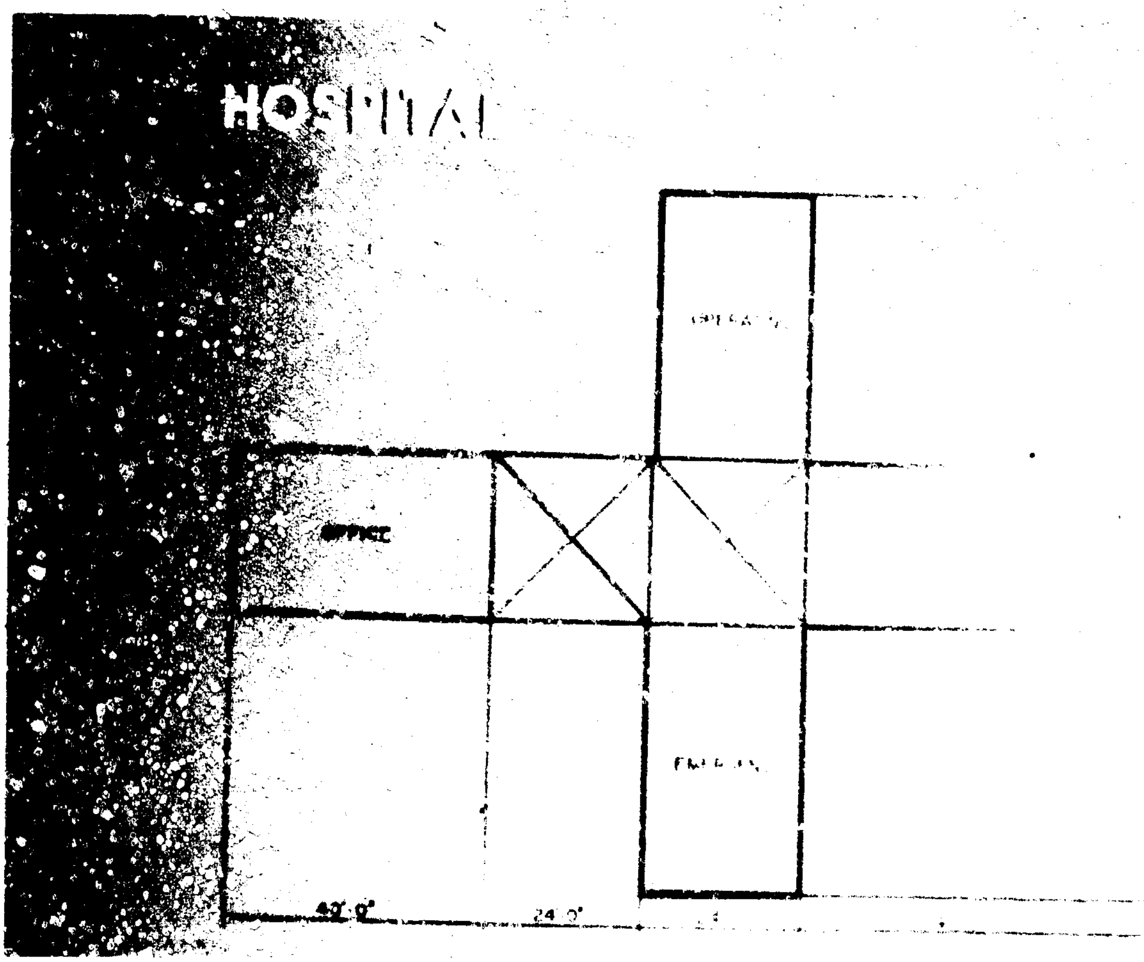


Fig. 15: Floor plan of hospital.

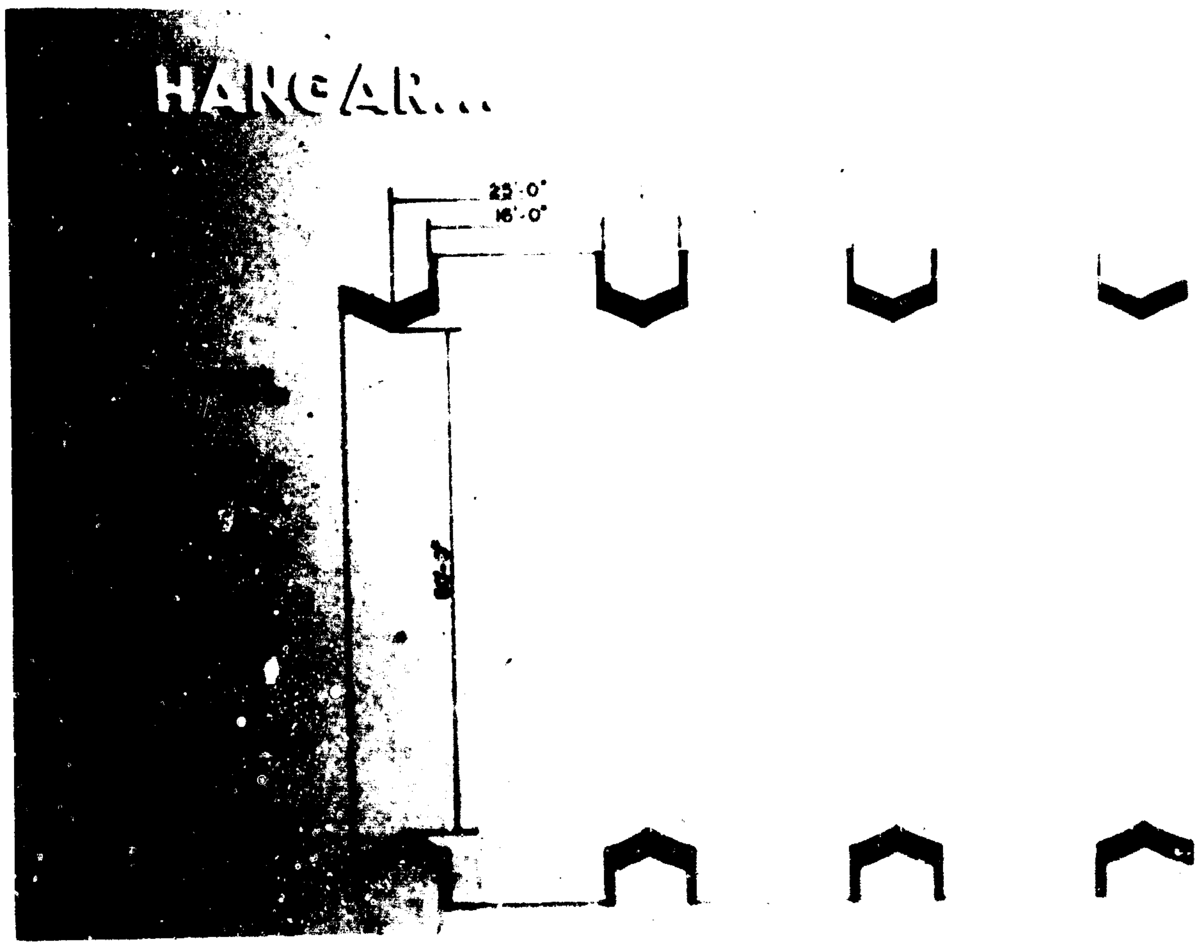


Fig. 16: Floor plan of hangar.

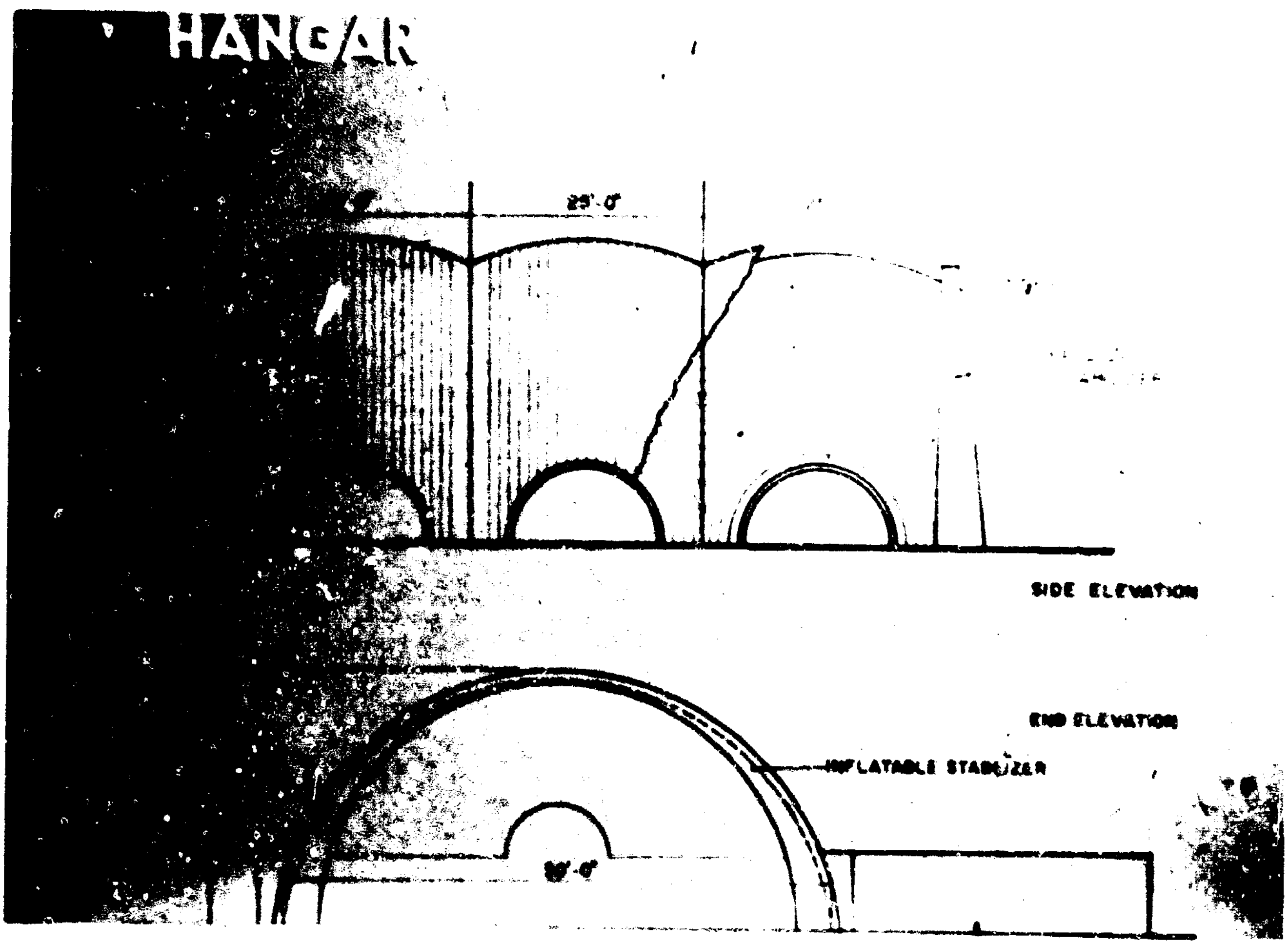


Fig. 17: Side and end elevation of hangar.

Fig. 18: Overall view of hangar with attached wings.

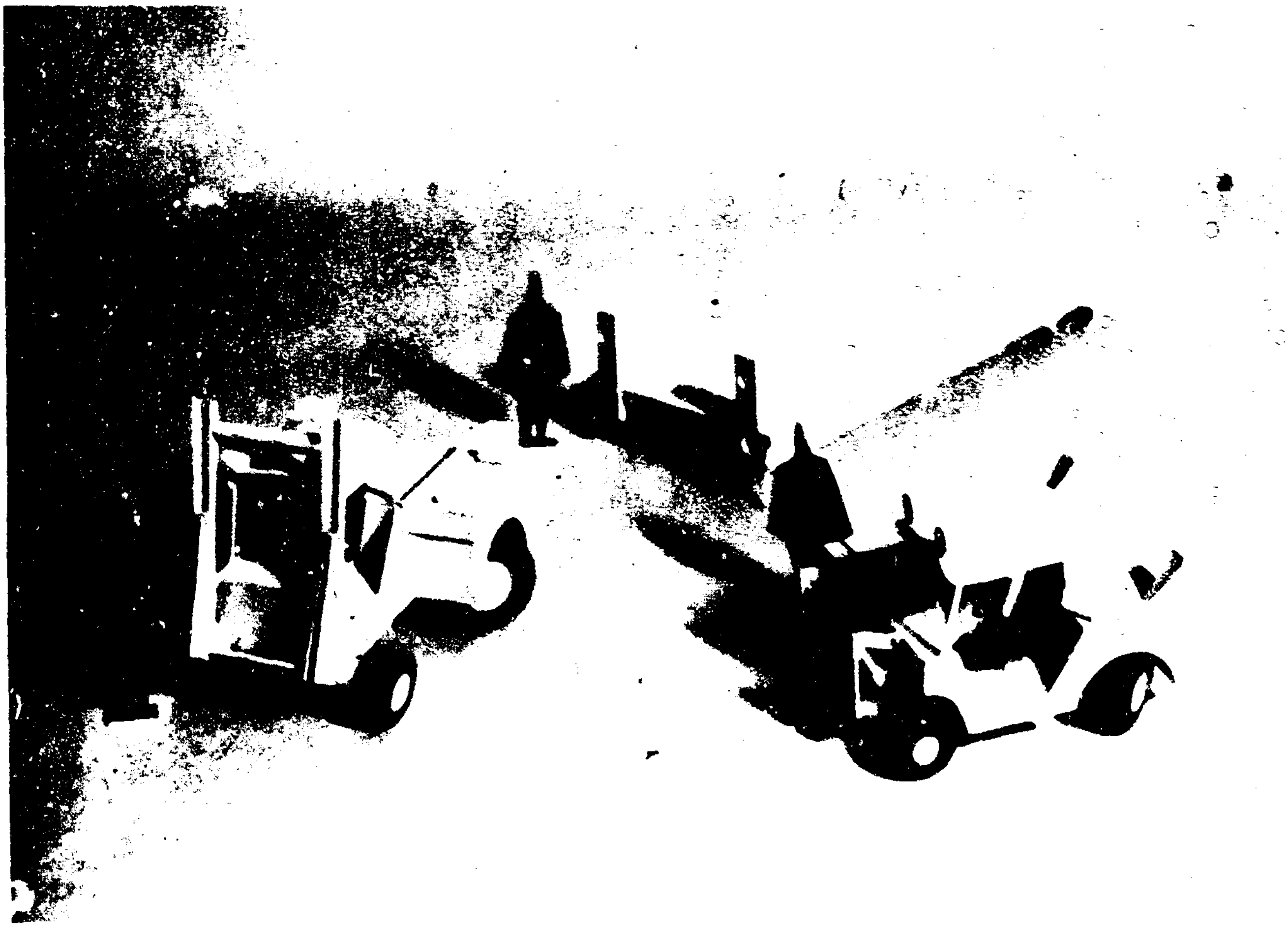


Fig. 19: Major vehicle components (two cab units and a trailer).

Fig 2o: View of posi-lock system.

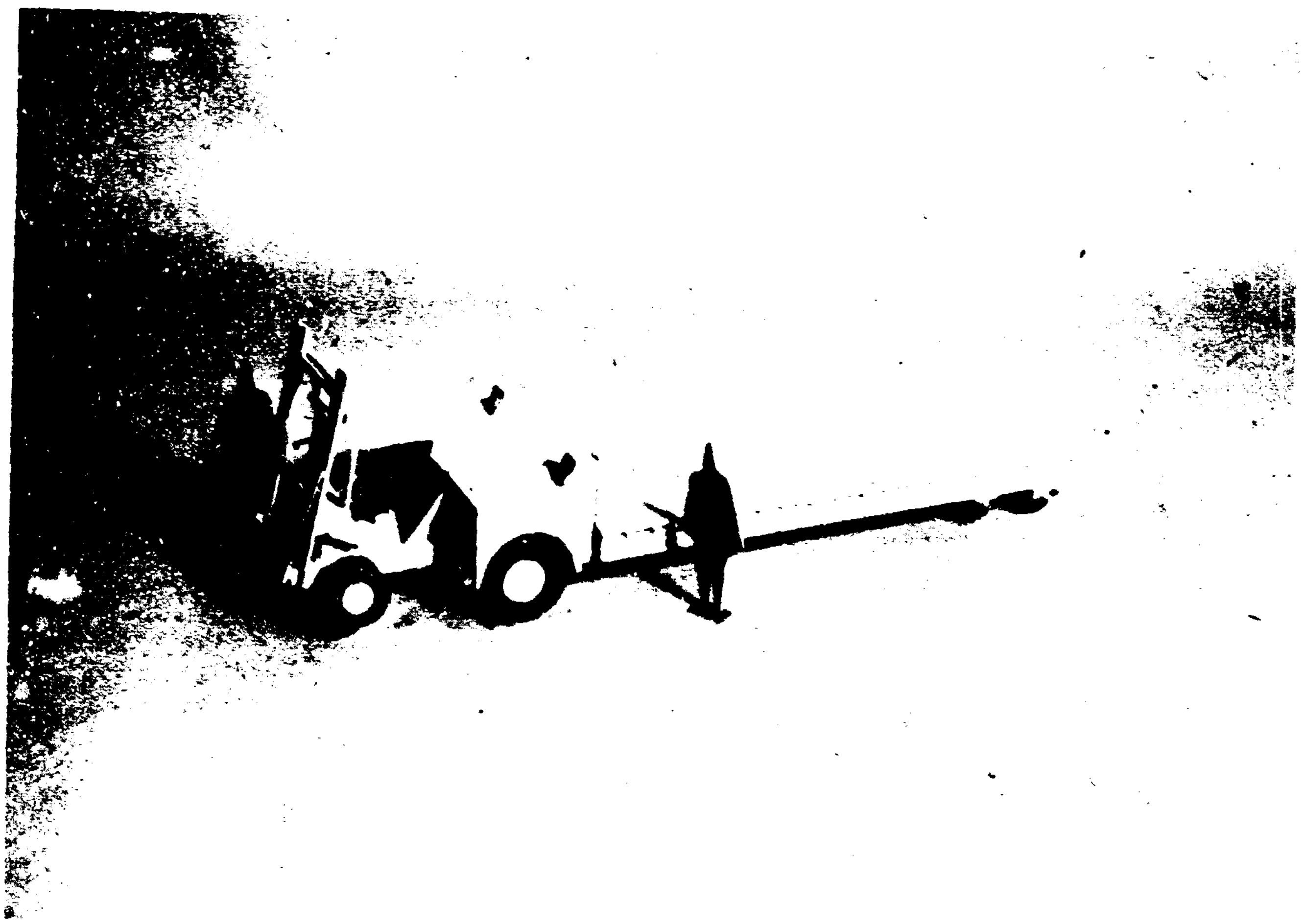


Fig. 21: Trailer attached to cab.

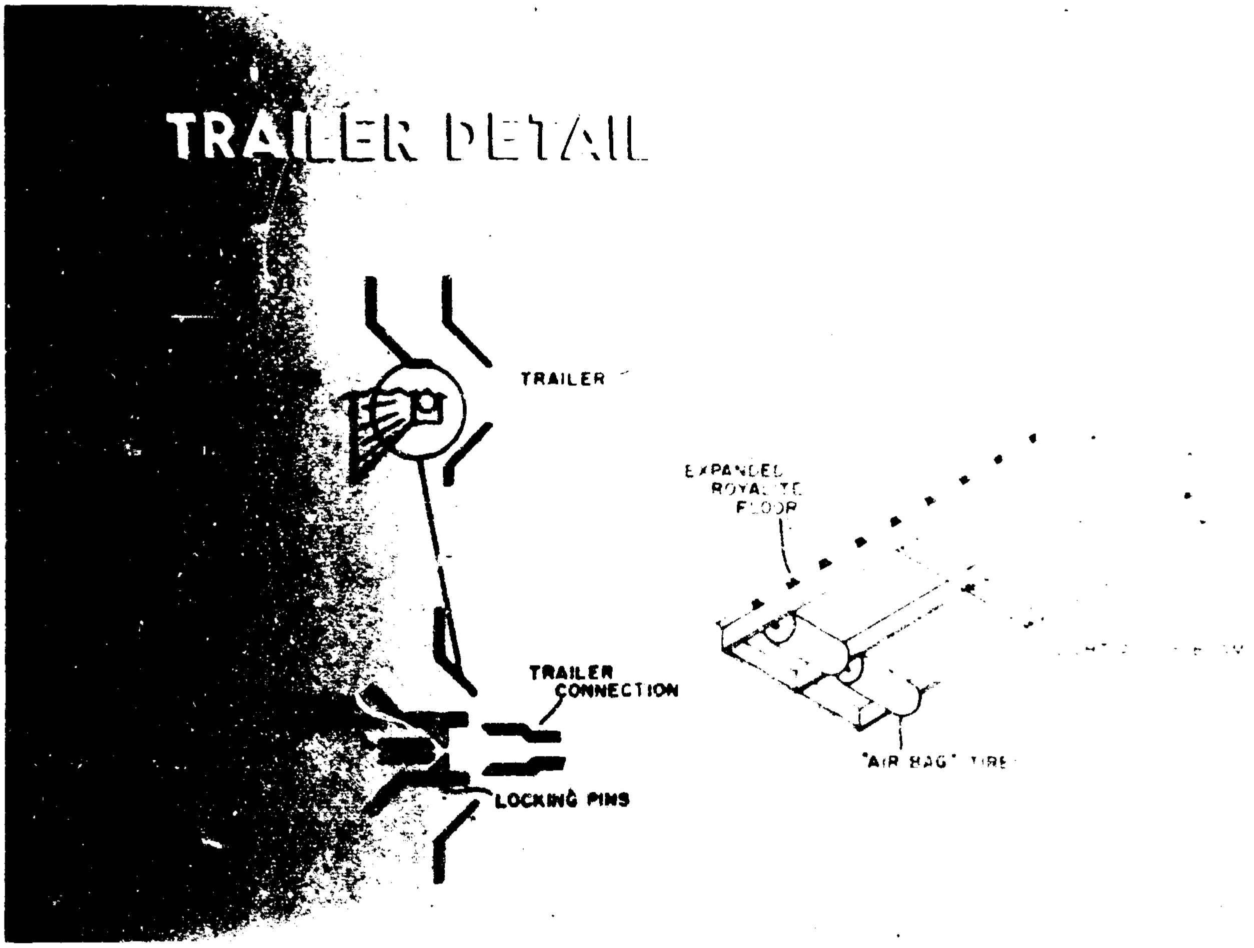


Fig. 22: Trailer details.

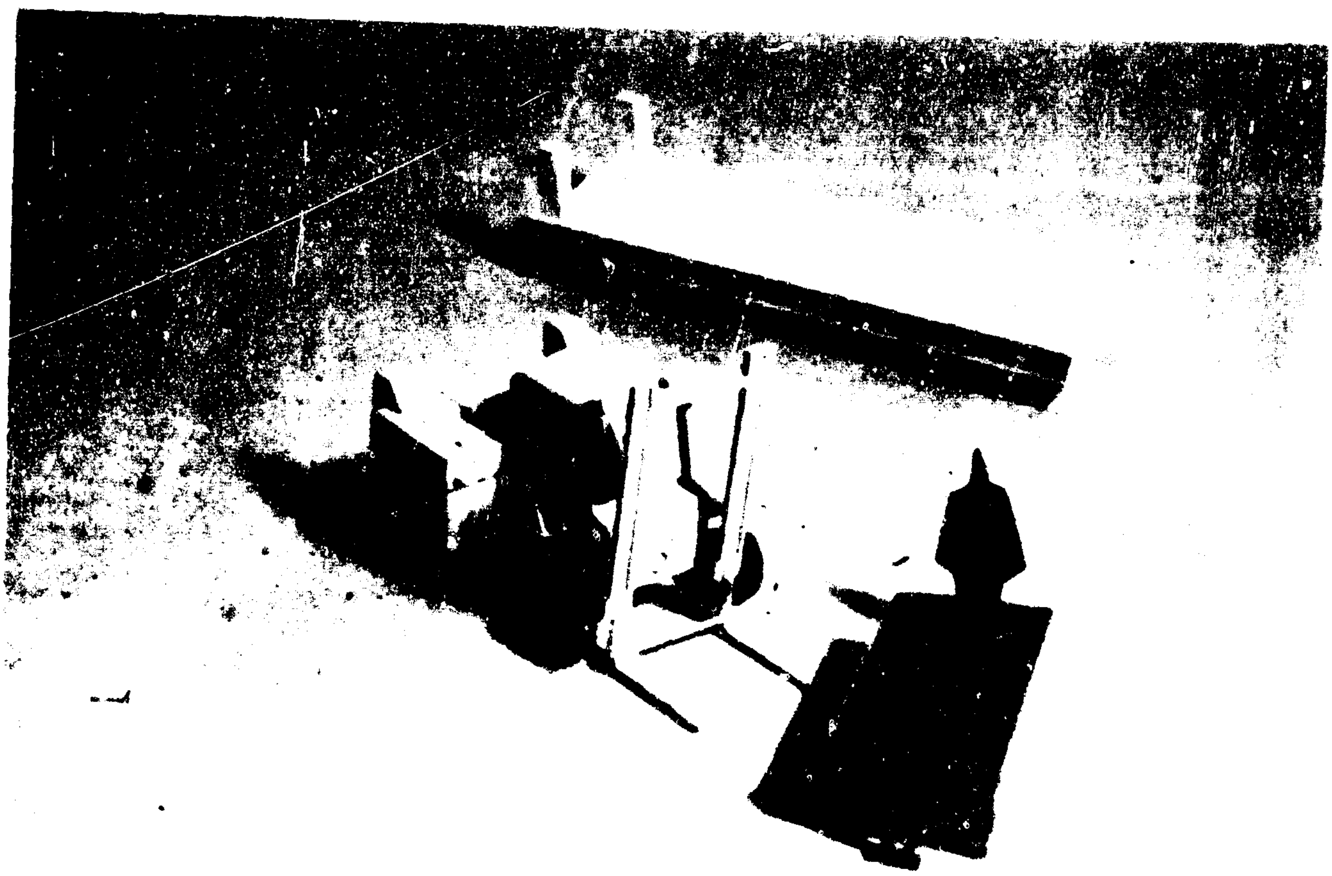


Fig. 23: Preparation for loading trailer with fork lift.

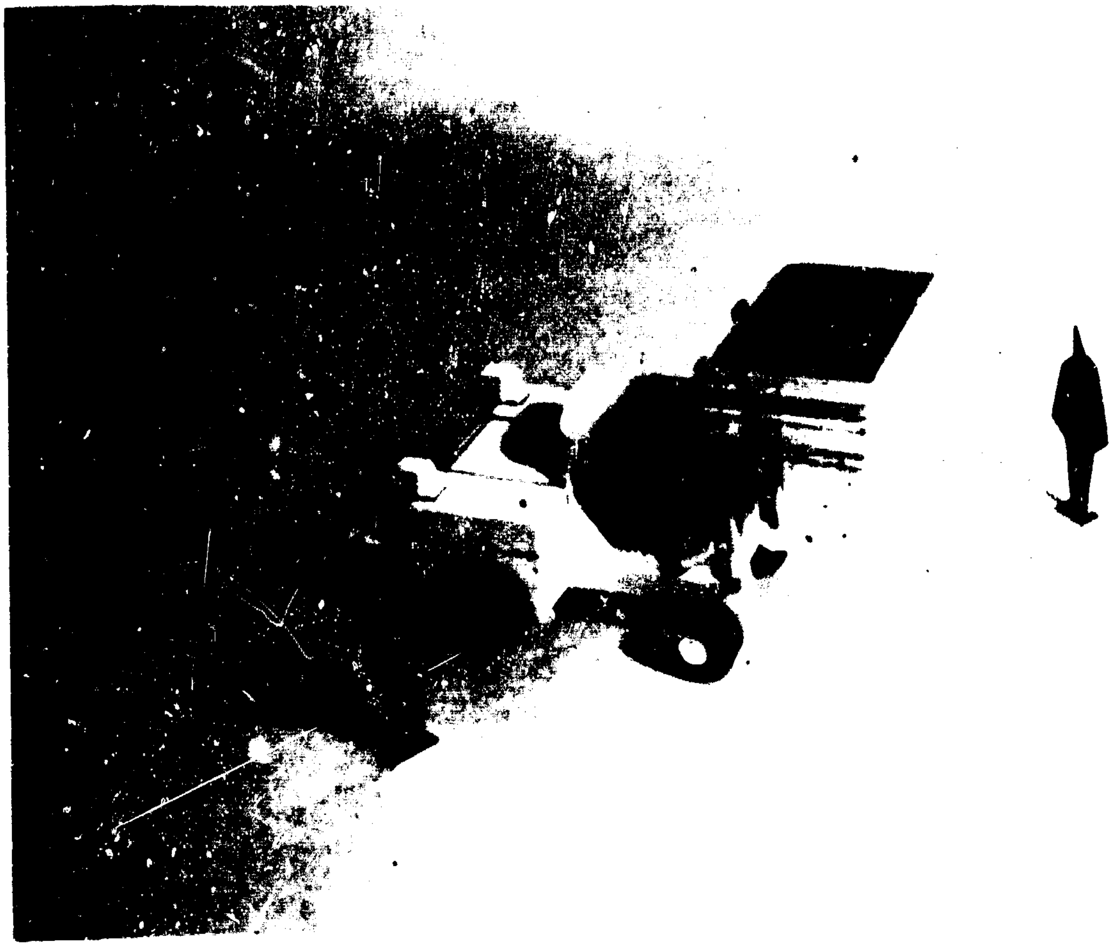


Fig. 24: Loaded fork lift in raised position.

Fig. 25: Grader blade attached to cab unit.

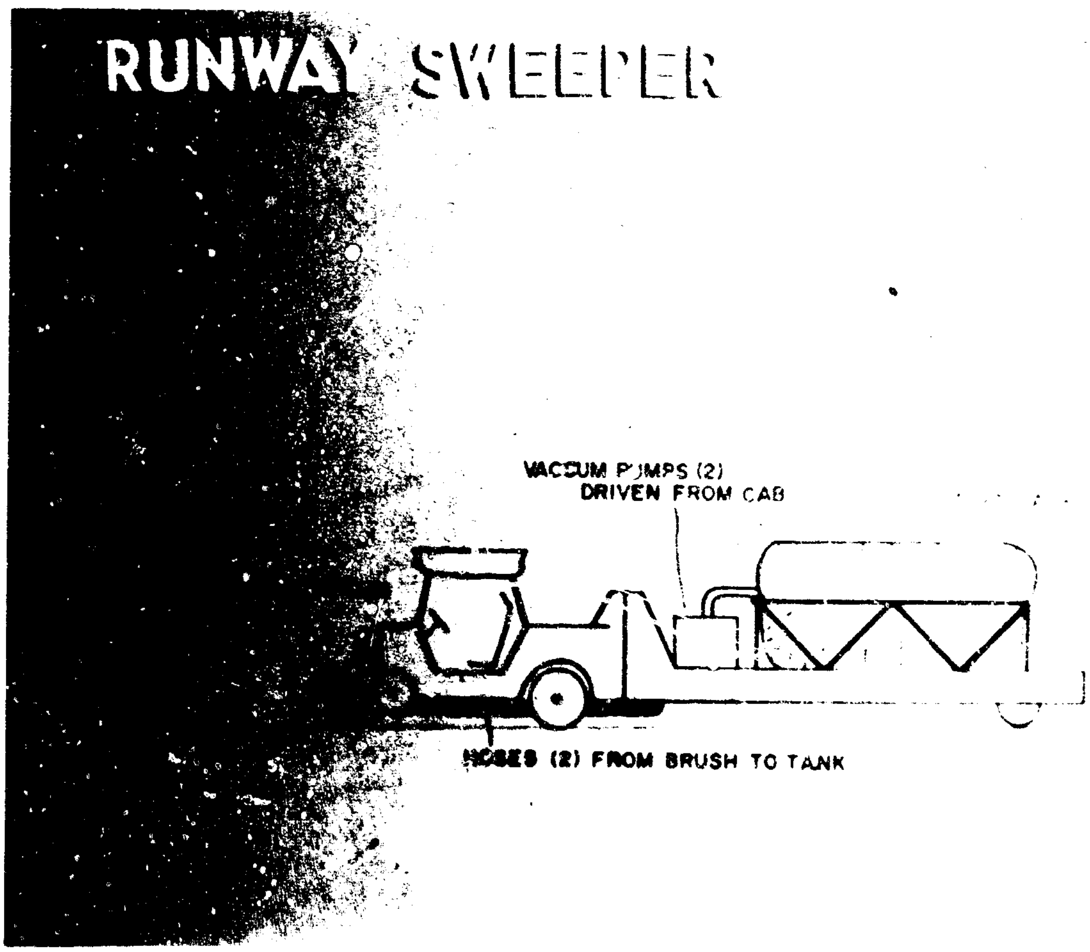


Fig. 26: Runway sweeper.

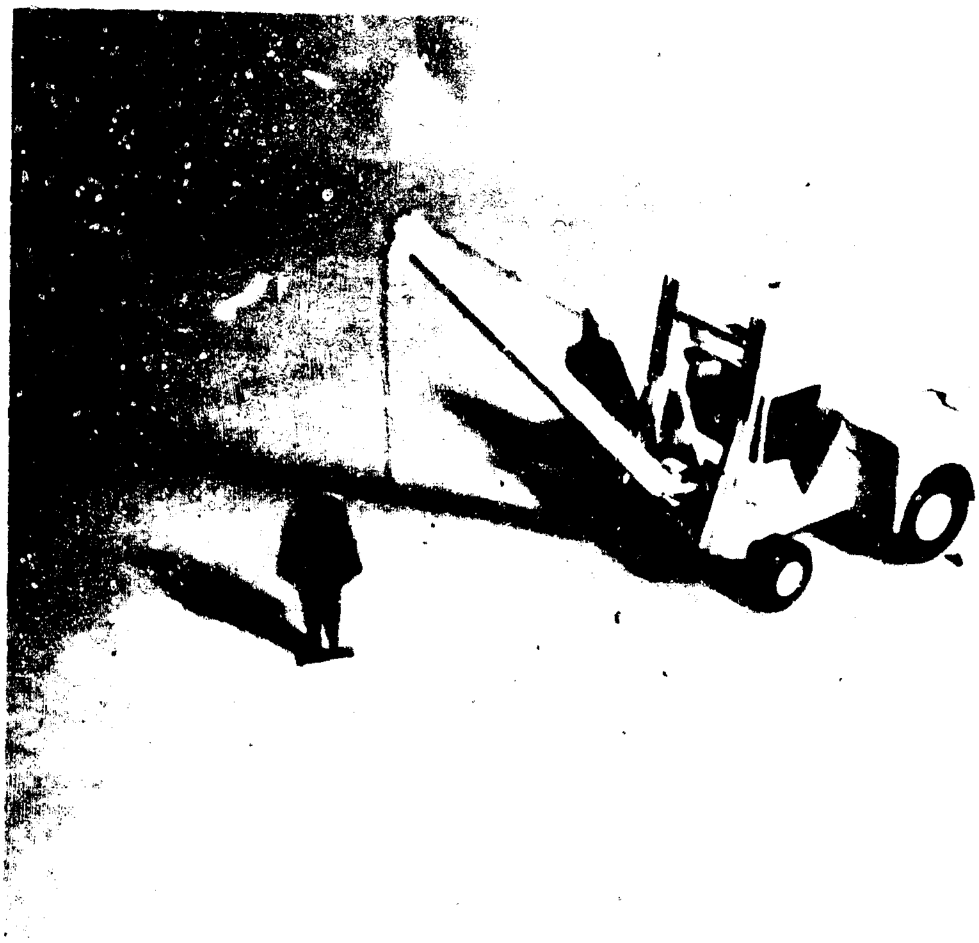


Fig. 27: Crane attached to cab unit.

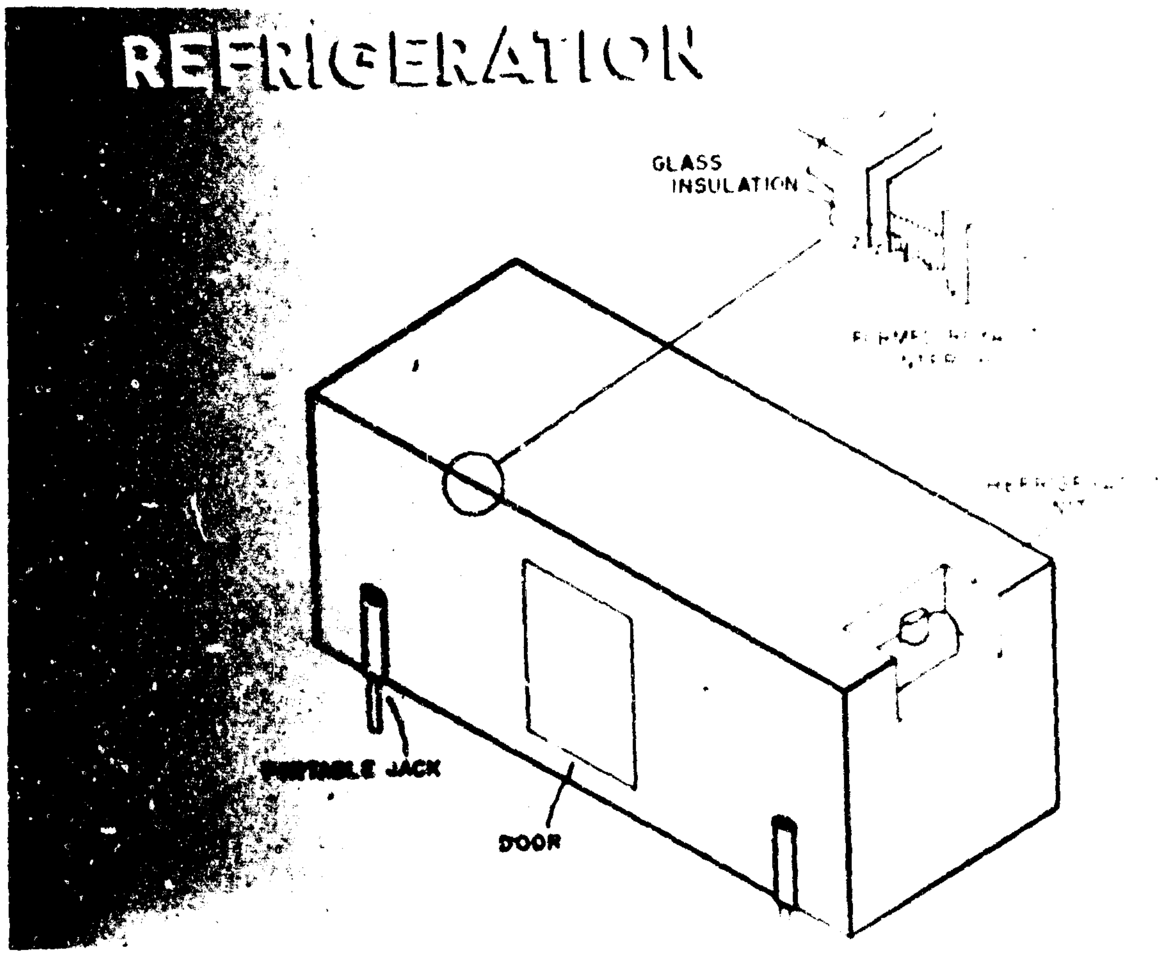


Fig. 28: Refrigeration unit.

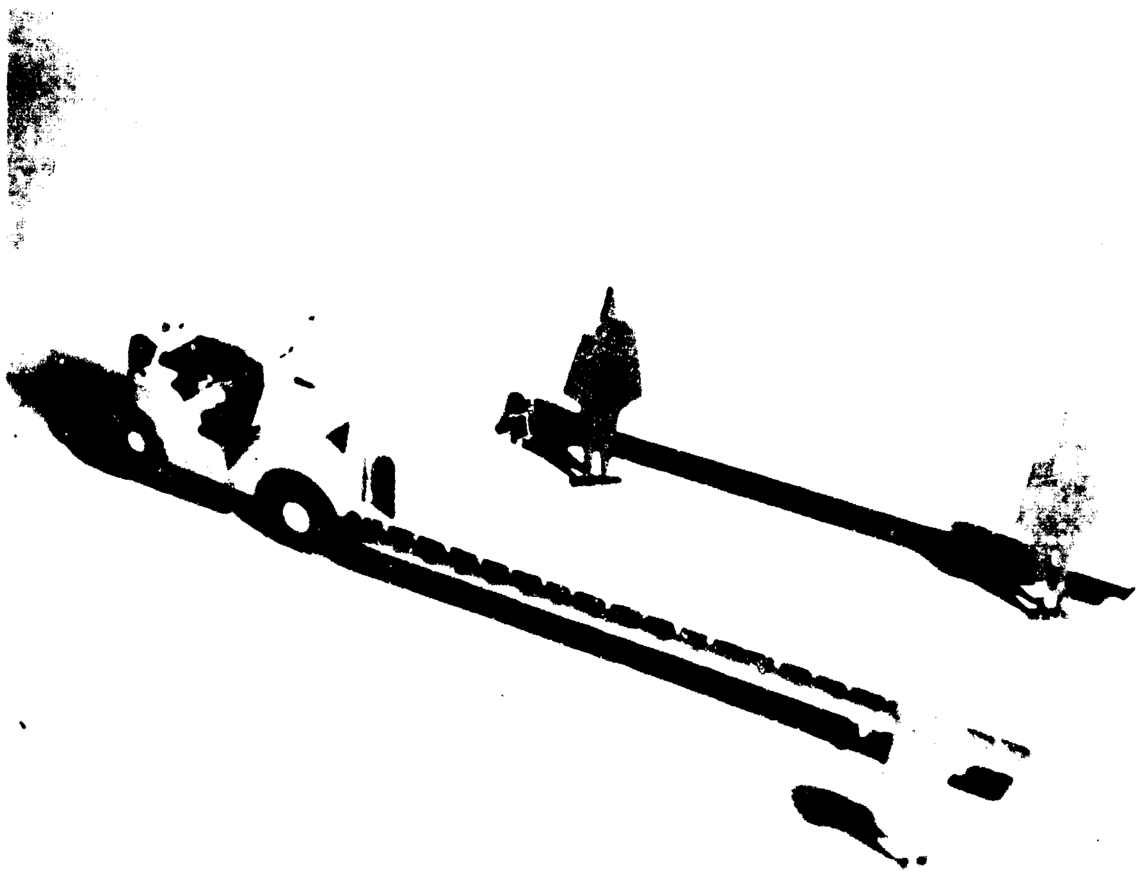


Fig. 29: Personnel carrier.

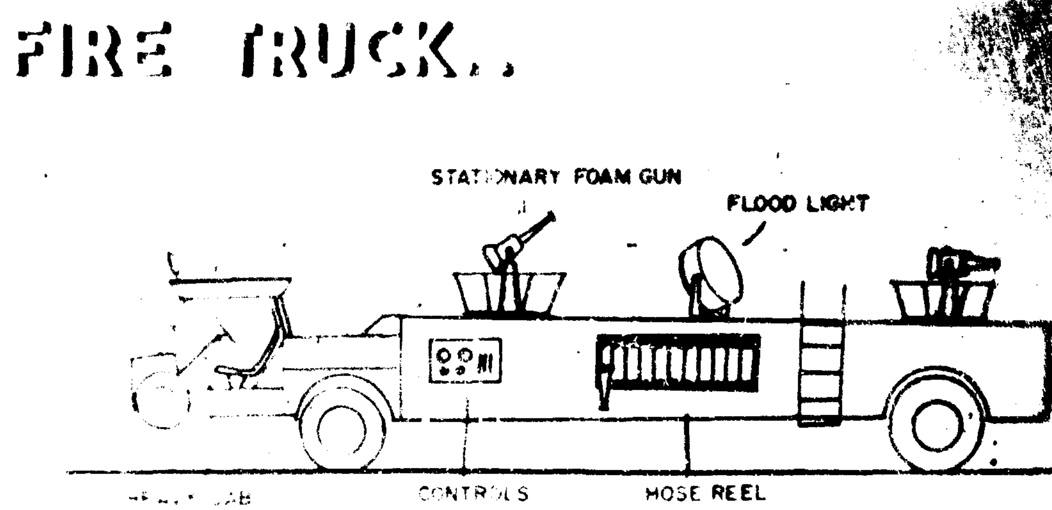


Fig. 30: Fire truck.

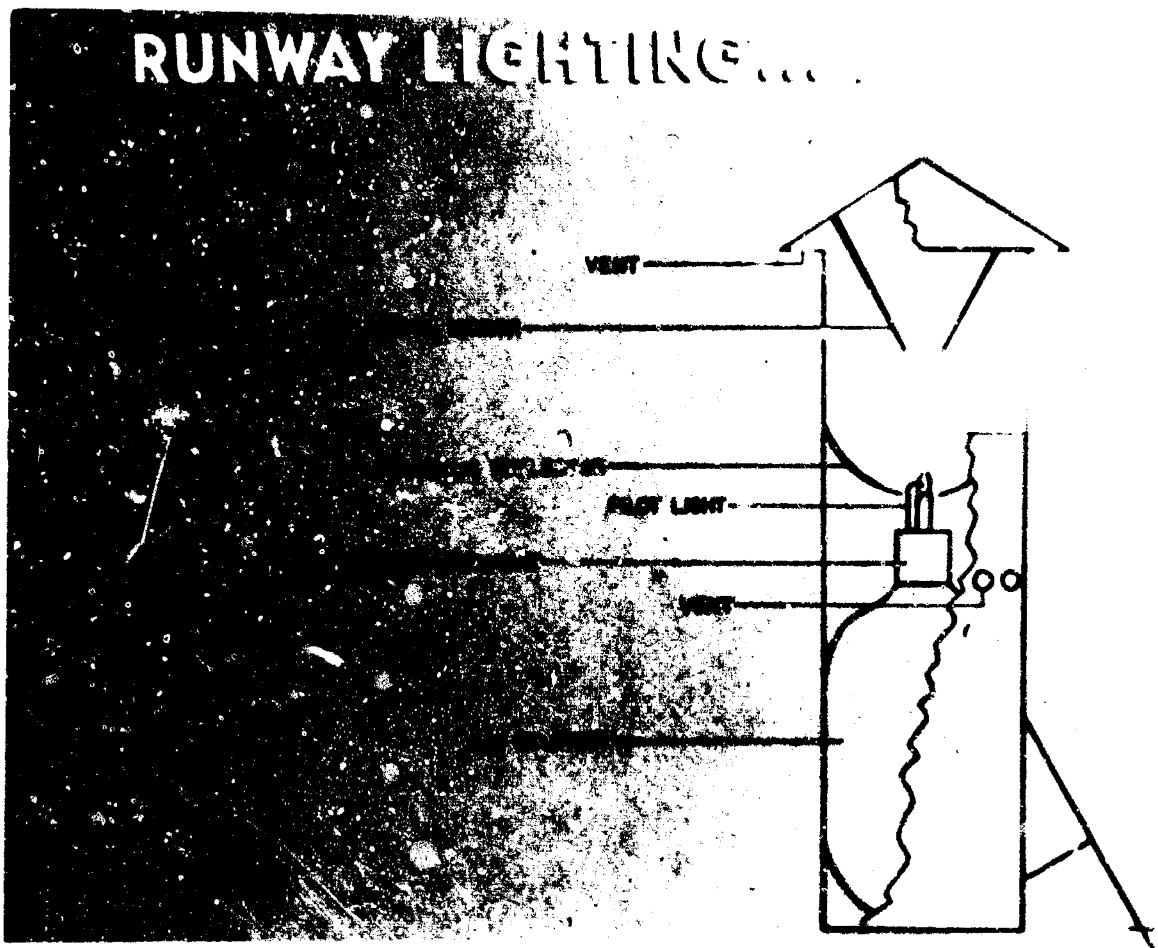


Fig. 31: Details of runway lighting system.

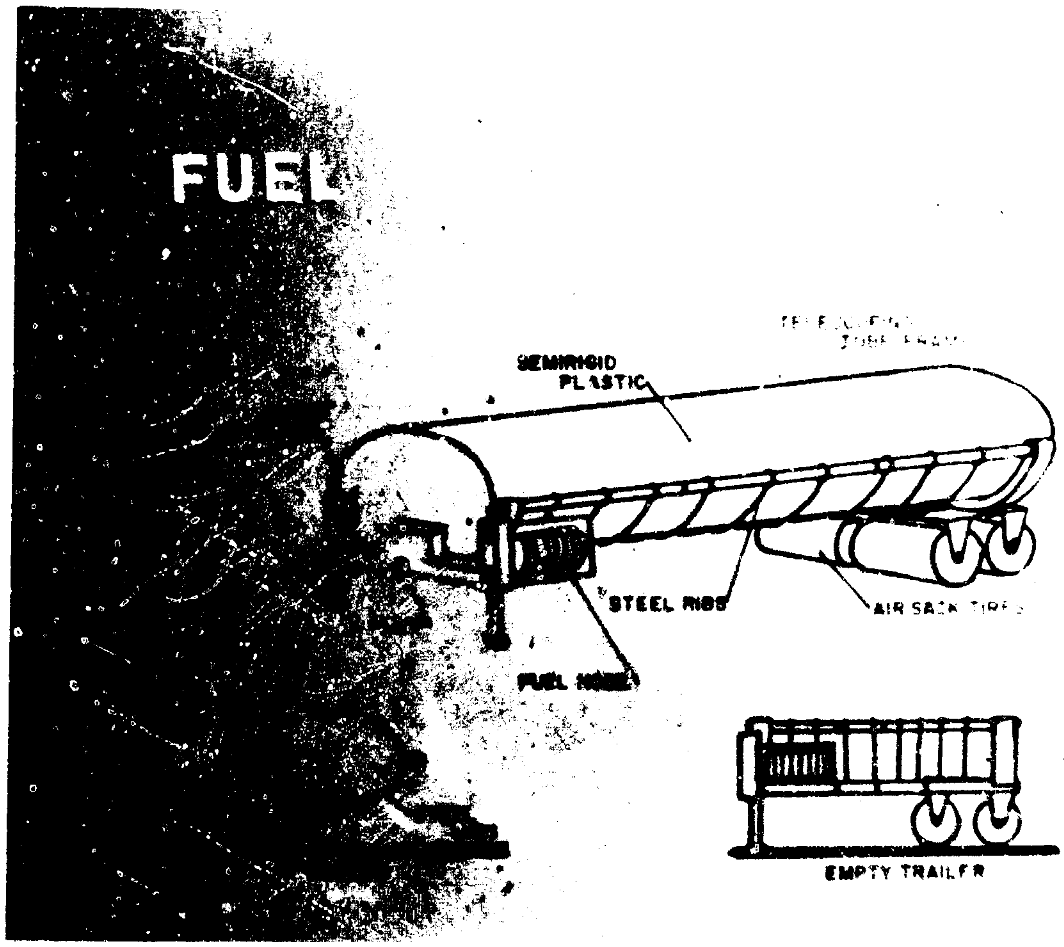


Fig. 32: Fuel trailer.

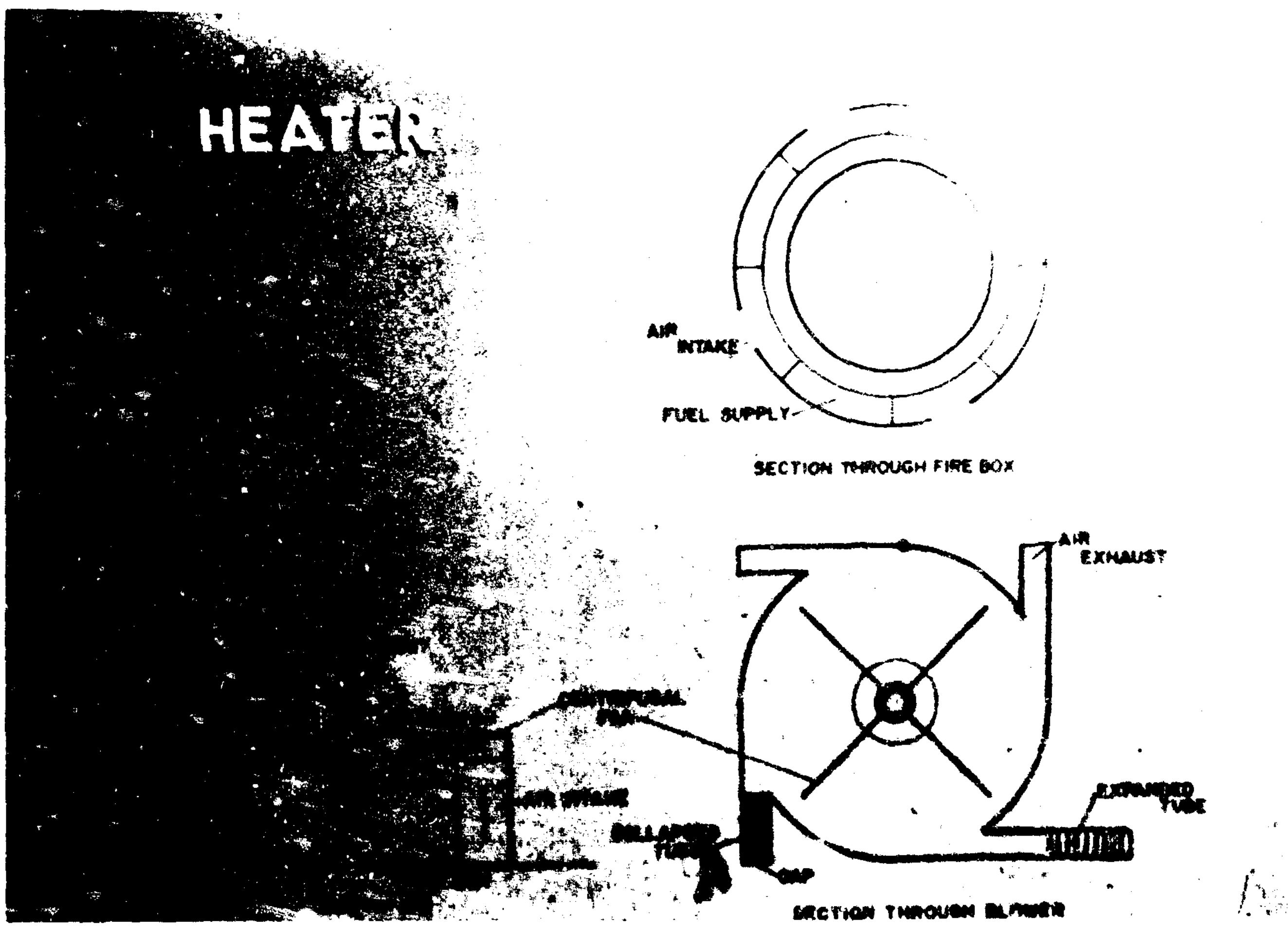


Fig. 33: Space heater for a shelter complex.

TEAM 3

Hans Bleiker	Architecture '66
Jerry Chuck	Industrial Design '65
Philip Joehnk	Architecture '66
Robert Wiesman	Industrial Design '65

SITE ANALYSIS

Our site is an elaborate airfield on the Atlantic Coast. In analysing the airfield (Fig. 1) we find that it would be best to use one major runway, one alternate and one for take off of TAC alert aircraft only. We would set aside 3 aircraft from each of the two squadrons to be designated and placed on an alert status at the northern end of the field.

The terrain of our site is very advantageous to the security of our base. Along the western coast there is a cliff rising 200 feet above the water. From the cliff running easterly there is a 2% slope. In locating the fuel storage areas, we use natural drainage to our advantage. In the event of fuel leakage it will not drain across the base. We designate two areas for fuel storage, thereby reducing the vulnerability of attack. In the same manner we designate two munitions dumps.

Special features of the site are a large, unbroken apron space and a small mound located centrally within the airfield complex. The latter lends itself quite readily for an air control center. The former will be used for a terminal area, TAC ready area, motor pool, run-up, hangars and maintenance of aircraft and vehicles. This allows all of the units to be located within close proximity of each other.

There is a main road running North and South to the east of the field with branches leading to the apron space, a taxi way and the southern fuel storage and munitions area. Access to the northern fuel storage area will require a minimum amount of paving. The northern munitions dump and liquid oxygen production and storage will be along the main road. Air police will set up check points at all intersections with main offices located at the junction of the branch that approaches the terminal area. Fire and Rescue units would be located between the main runway and the alert runway with easy access to both. Initial utilities for the entire base would be located just east of the terminal area. Billeting, messing, administration, the hospital and all special housing will be sited east of the main road away from the main operating areas. Larger support utilities will be located in this area. A small amount of grading and paving will be necessary in preparing this camp area (Fig. 2).

PRIORITIES

In setting up priorities we vary from the Gray Eagle system by a different break down and sometimes by a different sequence. This system, like the present one, will work except when special circumstances prevail.

FIRST PRIORITY

A. Air Police to set up security immediately for the base.

B. Establish Terminal Area, Fire and Rescue, and Air Control to take care of the arrival of initial flights.

SECOND PRIORITY

A. Initial utilities for operation of the airfield only.

B. Motor Pool and Ground Equipment.

C. Support utilities to be established for the arrival of additional personnel.

D. Billeting and Messing.

THIRD PRIORITY

A. Maintenance and Run-up Area.

B. Initial fuel storage, munitions and liquid oxygen.

C. Operations.

D. Increased Billeting and Messing.

From the loading of the C-130's at the rear main operating base to the end of our Third Priority presently takes 72 to 96 hours. With the use of the equipment we have designed we believe this time will be cut down considerably.

FOURTH PRIORITY

A. Arrival of Tactical Air Craft.

FIFTH PRIORITY

A. Administration Building.

B. Hospital.

C. Special Housing.

SIXTH PRIORITY

A. Hangars

B. Erection of remainder of base and camp.

SEVENTH PRIORITY

A. Improvements based on projected length of tenancy.

INTERPRETATION

We interpret this problem to consist of reducing the effort of making a bare base operational. This we have accomplished by pursuing the problem in two areas.

The first area of attention is aimed at reducing the number of required support flights; the second area of attention eliminates much of the labor on the base. Some of our designs are successful in one of the two areas, others in both.

The number of C-130 support flights can be reduced by making the required equipment lighter and/or making more than one use of that equipment.

SOLUTION

Based on this, our interpretation, we have solved the problem with the following suggested designs:

A. PALLET-DOLLY SYSTEM

To accomplish the unloading of the C-130's faster and with less effort than the present method, we have designed a pallet-dolly system (Fig. 3). All equipment is loaded on wheeled pallets of 8'-0" x 8'-0", and in the case of longer items on wheeled pallets of multiples of this module. Rather than having a forklift unit carry equipment from the plane, our dollies are pulled out of the aircraft either one by one by a small vehicle or en masse, depending on the weight of the contents. A C-130 will hold five dollies.

B. FUEL CONTAINERS

Instead of shipping the fuel in 500 gallon rubber tanks, which have to be largely manhandled, we transport our fuel in 8'-0" high rack which contains 2250 gallons and is carried on one of the 8'-0" x 8'-0" dollies. The rack holds a 400-foot spool of 1'-0" diameter hose containing the JP-4 (Fig. 4). As the cargo lands, these dollies can be pulled from the plane and then unloaded whenever it is desireable to release the C-130 quickly (Fig. 5).

C. PERSONNEL SHELTER

We have modified the presently used military personnel tent so it can be erected in a fraction of the time now required. The 26'-0" x 26'-0" tent, housing twelve men, is supported by four pneumatic main arches Fig. 6). These arches are in turn braced from each other by two flatter pneumatic arches. Each of the minor arches has a tensile cord keeping its base from spreading. To erect it, the tent is laid out flat on the ground and a one-cubic-foot compressed air bottle (4000 psi) is used to inflate the entire system of arches simultaneously. The arches will be 1'-8" in diameter and will be inflated to approximately 5 psi. to effect the required strength. The fabric skin is attached to the ribs and is self erecting when the structure is inflated (Fig. 6).

With the addition of a semi-elliptical shaped piece of cloth, these individual tents can be connected to form any desired size and system of spaces.

D. PERSONNEL SHELTER FABRIC

Aside from the above mentioned advantages, the shelter will weigh only 50-60% of the present tent even though it incorporates a floor. This we achieve by specifying an elastic weave of a very light artificial fiber. The required strength is obtained by sewing strong tension members in at three feet intervals (Fig. 7). The average weight of the light areas, the reinforcing strips, and the pneumatic arches should be approximately one pound per square yard. The entire shelter weighs 277 lbs. and when the compressed air bottle is included, 300 lbs.

E. HANGARS, ETC.

The several C-130 loads of material which are required under the present system to erect two hangars, one or more motor vehicle buildings, a messhall, a hospital and any other large buildings, are almost entirely eliminated.

The one-foot diameter hose from the fuel containers are purged with nitrogen and then are used as structural members. The 400 feet of hose on one reel is made up of five 80'-0" sections connected by $2\frac{1}{2}$" unions. Each of the sections becomes a pneumatic arch with a 50'-0" span. As these arches stand side by side, one fuel rack accounts for five feet of the total 50'-0" hangar space, one C-130 load--or five racks make 25 lineal feet of hangar. A 100'-0" x 50'-0" hangar would require the hose of four C-130 loads. Only a portion of the fuel containers are used in this way, the majority remaining in circulation.

To make good use of the space and to provide for smaller areas for maintenance, engineering offices, storage areas and specialized shops and parts, the hangar arches rest on the welded-pipe fuel racks rather than on the ground. A waterproof membrane is pulled over the entire arch system (Fig. 8). As this system does not use up hose and racks at the same rate, different combinations are illustrated for the messhall complex (Fig. 9).

F. STYRENE-CORE CONTAINERS

Most of the equipment is shipped in 4'-0" x 4'-0" x 8'-0" hard-surface containers. They are made up of styrene core panels and aluminum extrusions (Fig. 10). The extrusions hold the panels together as is shown in the detail (Fig. 11).

To make full use of all materials shipped in, these panels and extrusions are designed to fit on the fuel racks (Figs. 12,13,14). The extrusions are snapped or screwed to the welded pipe and the styrene core panels are inserted becoming walls and doors of the large buildings' rigid perimeter structures.

G. MULTI-PURPOSE VEHICLE

In an effort to reduce the inventory of vehicles, we have designed a light multi-purpose vehicle (Fig. 15) which is capable of performing several of the less critical tasks. It can be used for carrying personnel, light hauling (Fig. 16), forklifting (Fig. 17), heavy carrying (Fig. 18), grading, and runway sweeping (Fig. 19).

A small turbine power plant located under the bed, drives the wheels and all other systems via hydraulic transfer of energy. The wheels are attached to the bottoms of four large hydraulic actuators which are capable of supporting the chassis at variable heights from two to six feet off the ground (Fig. 20). This system permits the carrying of relatively heavy loads as no manhandling of the load is required and the center of gravity is kept very low.

H. RUNWAY LIGHTING SYSTEM

The present runway lighting system's weight and vulnerability to sabotage has been reduced as our system eliminates all wire-stringing (Fig. 21).

Two light sources (Fig. 22) on each end of the runway shoot parallel beams of light along the runway (Fig. 23). Semi-spherical reflectors, placed at the desired intervals catch portions of the parallel light beams and reflect them in a dispersing pattern. The reflectors (Fig. 24) are made of a glass alloy which permits a percentage of the light to penetrate it and not be dispersed until it reaches the far side.

I. COOK'S STOVE

The cook's stove (Fig. 25) takes advantage of the facts that heat can be reflected effectively and that JP-4, a high temperature fuel, is available on the base.

Individual burners provide direct heat for the hot plates and the griddle. A large vertical parabolic reflector directs the heat to the oven at the far end of the stove. This oven is based on the camper's reflector oven. The heat is thrown evenly, from the top and the bottom, onto the baking shelf by the two flat reflectors (Fig. 26).

J. FUEL

Shipping, storing and handling of fuel is simplified by reducing the types of fuel in the inventory.

As JP-4 is an efficient fuel and has to be supplied in huge quantities (approximately 2,000,000 gallons per month) we recommend that all equipment be modified to burn it. This requires the use of turbine and/or diesel engines.

CONCLUSION

With our designs we are improving the current operations on these points:

A. Quicker and easier unloading of the C-130 transports.

B. Quicker, safer and easier handling of large quantities of fuel.

C. Quicker and easier erection of personnel shelters.

D. Lighter personnel shelters.

E. Reduction of material shipped by using some of the fuel containers for building materials.

F. Reduction of material shipped by using hard surface containers for structures' paneling.

G. Reduction of vehicle inventory.

H. Lighter and less vulnerable runway lighting system.

I. Lighter and more efficient cook's stove.

J. Simplification of operations by use of only one fuel on the base.

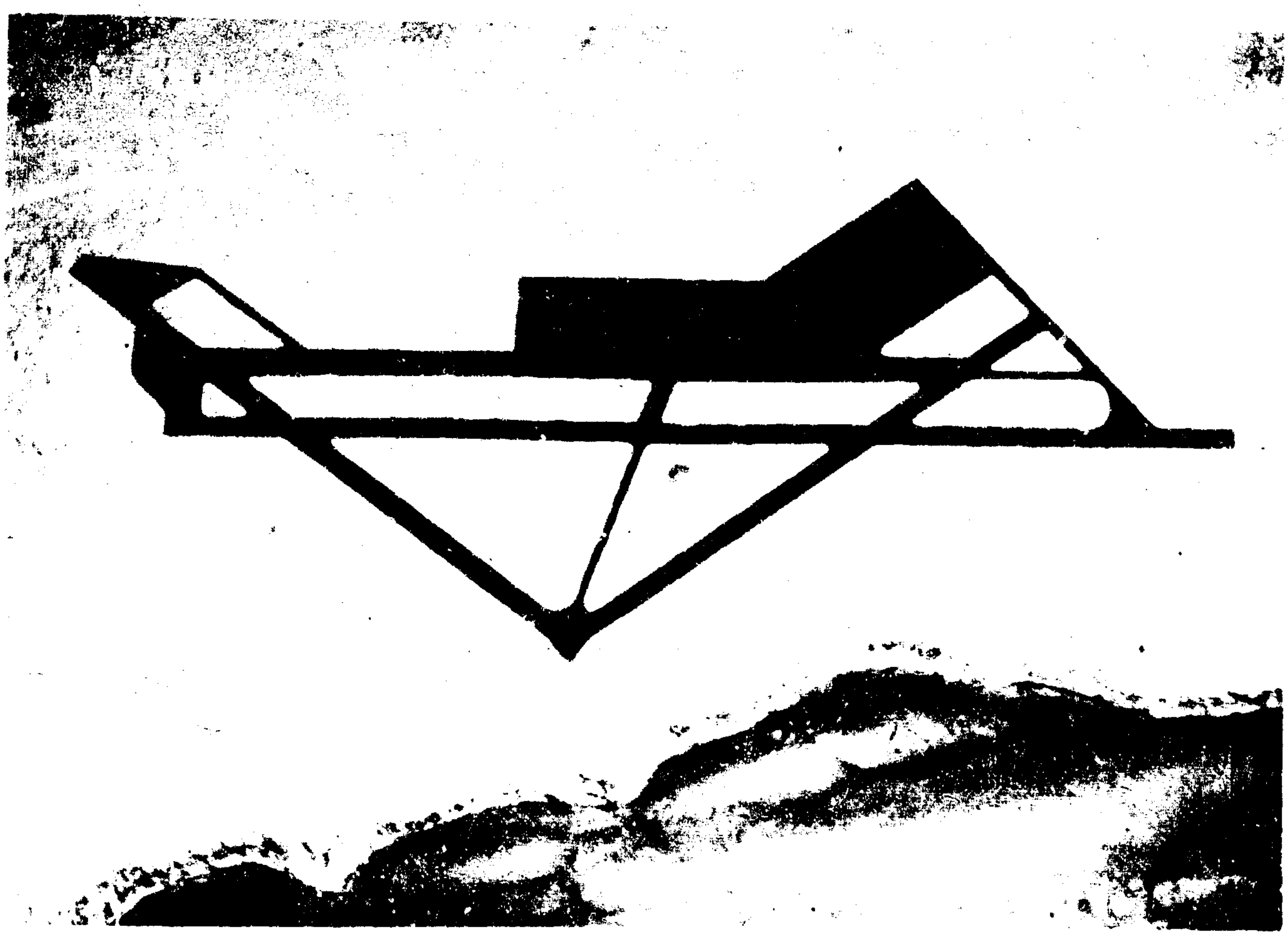


Fig. 1: Aerial view of site prior to development.

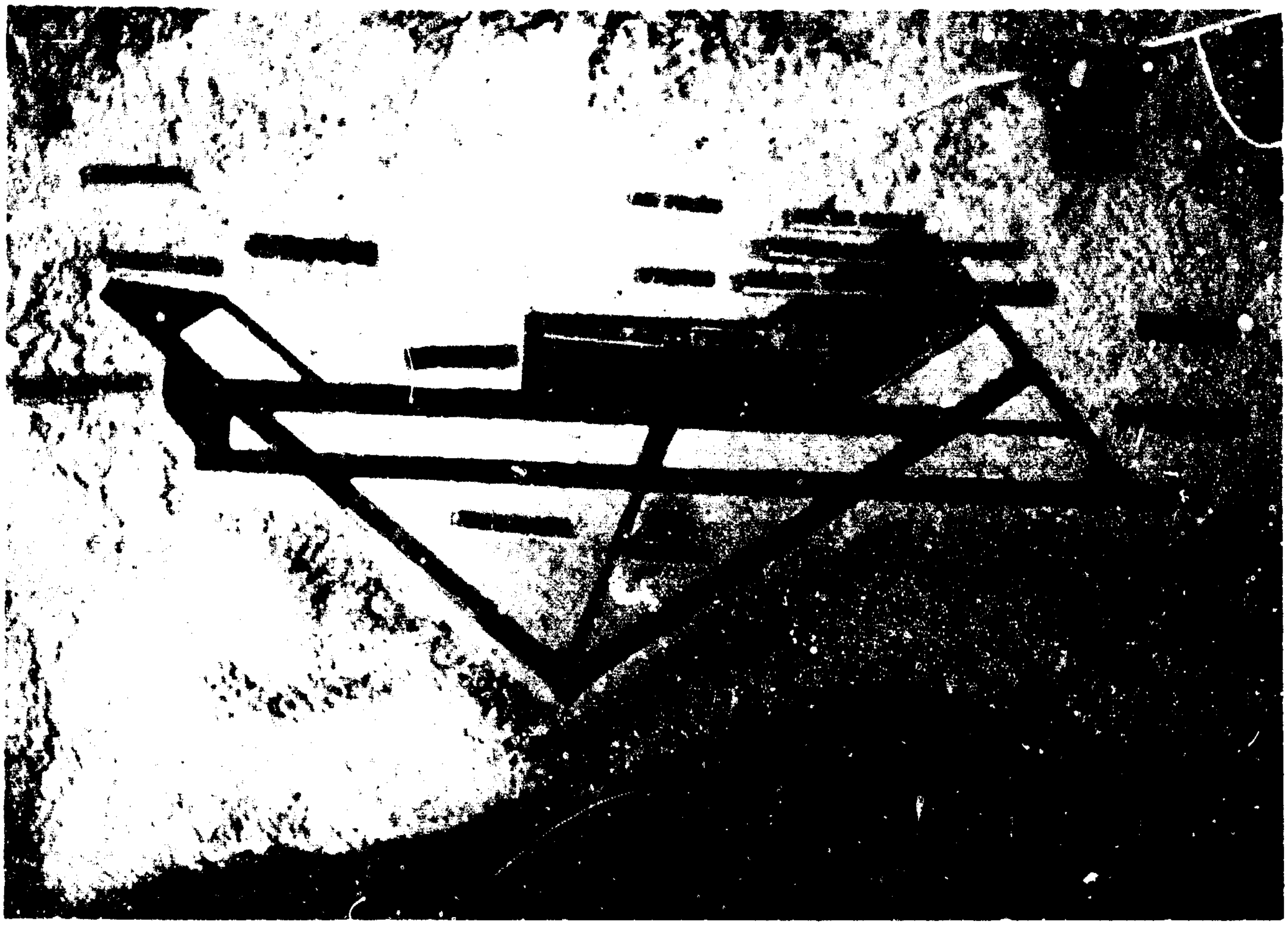


Fig. 2: Aerial view of site fully developed.

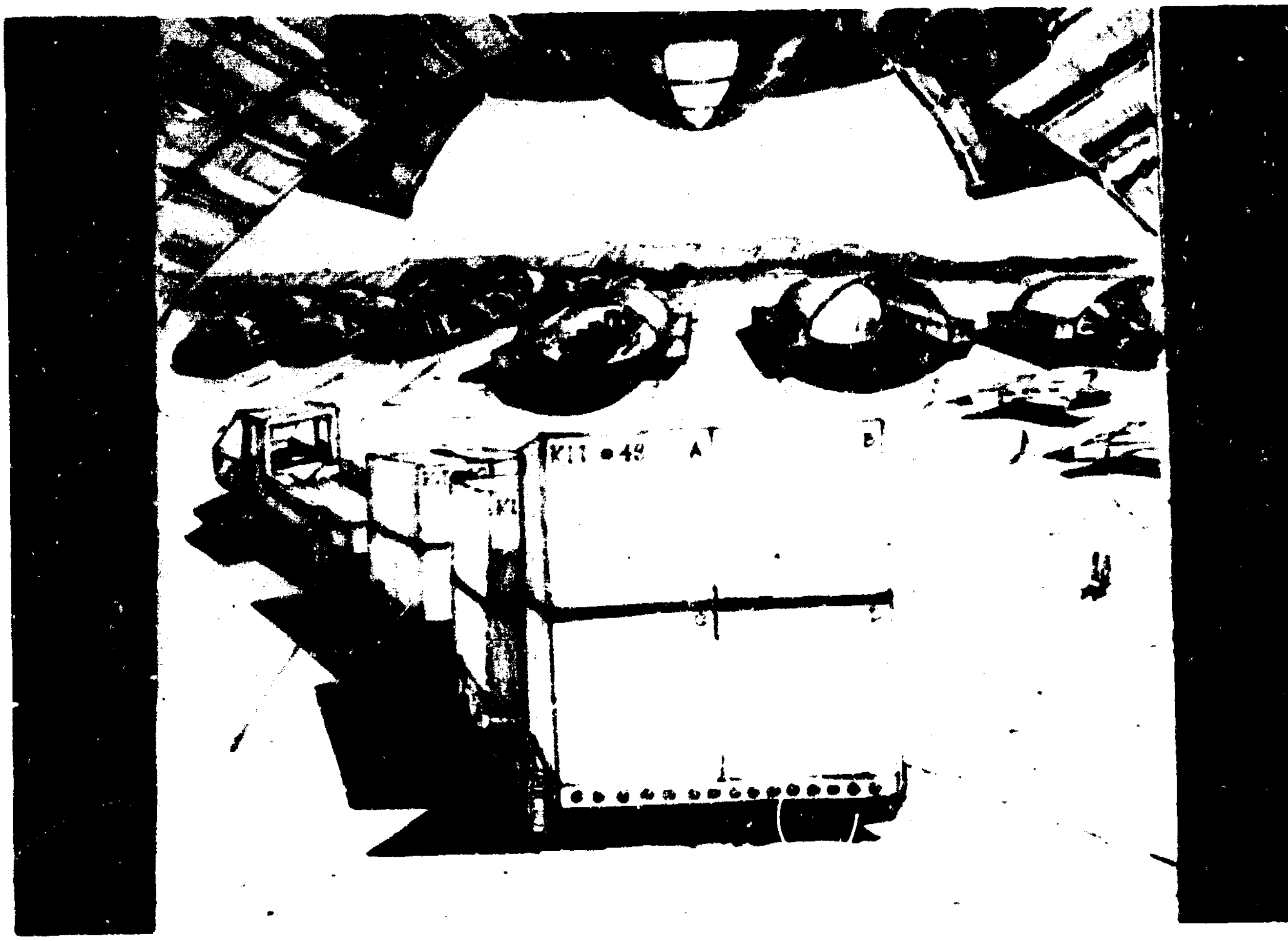


Fig. 3: View from interior of C-130 showing the unloading of aircraft using the pallet-dolly system.

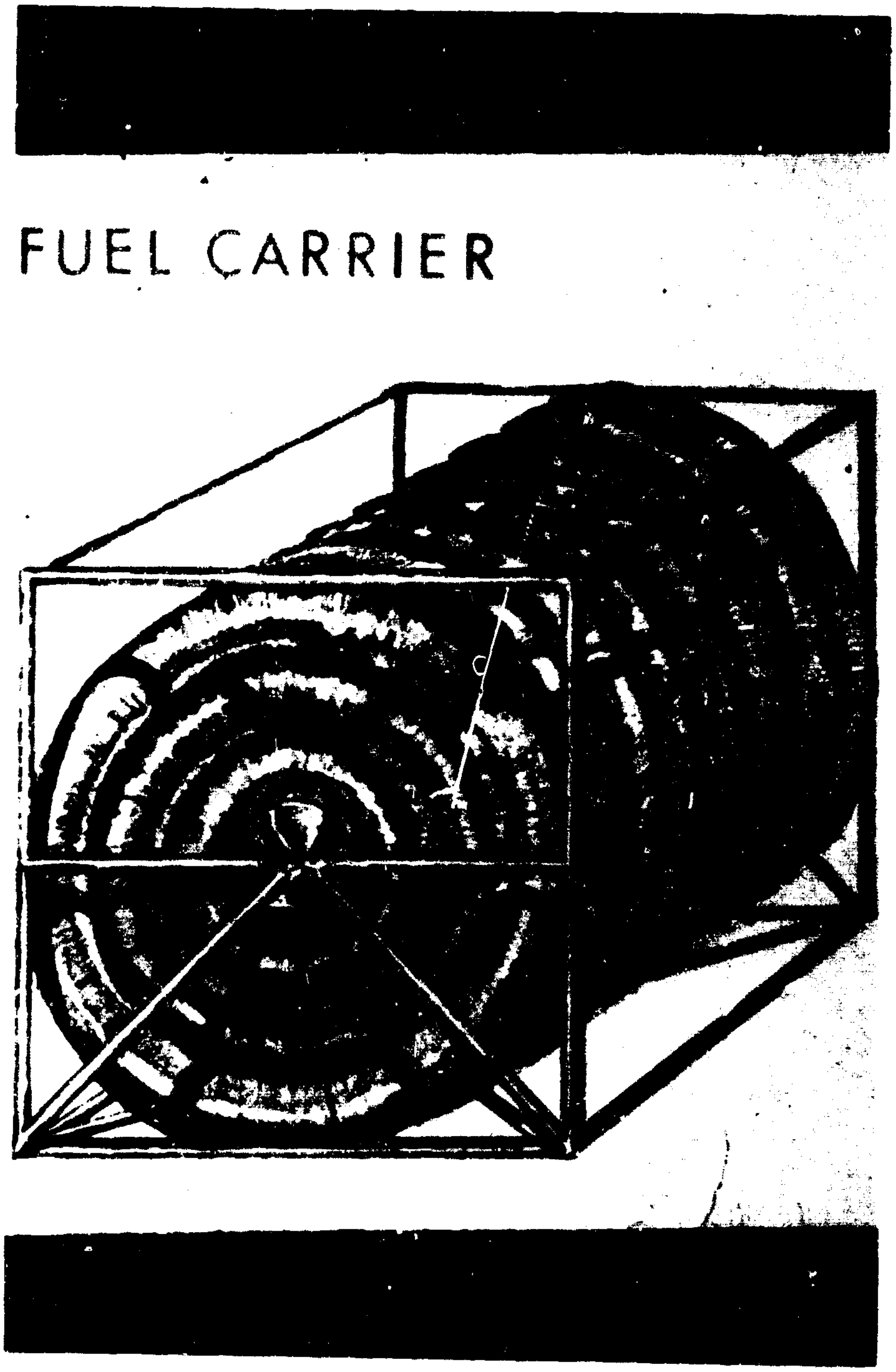


Fig. 4: Fuel carrier.

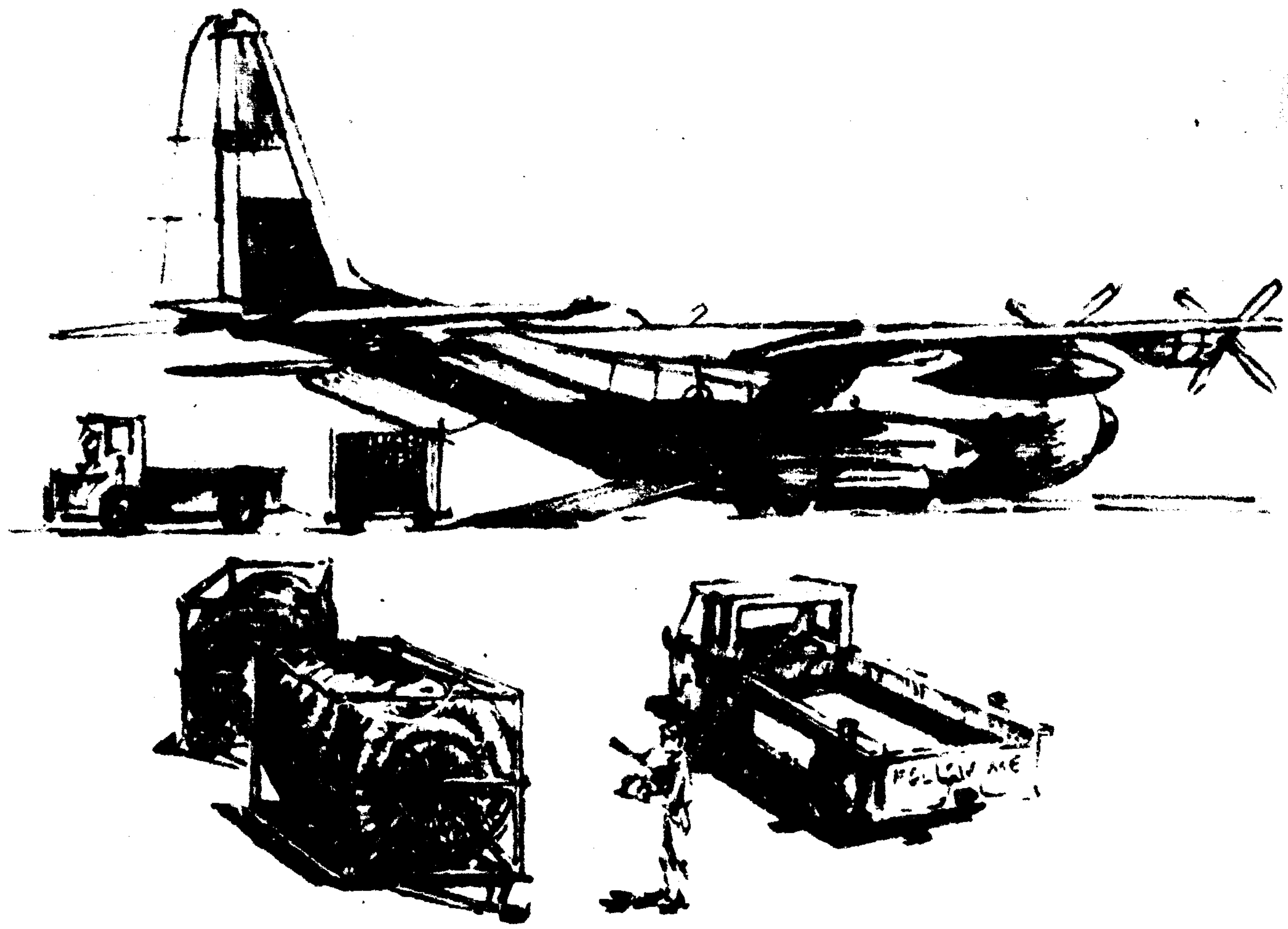


Fig. 5: Fuel carrier unloaded from C-130.

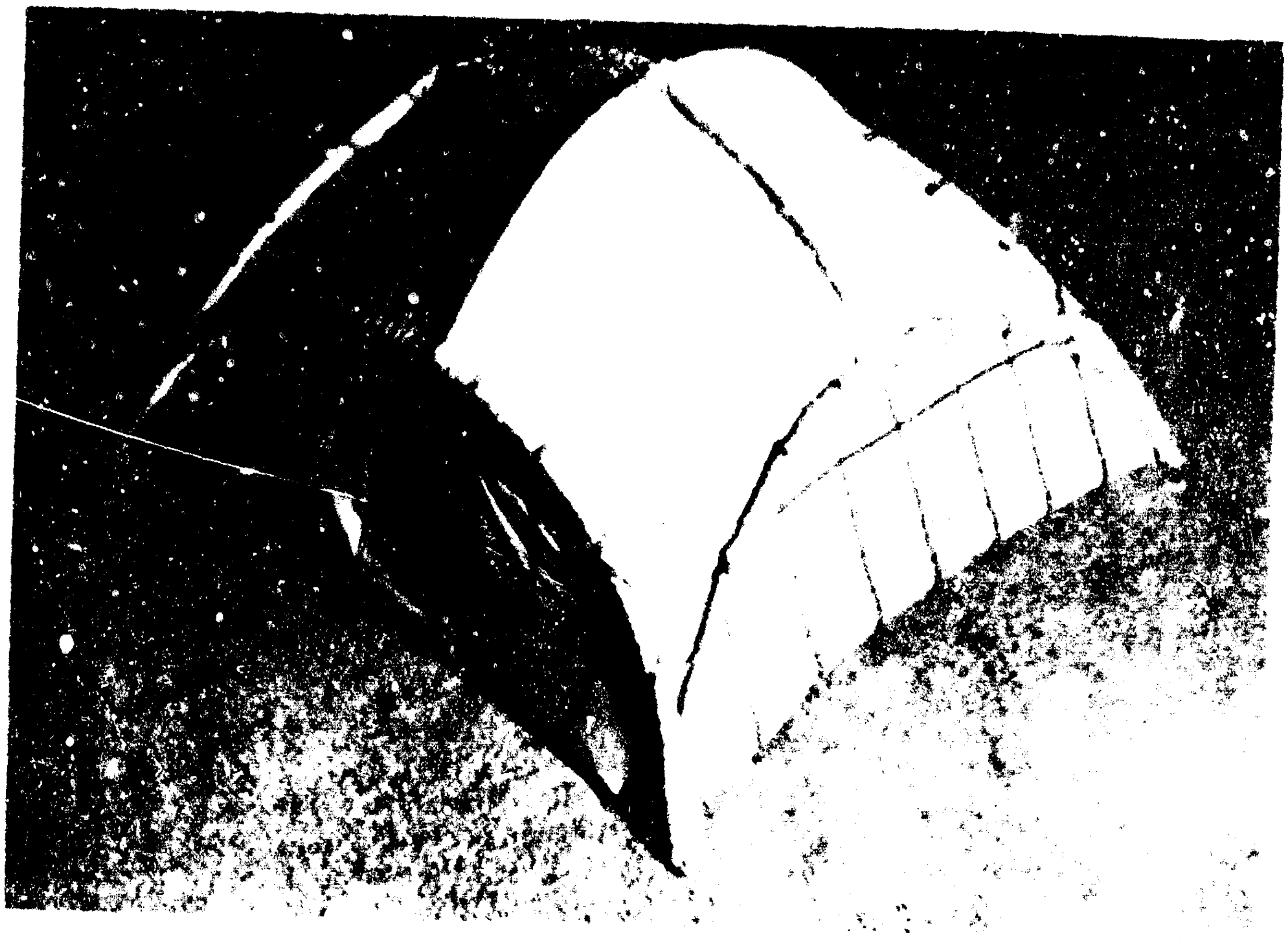


Fig. 6: Aerial view of erected shelter.

Fig. 7: Erected shelter showing reinforcing strips.

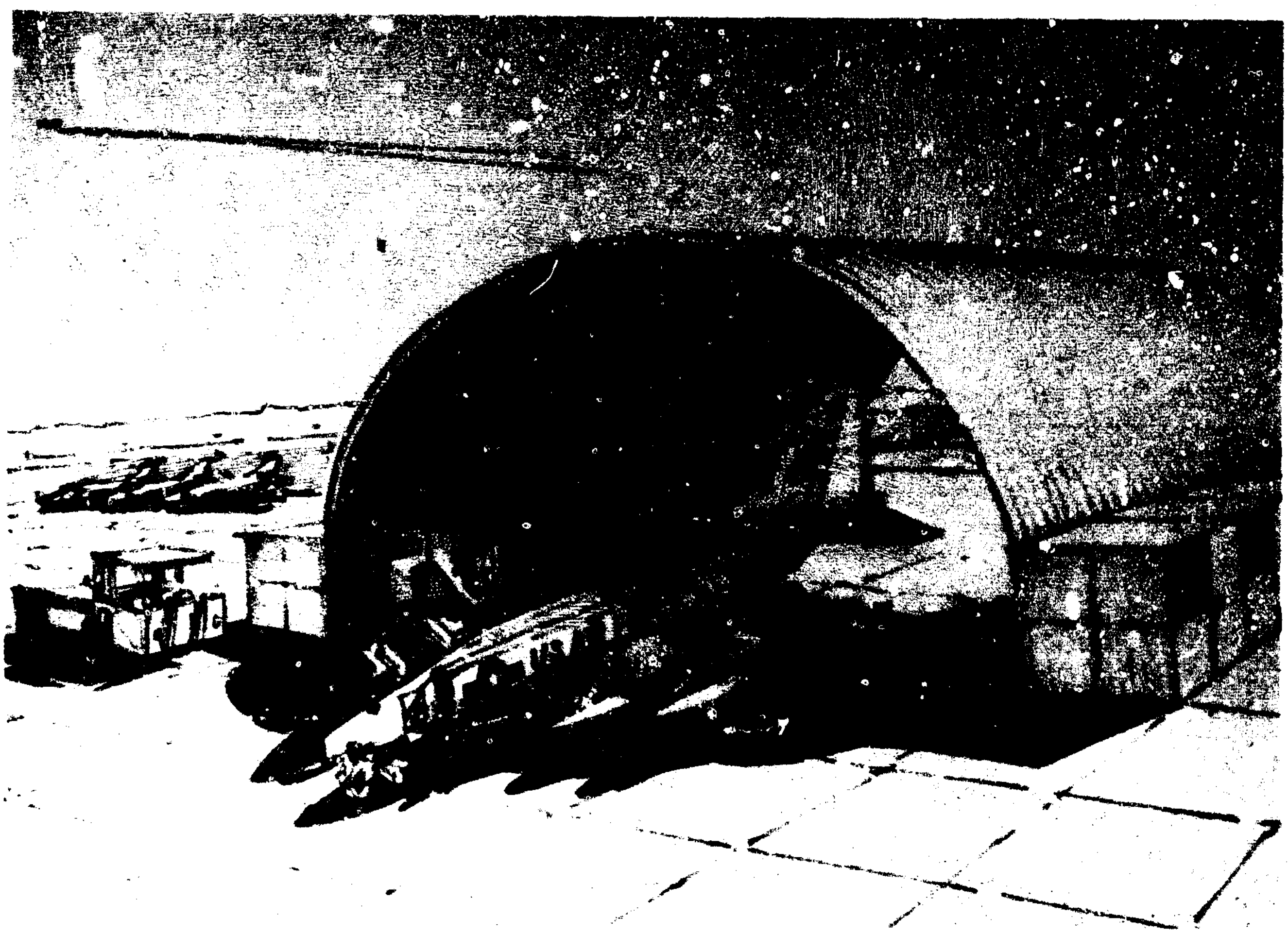


Fig. 8: Hangar showing inflated arches and flanking service cubicles.

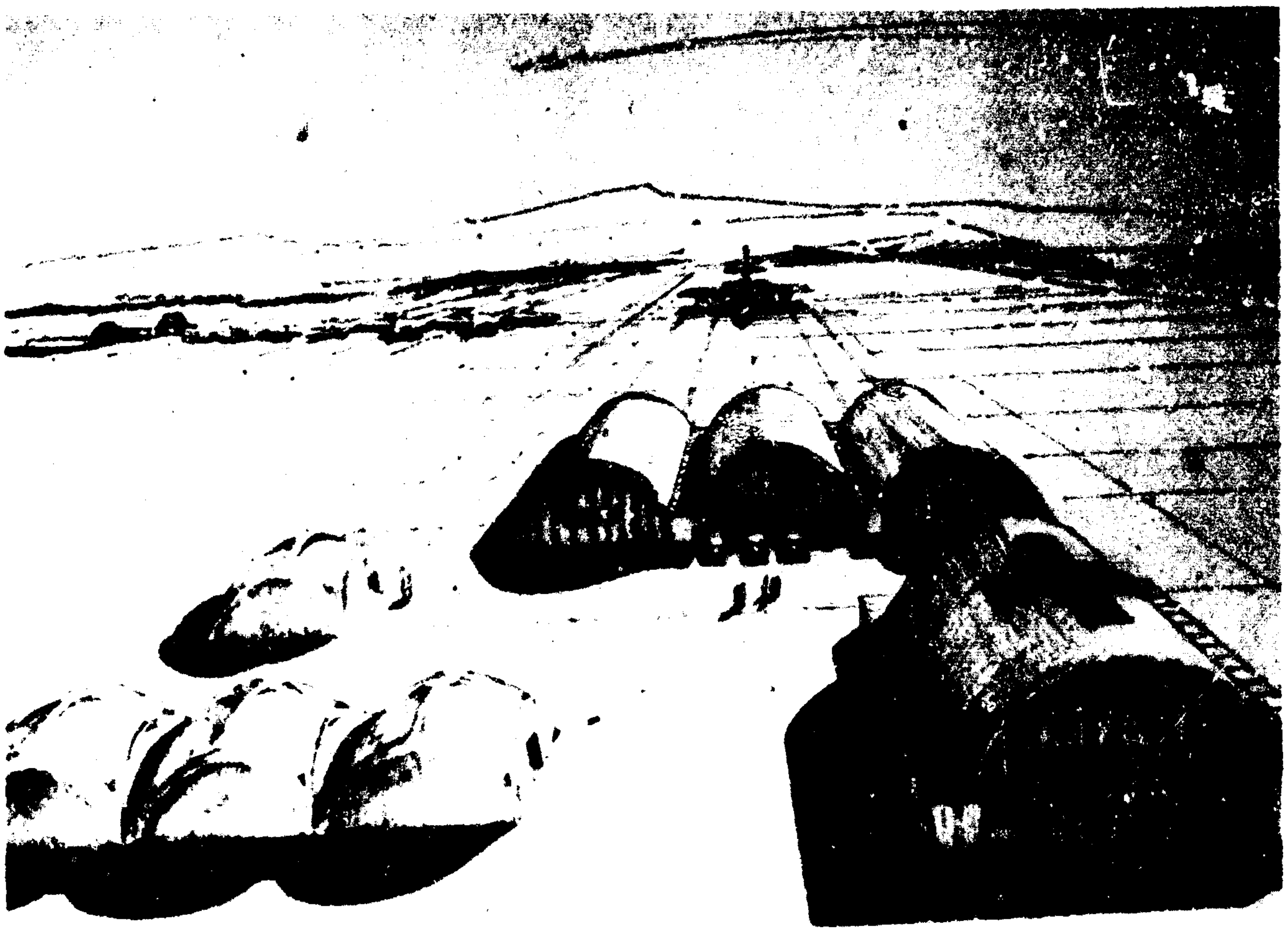


Fig. 9: Large inflated arches adapted to mess halls and hospitals.

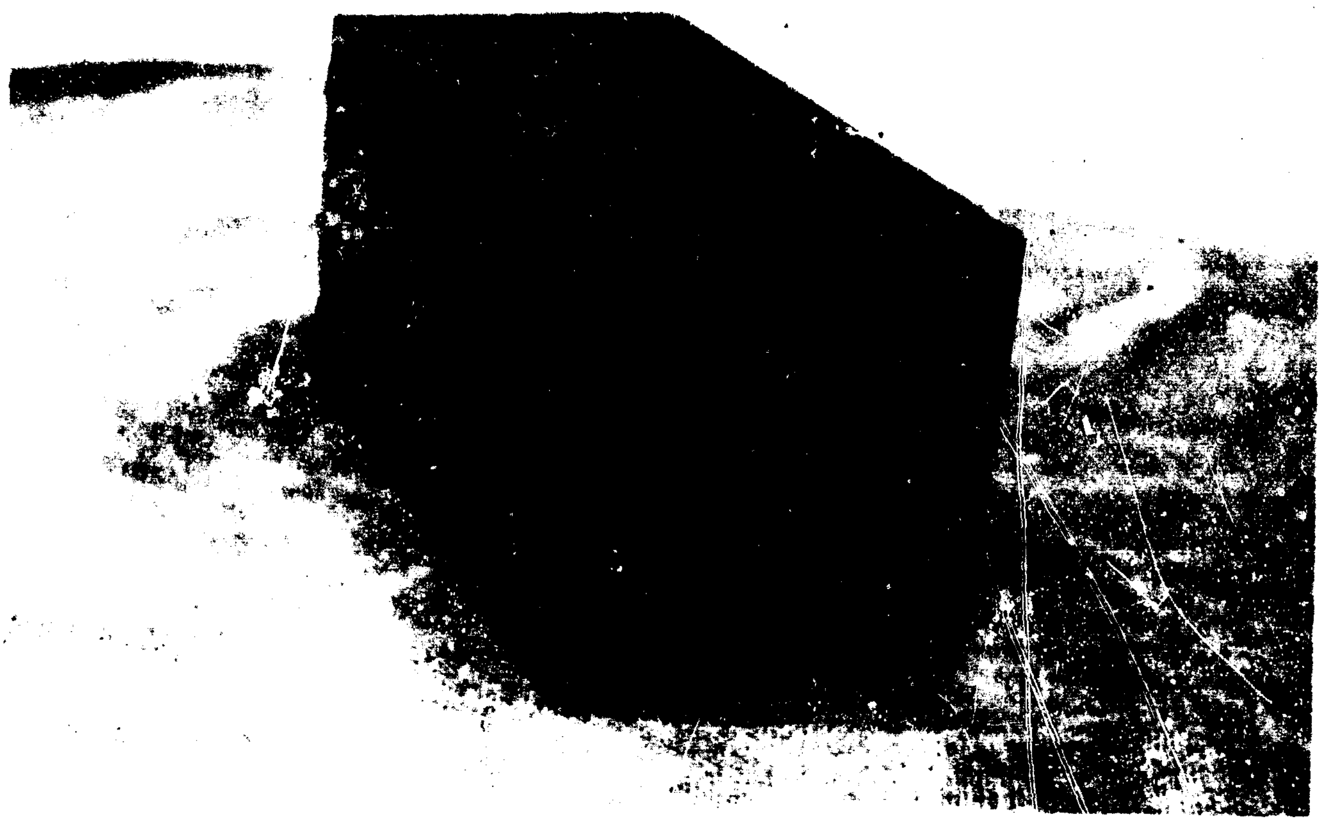


Fig. 10: Styrene-core containers as shipping package.

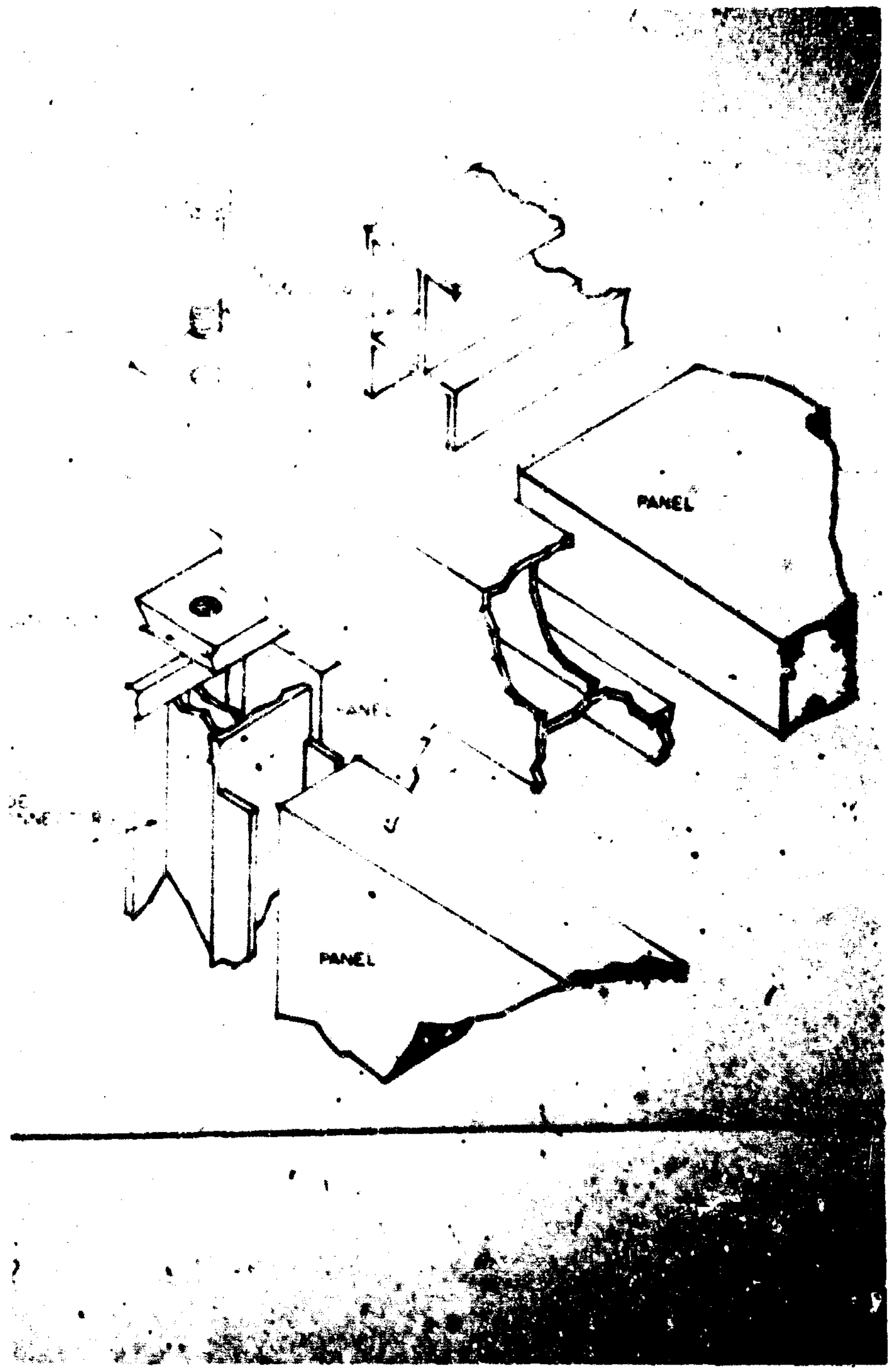


Fig. 11: Assembly details of styrene-core containers.

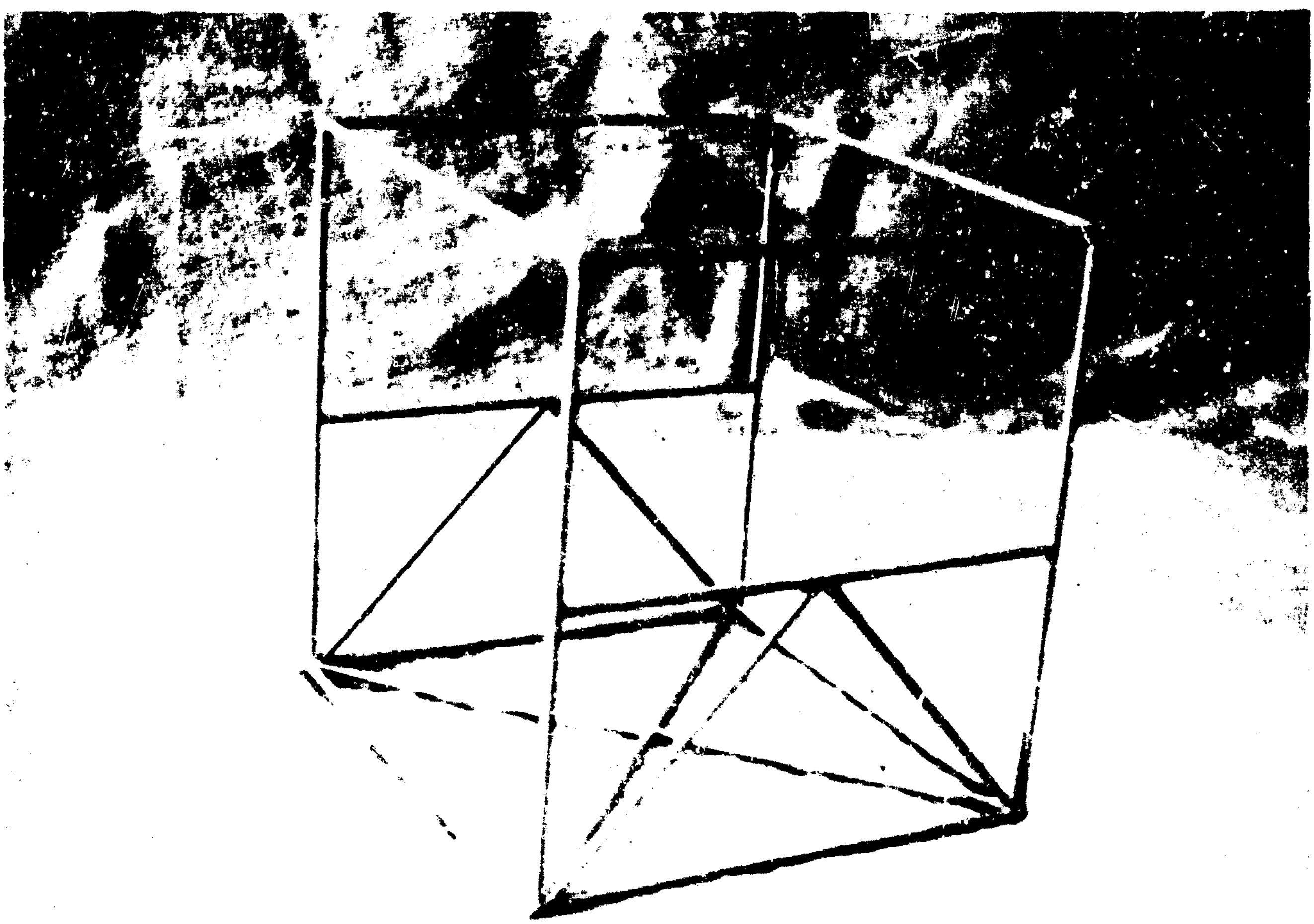


Fig. 12: Fuel rack.

Fig. 13: Fuel rack with extrusions attached.

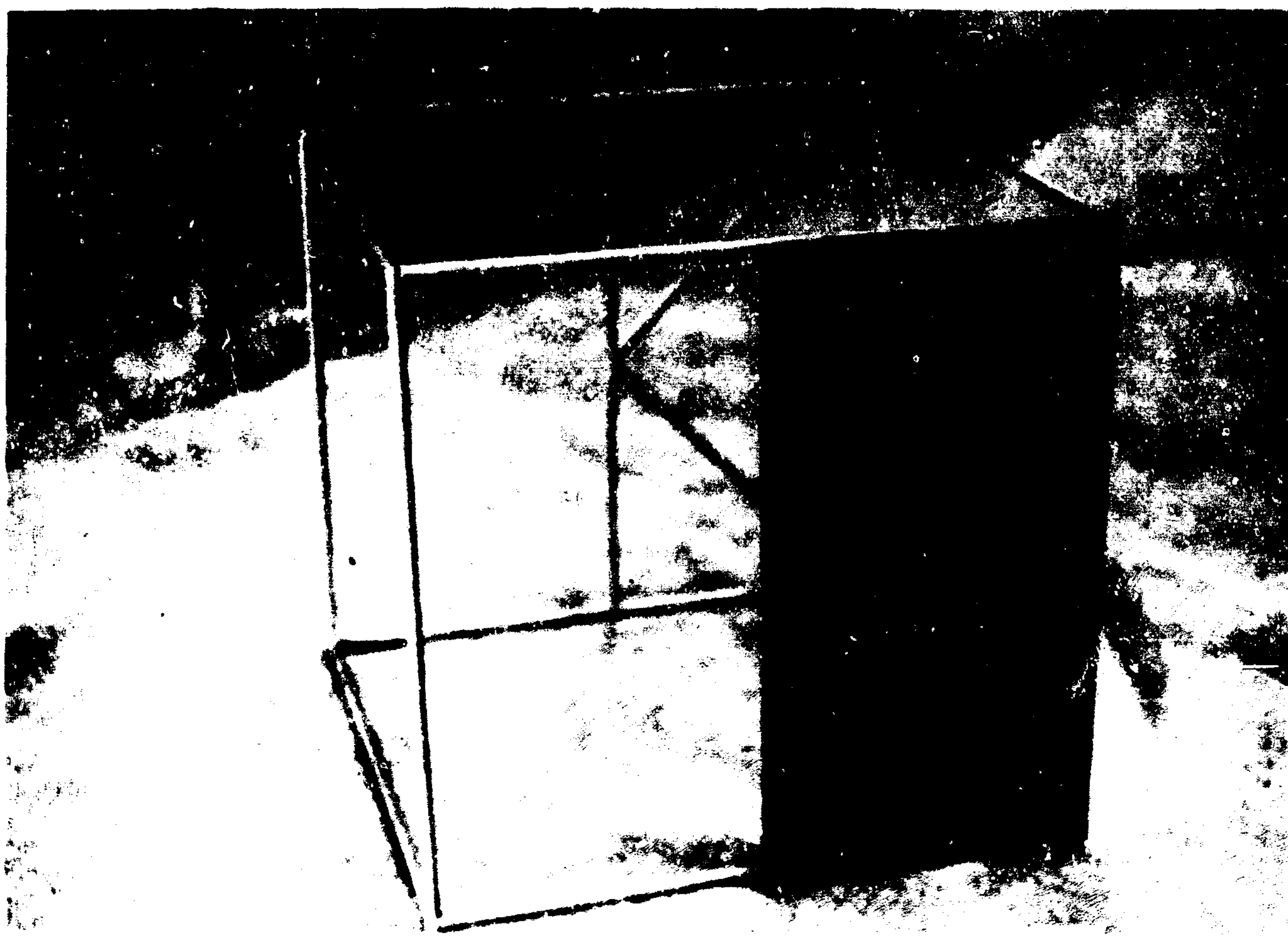


Fig. 14: Fuel rack with panels inserted (when fully assembled, become service cubicles and auxiliary structures).

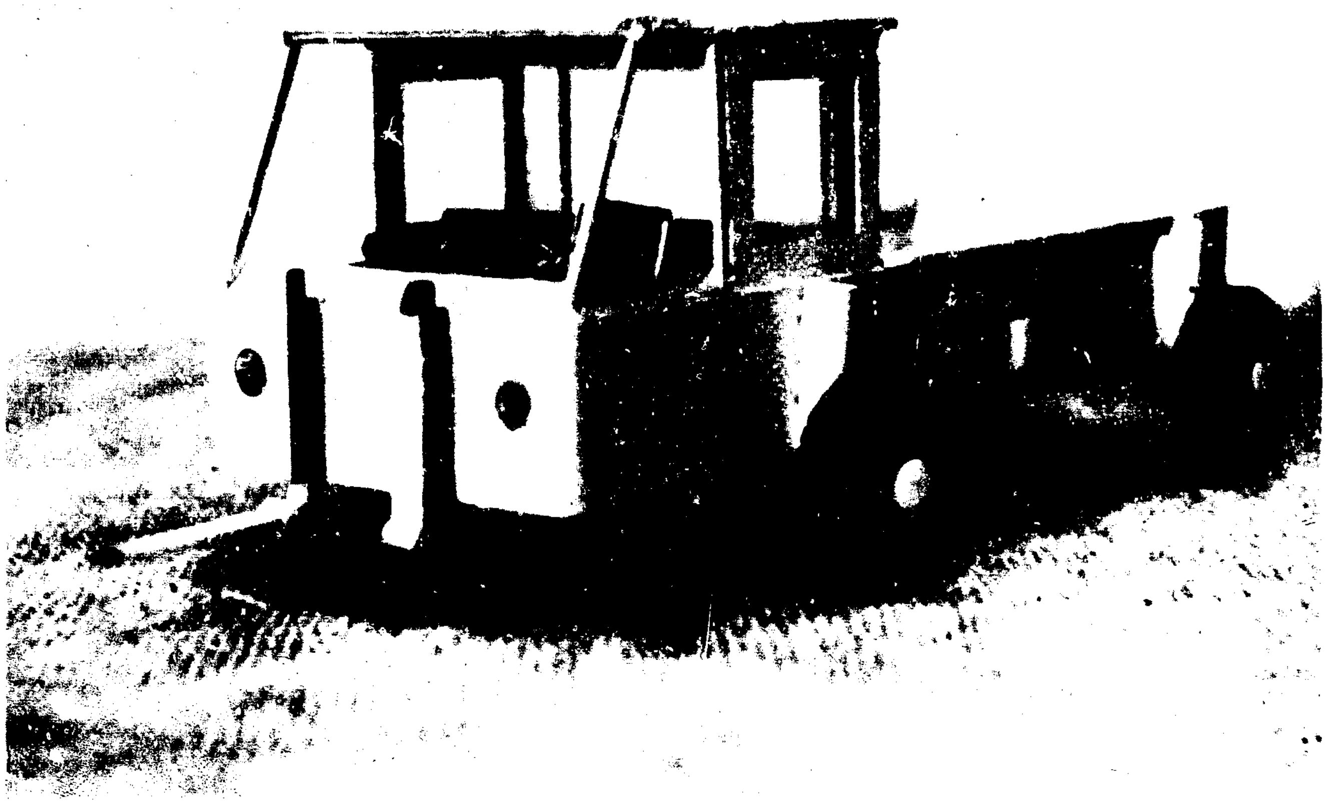


Fig. 15: Multi-purpose vehicle.

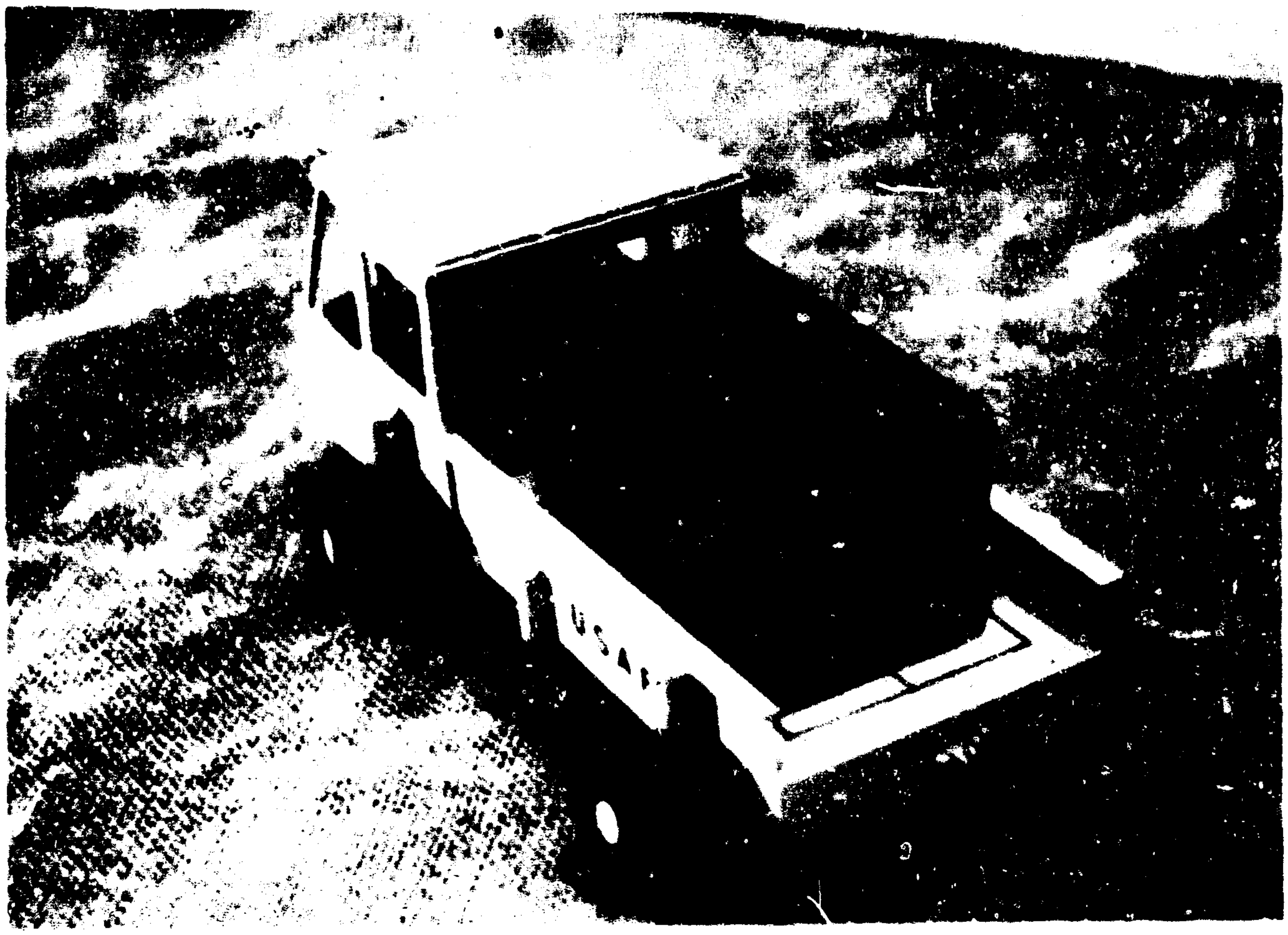


Fig. 16: Multi-purpose vehicle used for light hauling.

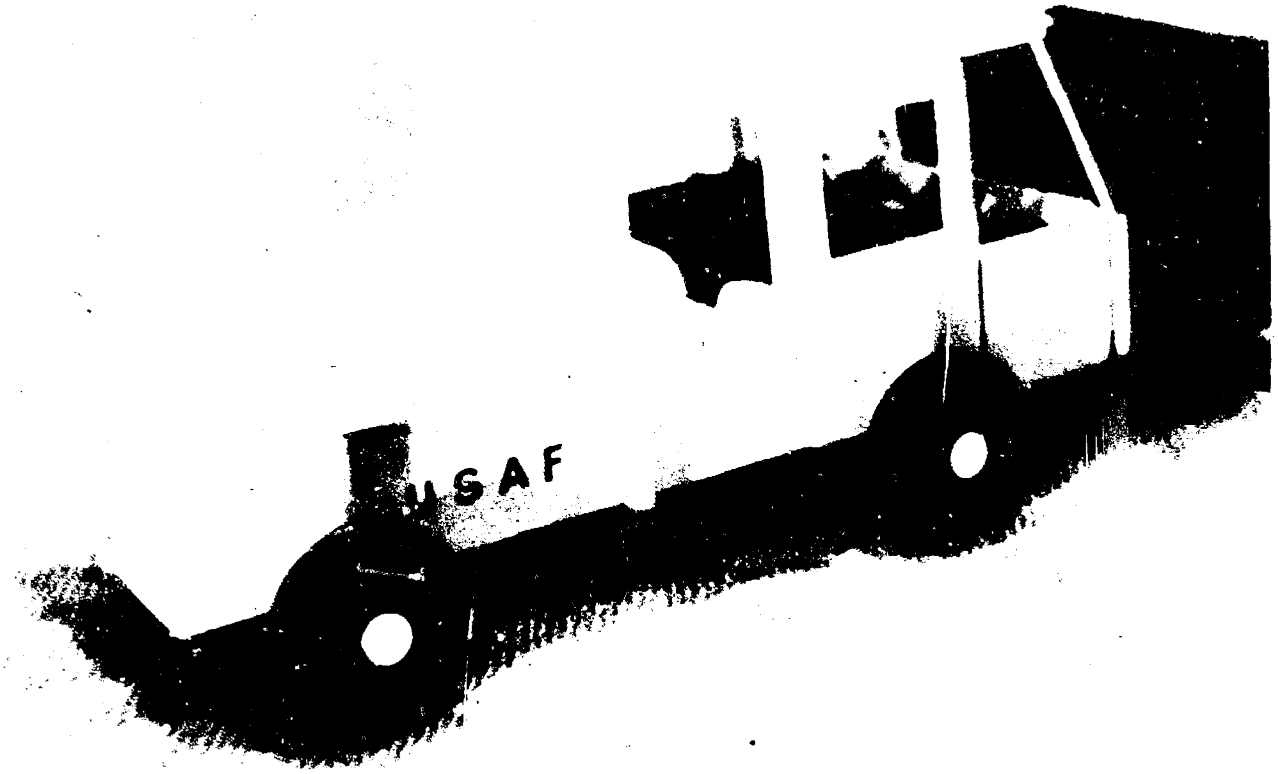


Fig. 17: Multi-purpose vehicle used as fork lift.

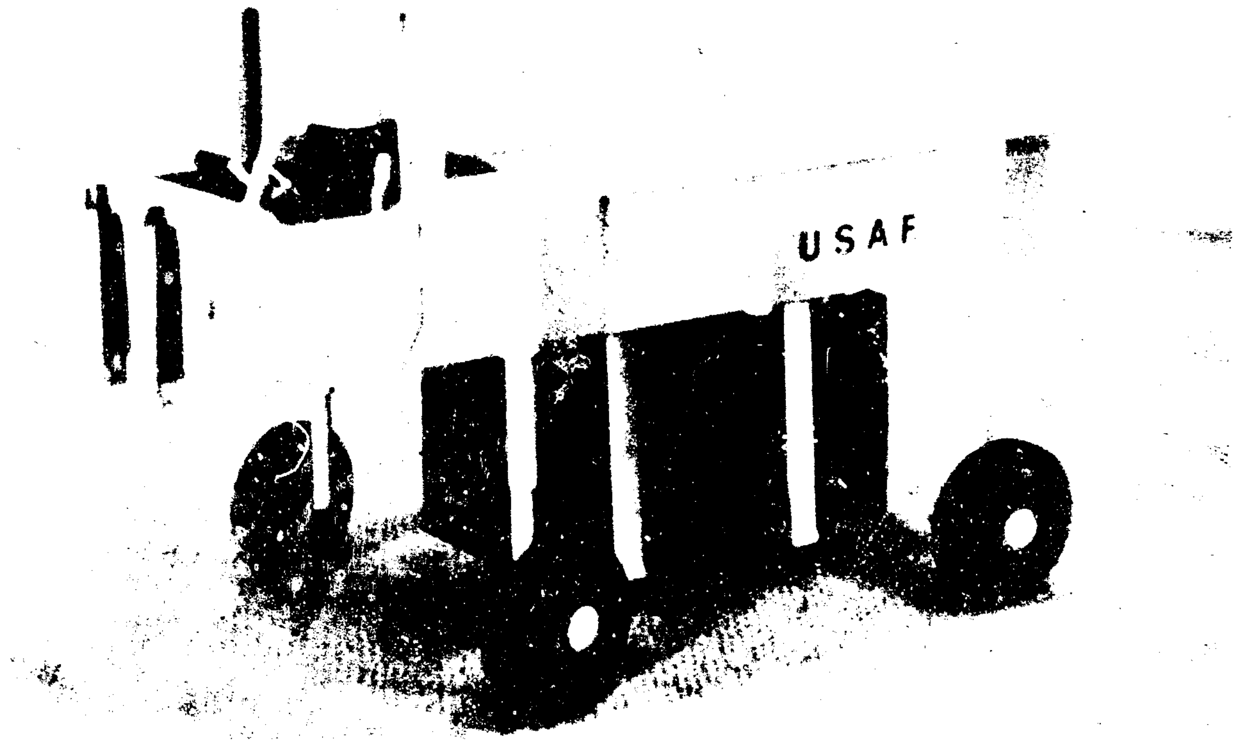


Fig. 18: Multi-purpose vehicle used for heavy hauling.

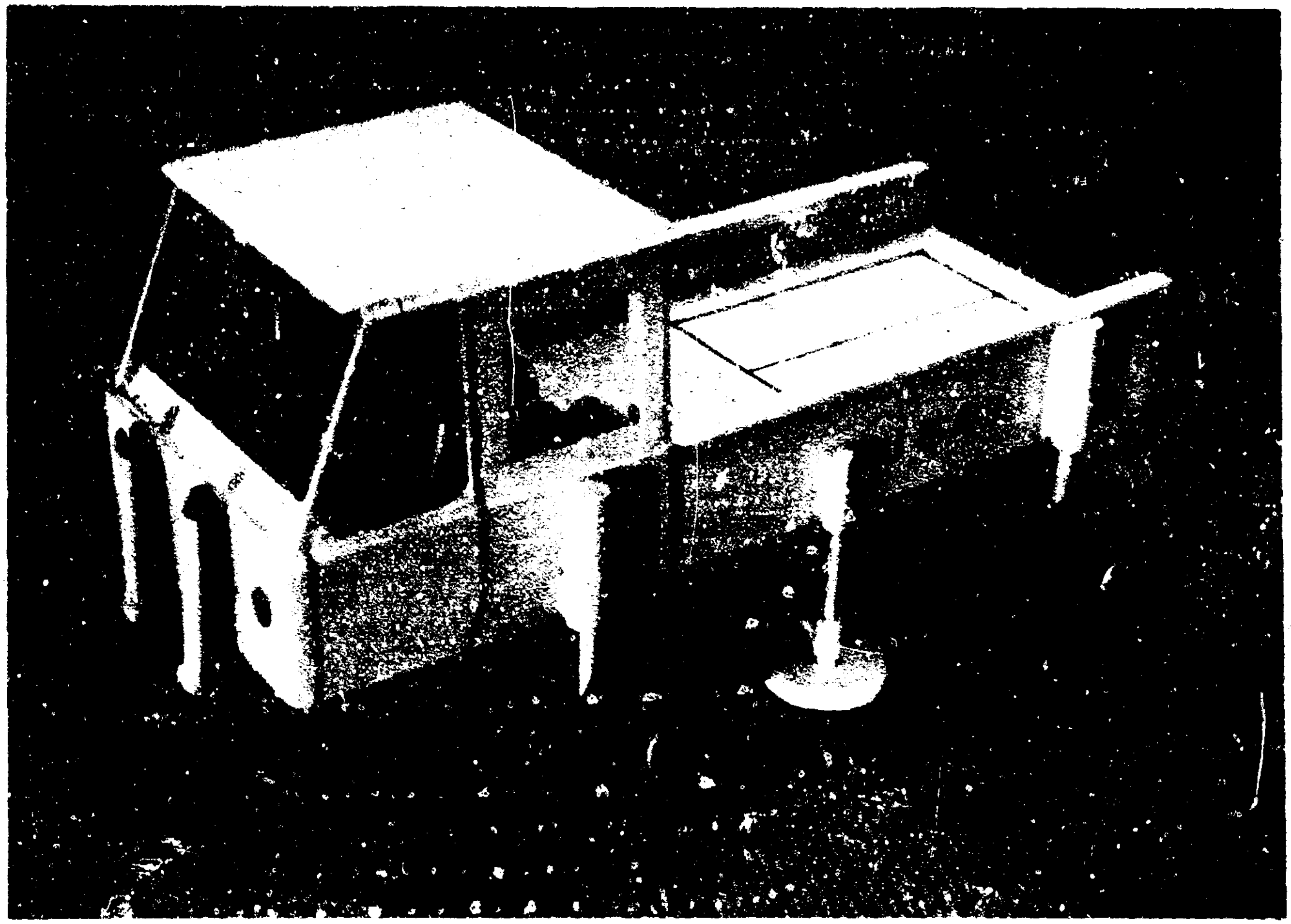


Fig. 19: Multi-purpose vehicle used as runway sweeper.

MULTIPURPOSE VEHICLE

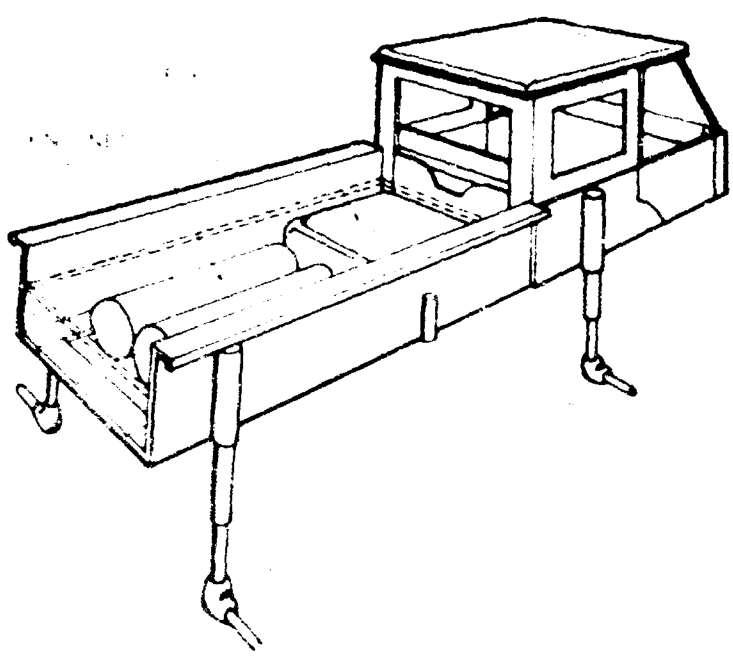


Fig. 20: Multi-purpose vehicle chasis showing hydraulic actuators.

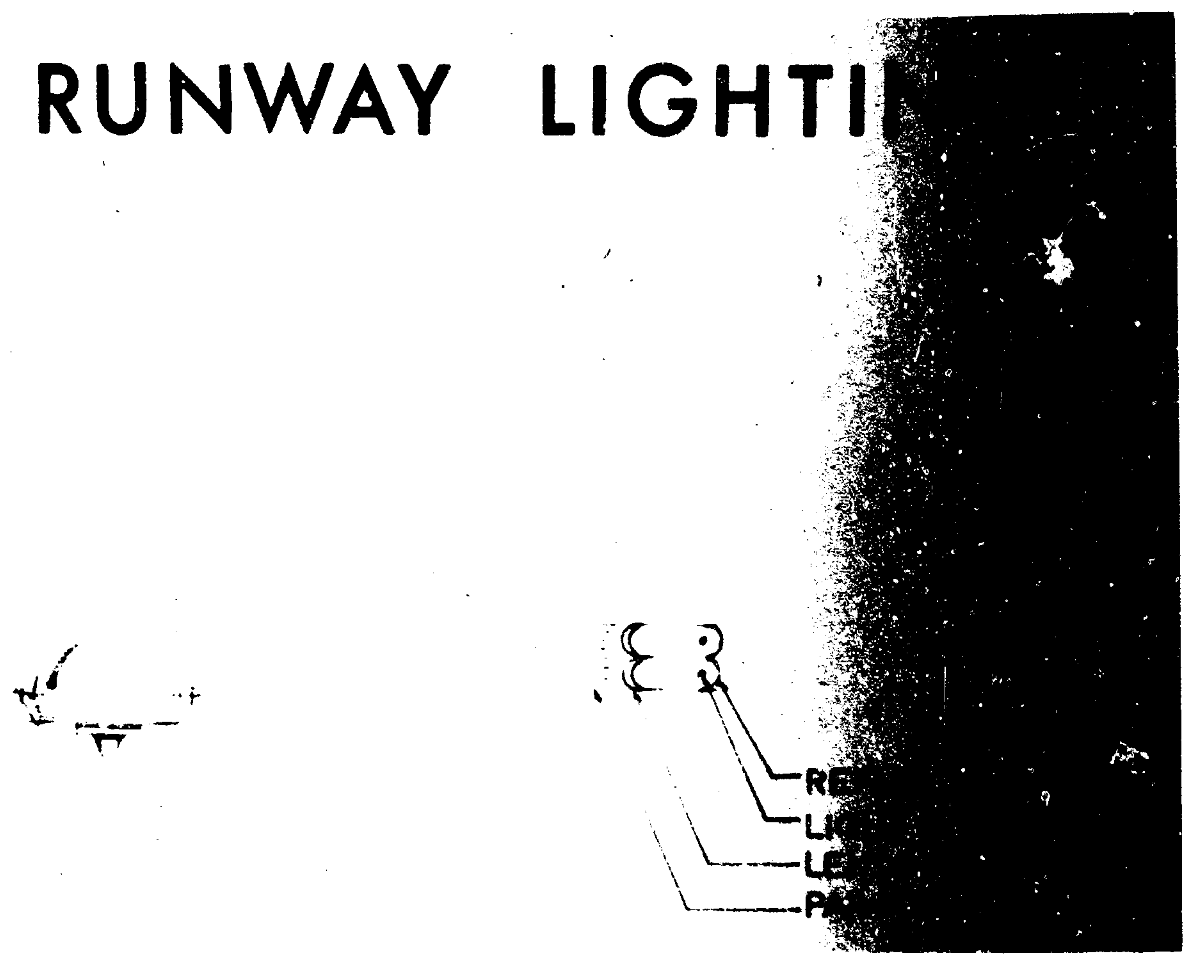
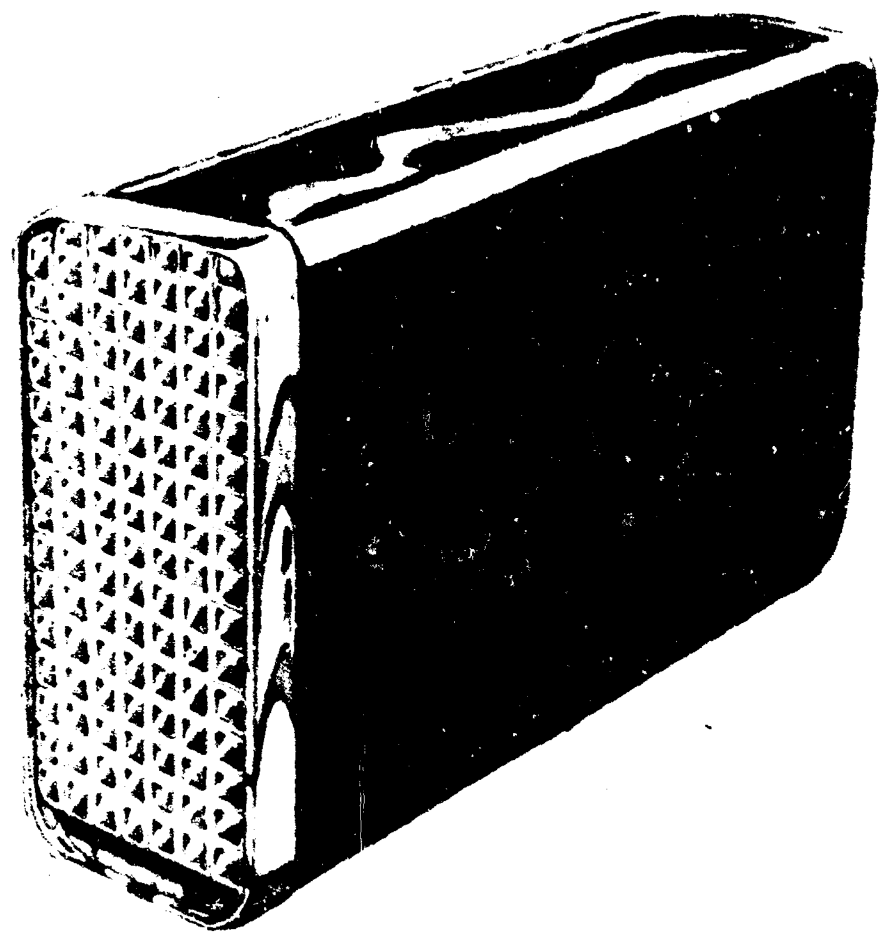


Fig. 21: Runway lighting system.



Fig, 22: Parallel beam light source.

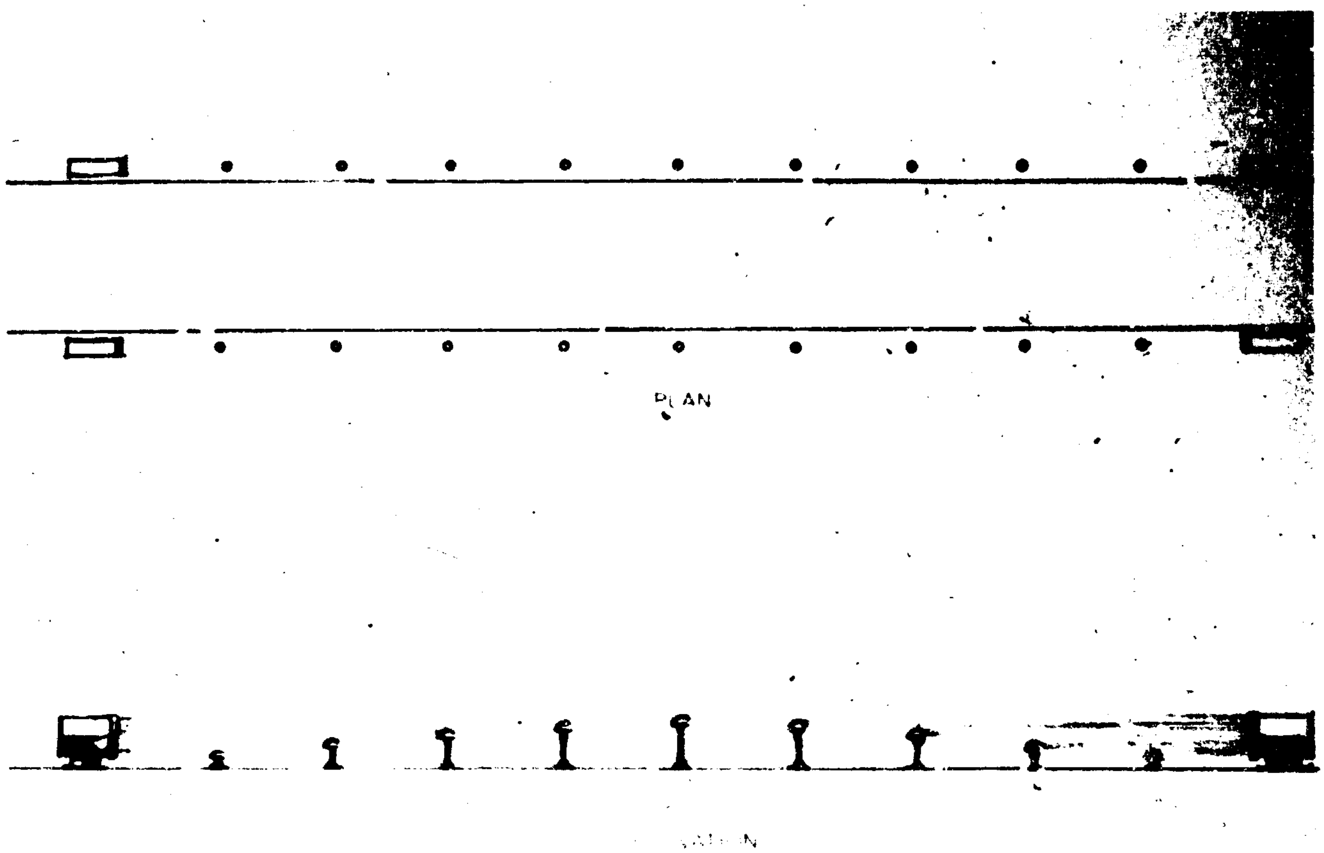


Fig. 23: Plan and elevation of runway lighting system.

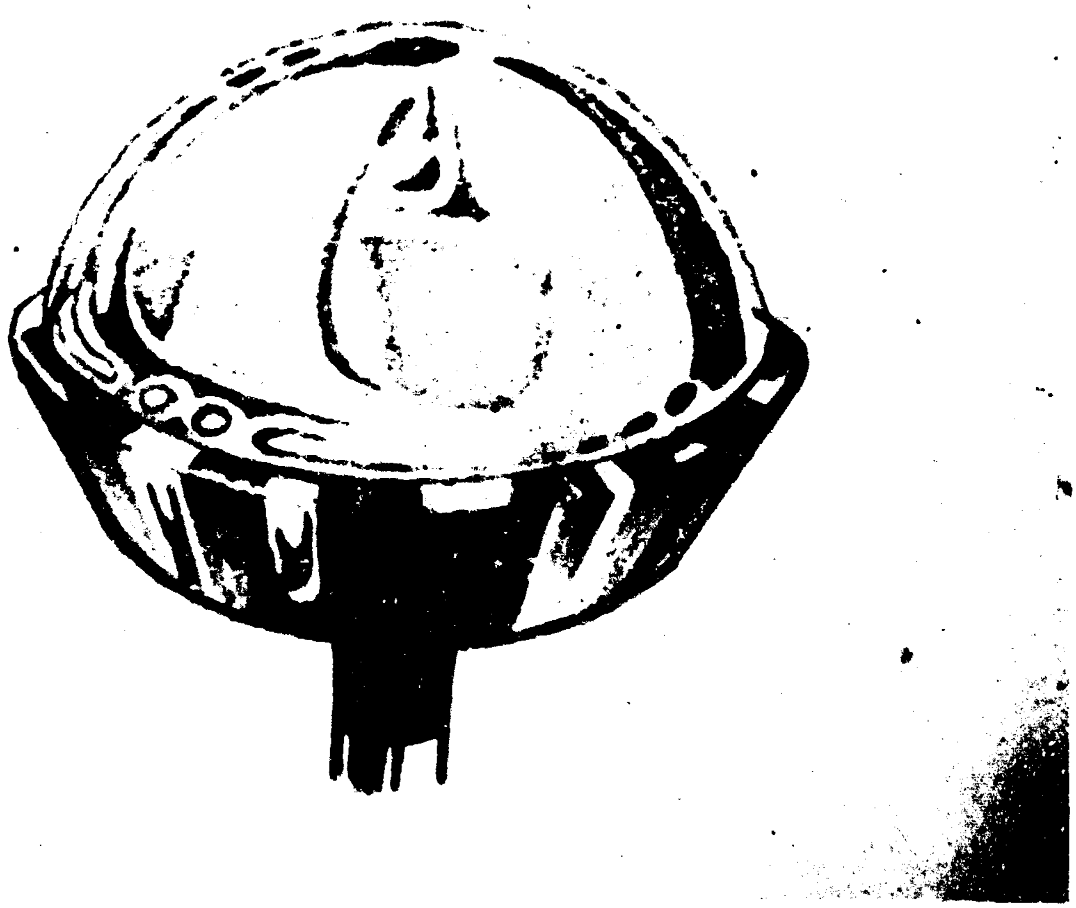


Fig. 24: Light reflector.

COOK'S STOVE

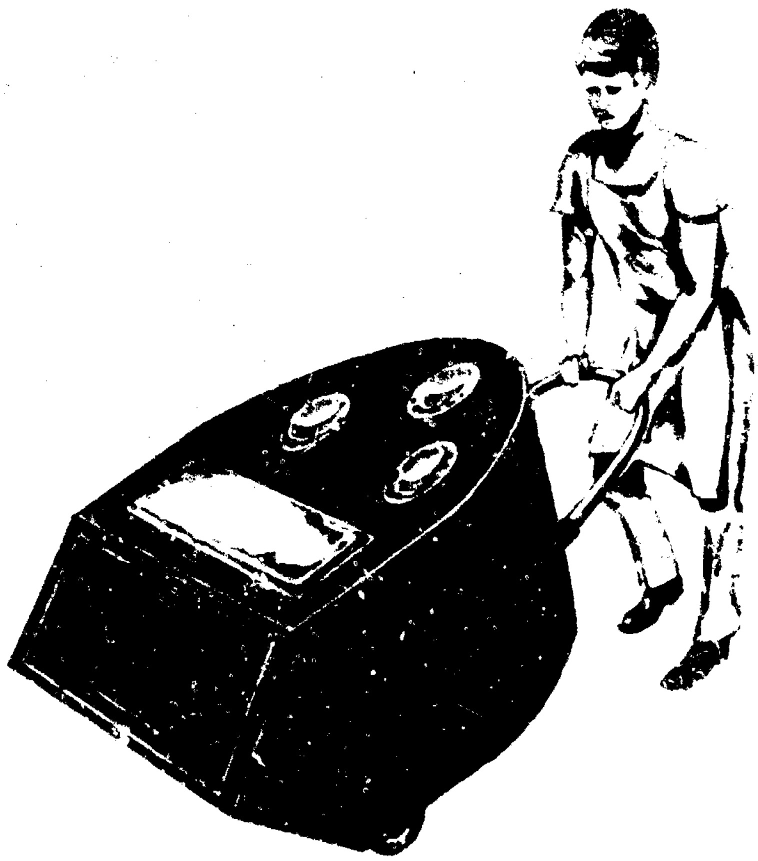


Fig. 25: Cook's stove.

1 INDIVIDUAL
2 GRI
3 OVEN
4 JP 4 FUE
5 VERTICAL PARAB
6 RETRACTAB

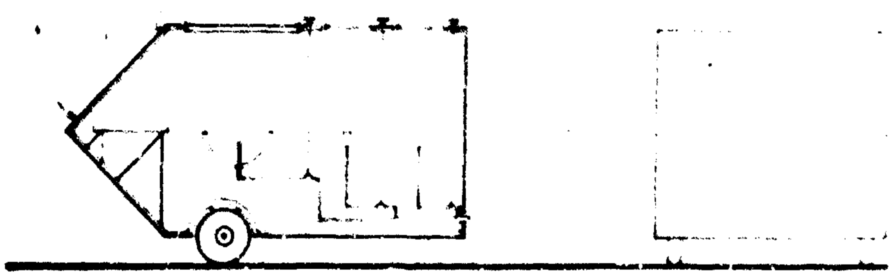


Fig. 26: Cook's stove details.

TEAM 4

Jeffrey Chambers	Industrial Design '65
John Coons	Industrial Design '65
Ronald Miller	Architecture '66
Rodney Lane	Architecture '66

DESIGN PHILOSOPHY

The main objective of our philosophy was to increase the effectiveness of Tactical Air Command. The approach was to decrease the total elapsed time necessary to make the Bare Base operational and make more equipment available sooner.

The two main points of our philosophy were the reduction of total tonnage and acquiring maximum use of facilities. The first is accomplished by the use of lightweight structural materials for equipment. Aluminum honeycomb sandwich panels are used in the construction of the shelter system. Another possibility for a lightweight core material to replace the expanded honeycomb is balsa wood. Lighter weight materials are used in the non-structural parts of the multi-purpose vehicle. The weight characteristics of aluminum are utilized wherever possible on all general equipment.

Minimum construction of all utilities and vehicles is another method used to reduce total tonnage. The idea is to minimize the use of construction materials by capitalizing on clean, functional design.

A third approach to the weight problem was to decrease the number of vehicles, utilities, and accompanying apparatus. This was facilitated by making as many units as possible completely independent. The result would be the elimination of the weight required by the additional power units. A second answer is to design equipment with multi-purpose capabilities.

The second point of the philosophy, that of acquiring maximum use of facilities, is also achieved through equipment designed with multi-purpose capabilities. Two important aspects of this approach are standardization and diversification. Standardization of parts gives a great range of flexibility to equipment. Diversification offers greater availability of individual units. Also, if more equipment can be made to operate independently, then less accompanying paraphernalia must be contended with.

A second method of maximizing utility of equipment is by replacing conventional systems through the intelligent use of modern technology. An example would be the replacement of electrical generators and other power items with a new solar energy system. The outstanding advantages include a great increase in the efficiency of equipment, a total reduction of weight, low maintenance requirements, and increased speed and ease in setting up equipment. Technology is also put to use in the vehicle. More efficient control and transmission systems have been included in order to increase effectiveness and maneuverability.

SITE ADAPTABILITY

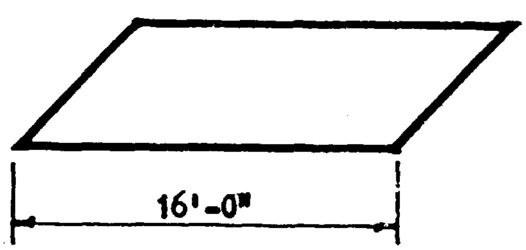
All equipment was designed with the capability of being adapted to any region included in the temperate zone. The vehicle is adequately constructed and maneuverable enough to handle all climate and terrain requirements. The shelter system is also plausible for the necessary range of temperature and terrain in that it offers adequate protection and insulation. We feel that, with the proper developmental course, the third phase of the operation, the solar energy system, could also be adapted to the full range of climate requirements. The unit converts light energy into electrical energy and was designed on the assumption that total darkness was necessary before no light energy was available.

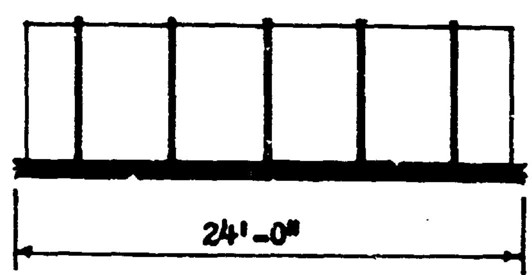
In regard to our particular site the vehicle is extremely maneuverable and very well suited to the type of terrain involved. The shelter system equally was well suited to the flat terrain and medium temperature range of our location. We feel that with the government interest that we are trying to stimulate, the solar energy system could also be made efficient enough to be adequate in this type of climate (Figs. 1,2,3).

SHELTER SYSTEM

CONCEPT

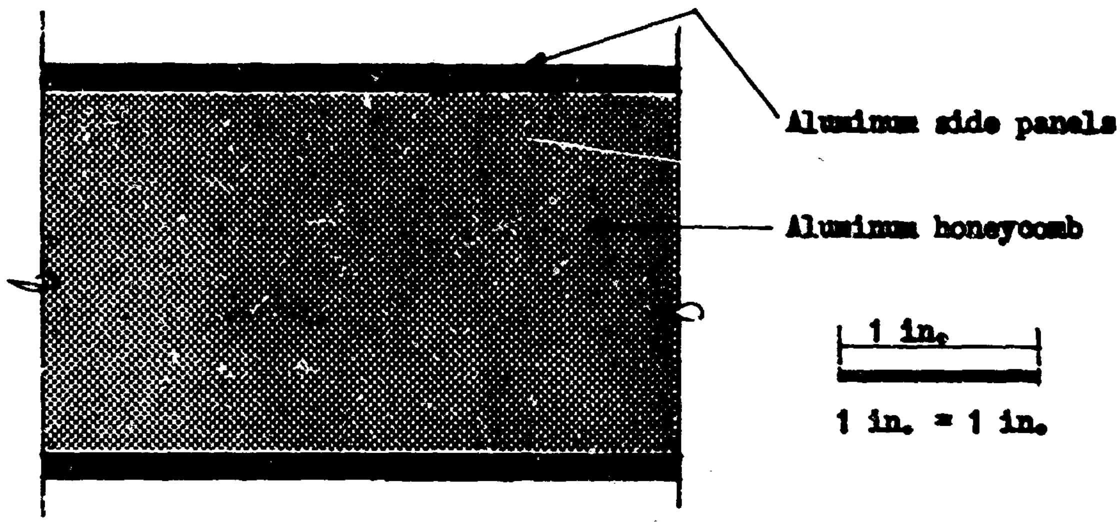
Our concept makes use of a pallet in two ways. First, it is a carrying platform for materials brought to the Bare Base site. Secondly, it is used as a shelter system for the Bare Base site.



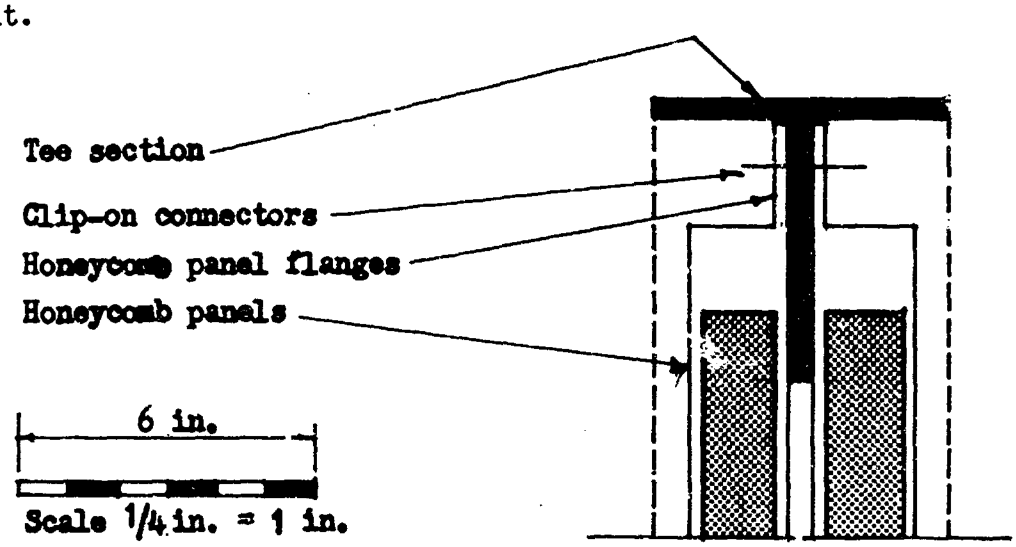


THEORY

The pallet is made of honeycomb sandwich panels. The honeycomb material is aluminum with aluminum side panels. The honeycomb is most structural when all forces are acting normal to the face of the panel. When the forces are acting parallel to the face of the panel, the side panels take the force. These side panels are strengthened against buckling by their connection to the honeycomb.

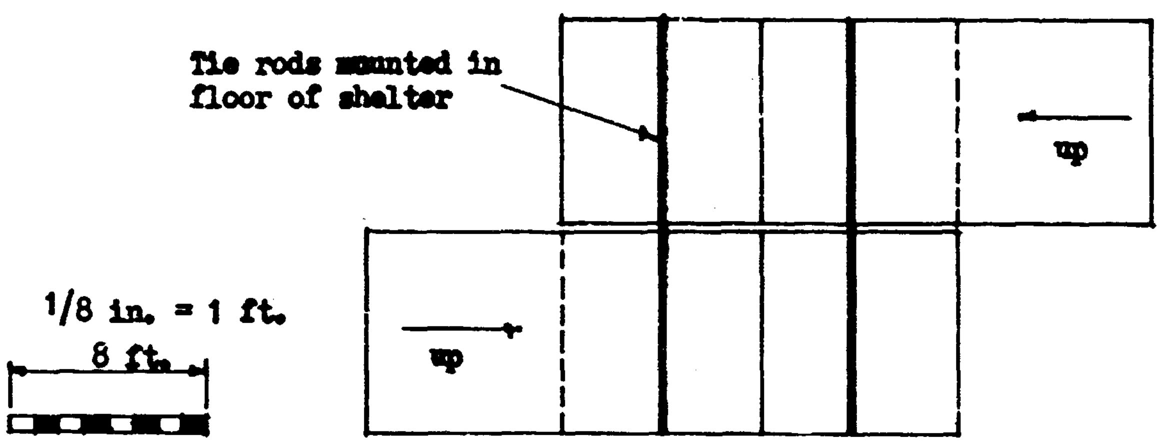


End panels for the housing units are brought in as a separate package unit.

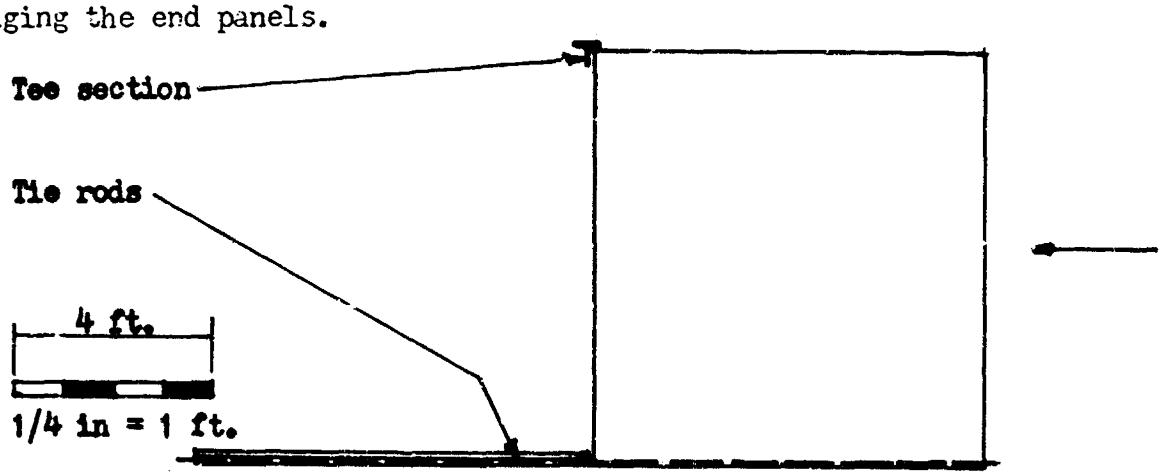


FLEXIBILITY - HOUSING UNIT

A housing unit designed for sixteen men is made up of two pallets and one end panel package. The erection of one housing unit is accomplished by first placing pallet on the ground as shown (Fig. 5).



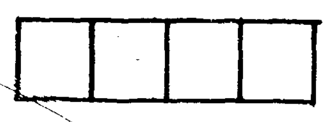
The floor of the unit is brought together by tie rods mounted in the honeycomb (Fig. 6). At this point, one pallet would be unfolded into position (Fig. 7) and an end panel placed into it (Fig. 8). This would make the unit rigid. A tee section would be mounted as shown (Fig. 9). The same clips would be used for this purpose as were used in packaging the end panels.

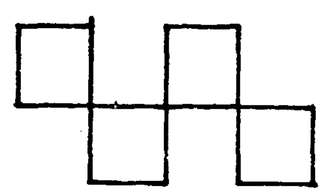


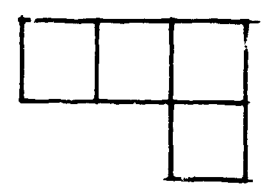
The second pallet is then raised into position and connected to the tee section. Tee sections are then placed into side joints (Fig. 10) and the second end panel is put into position. The unit is now complete (Fig. 11). Time allowed for one unit using three trained men for erection is 15 minutes. The time allowed for erection of all housing units required is approximately four hours.

FLEXIBILITY - MESSING, HOSPITAL, ADMINISTRATIVE STRUCTURES

The shelter requirements of these areas are accomplished by expanding the housing unit in any direction desired (Figs. 12,13,14). If the unit is expanded end to end, openings would be built into the pallet. Connection of the joining panels would be at these openings. Housing units connected side to side would be supported by alternating the fold direction of pallets and making a rigid connection at top and bottom.



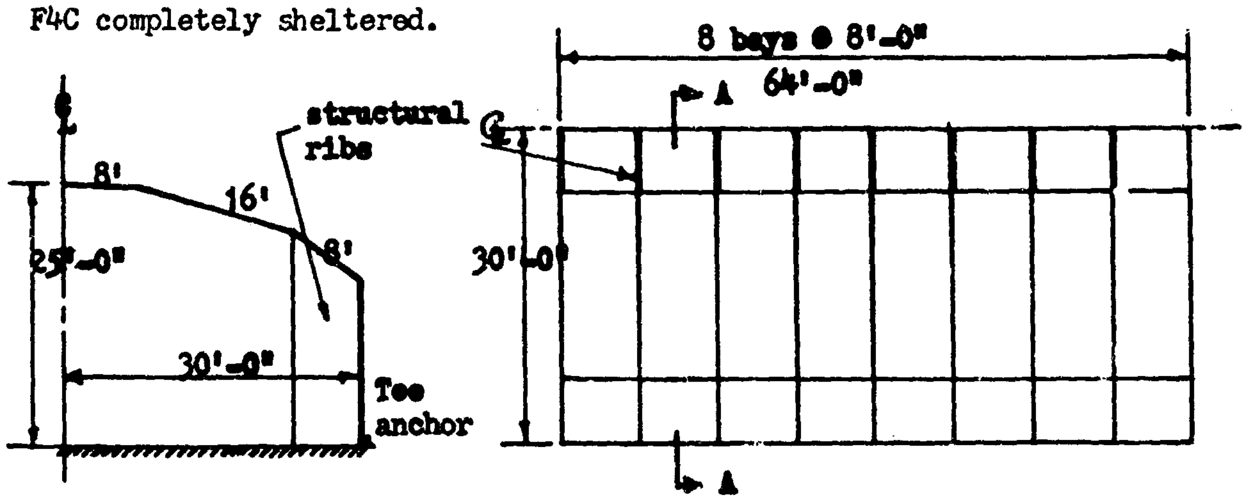




FLEXIBILITY - HANGAR

The hangar is constructed of the same pallets used for the smaller shelters. Their construction differs in that one joint is unhinged and the panels are extended to their full length (8' x 48'). Two pallets are butted end to end, making up one bay (see sketch) (Fig. 15). As in the smaller shelter, the panels are held together by tee sections acting as ribs.(Fig. 16). A similar method of attaching panels to tees is used. Structural ribs of honeycomb also stiffen the structure at interior points and on the ends (Fig 17).

Erection is carried out by approximately ten men with the aid of a crane. An experienced crew should be able to erect the structure in $2\frac{1}{2}$ to 3 hours. It will house two F4C fighter jets, nosed in or one F4C completely sheltered.



Section A-A

Plan

TRANSPORTATION CONCEPT

Our approach to the multi-purpose vehicle was a modular system consisting of a power unit and a trailer unit (Fig. 18). The basic vehicle was designed to cover the full range of vehicular duties required to set up a Bare Base. The main principles involved in the vehicle design were standardization and diversification. Emphases were also placed on lightweight compactness, maneuverability, and utility.

The power unit is basically a standard truck engine mounted on a compact steel frame (Fig. 19). The unit is based on a tricycle arrangement, the larger wheels being used for power transfer and the smaller set, rigged to the steering mechanism. The unit is capable of working several take-off power units required for the operation of attachments such as the forklift (Fig. 20), runway sweeper (Fig. 21), winch (Fig. 22), and farm implements (Fig. 23). Extreme maneuverability is facilitated by enabling the vehicle to be driven in either direction at comparable speeds. Also, tiller steering has been included to allow driver to sit or stand and face either direction.

The power unit is capable of a great range of diversification. The initial support requirements call for a heavy duty hauling version. This unit consists of a standard frame and a high out-put V-6 truck engine (Fig. 24). The gear ratios and tires are designed to compensate for the difference between the weight of the vehicle and the weight of the load. This version can be used as a plane two and powers the winch and fork-lift attachments.

A lighter weight utility version is available for later priorities. This one used a lower out-put engine and standard gear ratios, tires, etc. It is equipped with two seats, both of which are collapsible or removable (Fig. 25,26). The vehicle has a seating capacity of four passengers (Fig. 27) and hauling capacity equal to a 3/4 ton pick up truck (Fig. 28). The unit is capable of pulling trailer units and is equipped to work small take-off attachments.

Frame modifications are available for specialized vehicles which must be on constant alert. The standard frame is extended and fitted with a conventional truck drive train (Fig. 29,30).

The trailers are designed as lightweight modular units. Each is basically a flat cargo bed mounted on a two-wheel suspension unit (Fig. 31). Each unit is equipped with tongue steering and a modular coupling system. The unit has a good range of diversification. Its first application is as a hauling unit used to unload the C-130's. For this duty two units are joined rigidly to form a single four wheeled trailer (Fig. 3

The dimensions of this double cargo bed match those of the pallet and the unit is equipped with rollers and ramps for loading and unloading (Fig. 33).

The individual two wheeled trailer units are used for the many vehicular tasks required for bare base operation. They are also capable of being hooked together in a train in order to transport various units simultaneously (Fig. 34).

A summary of weight reduction results, made possible by our vehicular concept, reveals approximately a 44% decrease in vehicular weight. Approximated figures are as follows:

UNIT	WEIGHT	QUANTITY	TOTAL WEIGHT
H.D. power unit (10 tons)	4000 lb.	8	32000 lb.
L.W. power unit	3000 lb.	20	60000 lb.
Ambulance	4000 lb.	2	8000 lb.
Firetruck (heavy)	9000 lb.	4	36000 lb.
Firetruck (light)	5000 lb.	4	20000 lb.
Fork Lift attachment	1000 lb.	8	8000 lb.
Farm attachments	5000 lb.		5000 lb.
Runway sweeper attachments	1000 lb.	2	2000 lb.
Trailer unit (5 ton)	1500 lb.	61	91500 lb.
Refrigerator units	7000 lb.	3	21000 lb.
Crane (existing)	19000 lb.	1	19000 lb.
Crane (existing)	21000 lb.	1	21000 lb.
		Total -	393000 lb.
	Existing Total -	-	700330 lb.

32).

AUXILIARY SYSTEMS

In order to cut maintenance and weight, the qualifications of solar energy as a source of power have been explored (Fig. 35). Development of a new method of converting the sun's heat energy directly into electrical energy has eliminated the inefficient steam boiler and engine. This is accomplished by the use of the "Silicon Photovoltaic Cell".

Each silicon cell is approximately 1/400th of an inch thick, or about the thickness of a razor blade. The cells consist of two layers of silicon, each with different electrical properties. Sunlight causes electrons to move from the first (positive) layer to the second (negative) layer, thus creating an electrical current.

Storage of the energy is the main problem. It can be fed into an ordinary storage battery, but this adds excessive weight and bulk to the operation. Other fields explored include the use of certain chemical salts which absorb heat when changing from a crystal to a liquid state. Mercury batteries are also an alternative.

Applications of the use of solar energy to the Bare Base could include:

1. Airstrip Lighting - This would allow the lights to become individual, portable units, as they would contain their own power.

2. Generators - The weight of solar energy generators would be cut appreciably. Power and lighting could be supplied for the functions concerning administration, messing, housing, and aircraft operations as well.

3. Bath Units - Solar energy could be used to heat the water for bath facilities.

The use of solar energy to date has been limited mainly to arid regions of the world. This is largely due to the adaptability of the power source to the sparsely populated areas. The need for such a source has not arisen in the more populated areas of the world, although its usage is not limited to arid regions. Interest and exploration are the factors needed to make this a more feasible power source for the entire world.

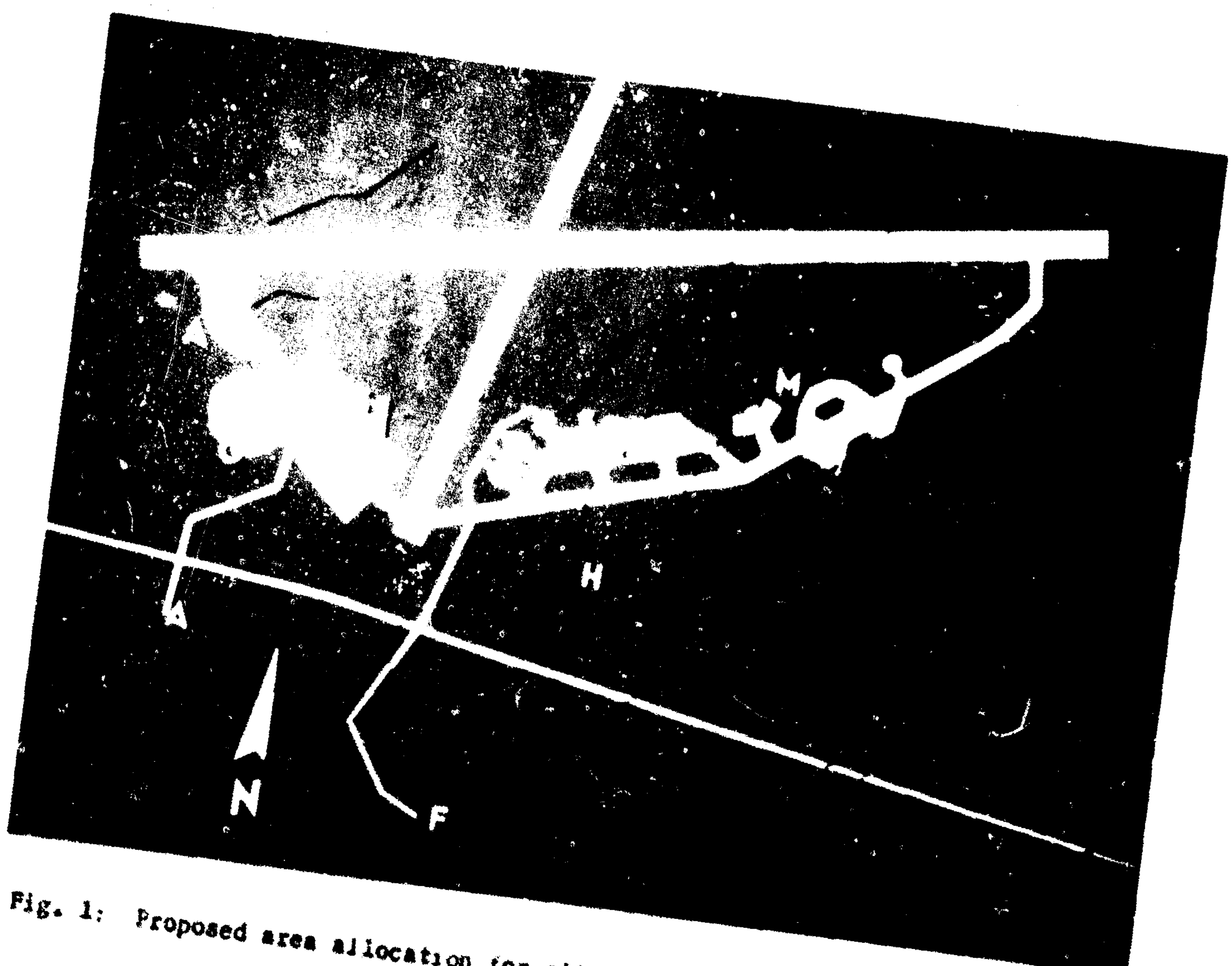


Fig. 1: Proposed area allocation for site.

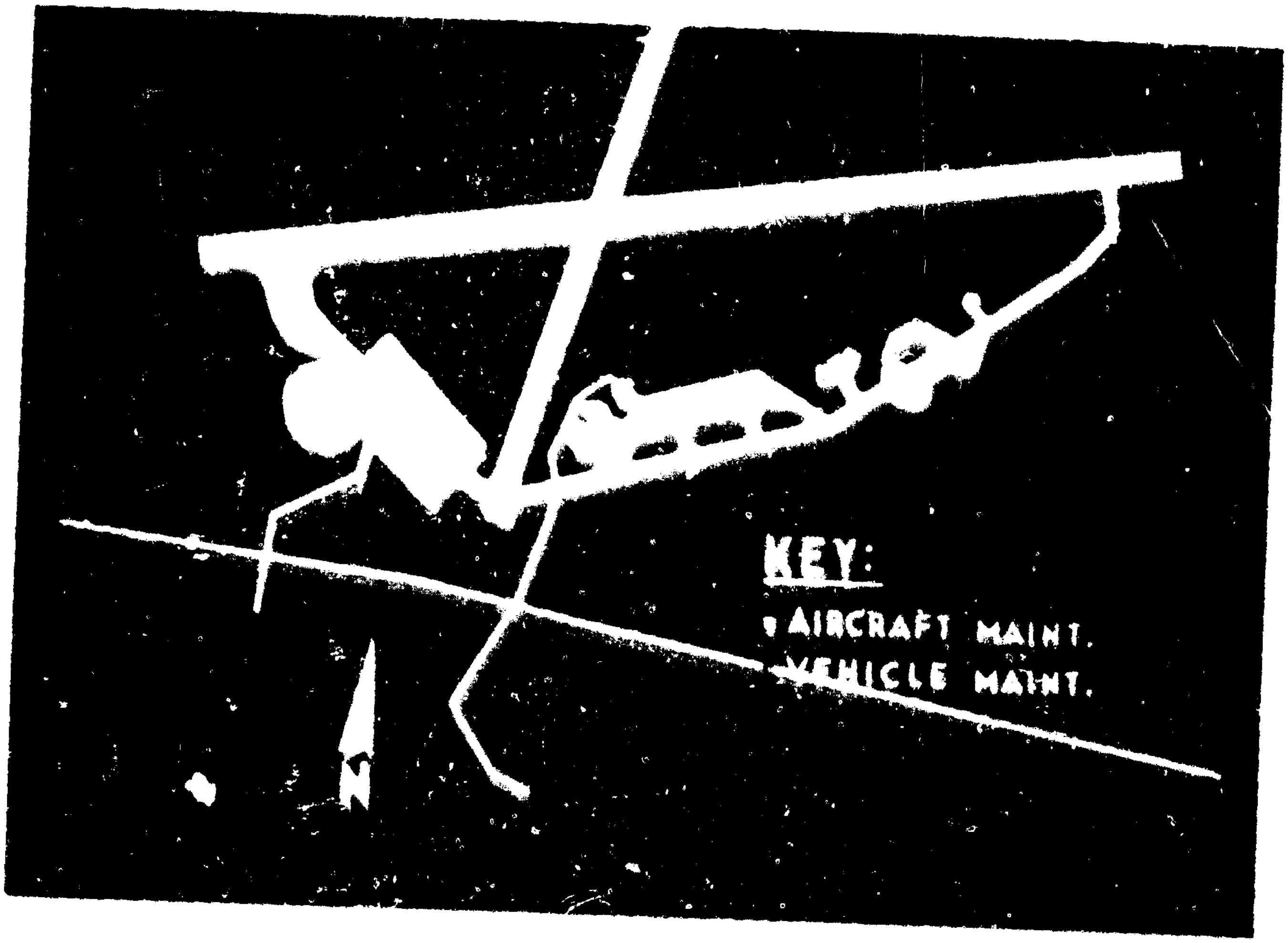


Fig. 2: Bare Base at first stage of development.

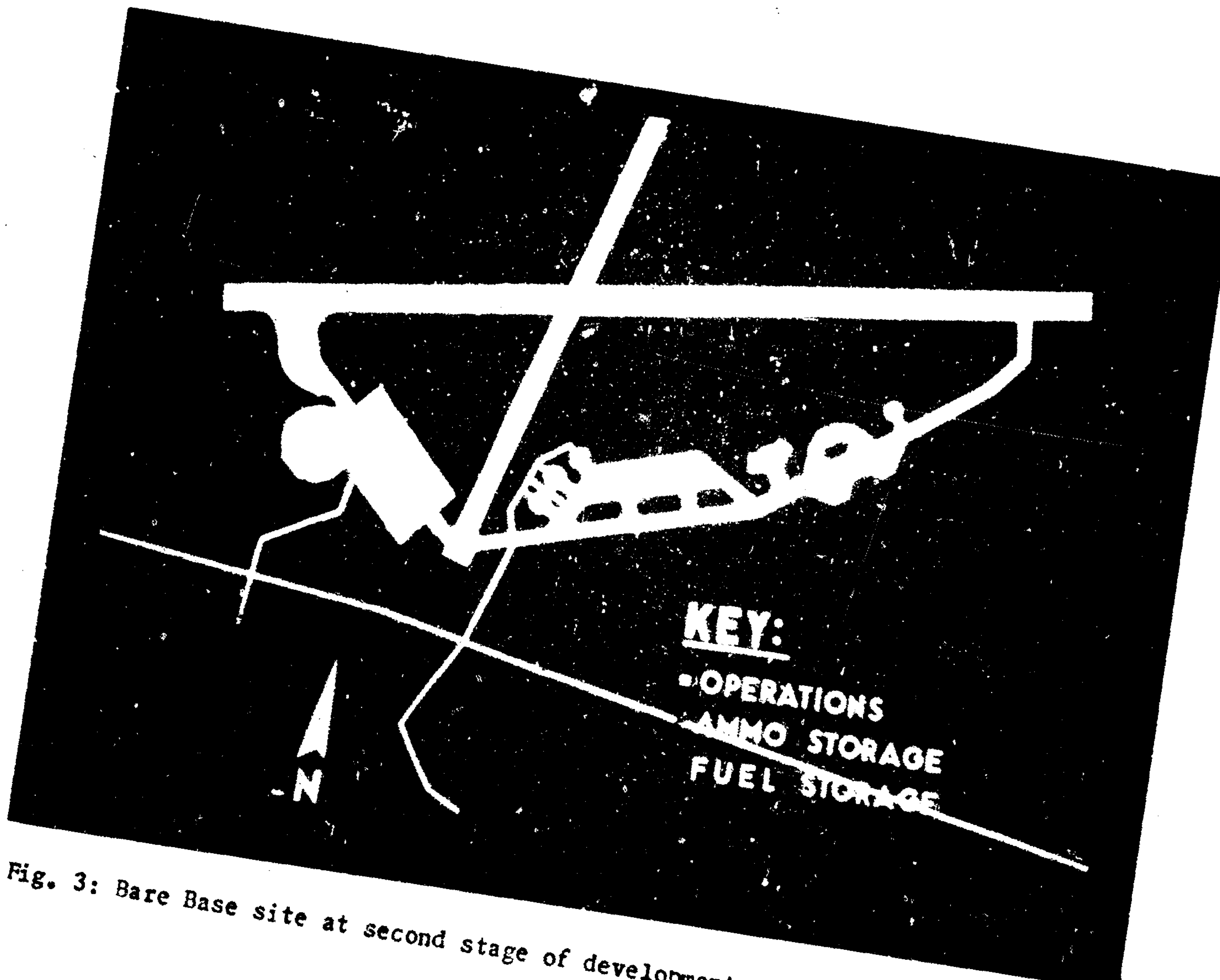


Fig. 3: Bare Base site at second stage of development.

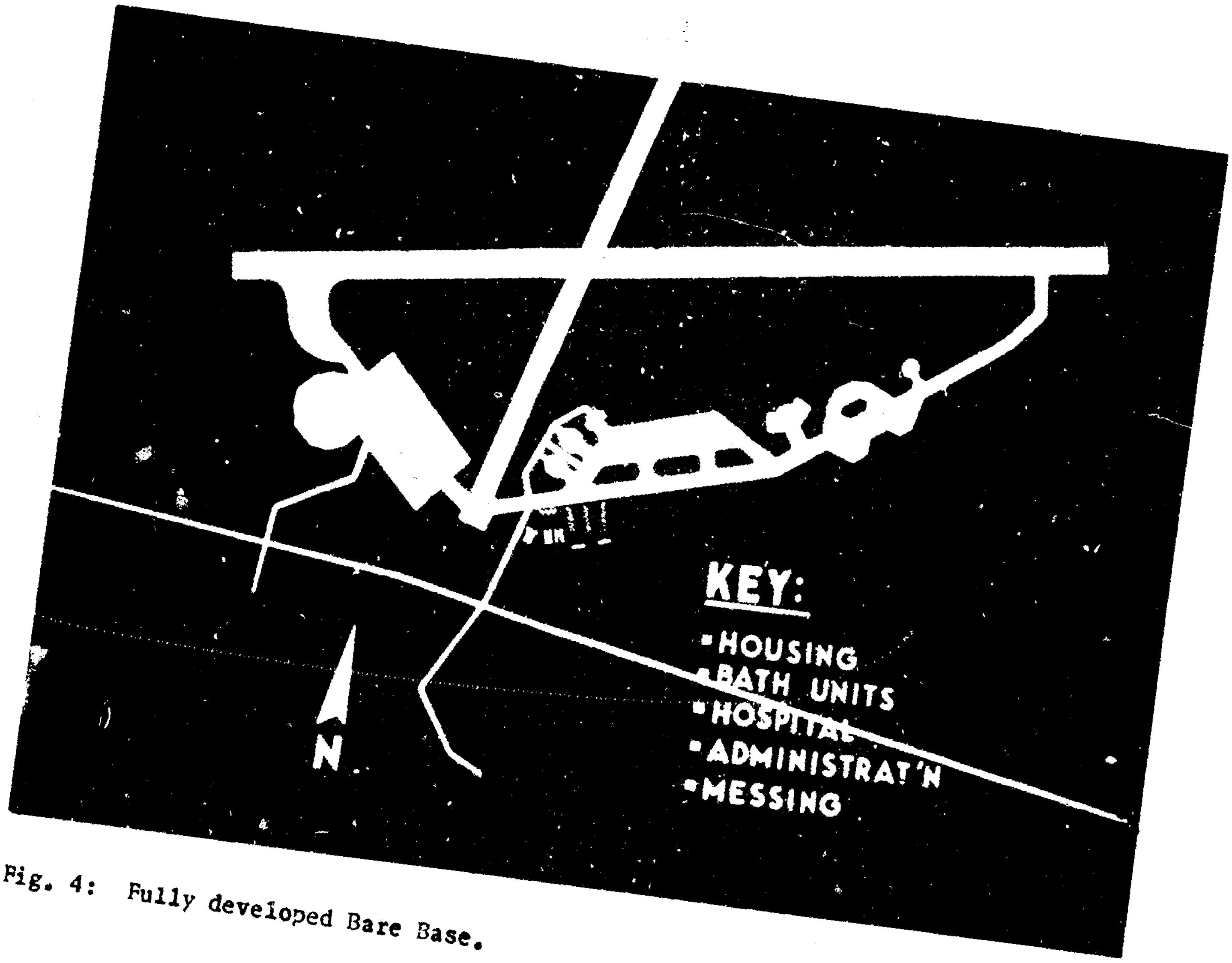


Fig. 4: Fully developed Bare Base.

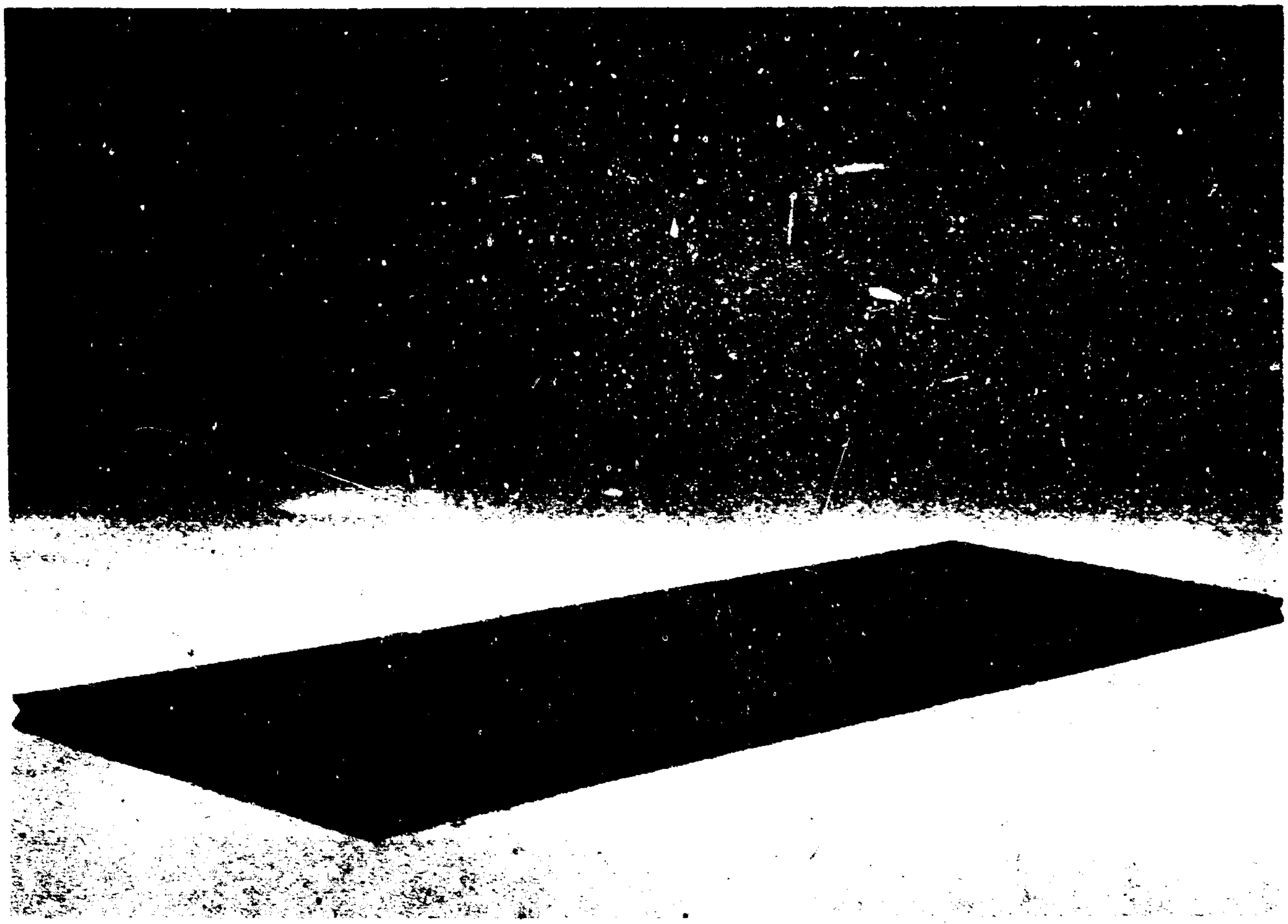


Fig. 5: Erection sequence: 1. First pallet placed on ground.

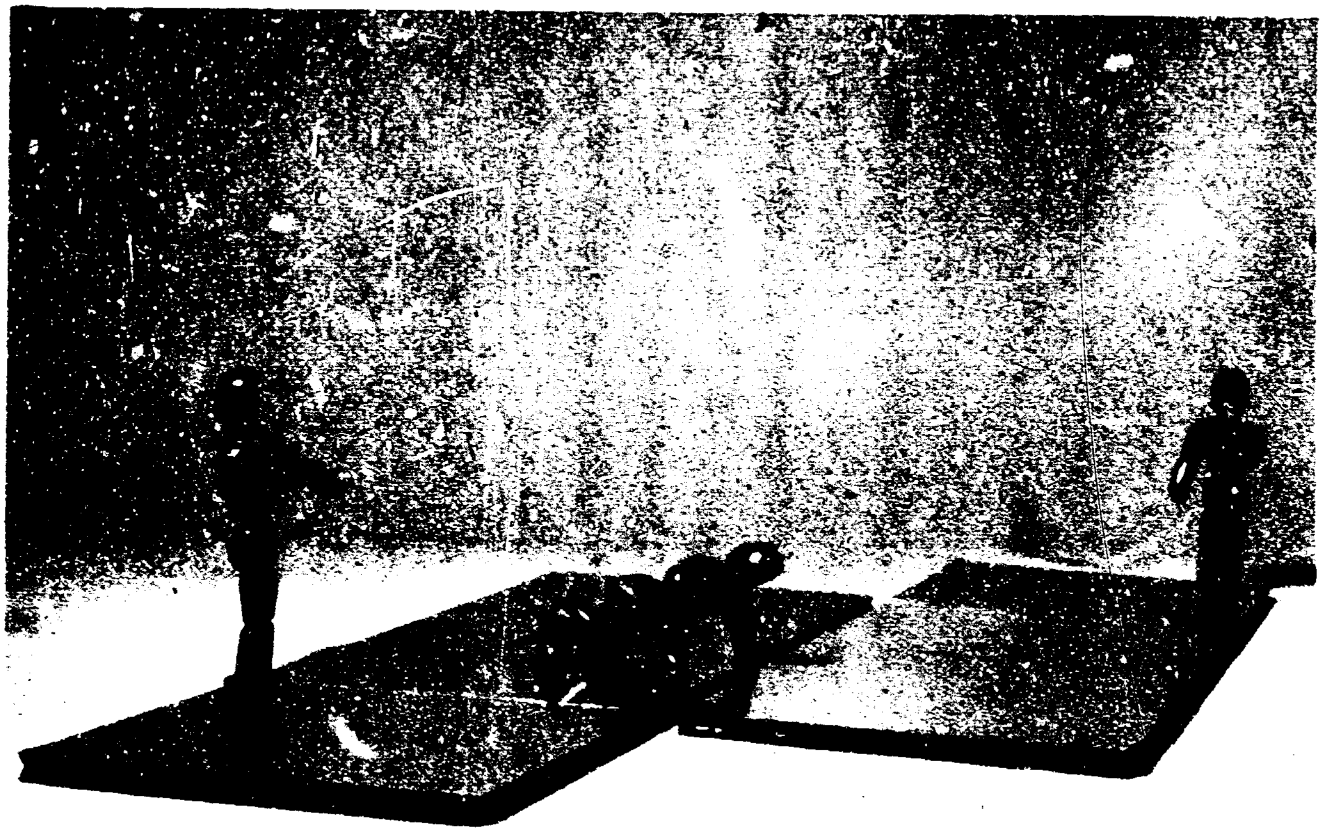


Fig. 6: Erection sequence: 2. Adjacent floor panels atteched.

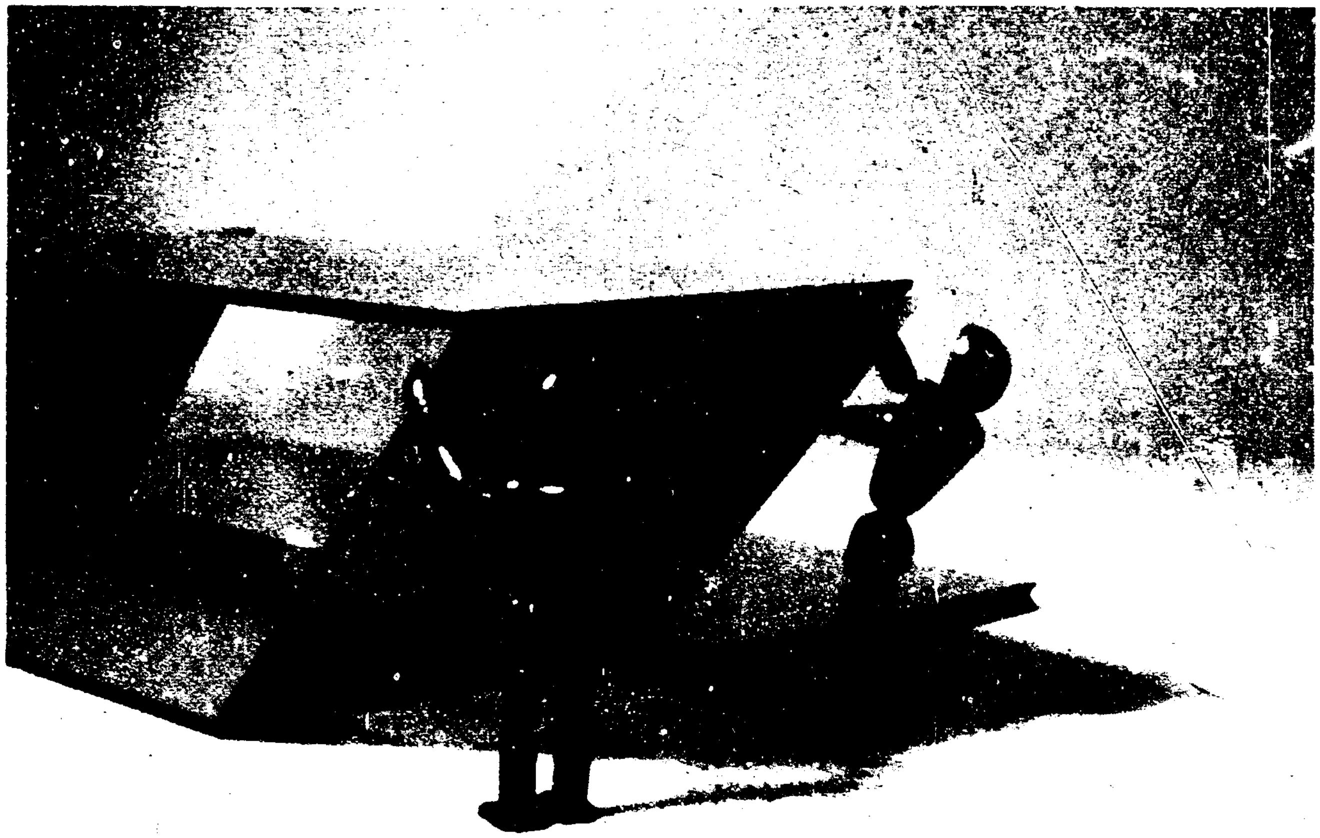


Fig. 7: Erection sequence: 3. One pallet unfolded into position.

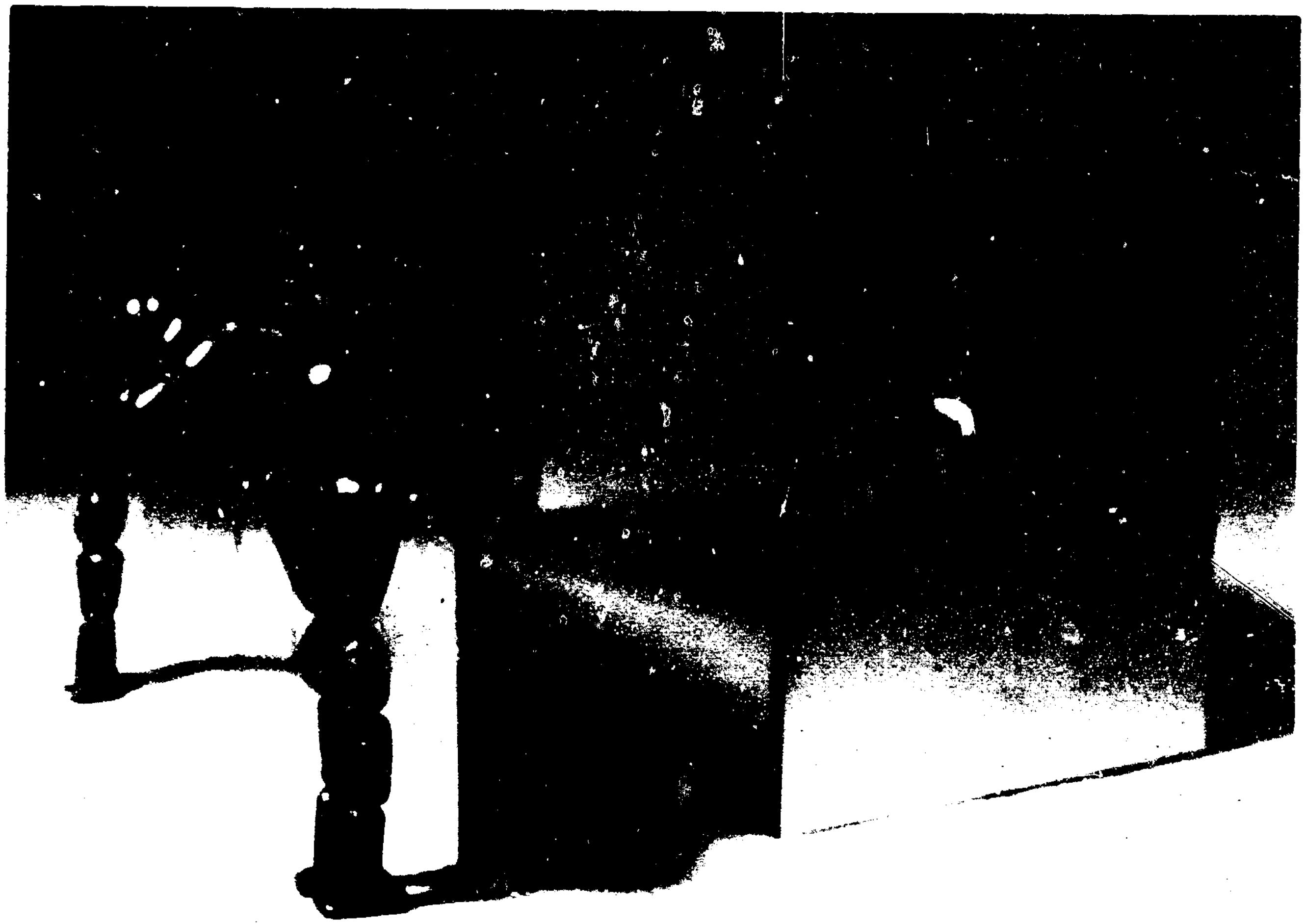


Fig. 8: Erection sequence: 4. End panels installed.

Fig. 9: Erection sequence: 5. Horizontal Tee section attached to the face of one panel.

Fig. 10: Erection sequence: 6. Vertical Tee sections inserted into side joints.

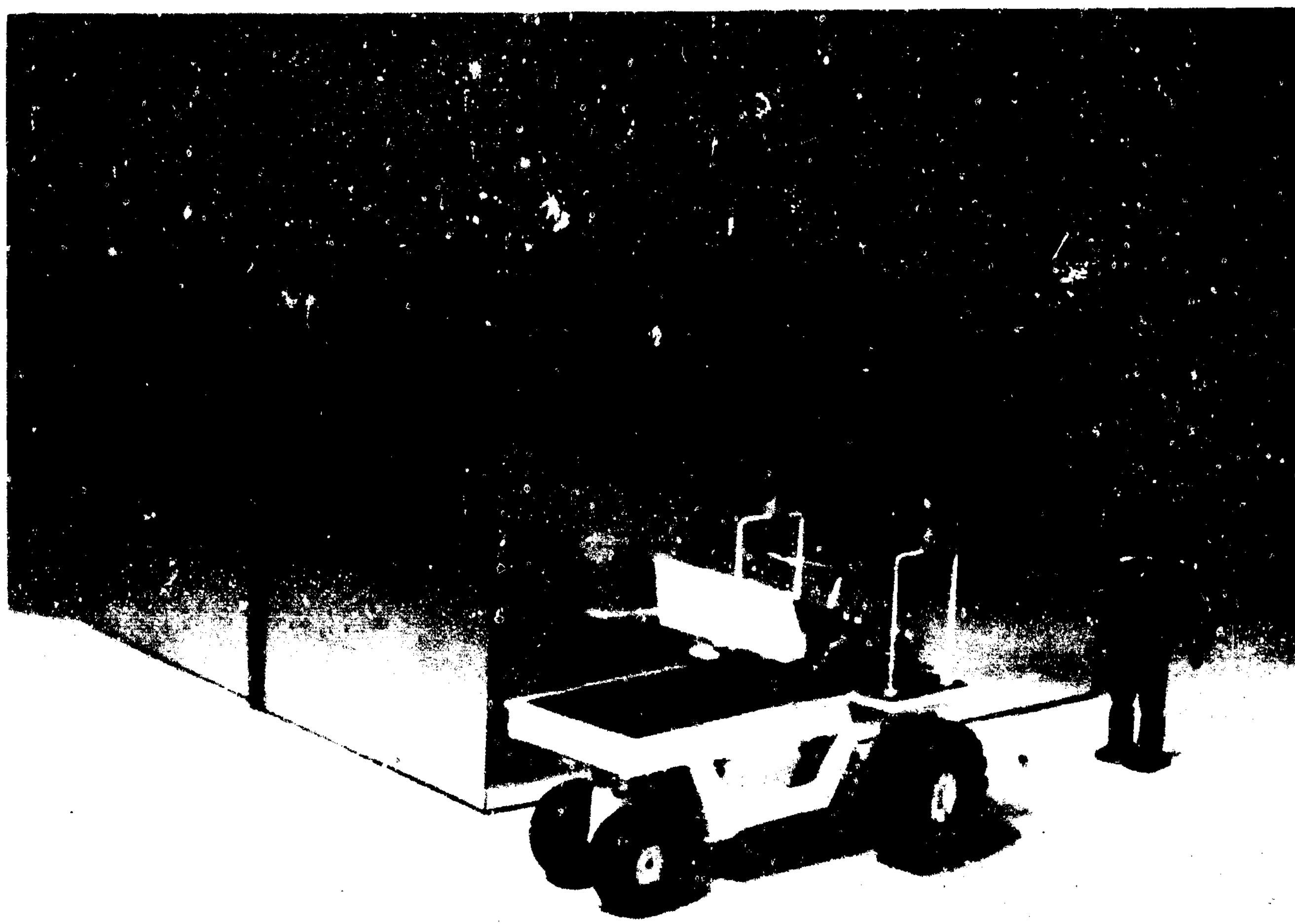


Fig. 11: Erection sequence: 7. Completed shelter.

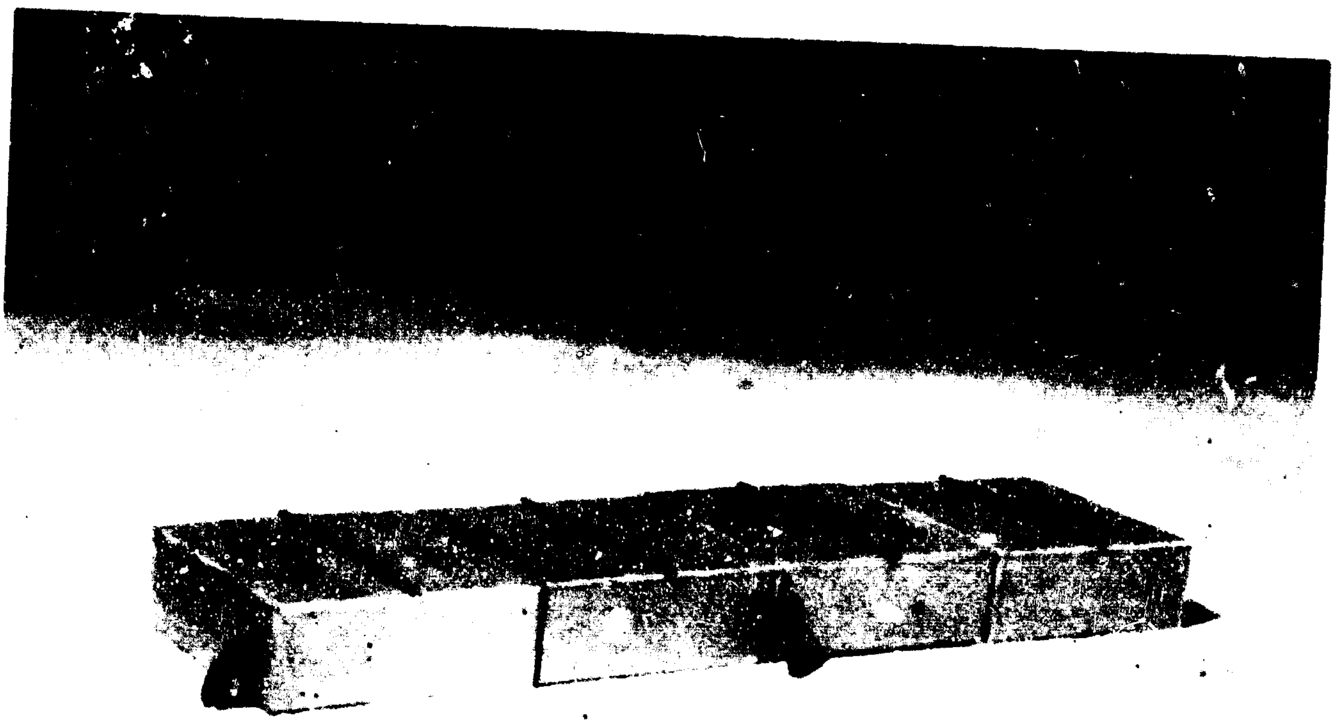


Fig. 12: Linear arrangement.

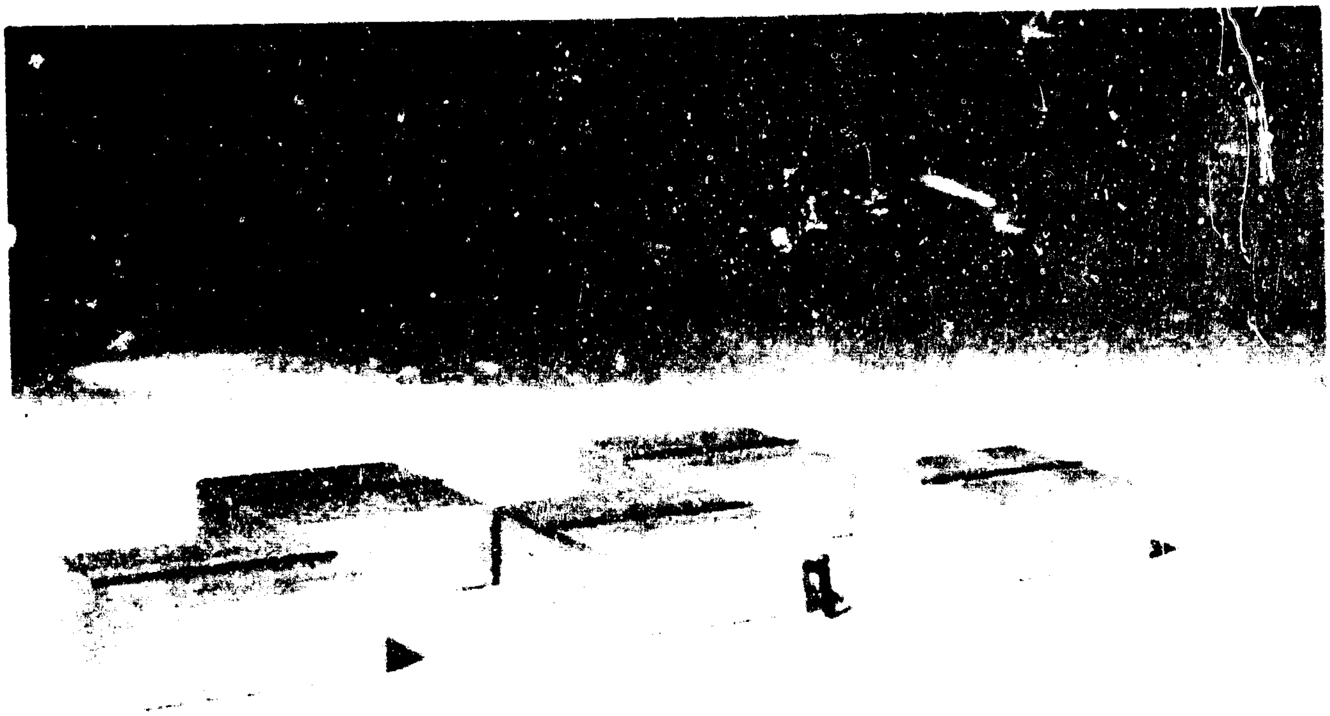


Fig. 13: Staggered arrangement.

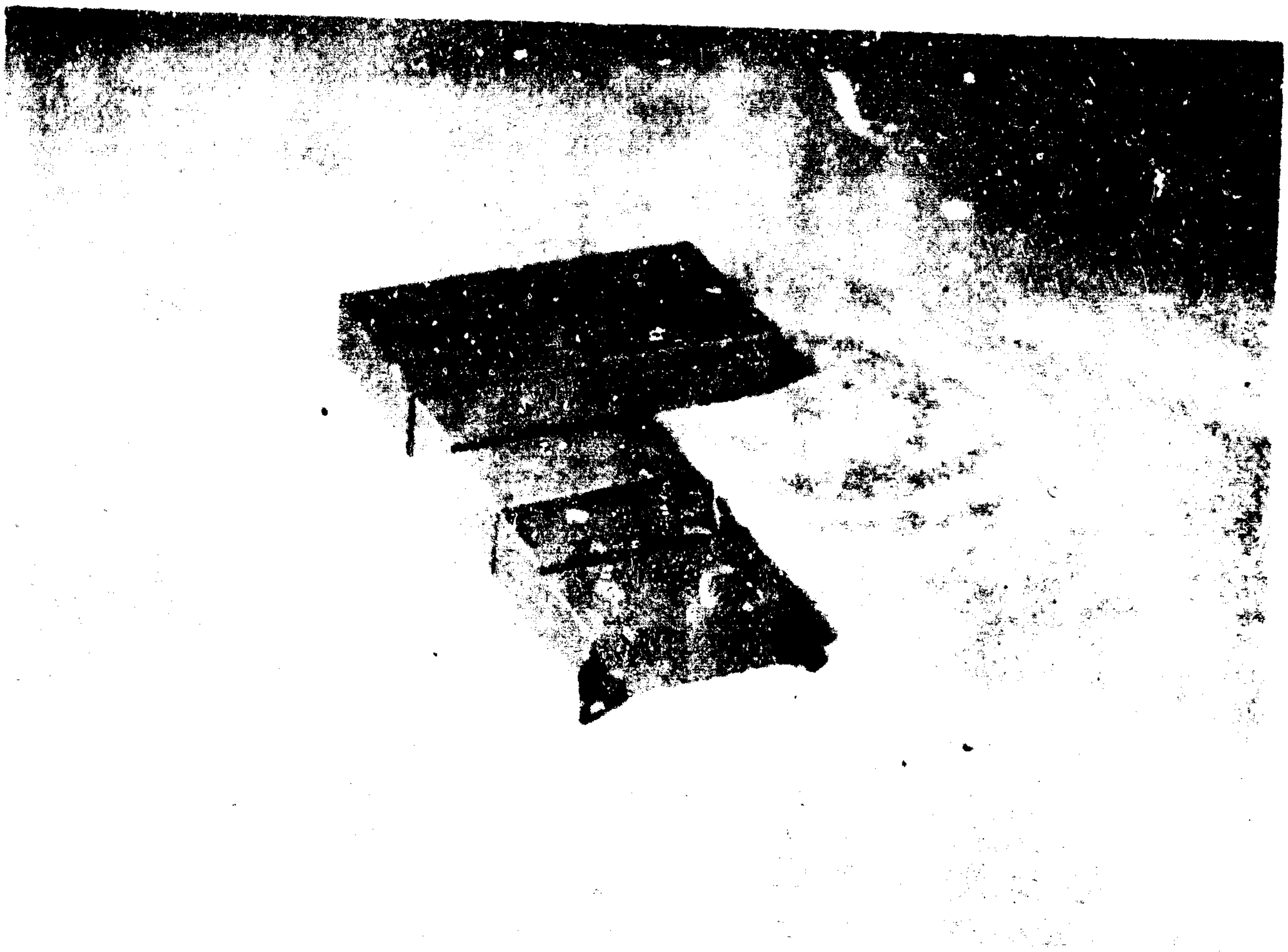


Fig. 14: L-shaped arrangement.

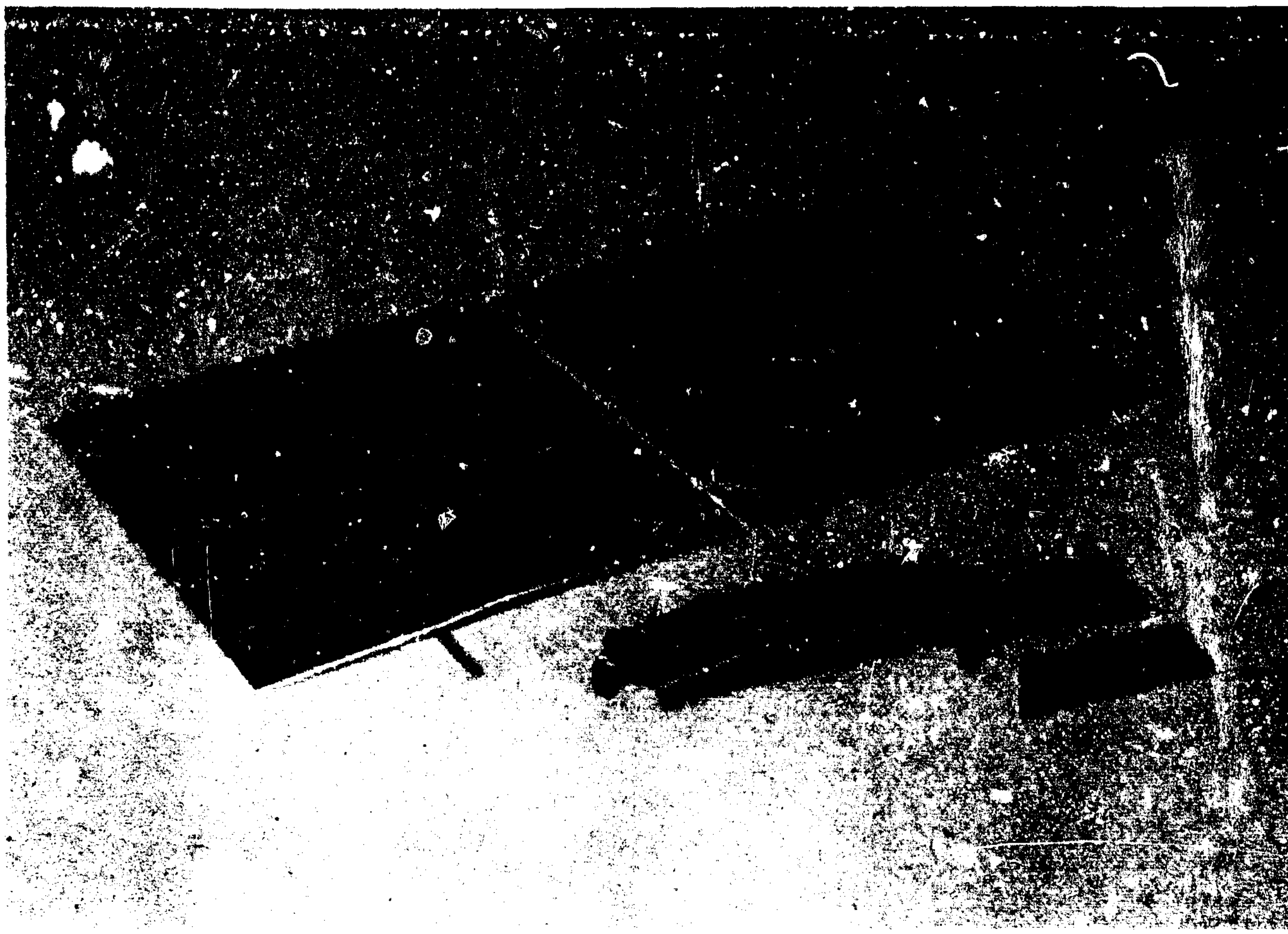


Fig. 15: Pallets unfolded and butted end to end.

Fig. 16: Adjacent panels connected with Tee section ribs.

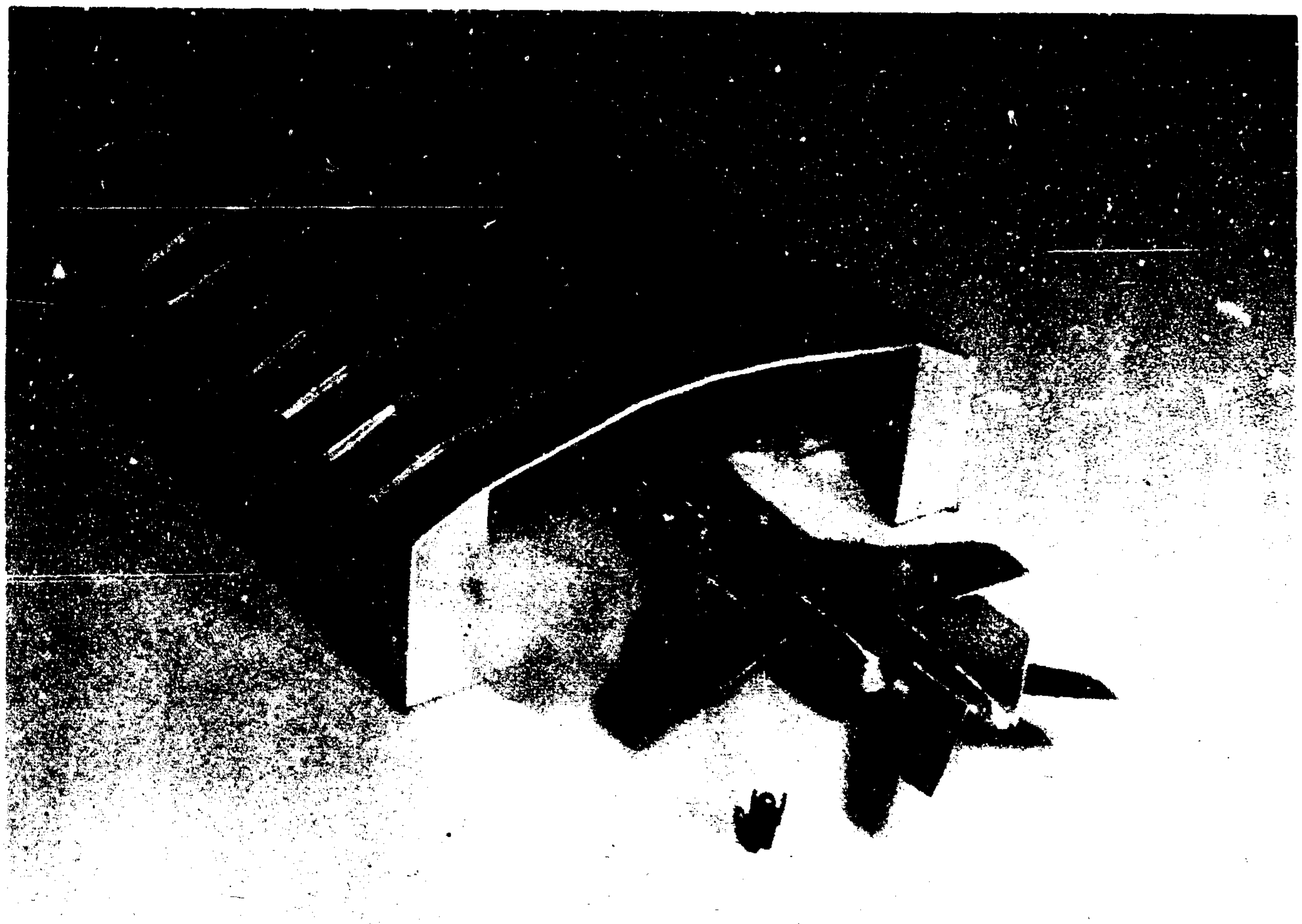


Fig. 17: Completed structure showing stabilizing panels at sides of opening.

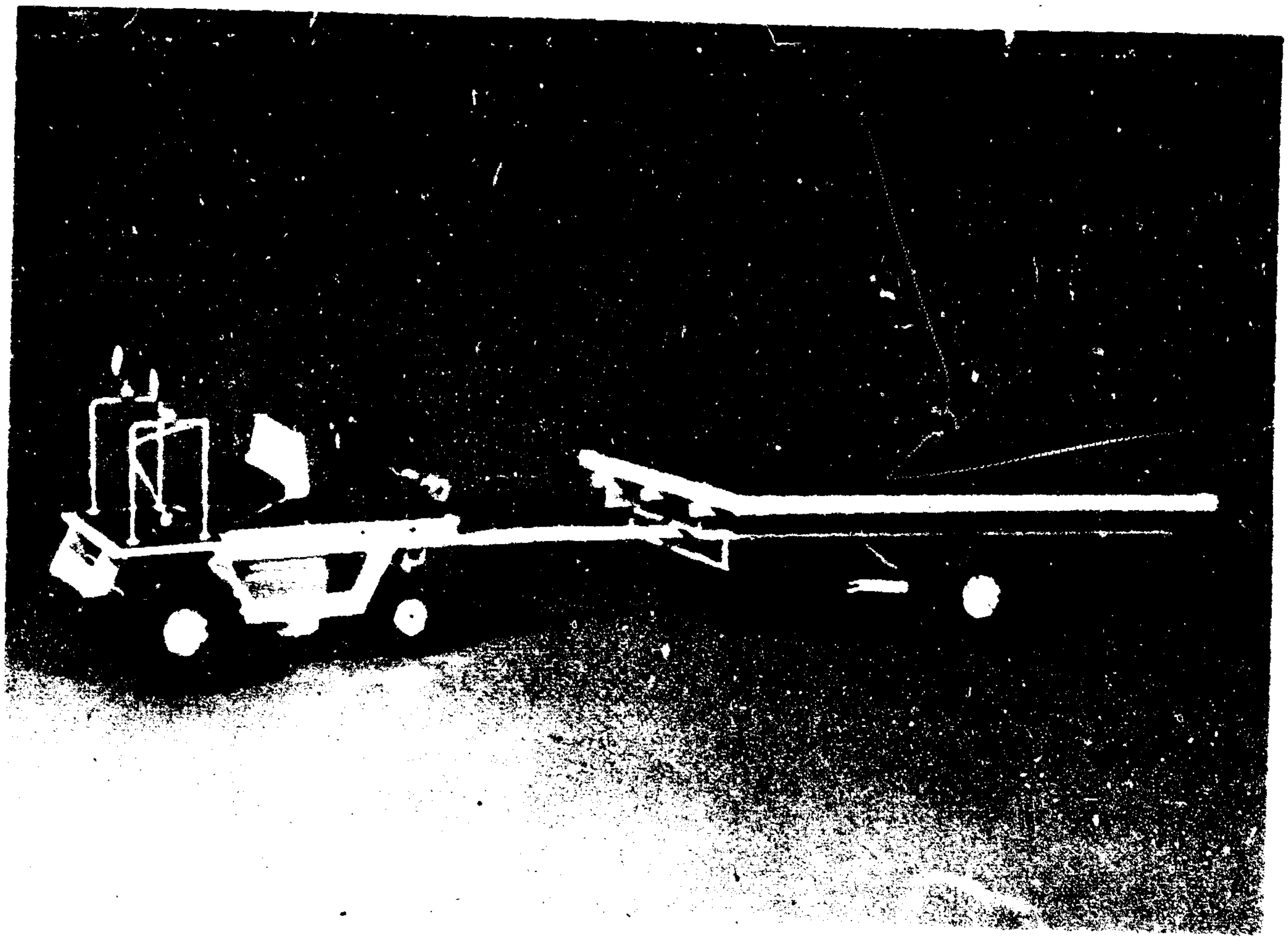


Fig. 18: Multi-purpose vehicle (power unit and trailer).

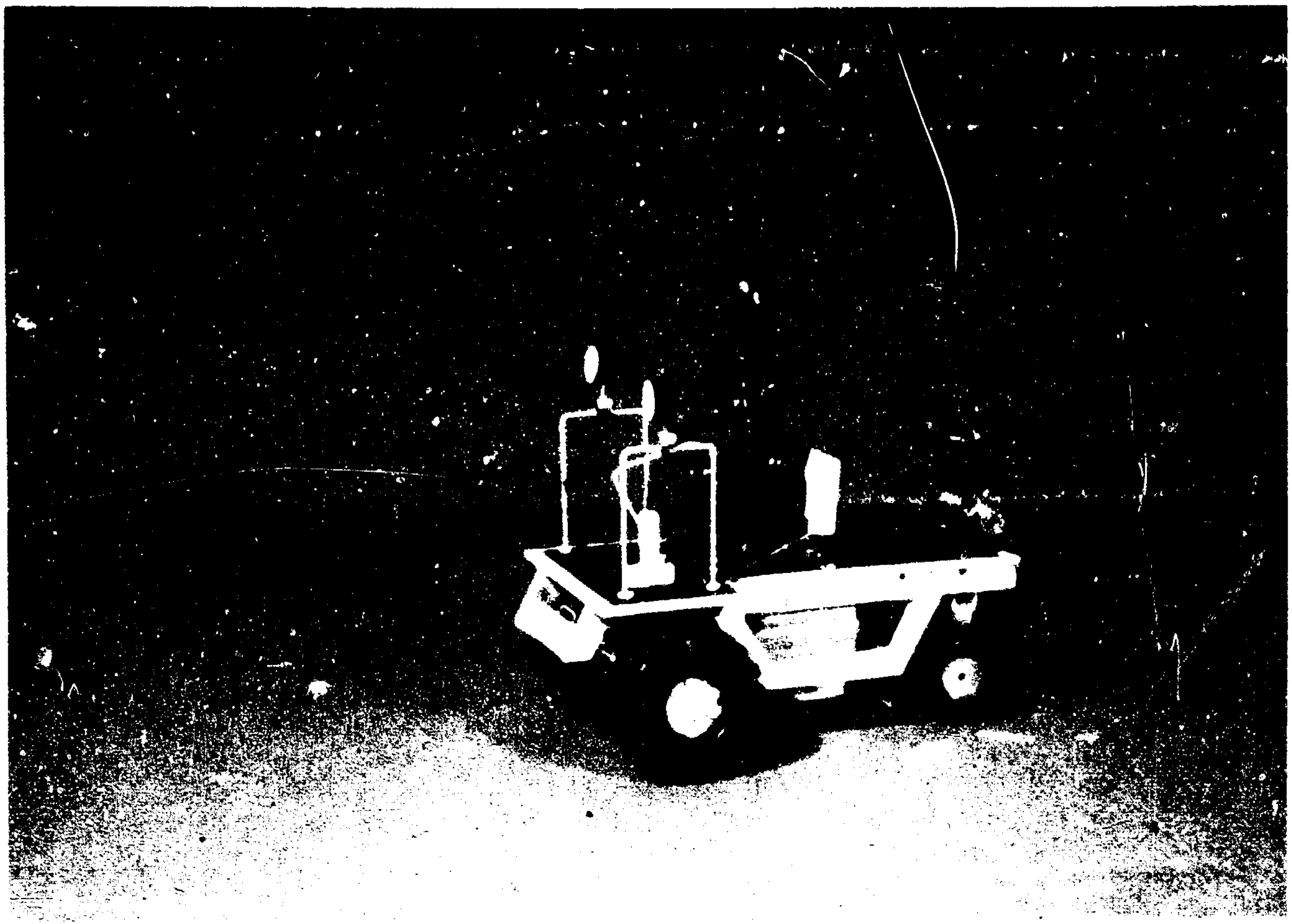


Fig. 19: Power unit.

Fig. 20: Multi-purpose vehicle with fork lift attachment.

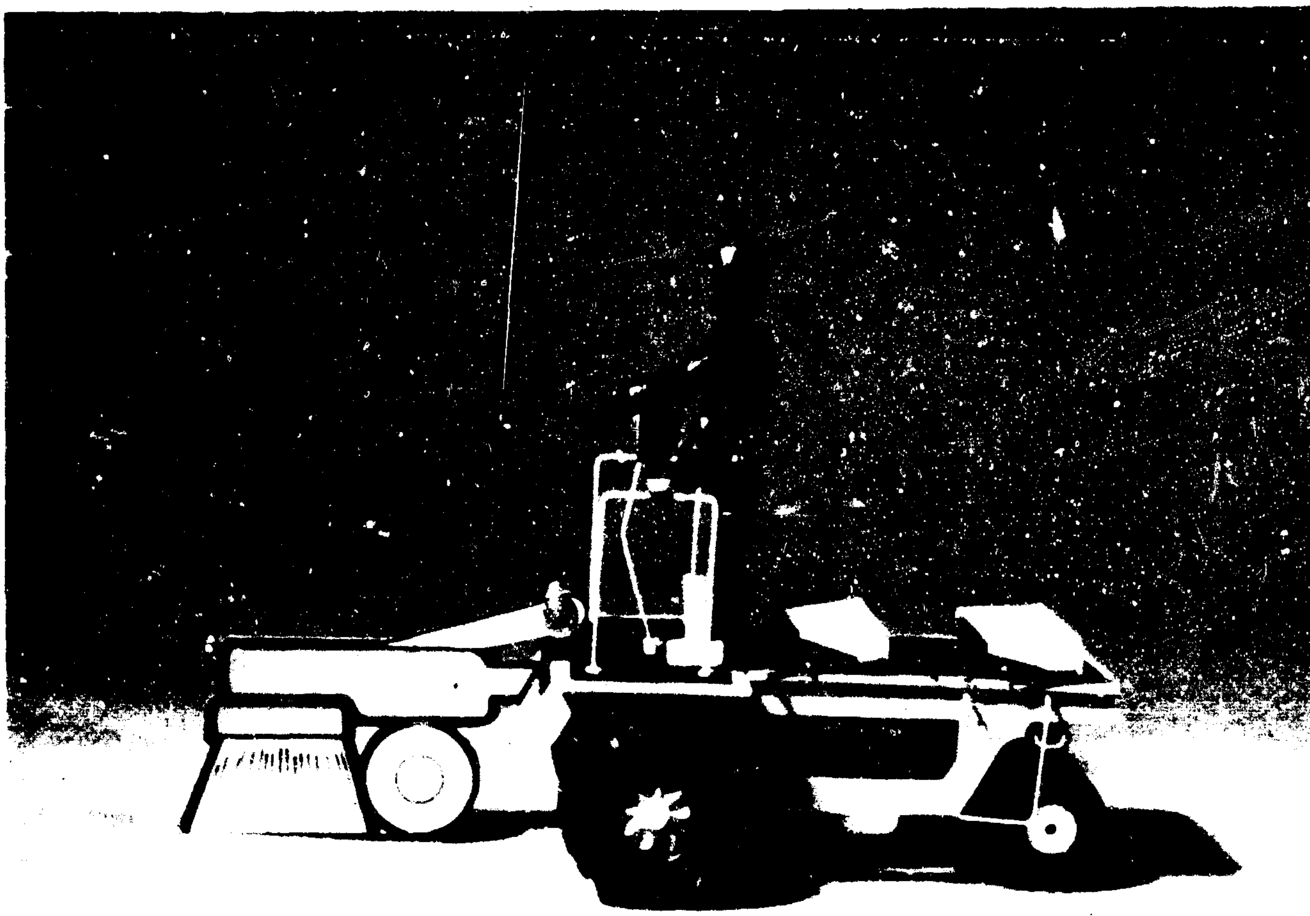


Fig. 21: Multi-purpose vehicle with runway sweeper attachment.

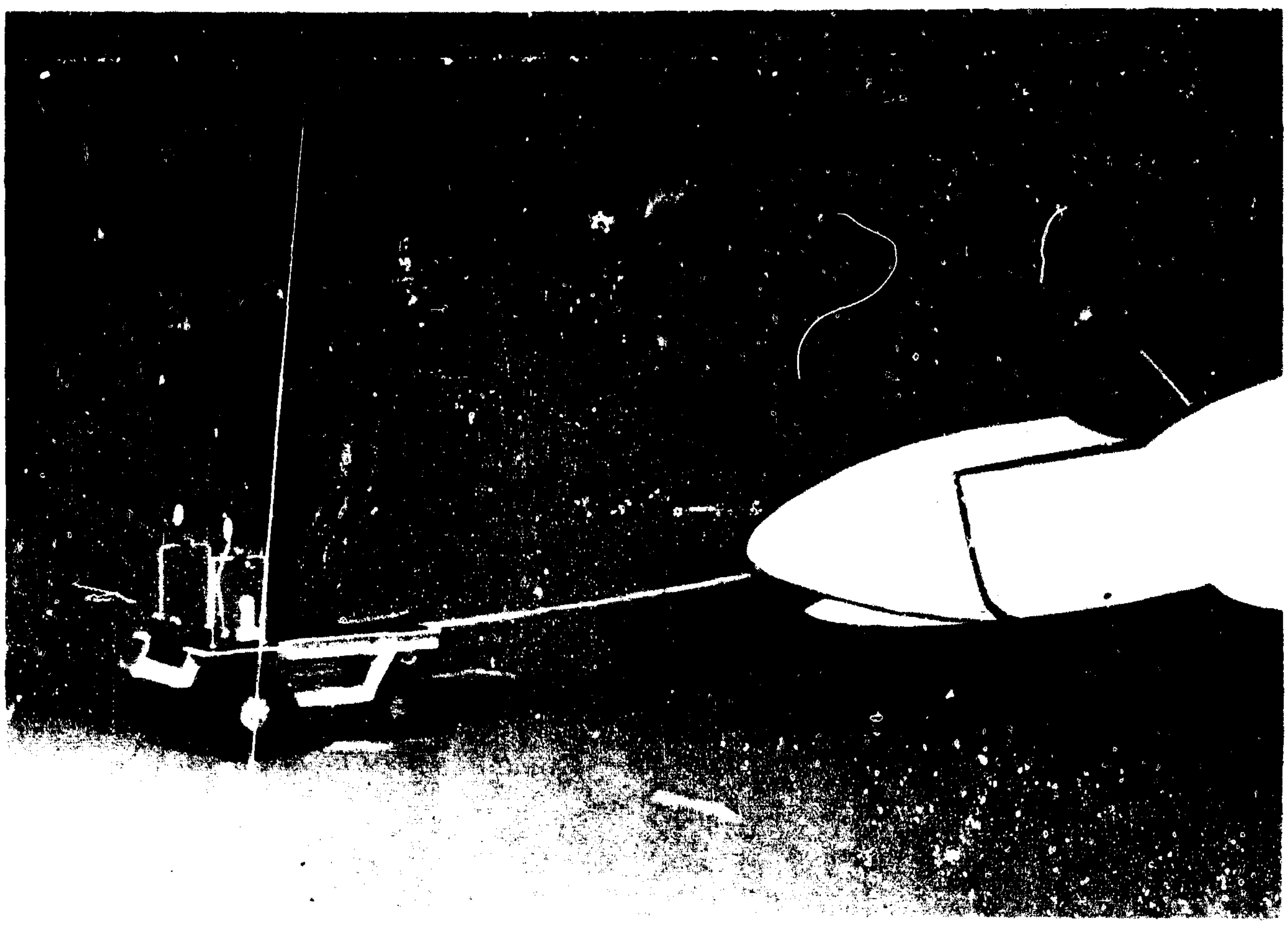


Fig. 22: Multi-purpose vehicle shown towing with winch.

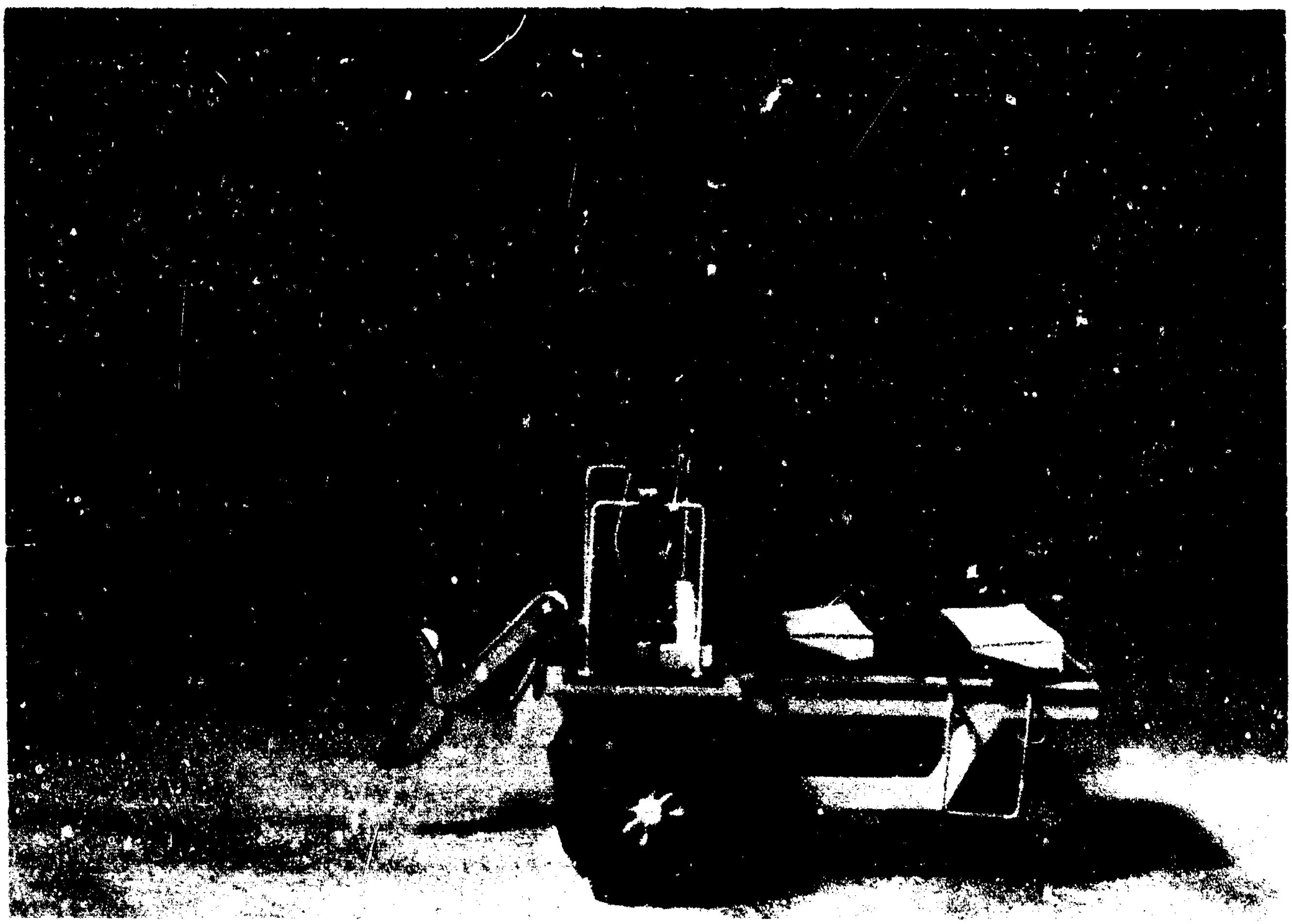


Fig. 23: Multi-purpose vehicle with scraper blade attachment.

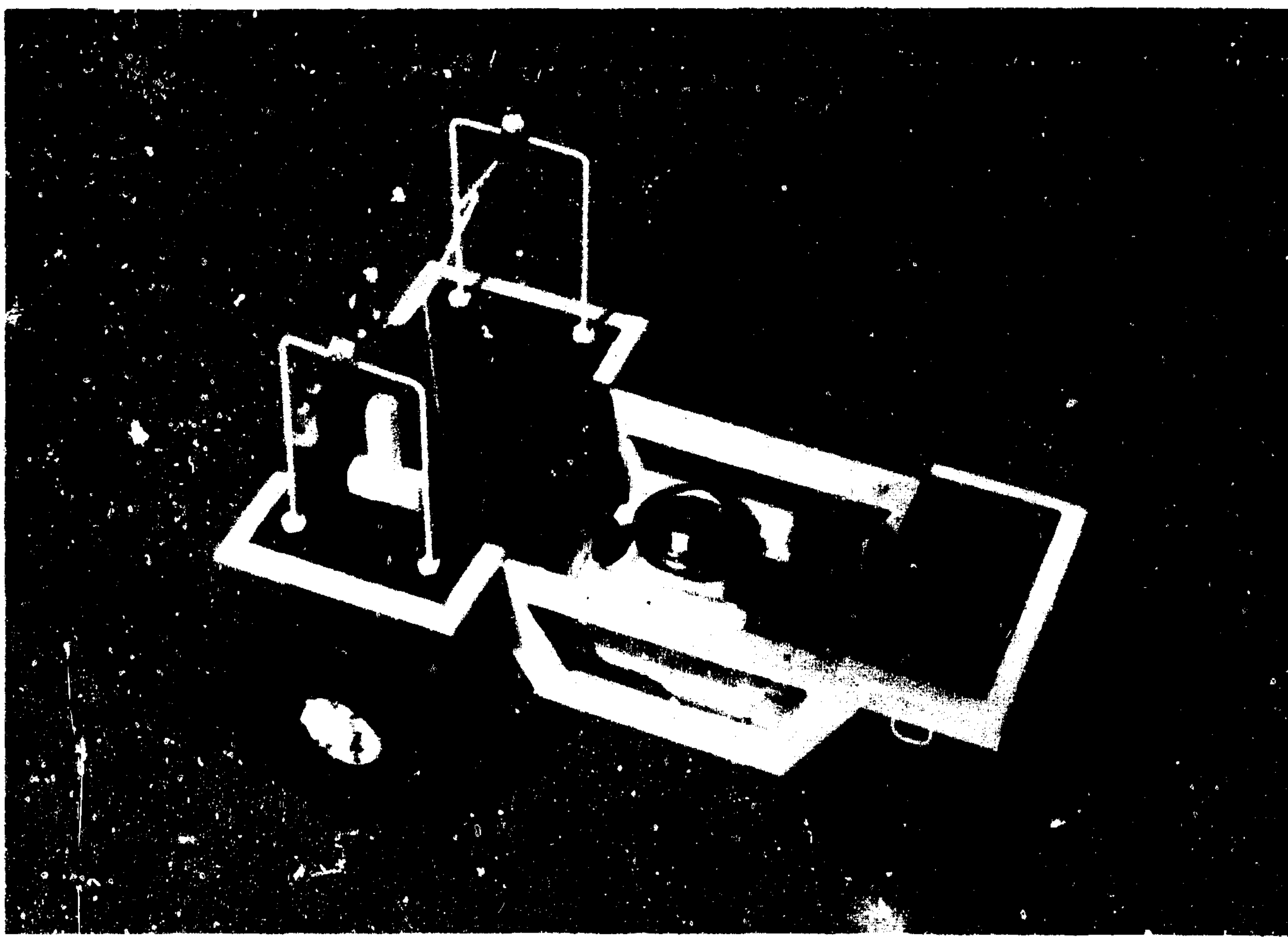


Fig. 24: View of chasis showing V6 truck engine.

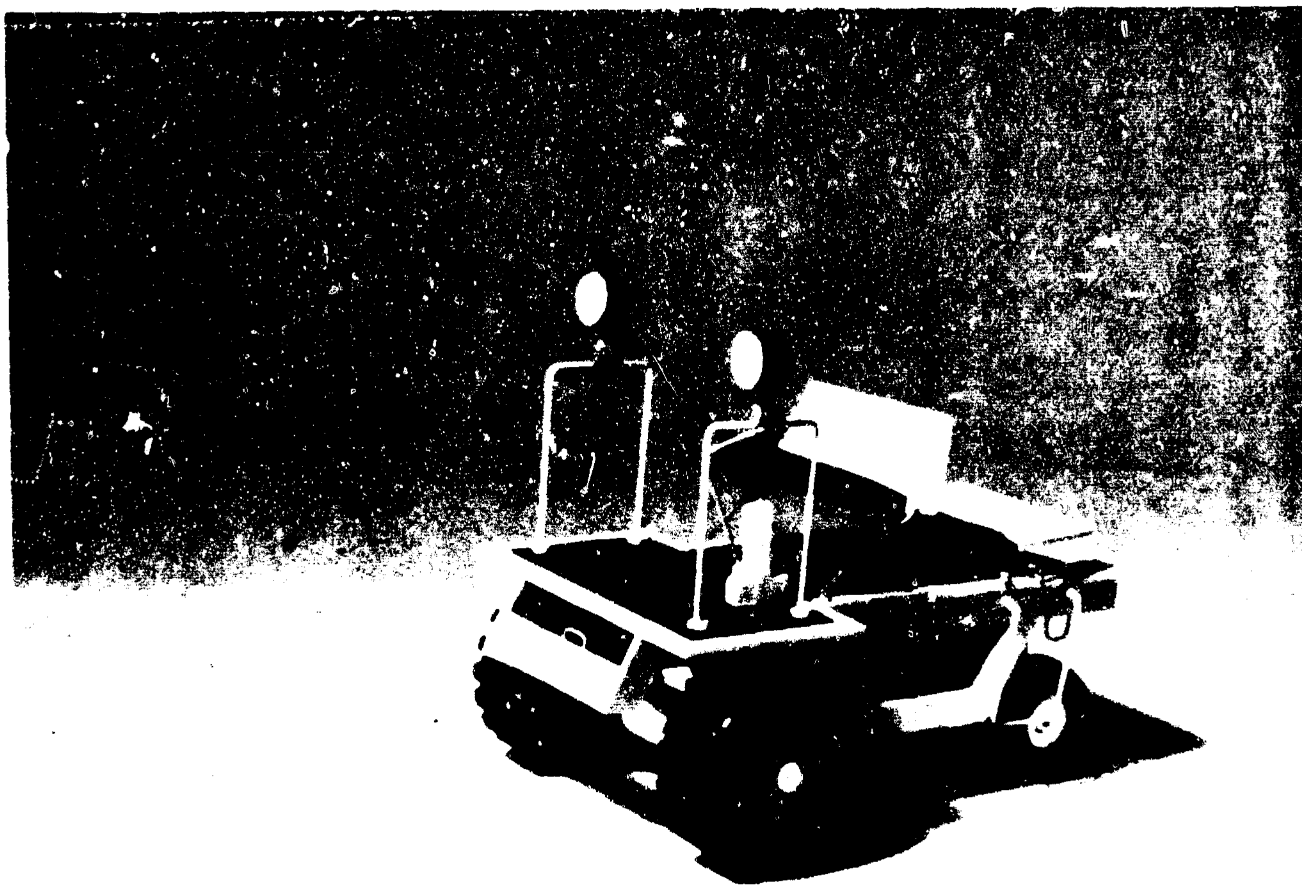


Fig. 25: Vehicle with driver's seat in place.

Fig. 26: Vehicle with seats folded as bed for light cargo.

Fig. 27: Vehicle as four-passenger personnel carrier showing detachable canopy.

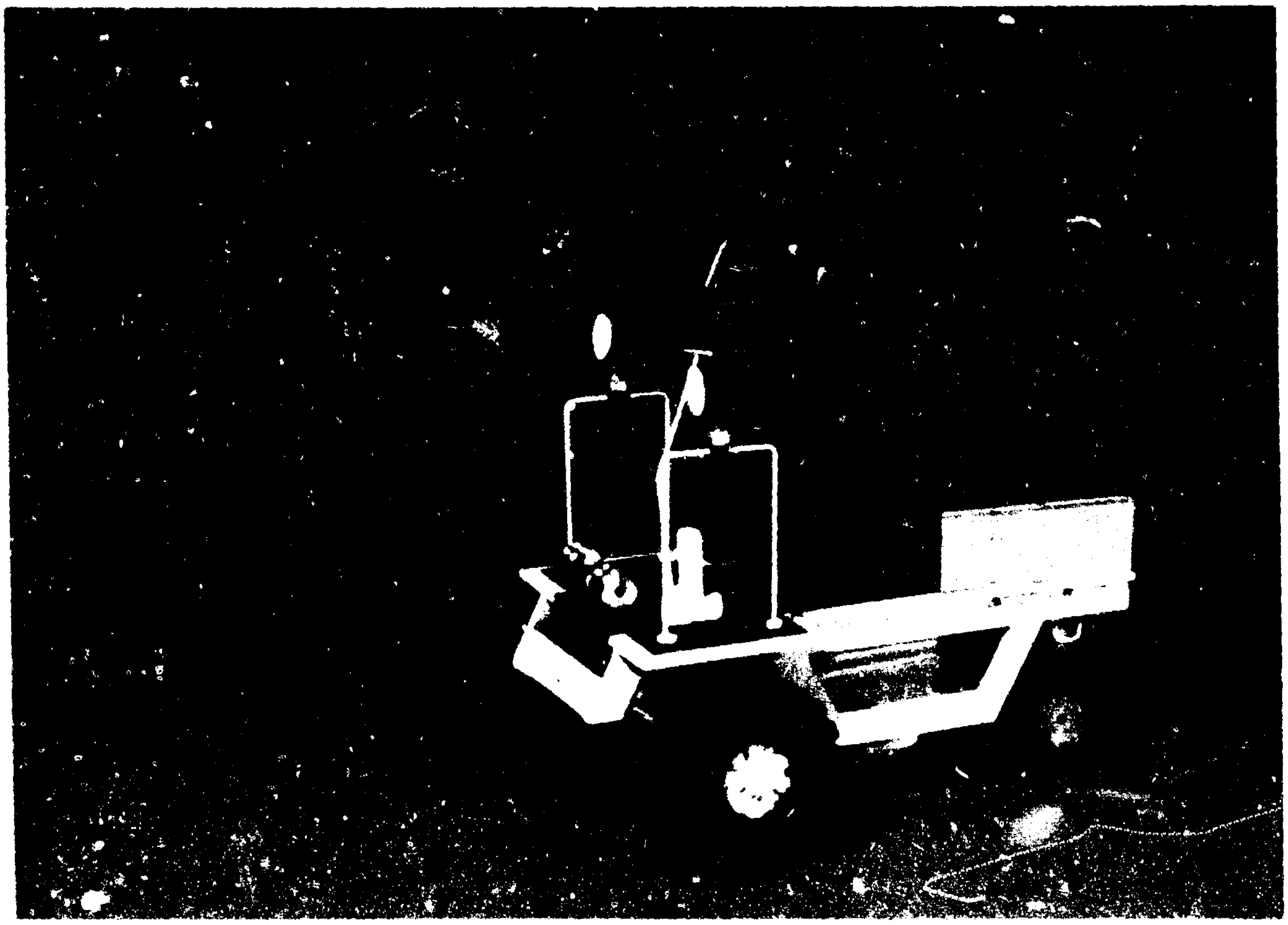


Fig. 23: Vehicle used for light hauling.

Fig. 29: Modified chasis showing extended frame.

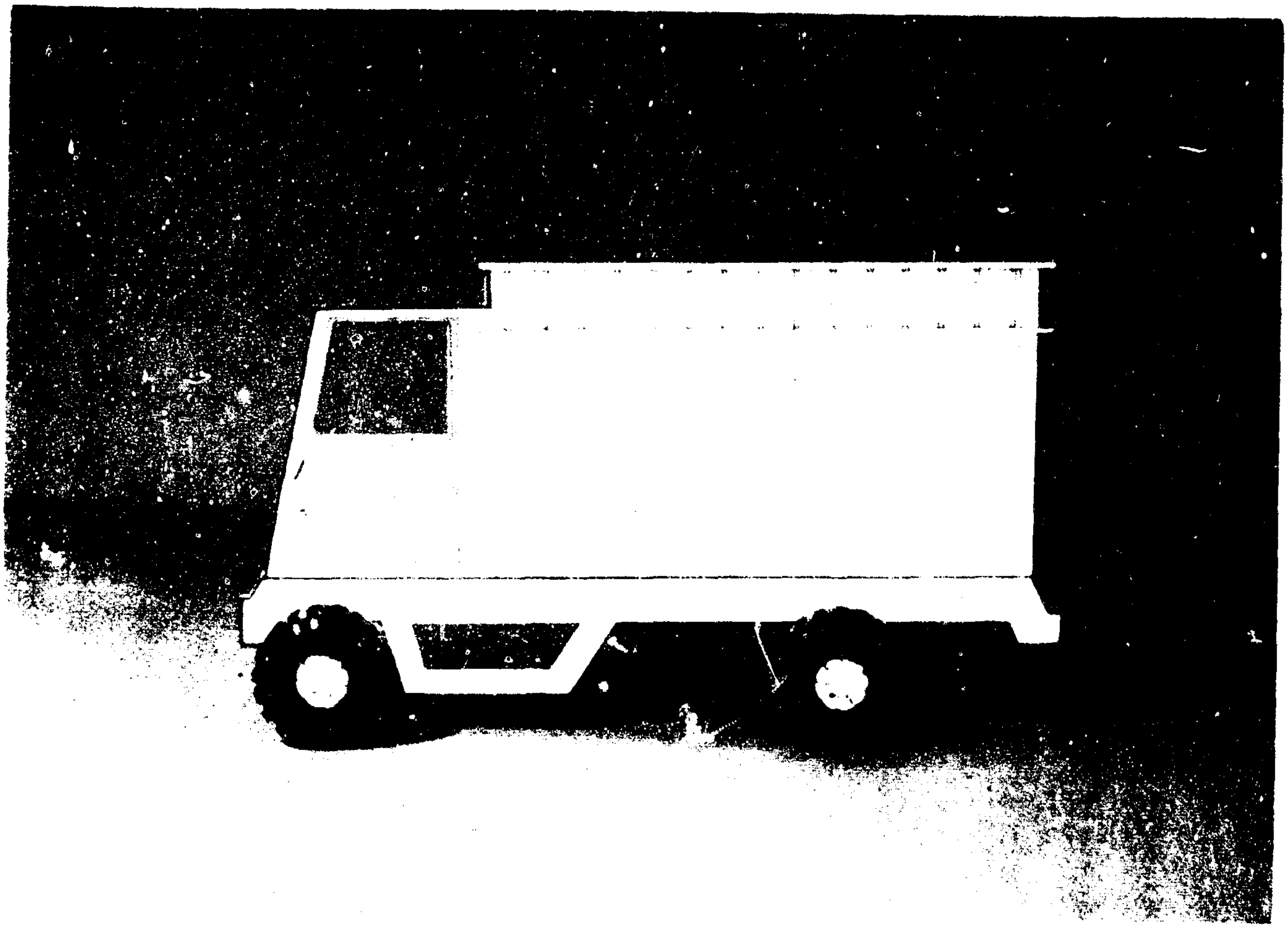


Fig. 30: Large van requiring extended chasis.

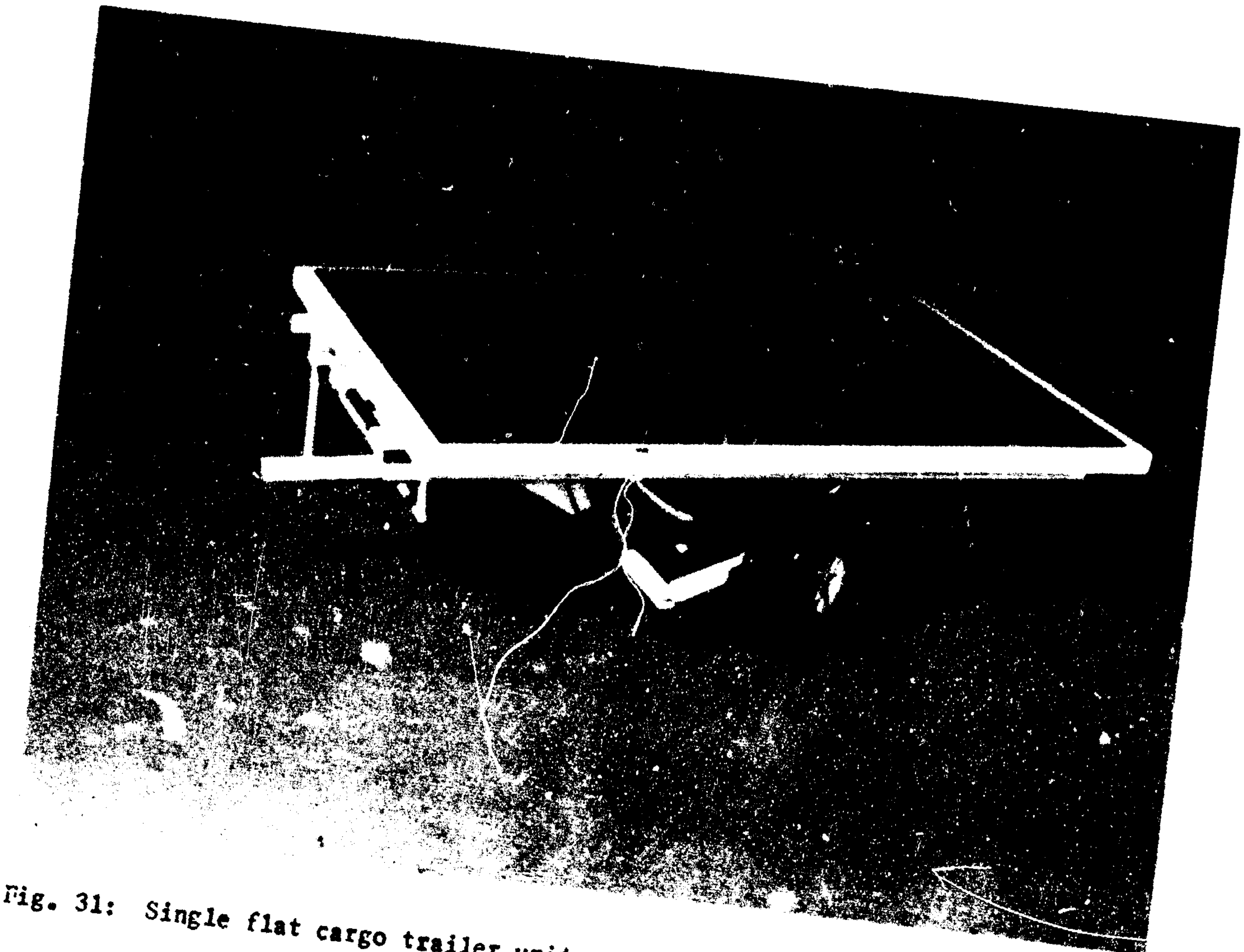


Fig. 31: Single flat cargo trailer unit.

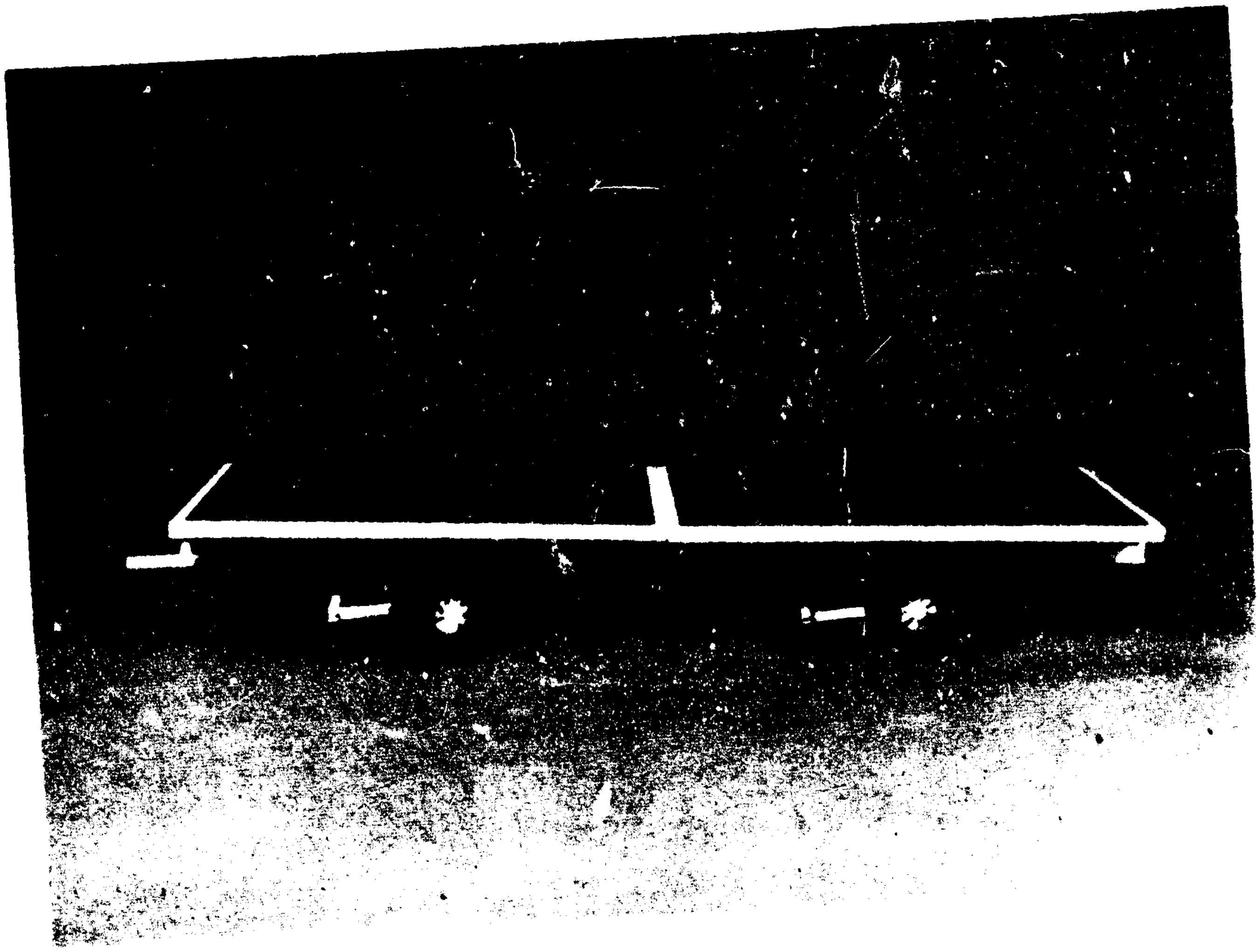


Fig. 32: Two trailers joined to form tandem unit.

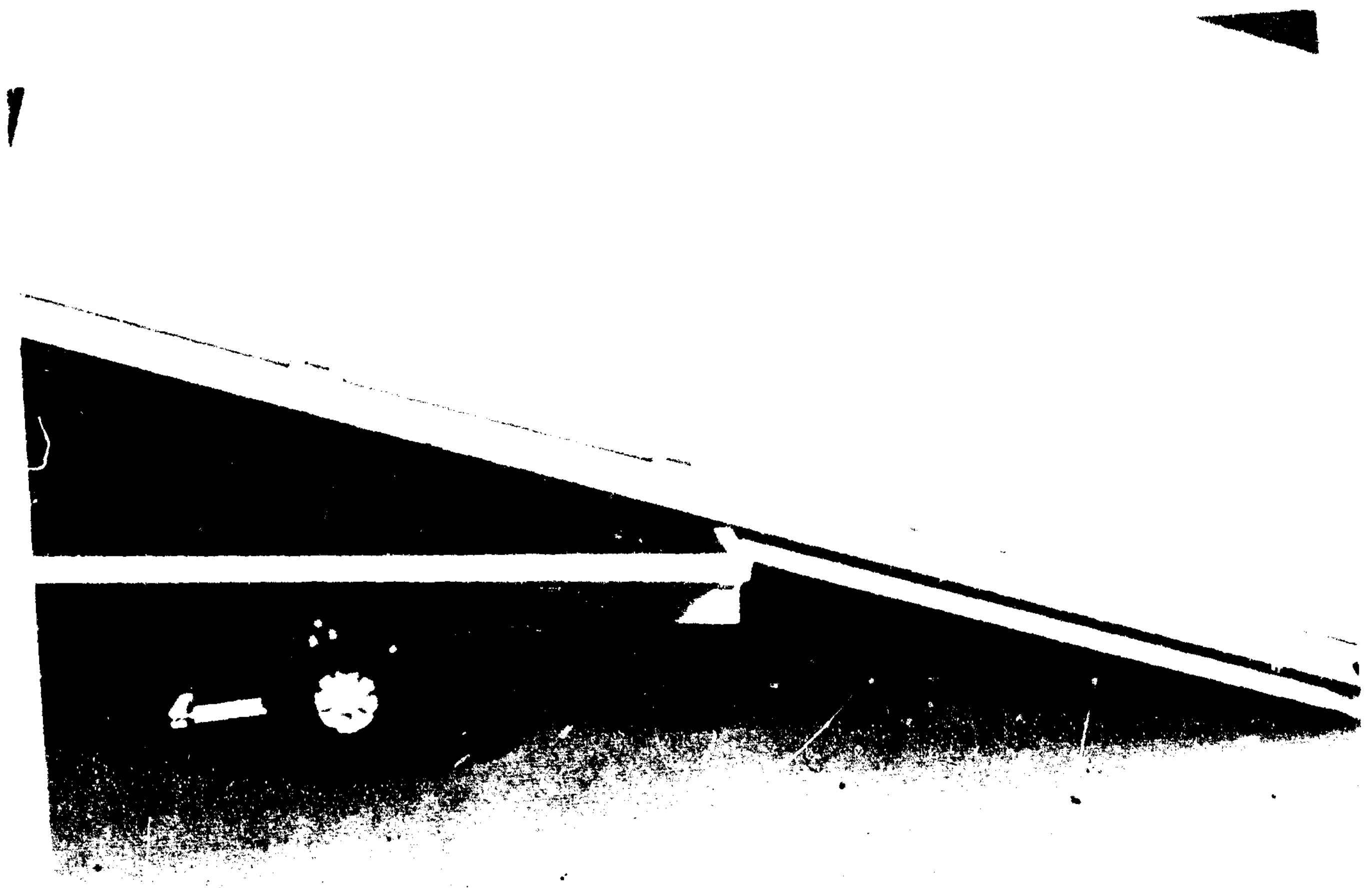


Fig. 33: Pallet being loaded on cargo trailer.

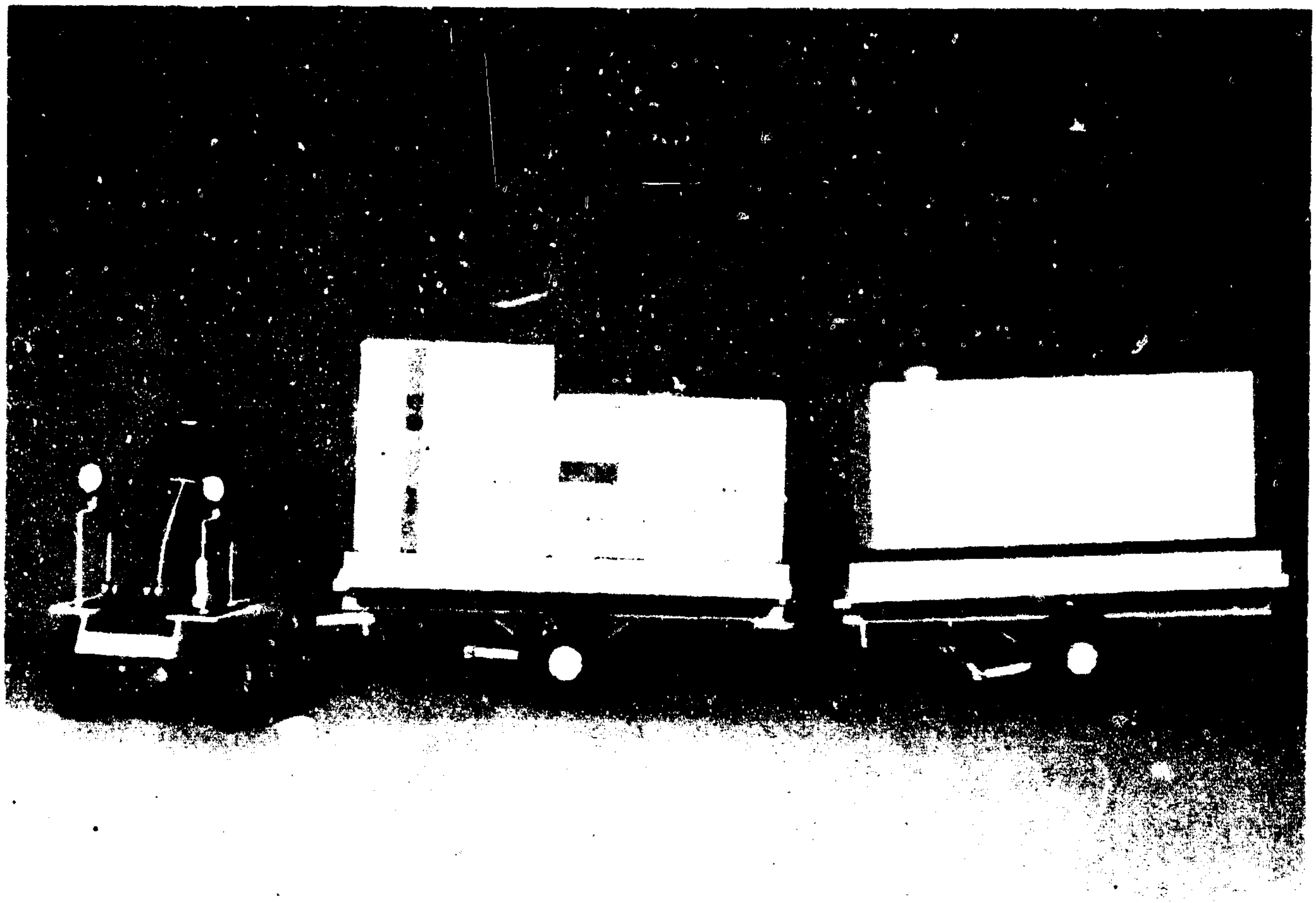


Fig. 34: Uncoupled single trailers in tandem.

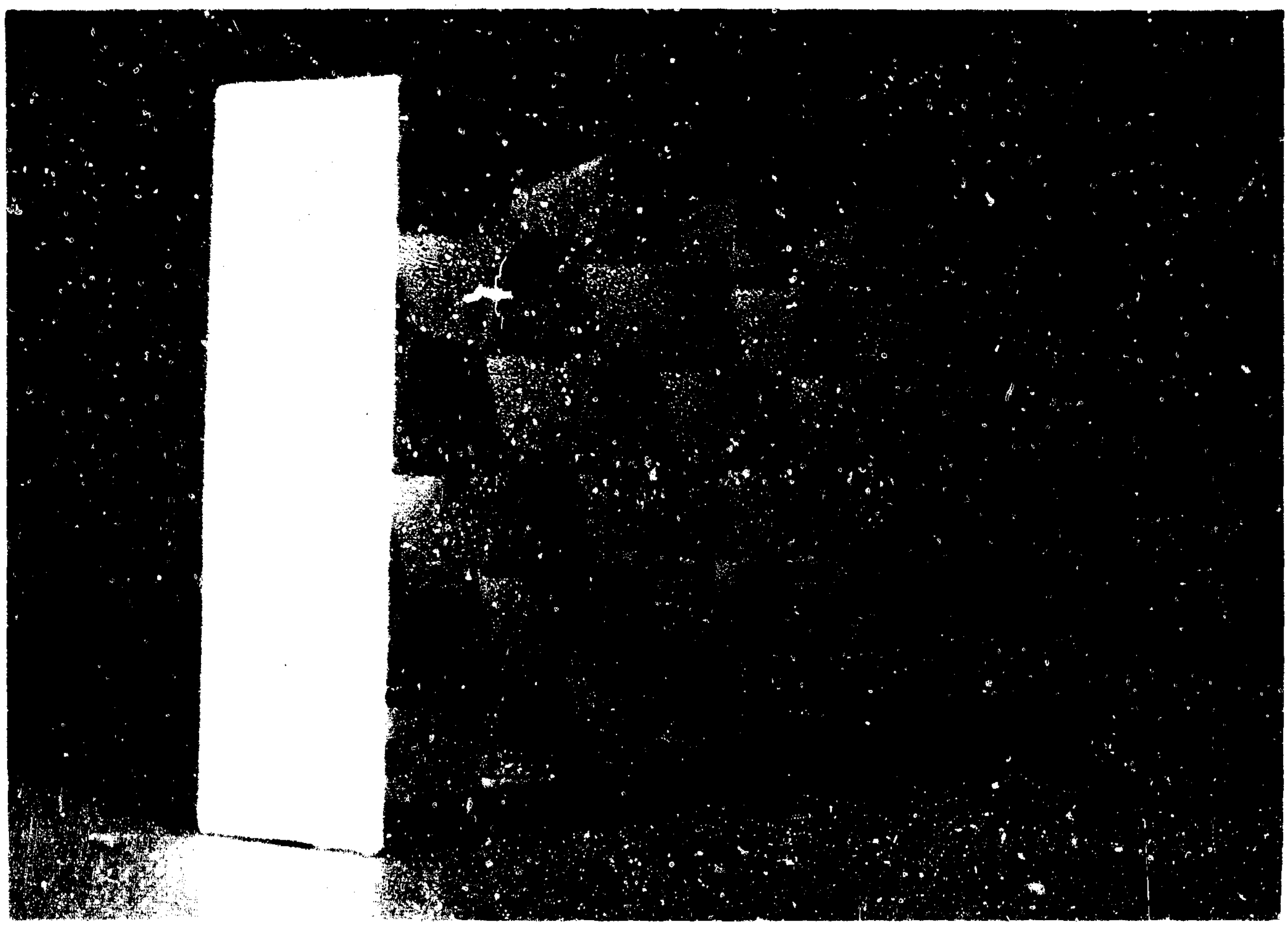


Fig. 35: Cellular structure of solar energy panel.

Fig. 36: Shower units (adapting solar energy to basic structural unit).

TEAM 5

Stanley Hoelle	Architecture '66
Raimonds Maculans	Architecture '66
Robert Coulter	Industrial Design '65

TEAM PHILOSOPHY

CONCEPT OF MODERN WARFARE

The concept of modern warfare has changed radically from one of massive retaliation to one of flexible response. This team felt that its contribution should be in line with the latter and that its proposals must be able to stand-up under the full spectrum of modern warfare: from an enemy propaganda campaign to all out war.

TEAM DECISION

Since there is a need to stamp out brush-fire wars in order to keep them from growing, the decision was made to maximize:

1. Speed
2. Efficiency
3. Versatility
4. Adaptability
5. Security
6. Camouflage & concealment

The team decided to minimize:

1. Risk
2. Number of components
3. Maintenance

The personnel selected to operate the team's proposal would have to be conditioned to the importance of total blackout, camouflage, and concealment in order that maximum effectiveness is achieved.

COMBAT ELEMENT PRIORITIES

This team felt that the following priorities should be assigned to the combat elements.

1st Priority - Manpower

2nd Priority - Jet fighters & equipment

3rd Priority - Airstrip

Since the mission of the base is to produce thirty-six F-4C's for tactical operations, this can only be accomplished if there is manpower to make them fly.

This requires the services of the tactical squadrons, maintenance squadrons and the combat support group. If they can survive a surprise attack, the airstrip can be operational in a matter of hours even with reduced equipment. Therefore maximum security, total blackout, and shelter camouflage are desirable.

BASE ASSEMBLY PRIORITIES

1st Priority - Tactical squadron shelters
Maintenance squadron shelters
Headquarters

2nd Priority - Combat support group shelters

3rd Priority - Mess hall
Hospital
POL

4th Priority - Ammo
Cyrogenic fluid production

5th Priority - Hangars

The team felt that the billeting shelters should be integrated into a single complex with the mess halls, headquarters and hospital. Most work shelters and all bomb shelters could be integrated if the site permits.

ADAPTABILITY OF APPROACH

VARIOUS SITES

This team's bare base concept is extremely adaptable since the shelter units require no anchoring and can be carried from one place to another. This requires no special equipment for assembly in sub-arctic areas where the ground is frozen solid.

If more insulation is needed, a special canvas layer can be attached on the inside with the space between rods filled with an insulator. Likewise the floor insulation can be boosted for colder climates.

For best results the camouflage pattern and color of each bare base kit should be suited for its intended geographical area. If this is not feasible, one broken-up pattern for all area use would still help attain the desired effect. The base layouts can vary with the site. In order to achieve the blackout complex a spreading out is desired. This also improves vehicular access. No more than six shelter units should be placed in a straight line to minimize loss of personnel from enemy strafing. Vehicles when not in use should be parked under camouflage nets.

PARTICULAR SITE

The team had no particular difficulty in adapting its approach to its site (Fig. 1). Although it was limited by an existing system of roads a desired pattern was still attained. The possible solutions in the complex design are infinite and are limited only by the proposed site (Fig. 2).

SHELTER CONCEPT

BASIC SHELTER

The basic shelter is a arched structure with overall dimensions 36'-0" x 23'-0" x 11'-6" high. It will accommodate 12 men and their equipment.

The plan features a wide 10' center aisle when used as a billet. The aisle is used for circulation because the entire base is interconnected for total blackout under combat conditions. Since this layout must be closely knit, it becomes necessary to provide some means of camouflage to break up the rigid pattern.

All equipment for the bare base must be transported in the C-130. The inside dimensions of this airplane's cargo space are 9' high x 10' wide x 40' long. Therefore, the components for the shelter have been determined from these limitations.

REQUIREMENTS FOR BASIC SHELTER

1. Light weight
2. Less bulk
3. Ease of assembly
4. Little maintenance
5. Flexibility

COMPONENTS FOR BASIC SHELTER

"Delrin" plastic rods form the frame structure for the shelter. These rods have a compressive stress of 18,000 psi and a tensile stress of 10,000 psi. They are resistive to heat, cold, acids and mildew. They can be painted, pigmented, cut or welded (Fig 3).

1. 8 - Delrin rods - 1-1/2" diam. x 36'-0"
2. 2 - Aluminum channels - 4" x 6" x 36'-0"
3. 6 - Steel cables - 1/4" diam. x 25'-10 3/4"
4. One-piece lightweight canvas covering with plastic moisture barrier connected to floor portion - 36'-0" x 60'-0" (Fig. 4).
5. Removable canvas floor covering - 36'-0" x 23'-0"
6. 2 - Semi-circular end panels - 11'-6" radius
    a. connected to top covering by plastic zipper
    b. zip-in doors and windows
7. Divider unit - zip in canvas - 6'-0" x 20" 0"

STEPS FOR ERECTION

1. Untie shelter package - (36 cu. ft.)
2. Unroll one-piece unit
3. Fasten steel cable to aluminum channels
4. Insert spreader bars between channels
5. Insert one end of Delrin rod into one channel socket and bend to opposite side and insert rod into socket. (repeat as necessary to complete frame)
6. Snap on stabilizer rod at the top of arch

7. Pull canvas over top of frame and fasten to the other side.
8. Zip-in end panels
9. Zip-in windows and doors
10. Spread canvas floor covering
11. Install necessary equipment (forced night ventilation, etc.)

HANGAR AND MESSING SHELTER

The larger shelter is the same basic structure as the smaller (Figs. 5,6). It is framed by combining two standard 36'-0" rods at the center of the span with a special double socket fitting. The bay spacing has been reduced from 6 feet to 4 feet. The overall dimensions are 60'-0" long, 46'-0" wide and 23'-0" high.

COMPONENTS

1. 32 - Delrin rods 1-1/2" diam. x 36'-0"
2. 4 - Aluminum channels - 4" x 6" x 30'-0"
3. 10 - Steel cables - 1/4" diam. x 47'-6 1/4"
4. 2 - One piece lightweight canvas coverings with elastic moisture barrier connected to floor portion - 30'-0" x 120'-0"
5. Removable canvas floor covering - 46'-0" x 60'-0"
6. 2 - Semi-circular end panels - 23'-0" radius
    a. connected to top covering by plastic zipper
    b. zip-in doors and windows

ERECTION

The steps for erection are the same as for the basic shelter. The use of a crane would be helpful, but it can be erected with the use of enough men.

DEVELOPMENT OF BARE BASE

1. Bare base under consideration

2. 0000 hrs.

After selection and survey of bare base, the first C-130 loads at home base.

3. 1000 hrs.

First C-130 lands at bare base to unload.

4. 1030 hrs. (Fig. 7)

Two basic units have been assembled.

5. 1700 hrs.

1-POL set-up, 1-mess hall and hospital erected, and billeting for 200 men.

6. 2400 hrs.

Munitions dump, liquid oxygen and 2nd mess hall erected, and billeting for 400 men.

7. 4800 hrs.

Billeting for 700 men.

8. 7200 hrs.

Hangars erected, and billeting for 900 men.

9. 9600 hrs.

Completed bare base with emergency fuel and munitions dump and (8) anti-aircraft installations. Billeting for 1100 men.

VEHICLE CONCEPT

In our first consideration of a vehicle, we felt that we wanted a vehicle with as much simplicity of concept as possible. But, while striving for this simplicity, we wanted the most output from the least input. In other words, we felt that the more complicated the vehicle was in its basic power train, basic operation, and basic gadgetry, the harder the vehicle would be to learn to operate and to repair. The more complicated the various operations of the vehicle, the more difficult to repair. We wanted a vehicle that was an operator's dream not a mechanic's nightmare. Therefore, we divided the duties of the base between these two vehicles and arrived at this final concept.

VEHICLE DESCRIPTION

The basic body shell of the vehicle is of unitbody construction. This was used because of the maintenance to a body chassis combination and the ruggedness and rigidity of the unit construction.

The power is supplied through the use of a very efficient, uncomplicated 171 c.i., in-line four-cylinder, air-cooled engine. This engine would be equipped with an overhead camshaft and would develop 90 H.P. It is aircooled primarily because it could be operated in cold climates without the addition of antifreeze. The engine is mounted ahead of the front axle and delivers the power through a standard four-speed, fully synchro-meshed transmission. The vehicle has four-wheel drive and four-wheel steering to make it quite agile and maneuverable.

The length of the vehicle is 156", the width 84", and the height at the top of the cab is 72". The vehicle has a wide-track front and rear. The cab is equipped with dual-controls for operations facing the front or the rear. The driver is seated in the center of the cab on a swivel-seat, so as to have access to either front or rear controls (Figs. 8,9,10,11,12,13,14,15).

Both the driver and the engine are placed ahead of the front axle and to the left so that between 5/8 and 3/4 of the volume of the vehicle can be utilized. The cab's location to the front left with the engine located front-center allows for a front tailgate. The vehicle is equipped with both front and rear tailgates. This makes it accessible from either the front or the rear. Because of the openings front and rear, it makes possible the transporting of objects longer than the 156" of the vehicle (Fig. 16). Many standard jeep attachments can be used on this vehicle, which is equipped with a Power Take-Off front and rear. A forklift attachment (Fig. 17) is operated from the rear and is attached to the rear of the frame after the removal of the tailgate. Because of the equal ability of the vehicle to be operated forward or in reverse, the vehicle easily becomes a forward vehicle or a rear direction vehicle.

One additional attachment is a one-piece fiberglass top which converts the vehicle into a closed van, to be used as an ambulance (Fig. 18), delivery van, closed troop carrier or any of many uses requiring a closed vehicle. The standard cab comprised 1/4 of the top area with the bolt on top comprising the other 3/4.

The second vehicle was designed along the same lines but with minor changes to make it compatible to larger heavier jobs required on the base. This vehicle is primarily the same type as the smaller vehicle, the difference being in larger dimensions: 17' in length, 9' in width, and 8' in height (Fig. 19). The other change is that it is track-driven so that large dozer attachments may be used to their fullest extent. The second vehicle also has front and rear tailgates and does many of the large jobs not possible for the smaller vehicle. It comes equipped with telescoping crane/back-hoe, a dozer blade (Fig. 20), fire fighting attachments, or it may be used just in standard form to tow a plane.

We feel that the two vehicles would be capable of being adapted to handling all the duties around the base (Fig. 21).

CONCEPTS OF SELECTED ITEMS OF EQUIPMENT

RUNWAY LIGHTING

A very efficient type of lighting is neon. A single strip of light on both sides of the runway (Fig. 22) is sufficient for its location by the pilot.

The portable quality of the lighting is achieved by pumping the neon gas into flexible clear plastic tubing (Fig. 23) which can be wound onto reels that are mounted on a vehicle.

This single wire, cold cathode system can be powered by portable generators as needed.

Fig. 1: Aerial view of site prior to development.

Fig. 2: Aerial view of site fully developed.

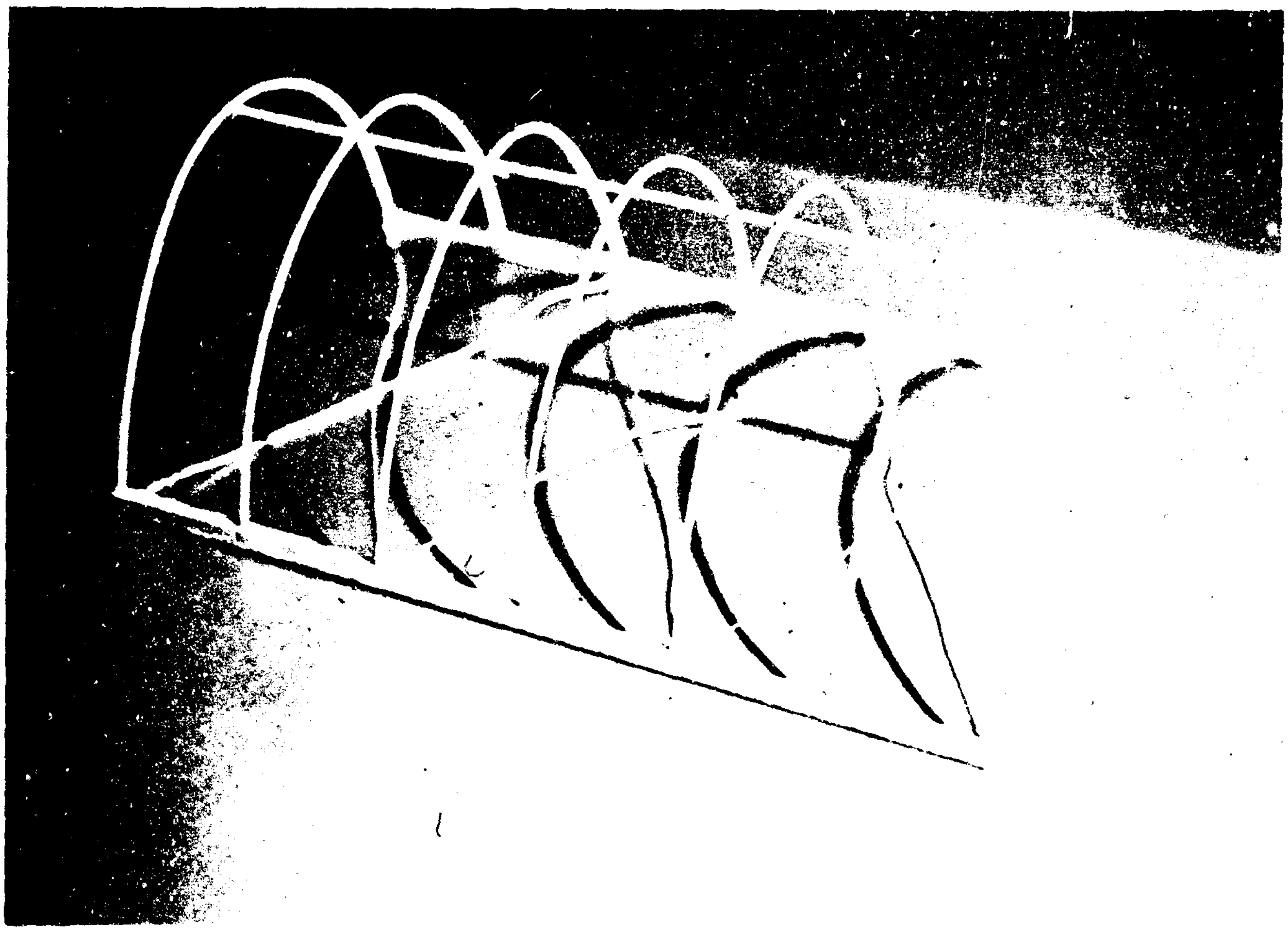


Fig. 3: Skeleton of structure showing plastic ribs, channel grade beams and steel cable tension lines.

Fig. 4: Completed structure showing camouflage canvas covering.

Fig. 5: Typical large and small shelter units joined.

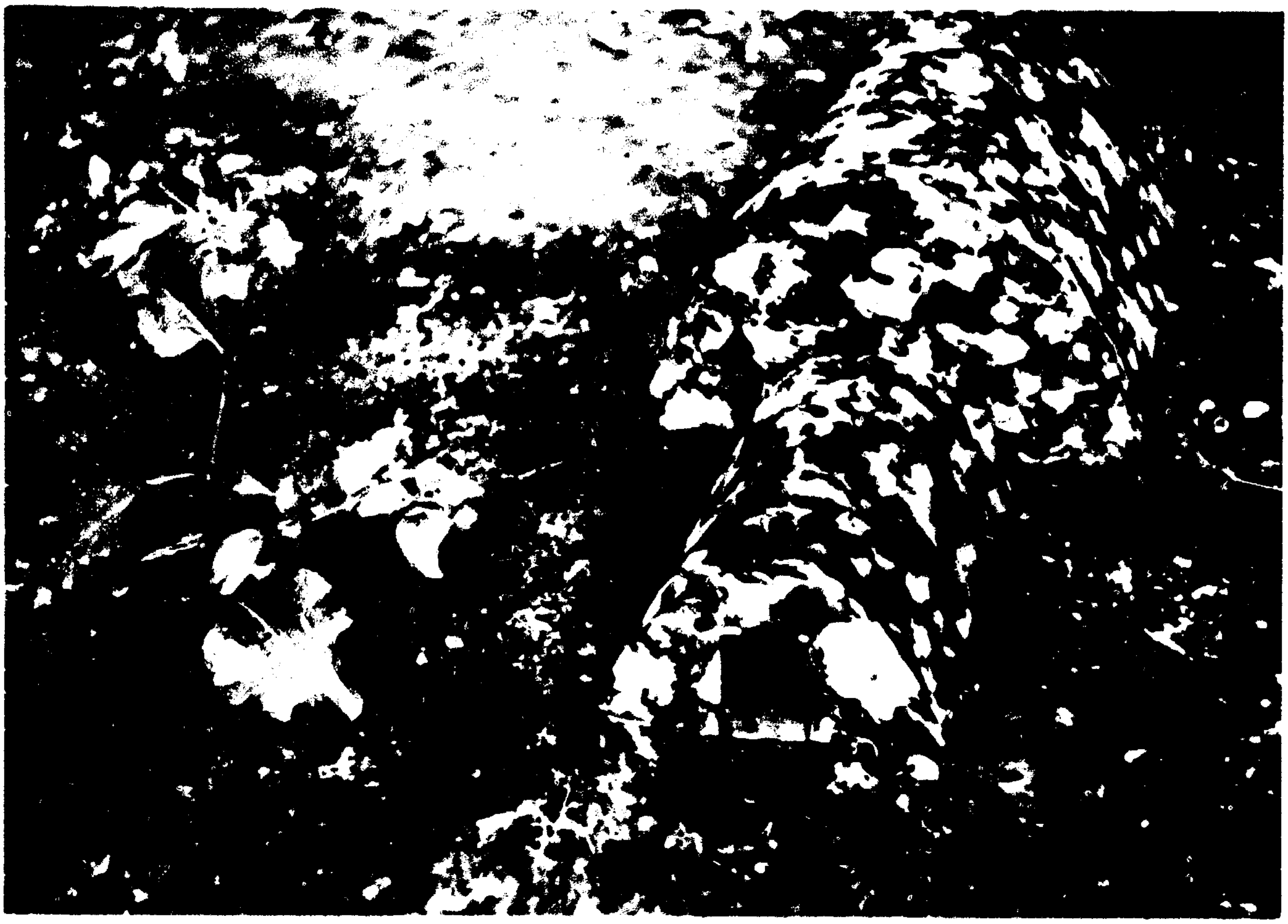


Fig. 6: View of completed structure showing effectiveness of camouflage technique.

Fig. 7: First C-130 lands at Bare Base site.

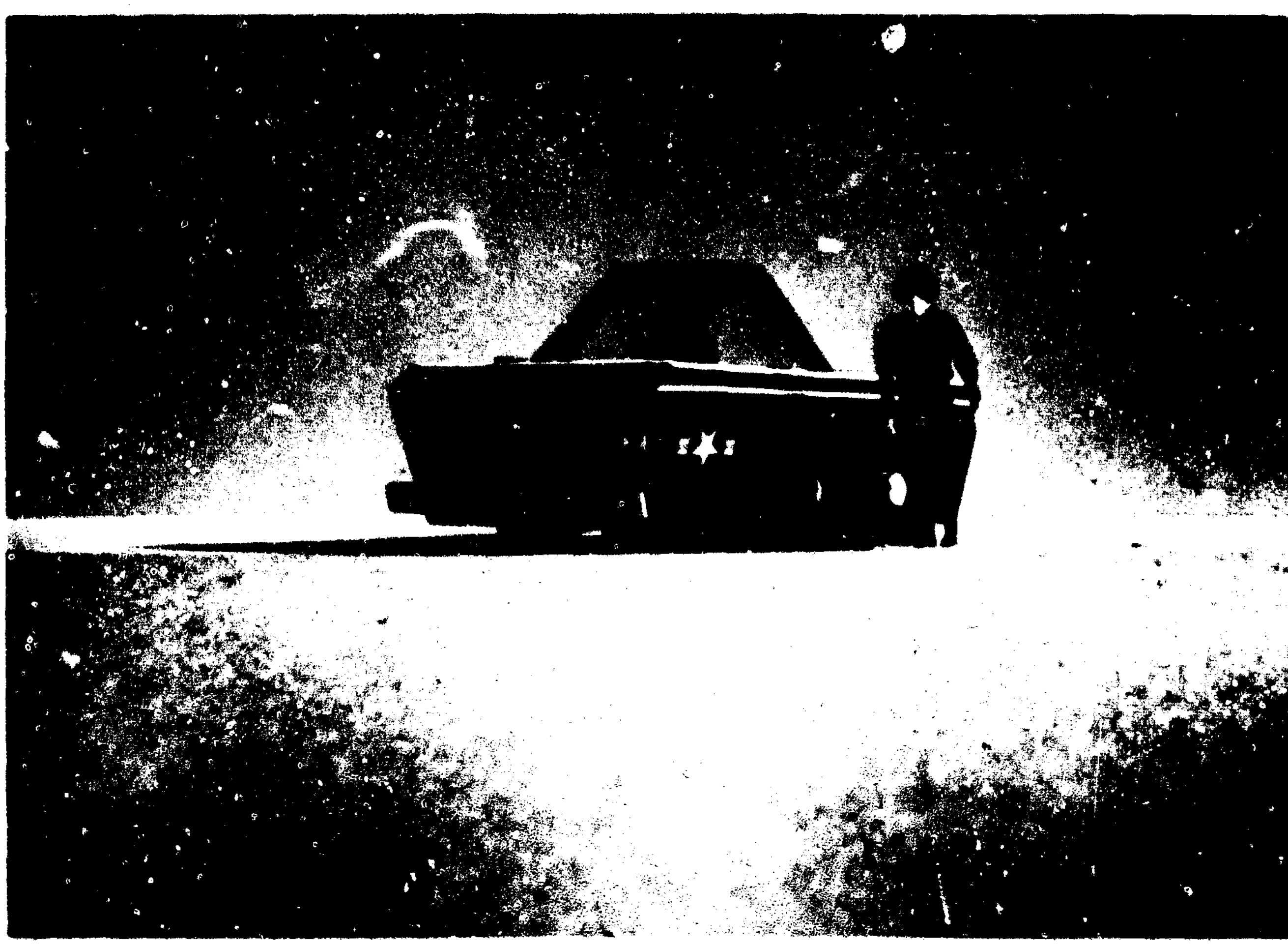


Fig. 8: General view of vehicle.

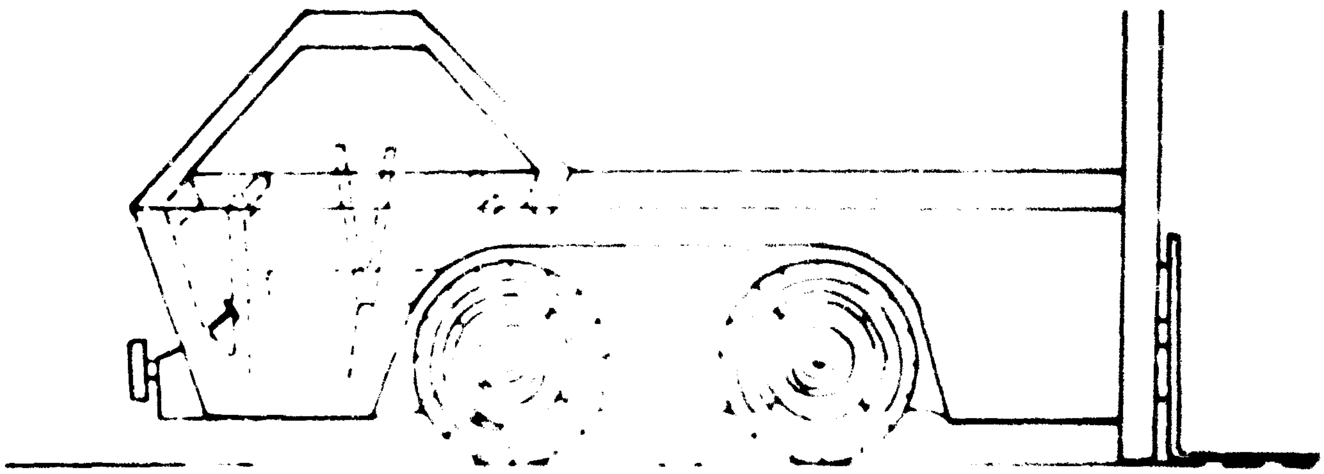


Fig. 9: Side elevation-sectional view with fork lift attachment.

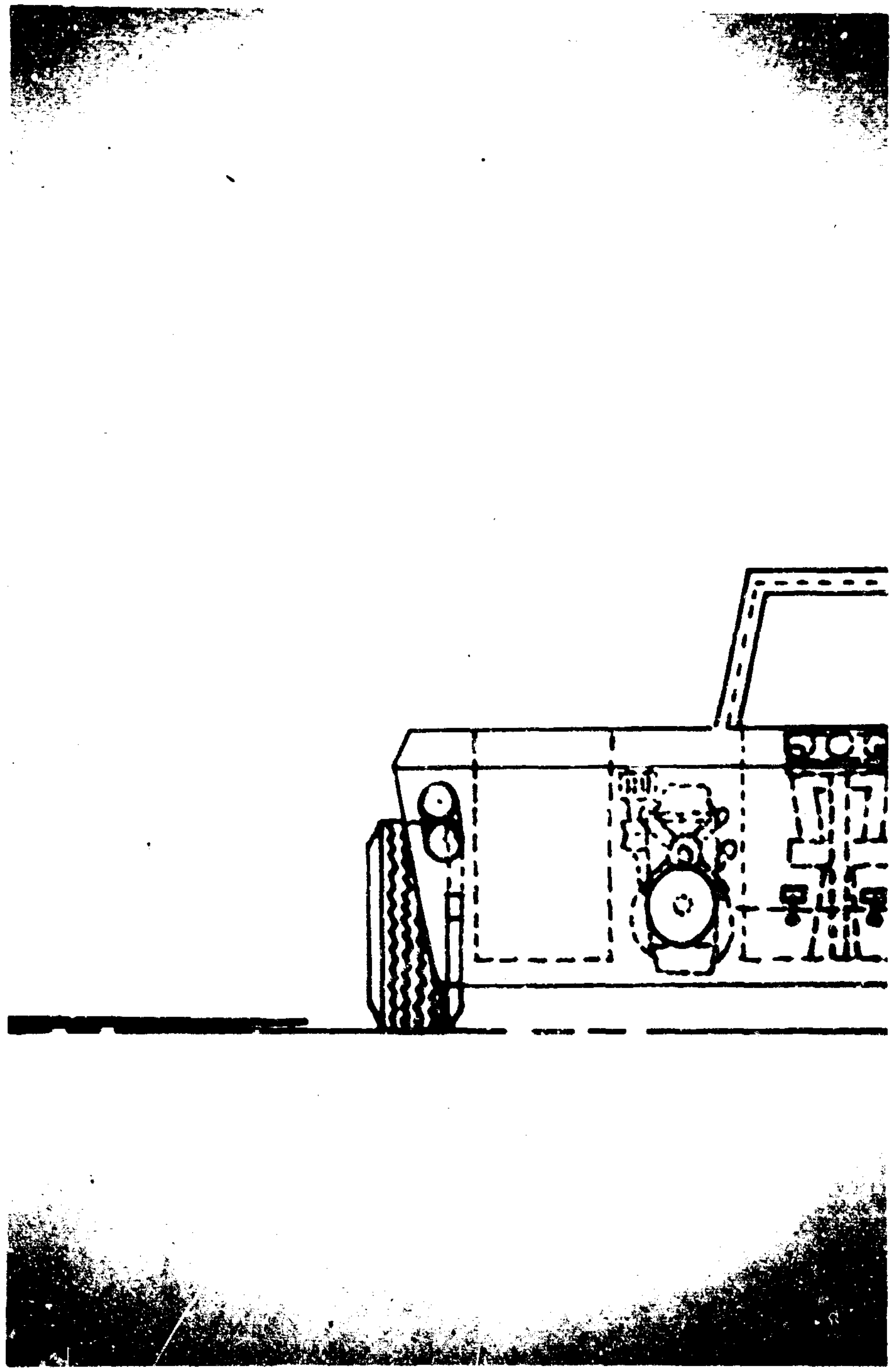


Fig. 10: Front elevation-sectional view.

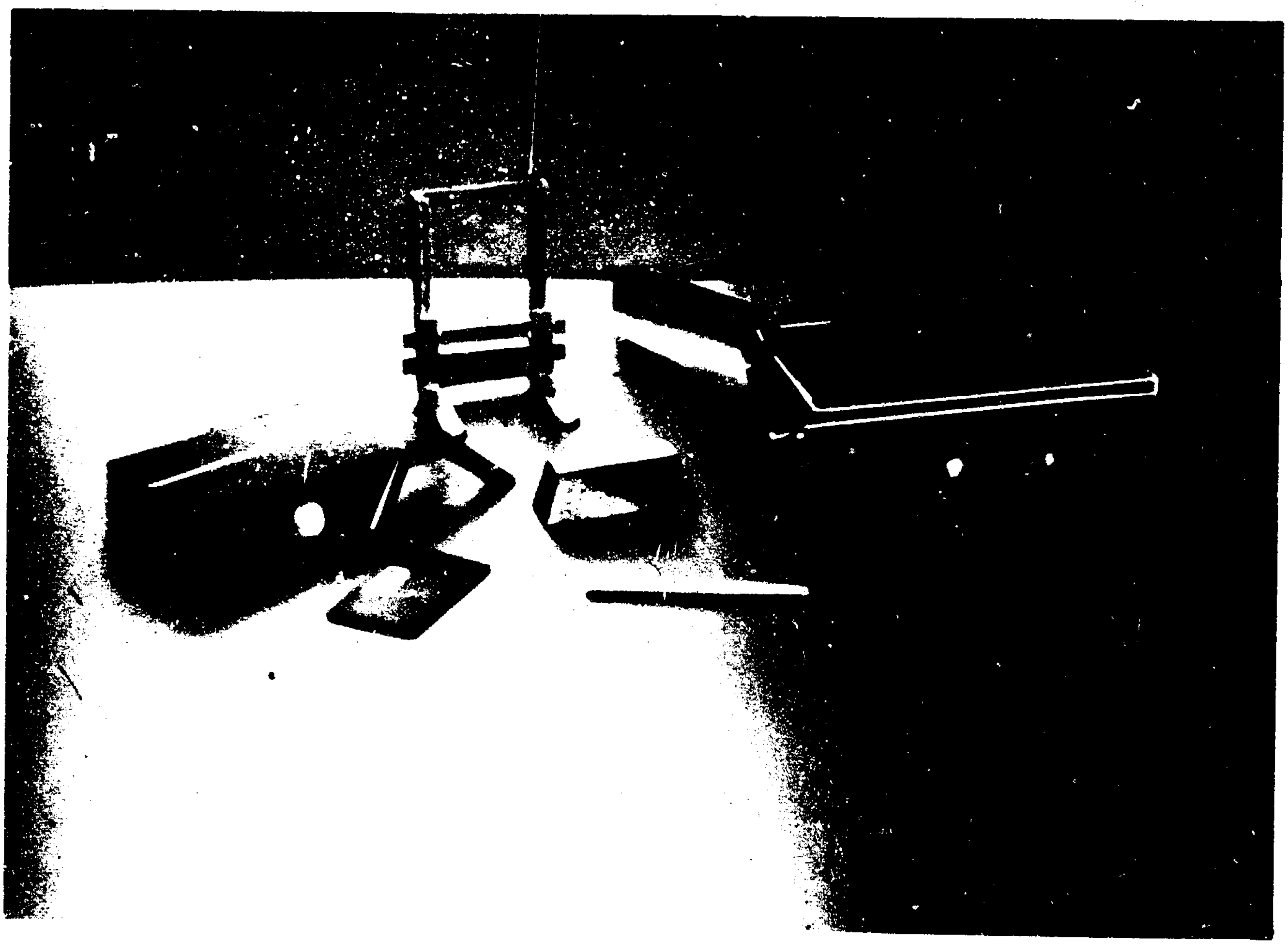


Fig. 11: Basic vehicle and assortment of attachments.

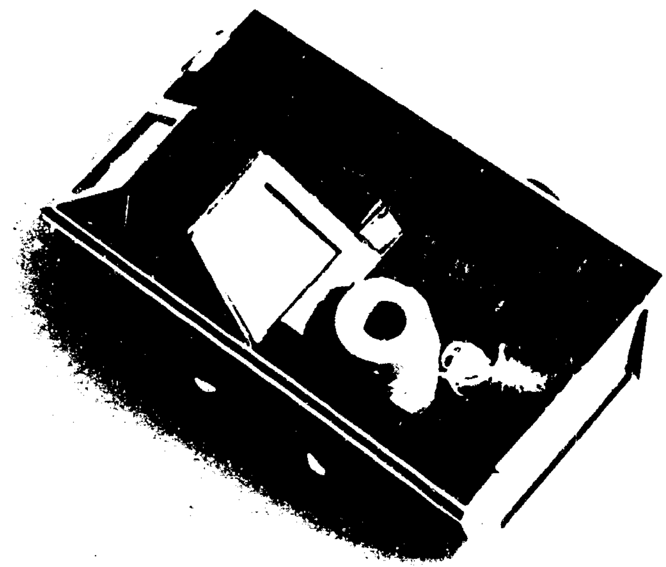


Fig. 12: Vehicle used for light hauling.

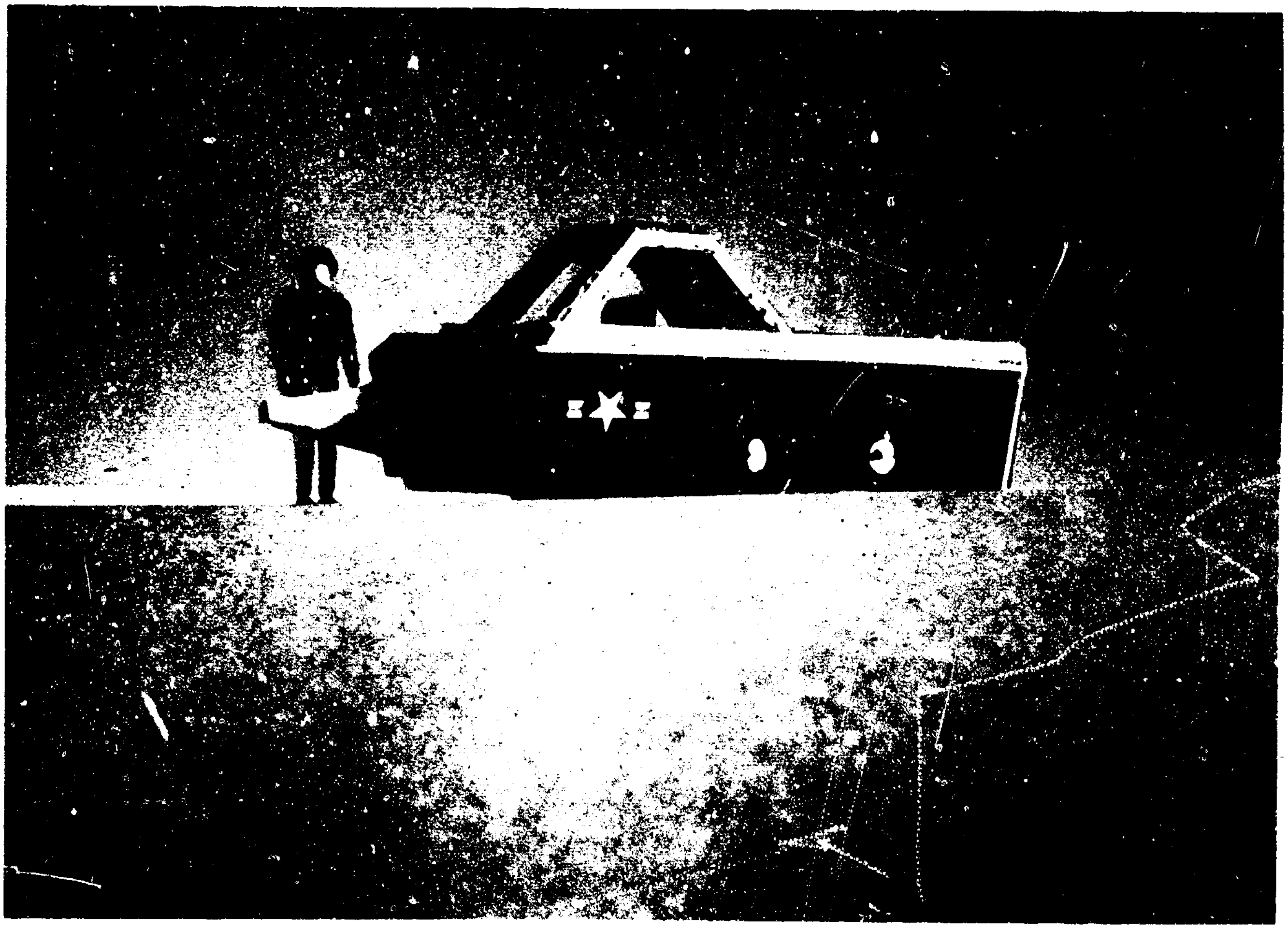


Fig. 13: Vehicle used as munitions carrier.

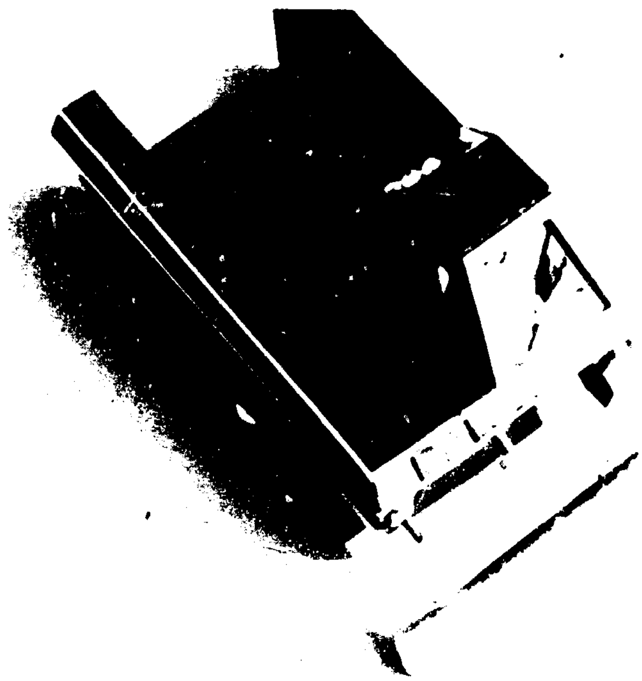


Fig. 14: Vehicle with scraper blade attachment.

Fig. 15: Vehicle with runway vacuum cleaner attachment.

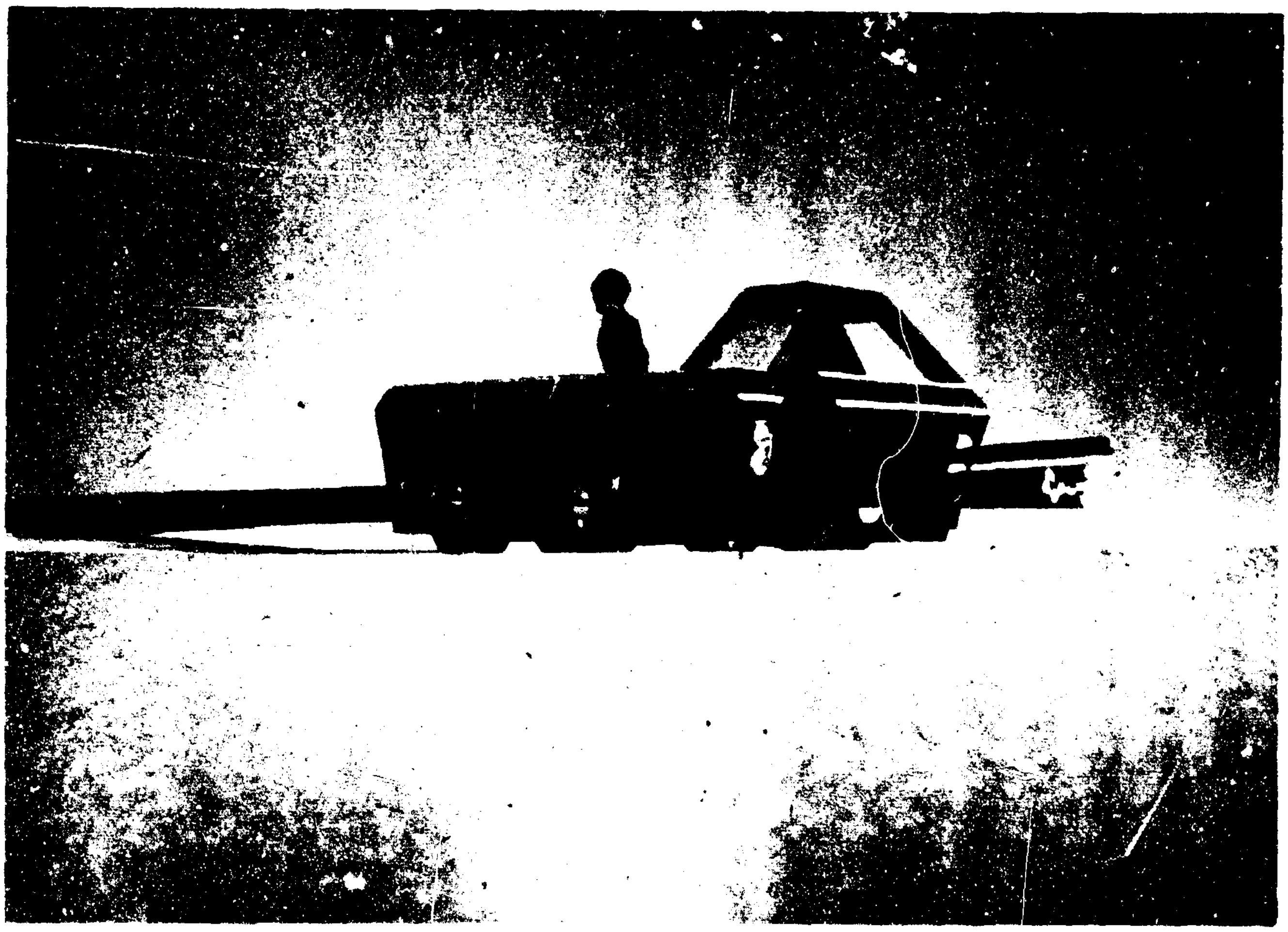


Fig. 16: Vehicle carrying structural members for shelter (lowered front and rear tailgates).

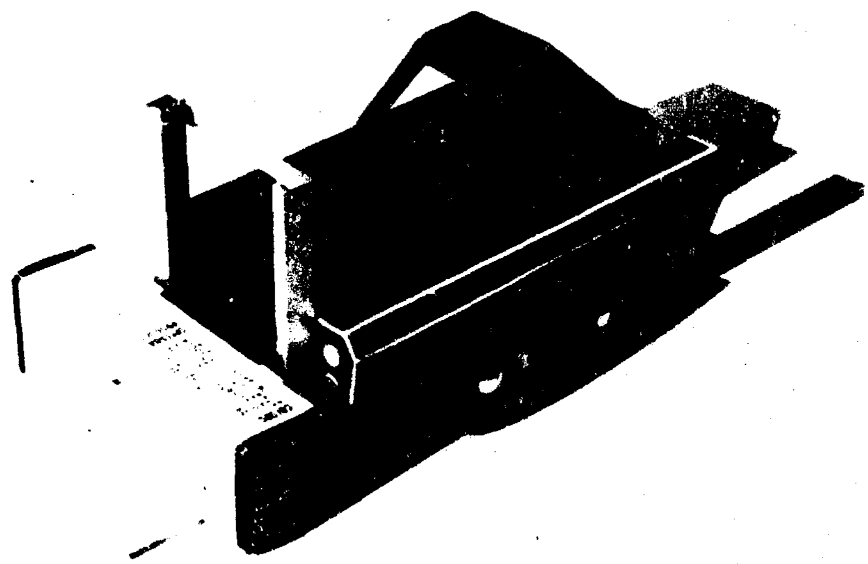


Fig. 17: Vehicle with fork lift attachment.

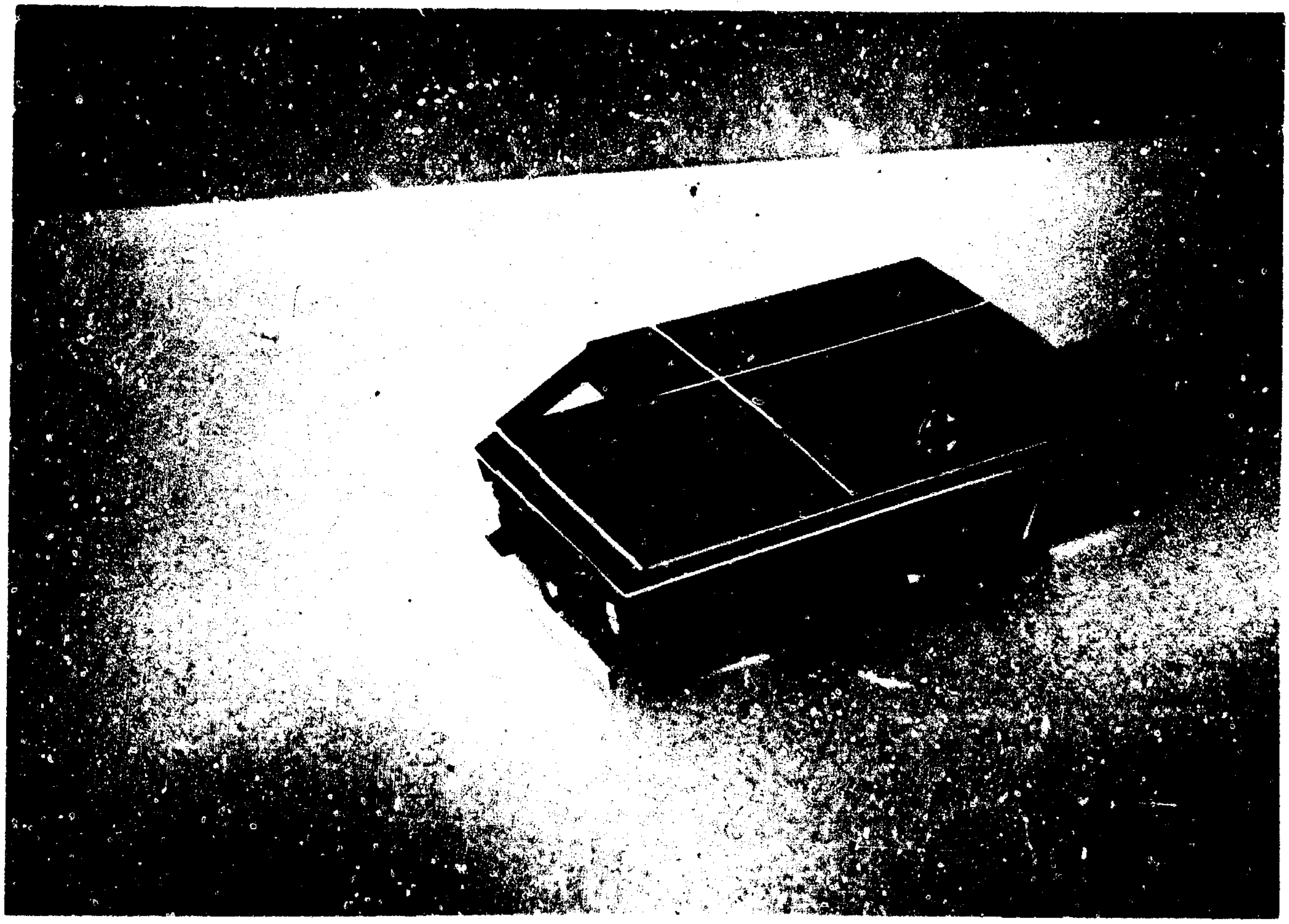


Fig. 13: Conversion of vehicle to closed van for use as ambulance.

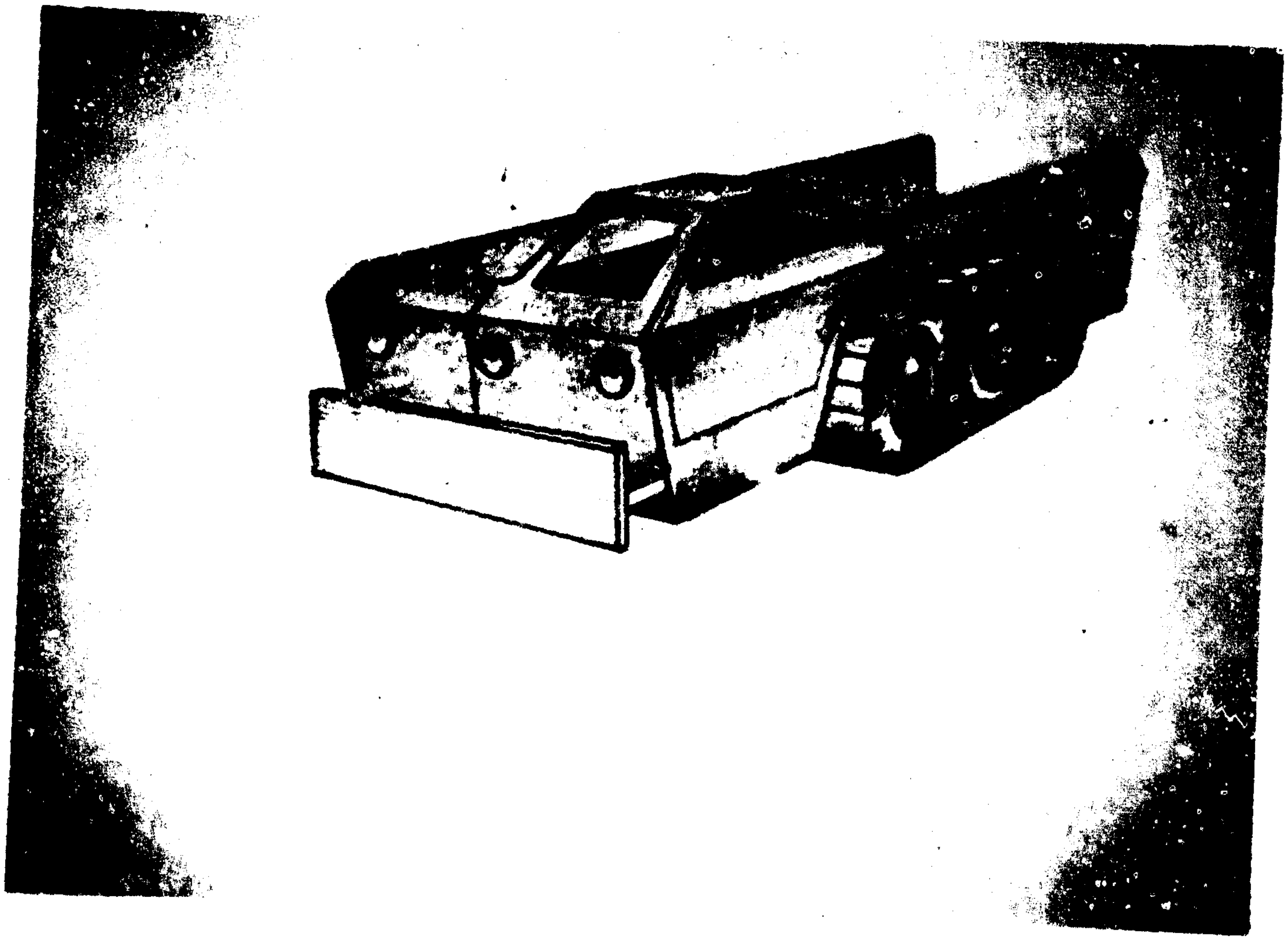


Fig. 19: General view of large vehicle.

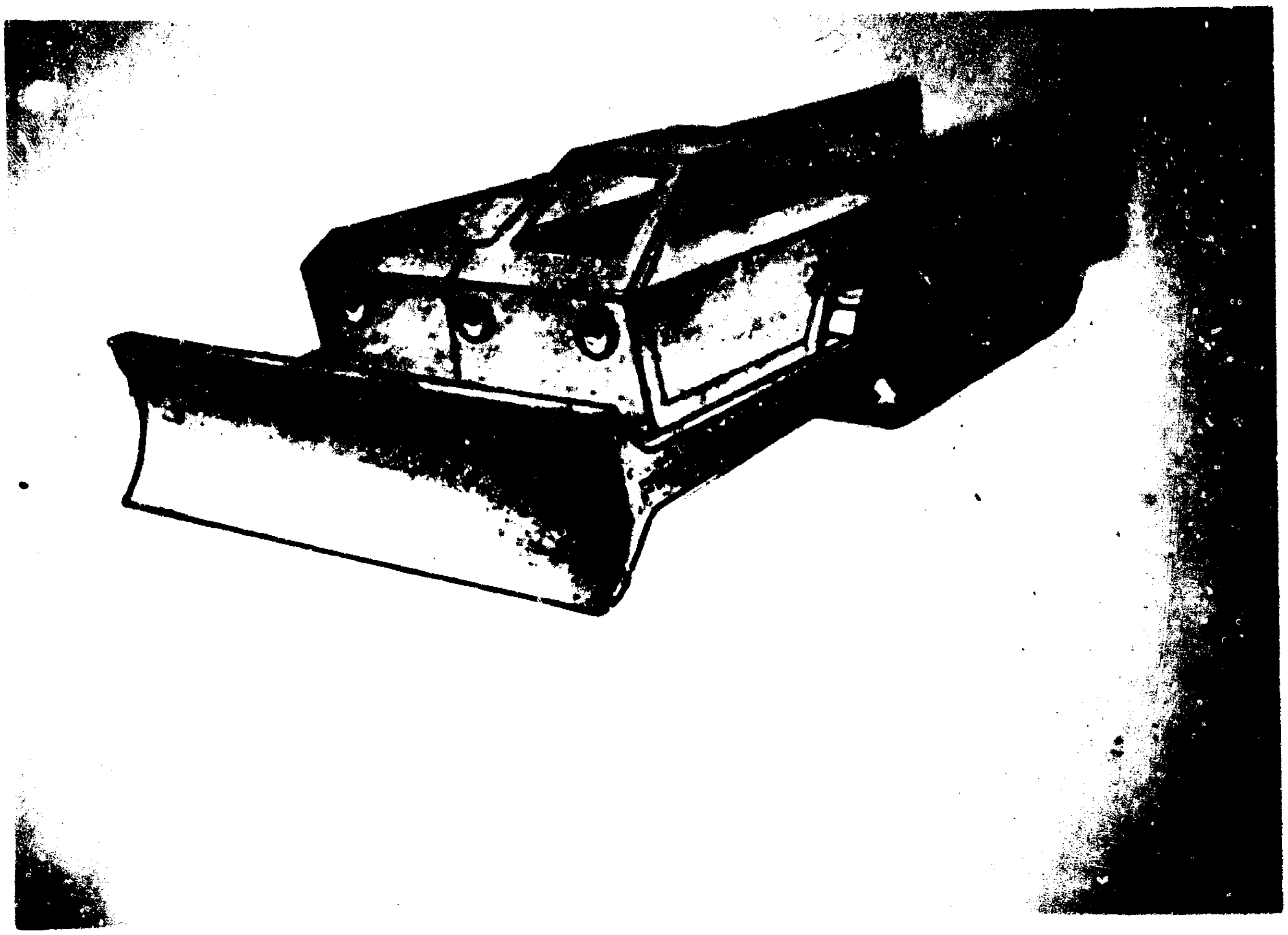


Fig. 20: Larger vehicle with dozer blade attachment.

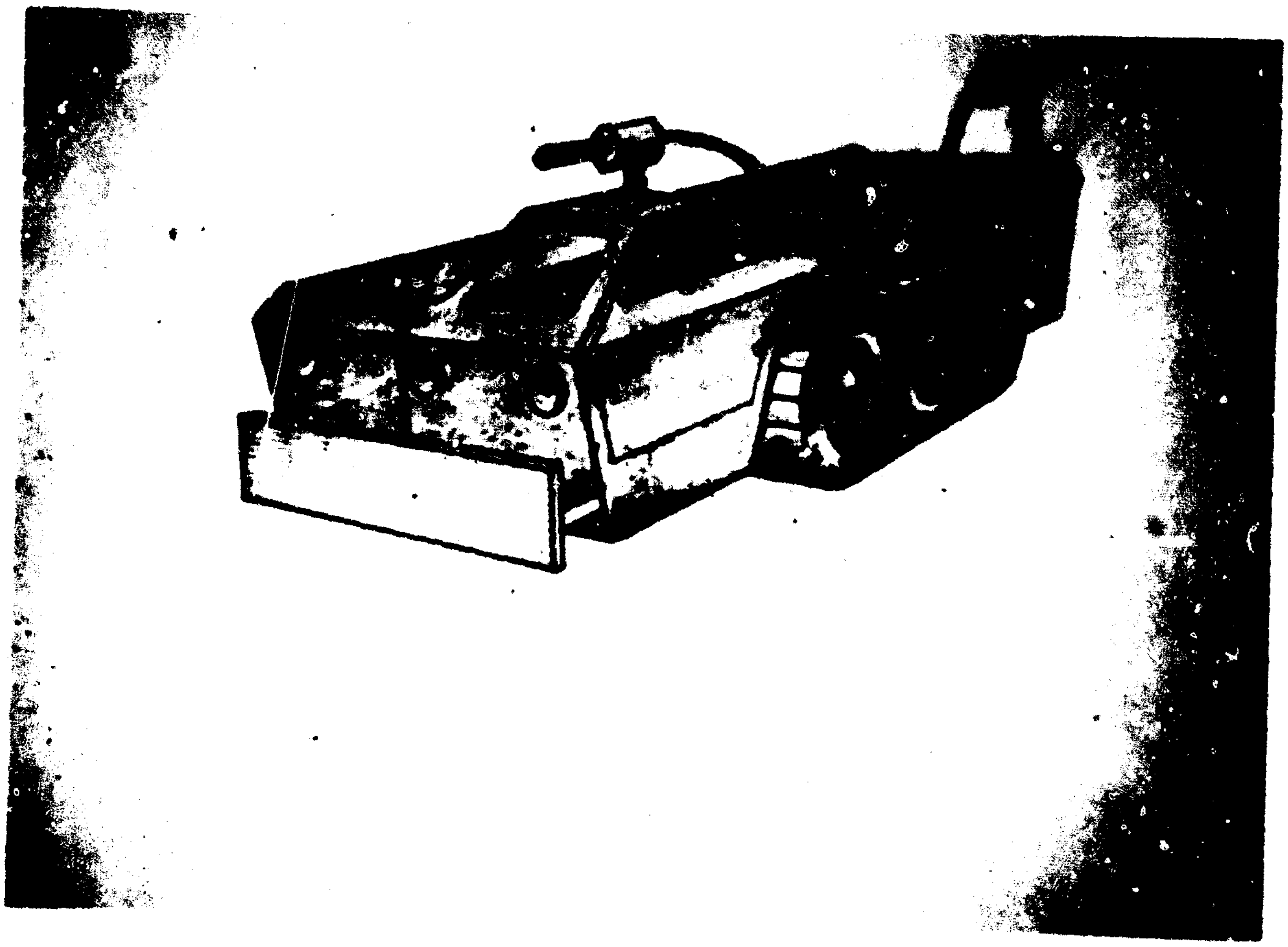


Fig. 21: Larger vehicle equipped as fire truck.

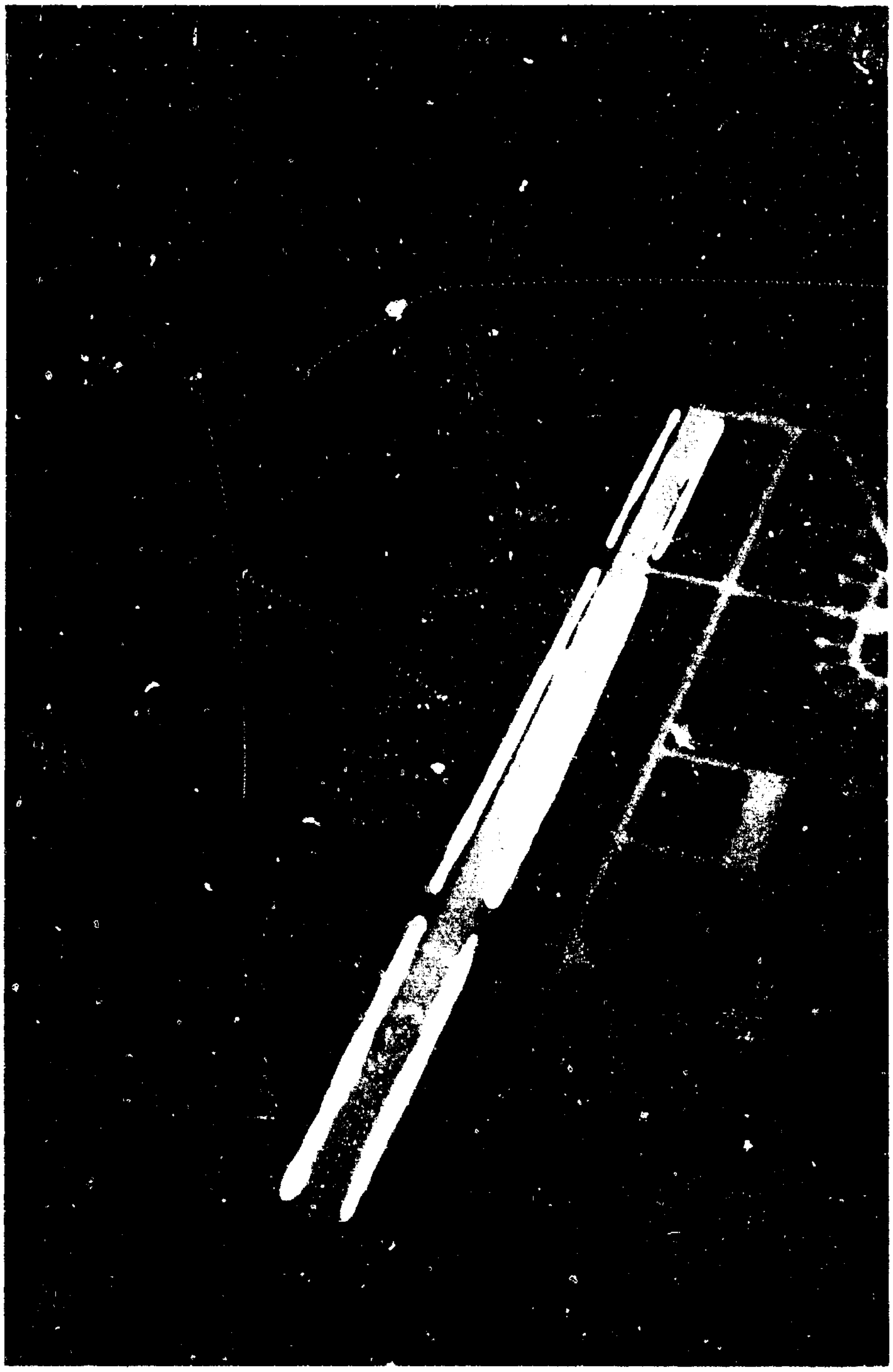


Fig. 22: Aerial view of runway lighting at night.

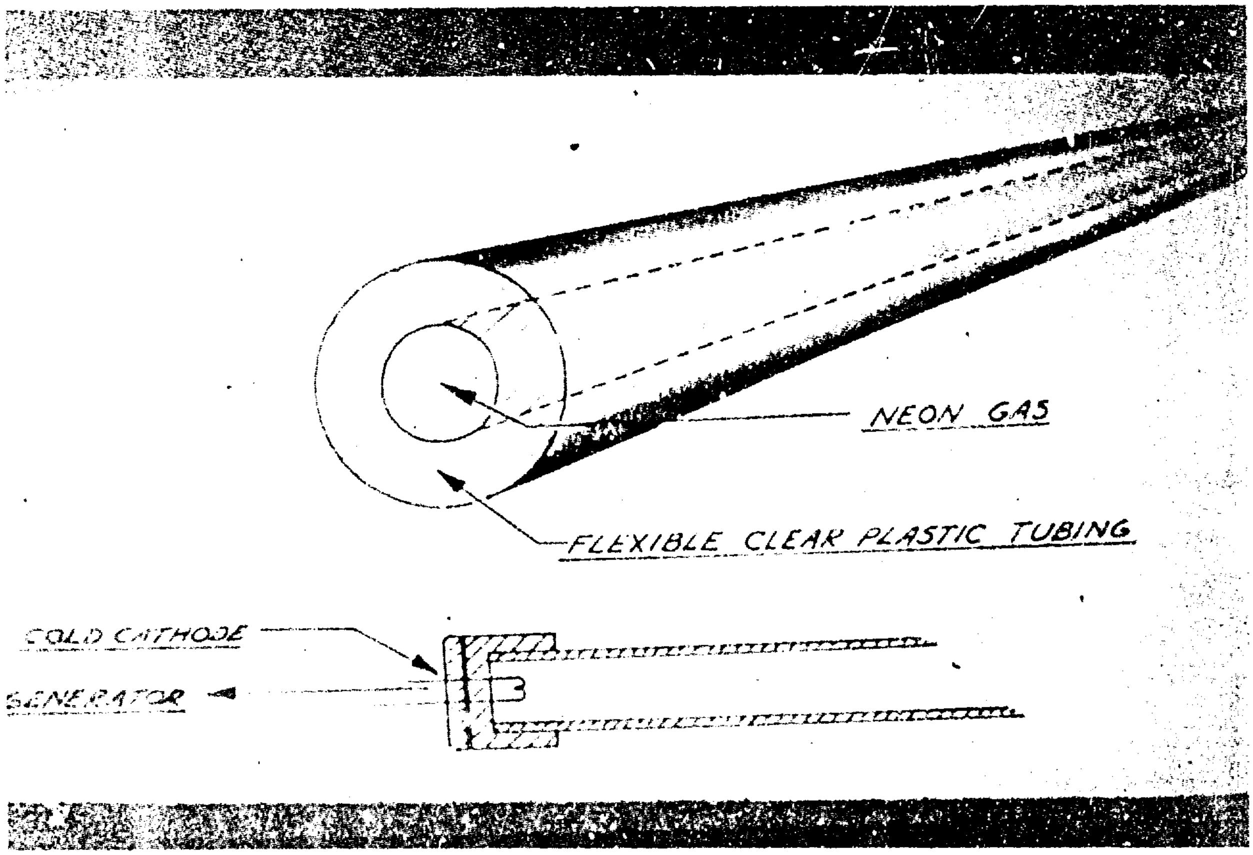


Fig. 23: Detail of runway lighting.