

## CHAPTER 4

## MATERIALS HANDLING EQUIPMENT (MHE) AND PRINCIPLES

## Section 1. BASIC PRINCIPLES

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**4-101. General**

*a. Definition.* Materials handling is the movement of materials to, through, and from productive processes; in receiving, storage, packing, and shipping areas. While materials handling practices vary, the basic principles remain constant. Since these basic principles are sometimes overlooked, certain underlying guidelines must be recognized.

*b. Least handling is the best handling.* The greatest economy in moving materials is secured by not handling the material at all. Since this situation rarely exists, an attempt must be made to keep handling to a minimum.

*c. Standardization of methods and equipment aids the materials handling activity.* Standardization of equipment results in the reduction of costs of operation, in that maintenance, repair, storage, and issue procedures can be simplified.

*d. Materials bundling equipment must be selected for a **multiple** number of applications.* Equipment selected should be chosen with the consideration that flexibility is the key note (i.e., that it can be used for multiple operations). Therefore, emphasis must be given to the flexibility with which equipment can be converted to handle other jobs.

*e. Specialized equipment **should** be kept to a **minimum**.* Materials-handling operations requiring special equipment are costly. Normally, **first** cost, cost of operation, and maintenance costs are greater for special equipment than for standard equipment.

*f. Volume dictates the method of handling materials.* The number of pieces to be moved determines the method of handling. Regardless of the

size, shape or value of an item to be moved, the first question to be answered before the selection of method for moving how many pieces are to be moved?

*g. Advanced planning on materials handling methods and equipment should be carried on simultaneously with other planning activities and **undertakings with full recognition of present and future factors.*** The most essential phase of any program is planning. To be effective, planning activities in our organizations must be coordinated. As an example, some of the factors requiring advanced planning are-

(1) *Protection required against weather or breakage.*

(2) *Legal and physical restrictions in **reference to transposition.***

(3) *The possibility of using unitized loads.*

(4) *The standardization of equipment and methods.*

(5) *Combining materials bundling **methods.***

(6) *Safety hazards involved.*

*h. Lengths and number of moves of **materials should** be kept to a minimum.* Movement paths of material should be studied for the possibility of reducing "backtracking" and length of moves, resulting in better utilization of equipment and personnel.

*i. Equipment capacities should never be exceeded.* The rated capacities of equipment should never be exceeded. Overloading causes excessive wear of equipment and creates additional accident potential.

*j. AU materials handling operations should be analyzed for improvement possibilities by elimi-*

*nation, combination or simplification.* Combination of operations may result in the simplification and reduction of the number of times that material has to be handled.

*k. Selection of materials handling equipment is based on the economies of operation.* These economies are measured in cost of moving the materials. Greater "pay loads" for each handling operation will result in less handling cost per piece.

*l. Physical state of materials is a factor in determining MHE.* The three physical states of material—solid, liquid or gas—determine the method of containment (pack). Gases are contained in cylinders; liquids such as acids are contained in carboys; and solids such as sheet and bar stock metals may require wood skids. This, in turn, influences selection of materials handling equipment.

*m. Straight line flow.* The shortest distance between two given points is a straight line. The time required to travel a given distance is reduced by following a straight line.

*n. AU materials handling operations should follow a defined method.* What causes variation in the length of time required for handling a given product? The method used in picking up, carrying to, setting down, and returning from is always the source of variation. The standardization of the method will provide a basis for determining handling requirements. It should be recognized that the establishing of this method, normally, will not require the detailed refinement as that used in such studies as micromotion analysis.

*o. Short, irregular moves lend themselves to manual materials handling.* Some materials handling operations do not occur with any degree of repetitiveness. The use of equipment for such an operation may be much more costly than manpower. When moves are short, irregular, and load capacity of men not exceeded, it may be more economical to use manpower.

*p. Wherever practicable, materials should be prepositioned for the handling operations.* Consideration should be given following handling operations. Such prepositioning moves as placing—

(1) Containers in a position to facilitate picking up.

(2) Containers on a conveyor in such a manner as to reduce accidents and lessen equipment damage.

(3) Materials so as not to obstruct other materials movements, will result in reduced materials

and equipment damage and a reduction in number of accidents.

*q. Wherever practicable, materials should be moved in horizontal plane or with the aid of gravity.*

When loading and unloading, personnel have to reach either down or up, excessive effort is used which might have been greatly reduced if the workplace layout had been planned. The ideal lifting position is at the waist. The nearer to the waist that a container or part can be picked up and disposed, the greater will be the efficiency.

#### 4-102. Containers.

*a. Definition.* A container is defined as a means which provides the necessary inclosure, using compatible material arranged so as to properly retain the product and restrain its movement to the degree necessary for protection in handling, storage and transportation. The proper selection and design consideration given to each container reduces loss or damage to parts and assures protection to the container, especially the re-usable types.

*b. Containers must provide necessary inclosure to retain the product properly and restrain its movement to the degree necessary for protection, handling and storing.* The principle states the requirements of any container. The degree to which the requirements are met depends on the economics involved. The container required for ladders would not have to retain or restrain the product to the same degree as one for aircraft engines.

*c. Minimum materials with maximum strength should be used in container construction.* When the possibility of tiering exists, containers should be so constructed as to support the maximum number of filled containers which may be placed on its top. While strength is required, a minimum of material capable of insuring that strength should be used.

*d. Containers should be designed for shipping and storage, as well as for use at point of use.* It is often possible to design a container so that it acts as a hopper or supply bin for work in process. When this situation exists, storage area, cost of handling and container costs may be reduced.

*e. Unit load is basic, container incidental.* Regardless of the type of container used, the important factor is the method of loading that container. Greater economy is obtained through the use of the unit load as more material can be moved at a single time. The more pieces or pounds moved, as a unit load in a single handling operation, the lower the

cost per piece or per pound and the shorter the time required to move any given volume.

*f. Collapsible containers require less storage space when empty, and can be returned at lower transportation costs.* Because of the high transportation costs, it is important that a thorough study be made before selecting returnable containers. Some of the factors to be considered in the selection of returnable containers are-

(1) First cost, including initial shipping from container manufacturer.

(2) Cost of transportation to and from its destination.

(3) Total investment required.

(4) Records involved.

(5) Potential loss resulting from damage to product.

(6) Maintenance cost.

(7) Accumulating, segregating and storage space involved at both user and supplier stations.

(8) Conservation of material resources.

(9) Number of re-uses likely to be made.

*g. Containers must be standardized wherever possible.* Standardization of containers facilitates materials handling, in that carriers, loading and unloading devices, conveyors, measuring methods and methods of handling can be standardized. When containers are standardized the amount of equipment necessary for handling can be reduced.

*h. Unit loads should be increased to economic maximum.* Greater economy is obtained as the unit load is increased, provided container or equipment capacity is not exceeded. The more pieces carried in one load, the greater the efficiency.

#### 4-103. Loading and Unloading

*a. General.* Those familiar with materials handling activities recognize the fact that the major portion of personnel in that area are engaged in loading and unloading activities. It is, therefore, important that this materials handling function be given a great deal of consideration. Loading and unloading activities cover the necessary operations to handle or transfer the many kinds of materials to or from various carriers.

*b. Where economical loading and unloading personnel should be replaced with mechanical devices.* Where volume, size and/or weight merit, mechanical handling devices can be used economically. Such devices as conveyors, industrial trucks, cranes, etc., aid the loading and unloading activity. Safety

hazards can be reduced and protection increased when mechanical devices are used in place of personnel. The opportunity for loss and damage of packages is greatly reduced when manual handling is kept to a minimum.

*c. Proper loading and unloading will prevent damage.* In most instances, loose material is subjected to more damage than properly packed material. Adequate planning should precede any loading operation, recognizing such factors as center of gravity of carrier, adequate dunnage, heavy material on bottom, rated capacity of carrier, possibility of container and product damage while in transit.

*d. Points of material pickup and delivery should be kept to a minimum.* A larger number of pickup and delivery points will increase the loading and unloading requirements, thus affecting manpower and costs. The possibility of combining several pickup points into one central point should be considered.

*e. Where economical, material should be segregated by source or destination.* In segregating material by source or destination, unnecessary shuffling and reshuffling of material is eliminated. Segregation of material for this purpose is advantageous in all cases where volume is great enough to warrant.

*f. High priority items should be placed in an accessible location.* Proper loading of high priority material will expedite delivery at destination, so it can readily be unloaded.

*g. Area, materials, tools, and equipment should be provided at proper locations.* In the loading and unloading of boxcars, areas for dunnage, strapping, strapping tools, lumber, tools, and other miscellaneous equipment and supplies should be provided at easily accessible points.

*h. Adequate lighting and ventilation must facilitate loading and unloading.* Proper ventilation and lighting facilities will aid in the reduction of errors and accidents in loading and unloading area. Portable lights and fans should be considered on docks and carriers where needed.

*i. Dock heights should, as nearly as possible, be compatible with bed height of carriers.* This is primarily achieved with bridge plates or permanently installed adjustable ramps.

*j. Expedited materials should be loaded and unloaded at a specific dock or location.* Such items as parcel post, air freight, express have the tendency

to congest dock areas unless ample facilities are provided. Normally, the "detention time" for the agency, acting as carrier of expedited material, is short; but the loading and unloading delays which they may create are costly.

#### 4-104. Conveyors

*a. Definition.* A conveyor, excluding mobile units, is defined as a device to move materials along a defined path. The storage and shipment of units in large quantities and materials handling depend upon each other. Since conveyors are one of the major devices for the handling of materials, the task of getting the highest efficiency and economy out of the use of conveyors involves selecting the right conveyor or system of conveyors for the job. Today, the conveyor is recognized as one of the more important tools in the materials handling field. It is a cost-saving, energy-saving, and profit-making modern mechanism.

*b. Before selecting a conveyor as a purely transporting medium, the economics involved should be studied.* The cost of placing the item on, or removing it from the conveyor may exceed the value gained through the use of the conveyor.

*c. Gravity conveyors should be used where practicable.* When the analysis of the product indicates that for loading and unloading highway and railway equipment some type of conveyance" is required to facilitate the operation, roller feed gravity conveyors should be considered. Gravity conveyors are used to advantage when loading or unloading small containers as they reduce handling and the need for industrial trucks, thus reducing detention time. Maintenance cost for gravity feed conveyors is considerably lower than for other means of conveyance.

*d. Conveyor speed controls rate of material delivery.* The rate at which materials arrive at the work station can be controlled by the conveyor speed to maximize work station output.

*e. Whenever practicable, conveyors should be standardized.* Conveyors should be purchased utilizing standardized specifications to reduce the cost of repair, the stockage of repair parts, and the cost of maintenance training. Cost and repair data should be maintained and used in the improvement of specifications.

*f. Wherever practical, conveyor loading and unloading should be accomplished by mechanical means.* A basic principle of any materials handling operation is: "Do not handle the item except for

performance of essential operations." Material should be moved mechanically whenever possible with emphasis on movement through the entire operation with minimized manual actions. Mechanical loading and unloading of material should be emphasized (i.e., items can be moved from belt conveyors to power and free conveyors by automatic pickup station). The use of mechanical handling aids will maximize the productive time of available manpower.

*g. Synchronization of conveyors eliminates waits at transfer points and destination.* Another advantage of the variable speed conveyor is that it can be set so as to tie in with other lines of operations.

*h. Conveyor installations must provide adequate clearances for industrial trucks.* This applies not only to the vertical plane, but also to the horizontal plane. In conveyor installations, ample clearance should be provided for industrial trucks and loads to be carried.

#### 4-105. Industrial Trucking

*a. Definition.* Industrial trucks are defined as mobile equipment and accessories designed for intradepot or on base facilities materials handling. This covers a wide variety of mechanical equipment, each designed to perform some materials handling job efficiently. No one unit will perform all operations.

*b. An economic balance exists between the amount of equipment used and the volume of materials handled.* Too often the amount of equipment available is not sufficient. This results in the use of more costly means of moving materials or not being able to keep up with required schedule. The condition sometimes exists where too many units are available; consequently, there are idle units. Through proper performance records and planning the most economical number of operating units can be determined.

*c. The distance to be traveled is the principal factor in determining the proper equipment.* "How far" will determine the equipment to be used. A tractor train is more economical to use for long hauls than the fork truck. In some instances manual movement is more economical when the distance is just a few feet.

*d. Industrial trucking operational costs should be analyzed.* It is important that an operational cost record be kept of every unit of equipment to provide information which, among other things, may be

used to improve preventive maintenance and the selection of new equipment.

#### 4-106. Effective Utilization of Manpower

*a. General.* Manpower is perhaps the most basic facility for handling materials. Throughout the materials handling and processing cycle manual handling may occur. In view of this condition each

situation should be examined for possible improvement.

*b. Efficiency in MHE operations.* Where a known manual handling operation exists, it should be accomplished in an efficient manner to preclude repetitive handling at another stage in the material processing cycle. An example would be proper palletizing of material at the receiving dock to eliminate **repalletizing** at the warehouse where the material will be stored.

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#### 4-201. Introduction

The illustrations in this section show some of the basic MHE and storage accessories used by DOD Components. The MHE equipment illustrated falls into two basic categories: powered and nonpowered as defined and set forth in Military Standard 137C, Materials Handling Equipment. The inclusion of MHE and storage accessories in this section does not preclude the continued use or adoption of devices with similar purposes.

#### 4-202. Forklift Trucks

##### *a. General.*

(1) A forklift truck is a vehicle designed to pick up, carry, and stack unit loads of supplies and equipment. Standard forklift trucks are available with lifting capacities of from 2,000 to 20,000 pounds and lifting heights of from 100 to 210 inches. The trucks are equipped with telescopic masts that permit loads to be lifted beyond the height of the collapsed mast, and most trucks have **free** lift, which is the height to which the forks can be raised before the inner slides move upward **from** the mast and in-

crease the overall height. Gasoline-powered forklift trucks may be equipped with solid-rubber or semi-solid tires for use in warehouses or pneumatic tires for use in outdoor storage areas; electric-powered forklift trucks are equipped with solid-rubber or semisolid (or cushion) tires for indoor operation only. Forklift trucks are not designed to be used as tow vehicles and should not be used for that purpose.

(2) Whenever a truck is equipped with vertical only, or vertical and horizontal controls **elevatable** with the lifting carriage or forks for lifting personnel, the following additional precautions shall be taken for the protection of personnel being elevated

(a) Use of a safety platform **firmly** secured to the lifting carriage and/or forks.

(b) Means shall be provided whereby personnel on the platform can shut off power to the truck.

(c) Such protection from falling objects as indicated necessary by the operating conditions shall be provided.

*b. Standard items.* The following types of forklift

trucks have been adopted as standard for the military services.

(1) *Truck, forklift, solid or semisolid rubber tires, 2,000-pound 100-inch lift.*

(a) *Type of power.* Gasoline.

(b) *Load center.* 24 inches.

(c) *Standard operating aisle.* 9'6 with 40 load length.

(d) *Application.* This is a special-purpose light duty forklift truck designed for use in areas where low overhead clearance requires the use of a truck with a low collapsed mast height. Also suitable for truck and rail car loading (fig. 4-1).

(2) *Truck, forklift, solid or semisolid rubber tires, 2,000-pound, 100-inch lift.*

(a) *Type of power.* Electric.

(b) *Load center.* 24 inches.

(c) *Standard operating aisle.* 9'6 with 40 load length.

(d) *Application.* This truck is normally used for essentially the same purposes as the gasoline-powered model. It is widely used for handling explosives and flammables, when properly shielded, and for operations that involve movement to and from cold-storage areas (fig. 4-2).

(3) *Truck, forklift, solid or semisolid rubber tires, 2,000-pound 127-inch lift.*

(a) *Type of power.* Gasoline or electric.

(b) *Load center.* 24 inches.

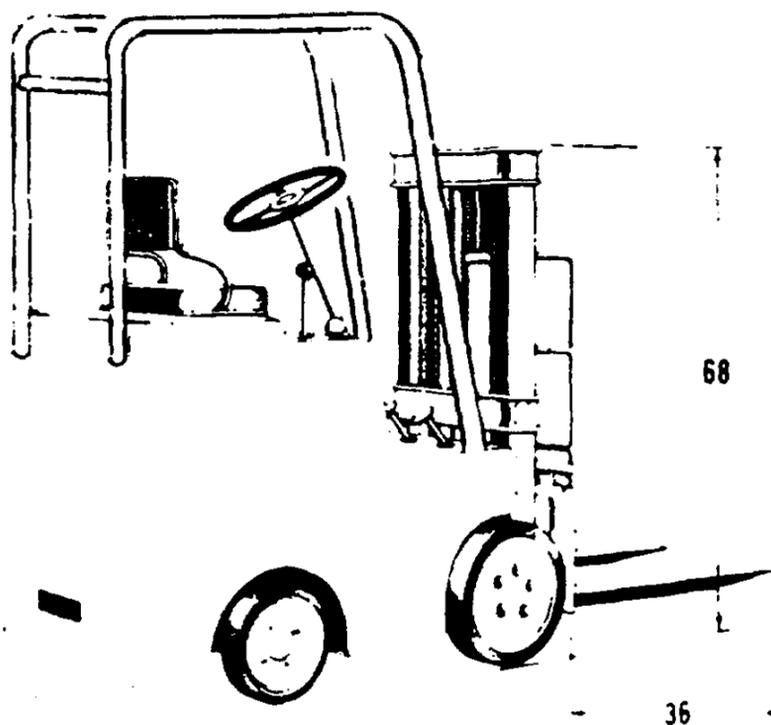


Figure 4-1. *Truck, forklift, solid or semisolid rubber tires, 2,000-pound, 100-inch lift.*

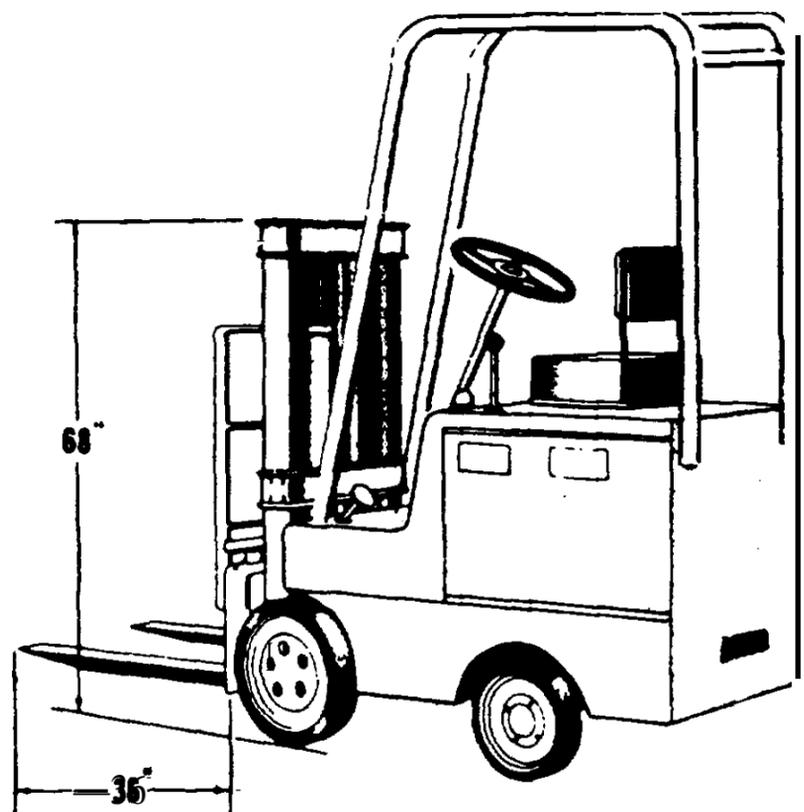


Figure 4-2. *Truck, forklift, solid or semisolid rubber tires, 2,000-pound, 100-inch lift.*

(c) *Standard operating aisle.* 9'6 with 40 load length.

(d) *Application.* Basic light-duty truck for indoor warehousing operations. Mast and lifting height permit entry into rail cars. Maneuverability allows fast and easy operation in cross and main aisles. Lifting height and capacity are sufficient for effective stacking of small, uniform, light loads. Electric-powered models are more suitable than gas for poorly ventilated areas and, when properly shielded, for handling of flammable items and explosives (fig. 4-3).

(4) *Truck, forklift, pneumatic tires, 2,000-pound, 127-inch lift.*

(a) *Type of power.* Gasoline.

(b) *Load center.* 24 inches.

(c) *Standard operating aisle.* 9'6" with 40 load length.

(d) *Application.* This truck is used in essentially the same manner as models with solid-rubber tires, and may also be used for limited outdoor storage operations in areas with hard standings and on relatively smooth surfaces offering little tractive resistance (fig. 4-4).

(5) *Truck, forklift, solid or semisolid rubber tires, 4,000-pound, 100-inch lift.*

(a) *Type of power.* Gasoline.

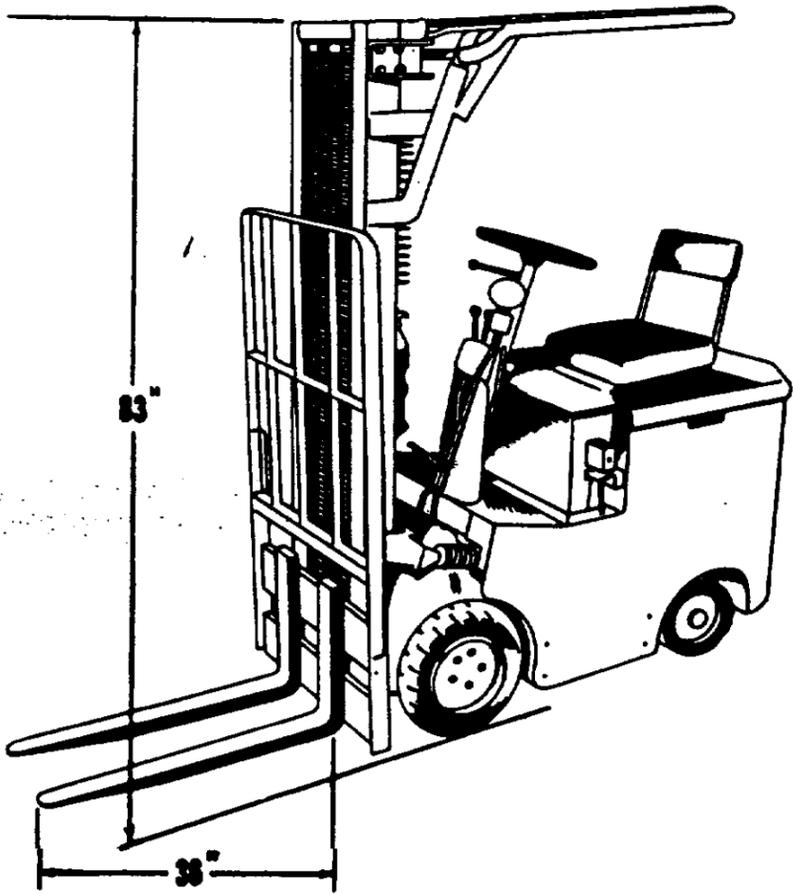


Figure 4-s. Truck, forklift, solid or semisolid rubber tires, 2,000 -pound, 127-inch lift.

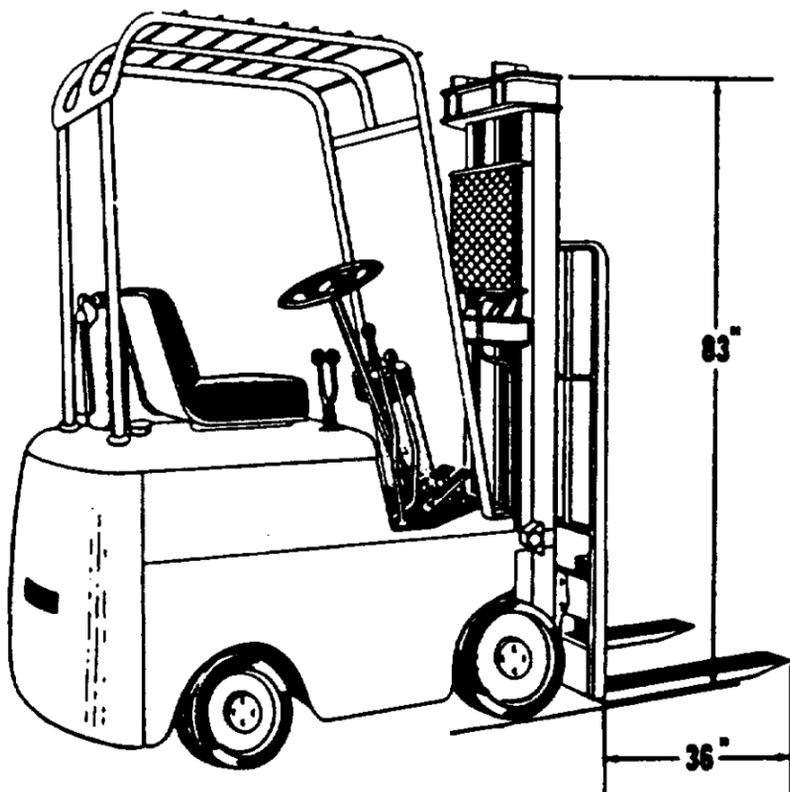


Figure 4-4. Truck, forklift, pneumatic tires, 2,000 -pound, 127-inch lift.

(b) *Load center.* 24 inches.  
 (c) *Standard operating aisle.* 10 feet with 40 load length.

(d) *Application.* Standard low-mast, medium duty forklift truck used in operations where low collapsed mast height is necessary because of limited overhead clearance (fig. 4-5).

(6) *Truck, forklift, solid or semisolid rubber tires, 4,000-pound, 100-inch lift.*

(a) *Type of power.* Electric.

(b) *Load center.* 24 inches.

(c) *Standard operating "aisles.* 10 feet with 40 load length.

(d) *Application.* Standard low-mast, medium-duty electric forklift truck used in essentially the same manner as the gasoline-powered model. It is more suitable than gas for operation in poorly ventilated areas and, when properly shielded, can be used for the handling of flammable items and explosives. It may also be used for operations in cold-storage areas (fig. 4-6).

(7) *Truck, forklift, solid or semisolid rubber tires, 4,000-pound, 144-inch lift.*

(a) *Type of power.* Gasoline or electric.

(b) *Load center.* 24 inches.

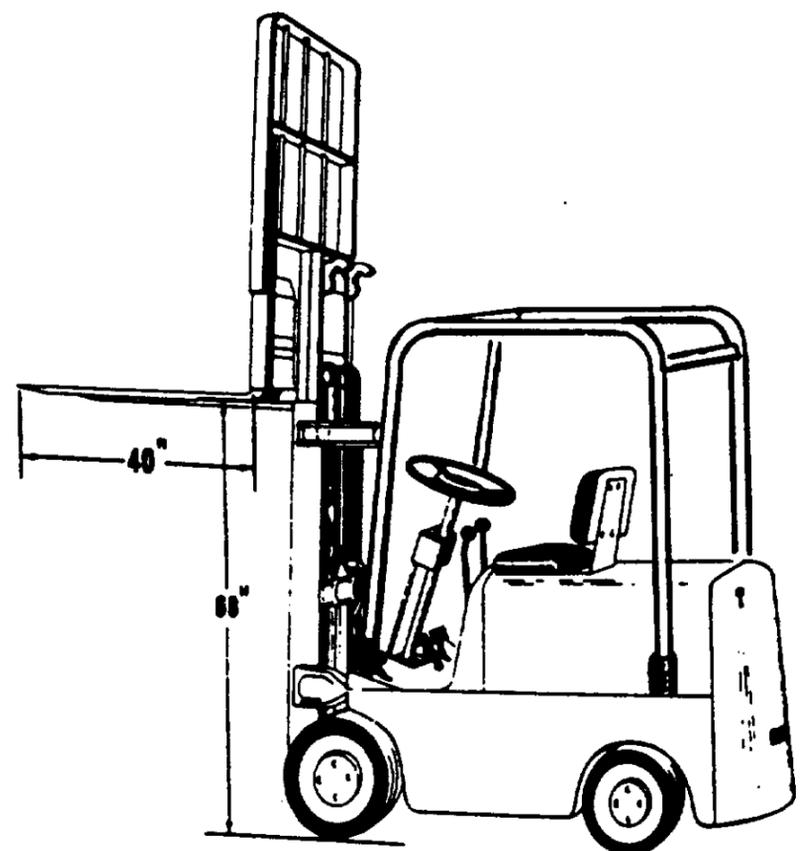


Figure 4-5. Truck, forklift, solid or semisolid rubber tires, 4,000-pound, 100-inch lift.

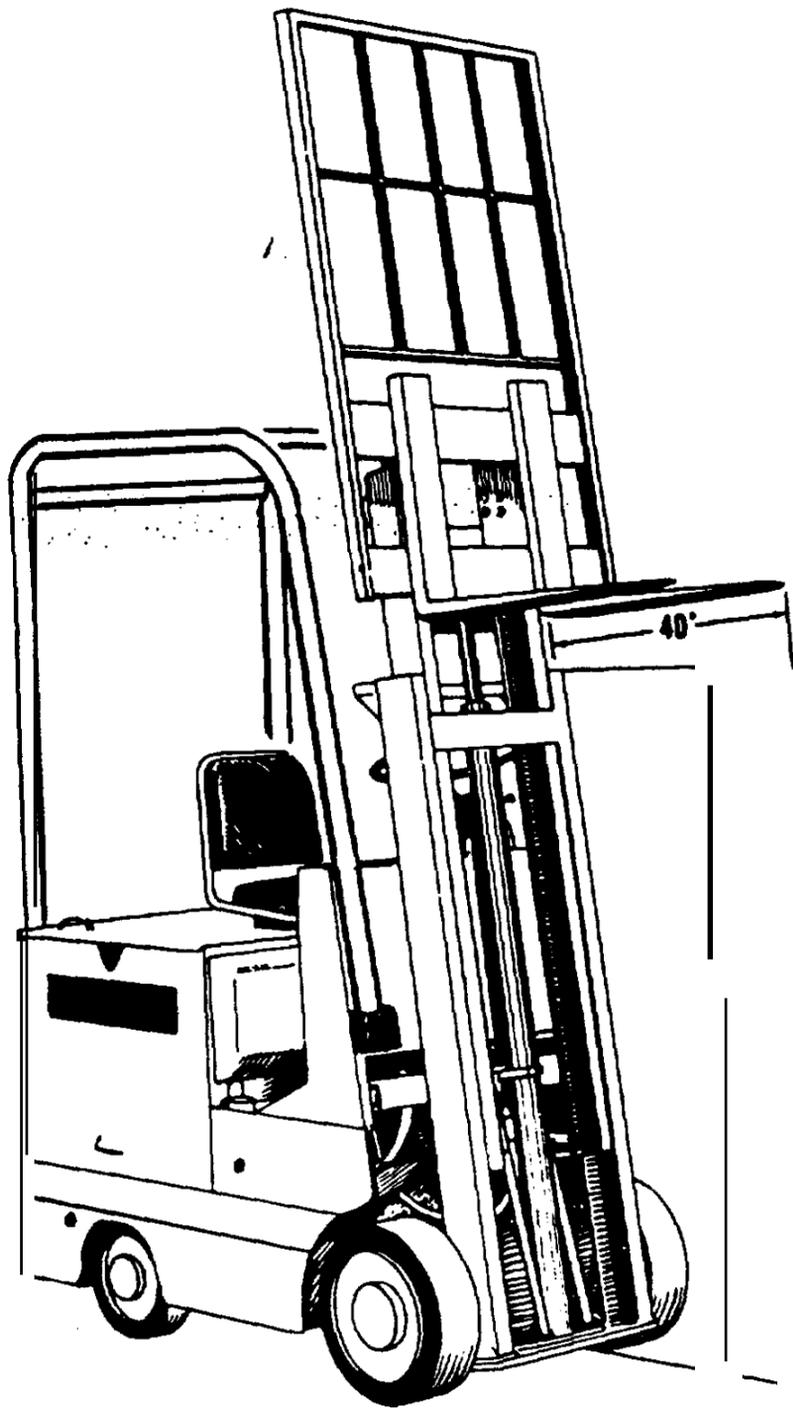


Figure 4-6. Truck, forklift, solid or semisolid rubber tires, 4,000-pound, 100-inch lift.

(c) Standard operating aisle. 10 feet with 40 load length.

(d) Application. This model is most widely used in the military storage system. Because of its versatility, it can be used for most general medium-duty inside warehousing. It is capable of entering rail cars for loading and unloading.

(8) Truck, forklift, pneumatic tires, 4,000-pound, 144-inch lift.

(a) Type of power. Gasoline.

(b) Load center. 24 inches.

(c) Application. General-purpose medium-duty forklift truck for outdoor storage operations.

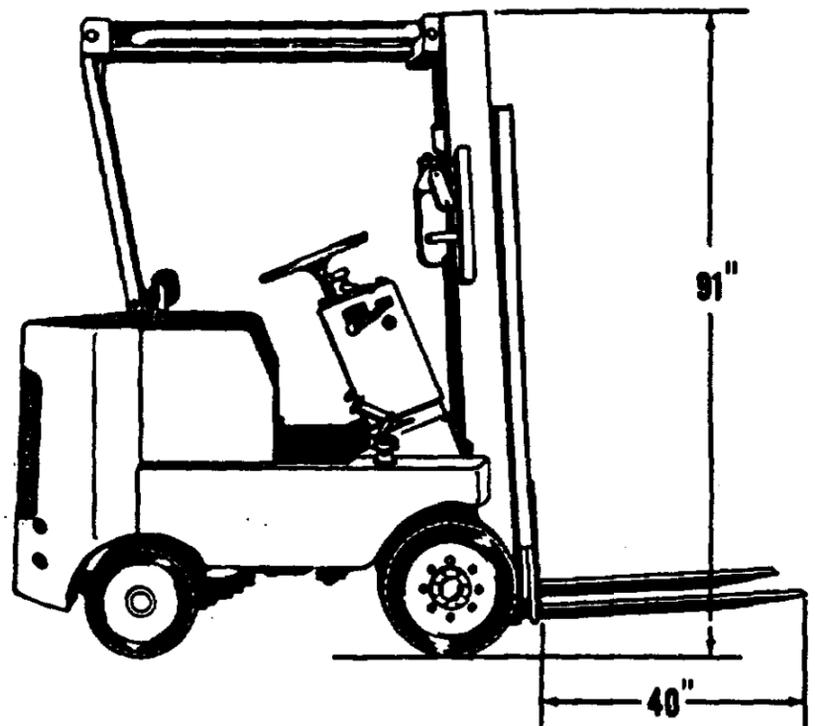


Figure 4-7. Truck, forklift, solid or semisolid rubber tires, 4,000-pound, 118-inch lift.

It has maneuverability to operate in relatively confined outdoor storage areas; and can operate satisfactorily on many types of road surfaces and graded areas, including cinders or gravel (fig. 4-8).

(9) Truck, forklift, pneumatic tires, 6,000-pound, 127-inch lift.

(a) Type of power. Gasoline.

(b) Load center. 24 inches.

(c) Application. Basic heavy-duty truck for outdoor storage operations. It has a longer wheel-

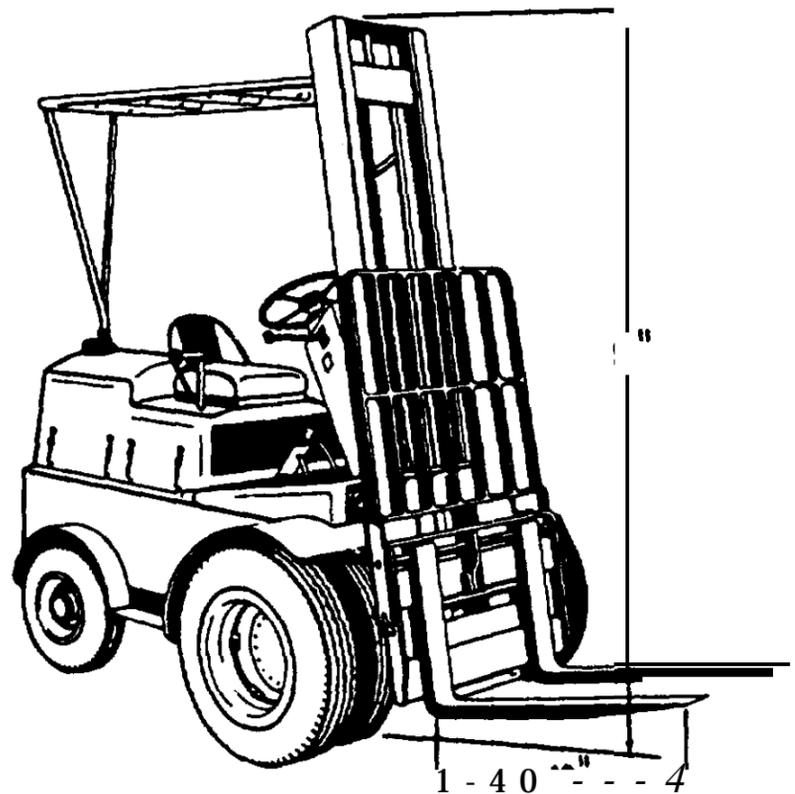


Figure 4-8. Truck, forklift, pneumatic tires, 4,000-pound, 144-inch lift.

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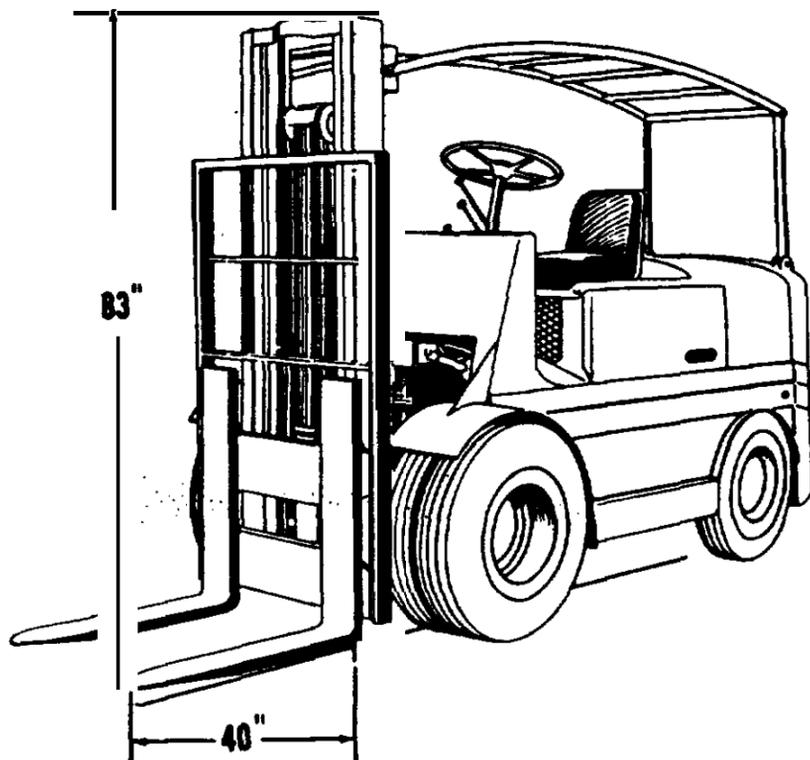


Figure 4-9. Truck, forklift, pneumatic tires, 6,000-pound, 127-inch lift.

base and greater stability than the 4,000-pound model and can operate over rougher surfaces. Selection of truck depends more upon size and weight of load than upon lifting height. Low lifting height and lack of maneuverability restrict adoption of truck as a general-purpose, heavy-duty model (fig. 4-9).

(10) *Truck, forklift, solid or semisolid rubber tires, 6,000-pound, 100-inch lift.*

(a) *Type of power.* Gasoline.

(b) *Load center.* 24 inches.

(c) *Standard operating aisle.* 11'6 with 40 load length.

(d) *Application.* A special-purpose, heavy-duty truck for indoor storage operations, principally shipping and receiving. The truck may also be used to handle and stack loads in low ceiling areas such as vaults at ports of embarkation. Although mast height permits entry into vans and rail cars, the weight of the truck and lack of maneuverability must be taken into consideration before the truck is used for direct loading or unloading. The truck may be used, however, to transfer heavy or bulky loads from rail cars to a tractor-trailer train (fig. 4-10).

(11) *Truck, forklift, solid or semisolid rubber tires, 6,000-pound 127-inch lift.*

(a) *Type of power.* Gasoline or electric.

(b) *Load center.* 24 inches.

(c) *Standard operating aisle.* 11'6 with 40 load length.

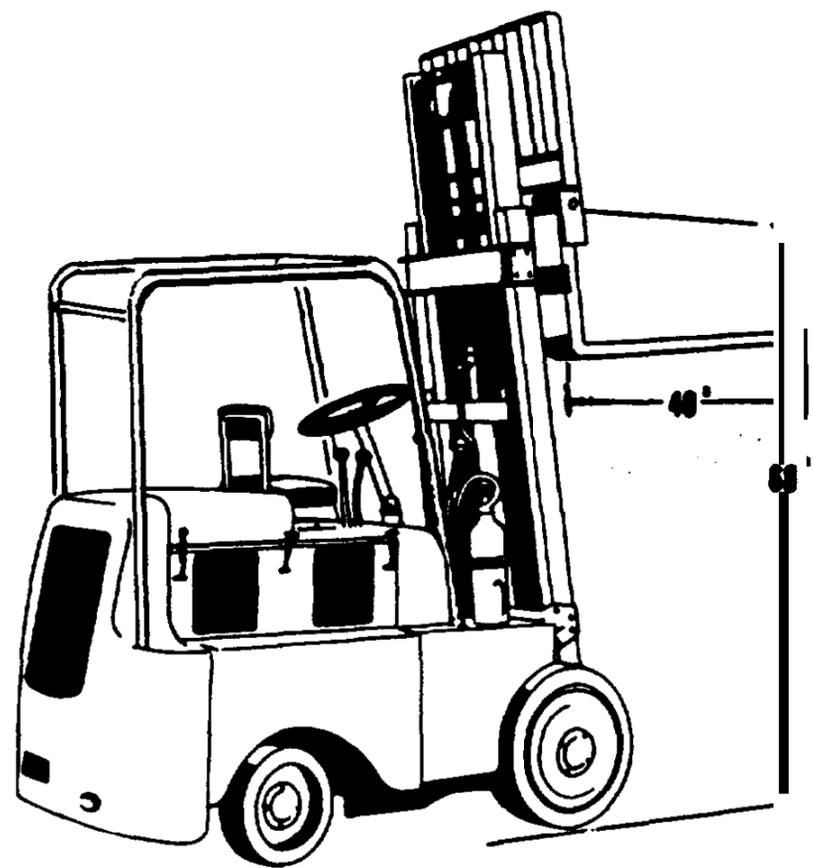


Figure 4-10. Truck, forklift, solid or semisolid rubber tires, 6,000-pound, 100-inch lift.

(d) *Application.* Basic heavy-duty truck for indoor storage operations. It is used when additional lifting capacity is required to handle heavy loads. Electric-powered models, when properly shielded, are used to handle explosive or flammable items and in areas where gasoline-powered trucks are impracticable due to possible damage to supplies or harm to personnel (fig. 4-11).

(12) *Truck, forklift, solid or semisolid rubber tires, 6,000-pound, 168-inch lift.*

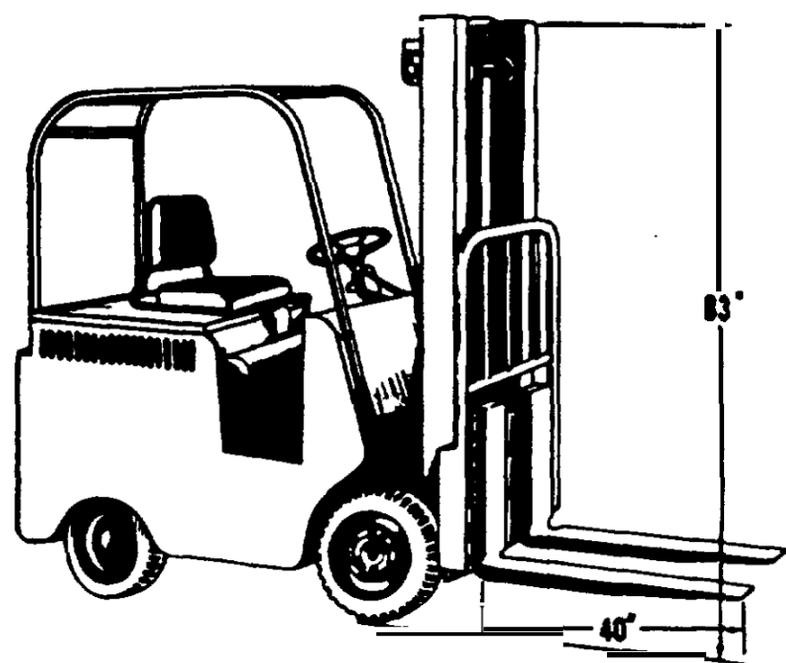


Figure 4-11. Truck, forklift, solid or semisolid rubber tires, 6,000 -pound, 127-inch lift.

- (a) *Type of power.* Gasoline or electric.
- (b) *Load center.* 24 inches.
- (c) *Standard operating aisle.* 11'6 with 40 load length.

(d) *Application.* A heavy-duty forklift truck for warehousing operations. It is used principally for stacking supplies above lift limit of light- and medium-duty models. **Greater** lifting capacity allows truck to handle bulky, oversize loads as well as heavier, compact loads. Limited maneuverability restricts use to wider operating aisles. High **collapsed mast** height restricts use to buildings with high ceilings and doors. Truck may be used for limited number of loading or unloading operations when trailers or flatbed trucks are involved (fig. 4-12).

(13) *Truck, forklift, pneumatic tires, 6,000-pound, 168-inch lift.*

- (a) *Type of power.* Gasoline.
- (b) *Load center.* 24 inches.

(c) *Application.* A heavy-duty forklift truck for outdoor storage operations. It is used principally for loading and unloading flatcars and trailers at yards, docks, and other outdoor shipping or receiving areas. The truck can be operated satisfactorily on all types of road surfaces. Use of chains makes it possible for truck to operate in snow (fig 4-13).

(14) *Truck, forklift, pneumatic tires, 15,000-pound, 210-inch lift.*

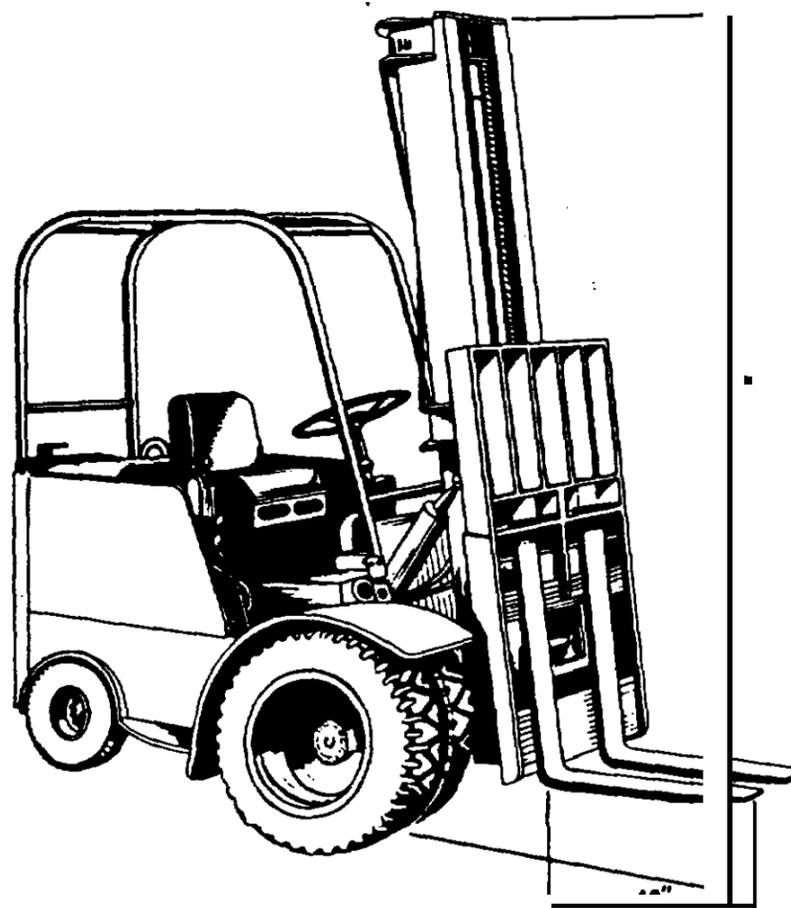


Figure 4-13. *Truck, forklift, pneumatic tires, 6,000-pound, 168-inch lift.*

- (a) *Type of power.* Gasoline.
- (b) *Load center.* 24 inches.

(c) *Application.* Maximum-capacity truck for outdoor storage operations. It is used principally for loading and unloading oversize heavy loads and for stacking and relocating **large** heavy materials in outdoor storage areas. It is very often needed

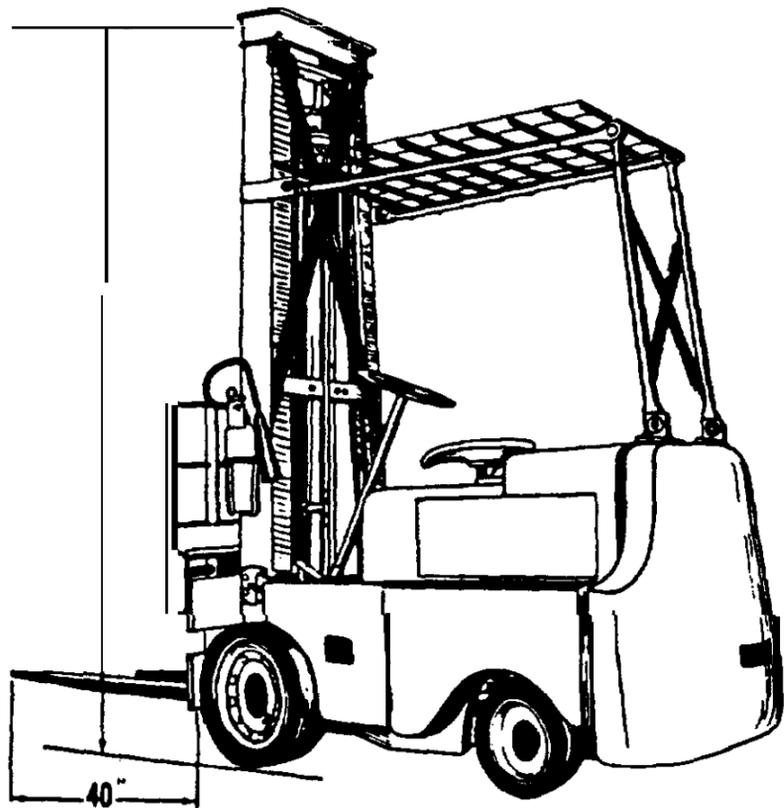


Figure 4-12. *Truck, forklift, solid or semisolid rubber tires, 6,000-pound, 168-inch lift.*

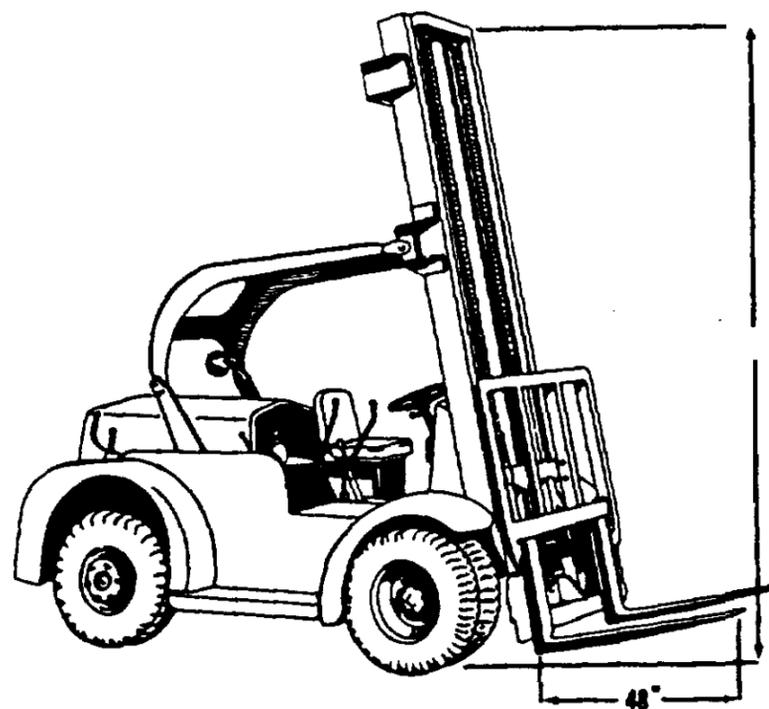


Figure 4-14. *Truck, forklift, pneumatic tires, 15,000-pound, 210-inch lift.*

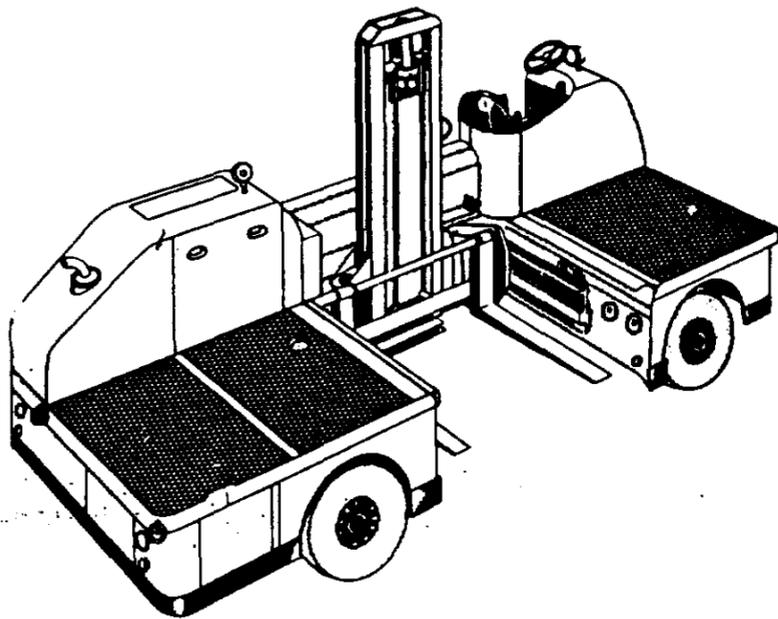


Figure 4-15. Truck, forklift, pneumatic tires, 10,000-pound, 144-inch lift, sideloading.

to handle less-than-maximum-capacity loads that, because of size or shape, require a load center greater than 24 inches. This type truck may, for example, lift 15,000 pounds at 24 inches and 11,000 pounds at 40 inches. The use of fork extensions or other attachments, such as a bar and hoist for unloading, will further reduce lifting capacity (fig. 4-14).

(15) Truck, forklift, pneumatic tires, 10,000-pound, 114-inch lift, sideloading.

(a) Type of power. Gasoline.

(b) Application. Standard sideloading truck used for receiving, transporting, and loading operations. It is used principally to load, directly into aircraft, supplies and equipment prepared for delivery by parachute. The truck can be used to handle pipe, lumber, or similar material up to lengths of 65 feet. It has a turning radius of approximately 25 feet and can travel on varying types of smooth surface roads up to a speed of 30 miles per hour (fig. 4-15).

(16) Truck, forklift, pneumatic tires, rough terrain.

(a) Type of power. Gasoline or diesel.

(b) Load center. 24 inches.

(c) Application. A standard rough terrain forklift truck, available in three load capacities-4,000, 6,000, and 10,000 pounds, is equipped with high-flotation pneumatic tires for operation on unprepared or unstabilized surfaces, over beaches, in deep sand, or in snow, ice, or mud. It is used primarily for loading and unloading flatbed trailers, landing craft, or other similar types of small cargo

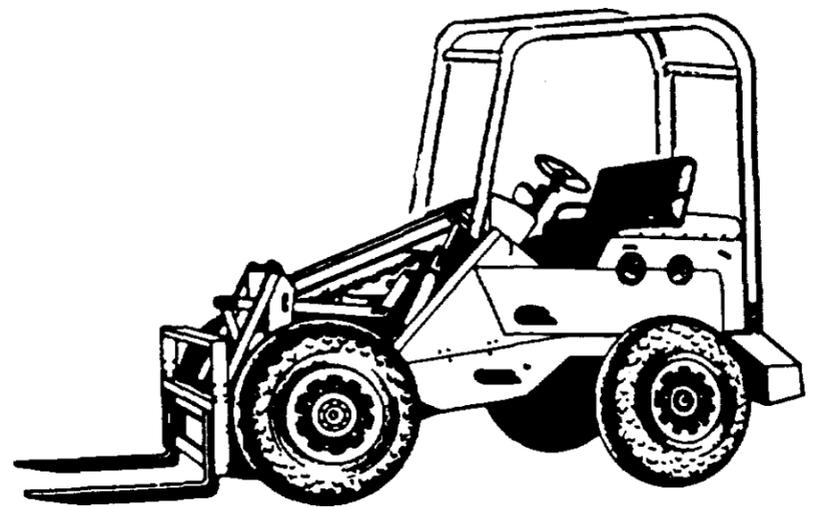
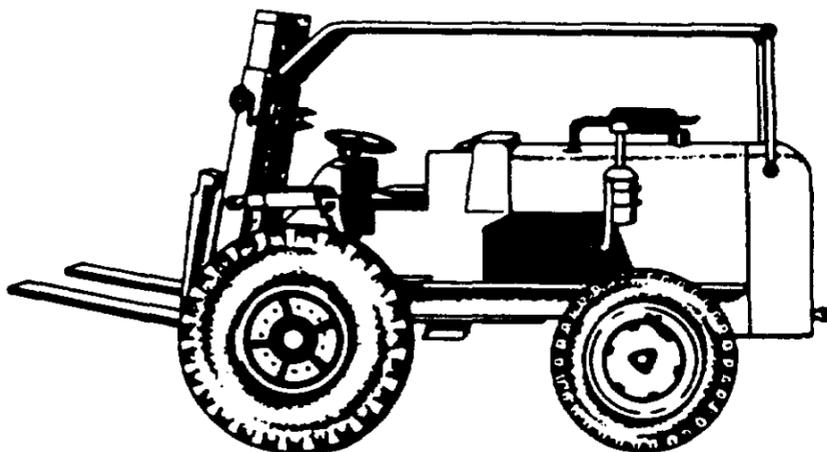


Figure 4-16. Truck, forklift, pneumatic tires, rough terrain.

vessels. It may also be used for stacking large, heavy loads of equipment (fig. 4-16).

#### 4-203. Warehouse Tractors

**a. General.** A warehouse trailer is an electric-or gasoline-powered vehicle designed to pull a train of warehouse trailers. Gasoline-powered models, equipped with pneumatic tires, have a rated drawbar pull of from 4,000 to 7,500 pounds. Electric-powered models, with solid-rubber tires, have a rated drawbar pull of 2,000 or 4,000 pounds. **Drawbar pull**, which is the motive force that the tractor can exert "in pushing or pulling loads, is merely a means of indicating tractor capability, and the actual capacity of the tractor is normally far in excess of the drawbar pull rating. A tractor with a drawbar pull of 4,000 pounds may, for example, have an actual towing capacity of 90 tons; and a tractor with a drawbar pull of 7,500 pounds, 200 tons. Its value to storage and warehousing, however, lies in the fact that the tractor-trailer train, when used in conjunction with forklift trucks, provides for the completely mechanized loading, transporting, stacking, and warehousing of supplies.

**b. Standard items.** The following types and sizes of warehouse tractors have been adopted as standard for the military services. These tractors are, in most cases, the low-profile industrial type. The 7,500-pound drawbar pull tractor may, however, be the agricultural type with high-flotation pneumatic tires for operation in rough or unpaved storage areas.

(1) *Tractor, warehouse, electric, solid-rubber tires, 2,000-pound drawbar pull.*

**Application.** Basic light-duty, electric-powered tractor for operation in warehouses and other closed storage areas. It may be used to advantage at arsenals for the movement of explosive and flammable items, when properly shielded, and at cold-storage installations where movement through areas of different temperatures will not have an effect on tractor performance. It may be used at shiploading points for movement of supplies directly aboard cargo vessels (fig 4-17).

(2) *Tractor, warehouse, electric, solid-rubber tires, 4,000-pound drawbar pull.*

**Application.** Standard heavy-duty tractor for indoor warehousing operations. It is used in essentially the same manner and for essentially the same purposes as the light-duty, electric-powered model.

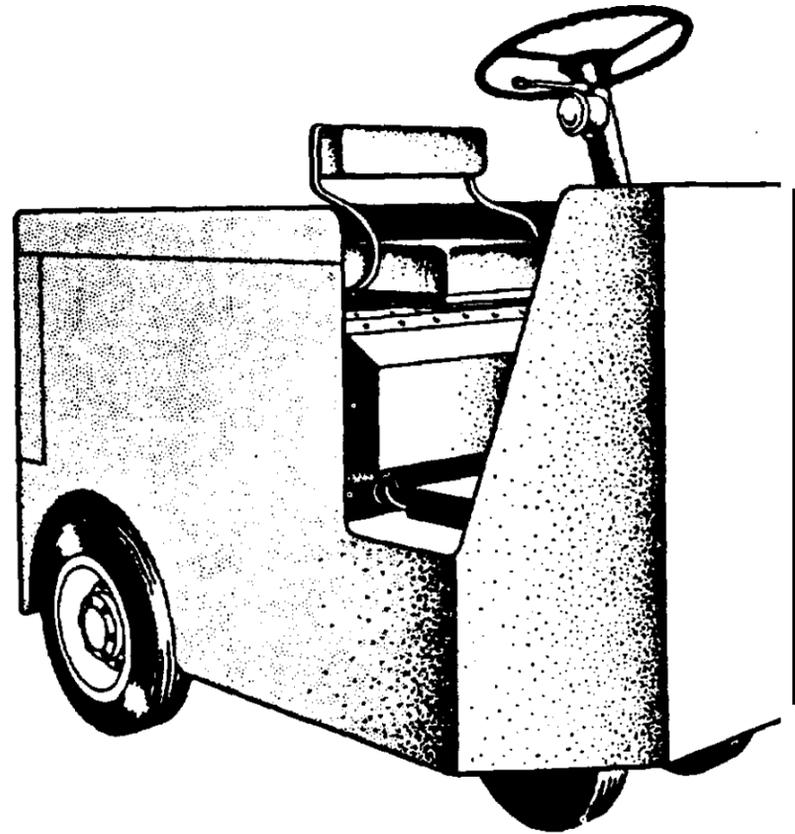


Figure 4-17. *Tractor, warehouse, electric, solid-rubber tires, 2,000-pound drawbar pull.*

**Drawbar-pull** rating or towing capacity should not be considered as deciding factors for selecting or excluding this tractor. The efficiency of a tractor-trailer train is not measured in maximum weight of supplies per trip; rather, it is measured by the total number of tons that can be hauled each day. The selection of the tractor and the determination of efficiency or economy of operation must be based, therefore, upon the physical conditions to be overcome, the number of stops involved, and the length of haul to be made (fig. 4-18).

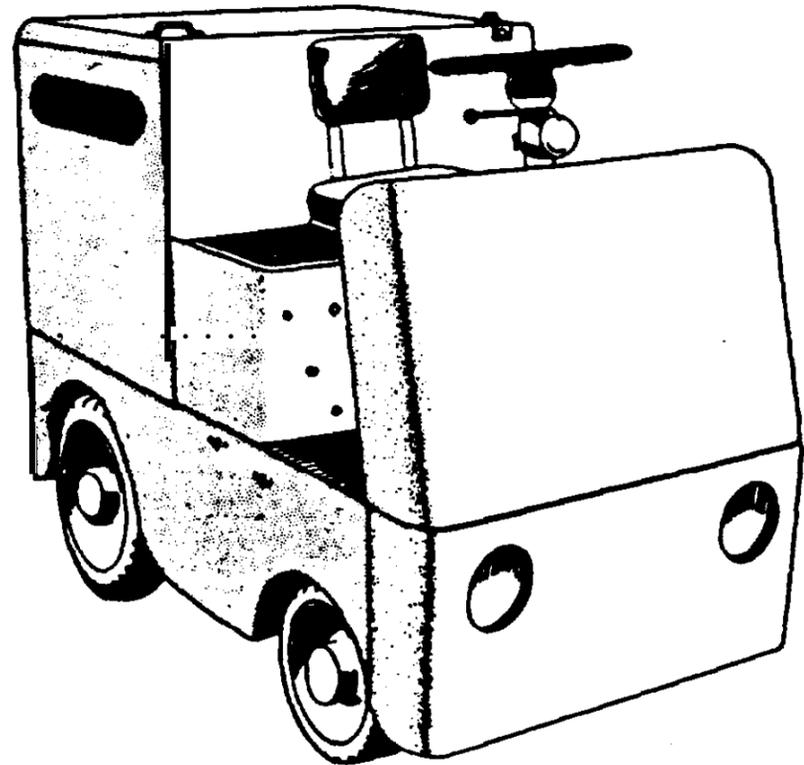


Figure 4-18. *Tractor, warehouse, electric, solid-rubber tires, 4,000-pound drawbar pull.*

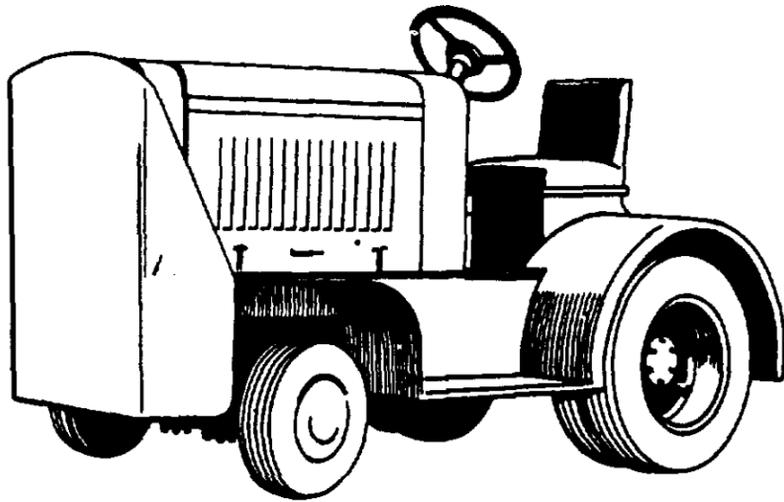


Figure 4-19. Tractor, warehouse, gasoline, pneumatic tires, 4,000-pound drawbar pull.

(3) Tractor, warehouse, gasoline, pneumatic tires, 4,000-pound drawbar pull.

*Application.* Standard medium-duty tractor for outdoor storage operations. It may be used in plant yards, for hauling trailers, or towing airplanes from hangars to airfields. It may also be used for **general-purpose** towing or pulling at freight sheds, piers, warehouses, or other areas. It **has** sufficient weight, horsepower, and traction to operate on virtually all types of running surfaces (fig 4-19).

(4) Tractor, warehouse, gasoline, pneumatic tires, 7,500-pound drawbar pull.

*Application.* Standard heavy-duty, gasoline-powered tractor for outdoor storage operations. This capacity tractor is available in two styles. The first is the low-profile, industrial type with conventional pneumatic tires on both drive and steering wheels. The second type is the high-flotation model with oversize pneumatic tires on the drive wheels. This tractor may be used in storage areas with rough or muddy terrain. It has a greater **underclearance** than the low-profile type, but lacks its speed and maneuverability. It is possible, however, to use both types for towing heavy equipment or large

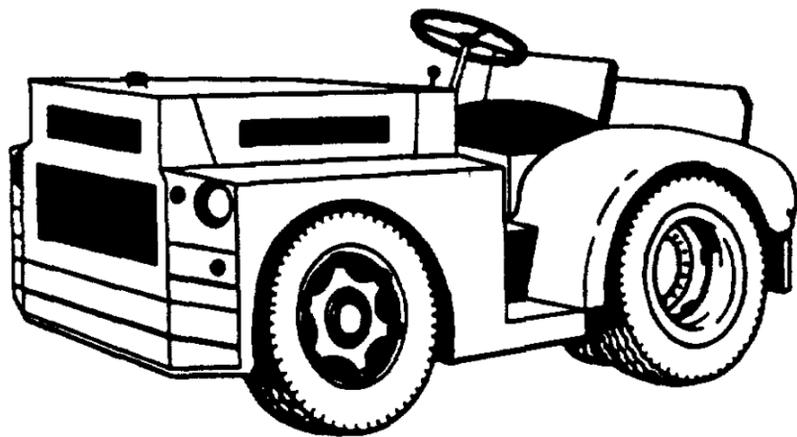


Figure 4-20. Example of tractor, warehouse, gasoline, pneumatic tires, 7,500-pound drawbar pull.

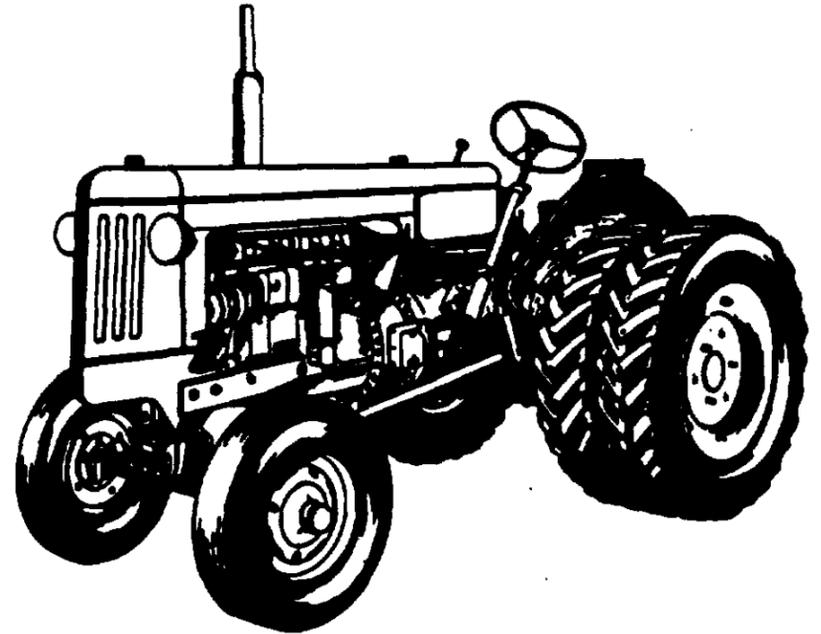


Figure 4-21. Example of tractor, warehouse, gasoline, pneumatic tires, 7,500-pound drawbar pull.

special-purpose vehicles such as refrigerator trailers. This may be accomplished by the use of a **fifth-wheel** attachment or truck carriers (figs. 4-20 and 4-21).

#### 4-204. Truck, Fixed Platform, Gasoline, or Electric

*Application.* The platform truck is a nonelevating electric- or gasoline-powered vehicle used exclusively as a load carrier. It may be used to supplement a forklift truck in the same manner as the tractor-trailer train depending upon the size and weight of the load and the distance the load is to be moved. In addition to transporting supplies, the truck may be used as a portable servicing unit when equipped with spare parts and tools or with gasoline and oil dispensing facilities. The standard **gasoline-powered** model, equipped with pneumatic tires, has a load capacity of 4,000 pounds. The electric-powered, usually equipped with solid-rubber tires, has a load capacity of 2,000 pounds (fig 4-22).

#### 4-205. Truck, Straddle, Carry

*Application.* The straddle truck is a gasoline-powered, four-wheel vehicle designed to straddle, pickup,

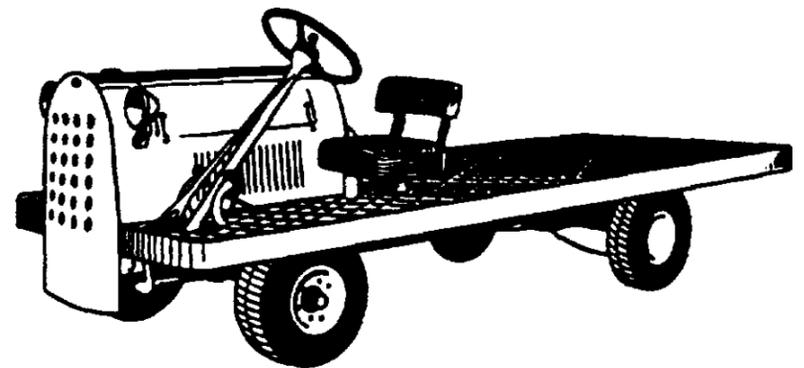


Figure 4-22. Truck, fixed platform, gasoline.

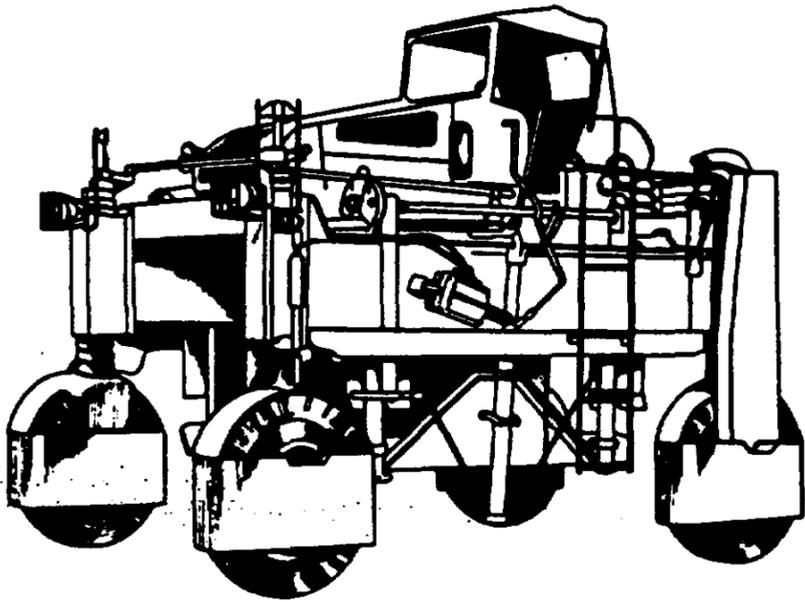


Figure 4-23. Truck, straddle, carry.

and transport loads of long and heavy supplies such as pipe, lumber, and steel. It may also be used for handling pulpwood; bridge members; and containers of bulk materials such as coal, rocks, and similar commodities. The standard straddle truck for the **Military** Departments has a capacity of 30,000 pounds (fig. 4-23).

#### 4-206. Crane Truck, Warehouse

*a. General.* A warehouse crane truck is a power-driven, self-propelled unit consisting of a boom mounted on a mobile wheel chassis. The boom can be operated independently so that **sluing** and toping can be accomplished without movement of the chassis. Power is supplied by a gasoline engine or by electric motors. Gasoline-powered crane trucks

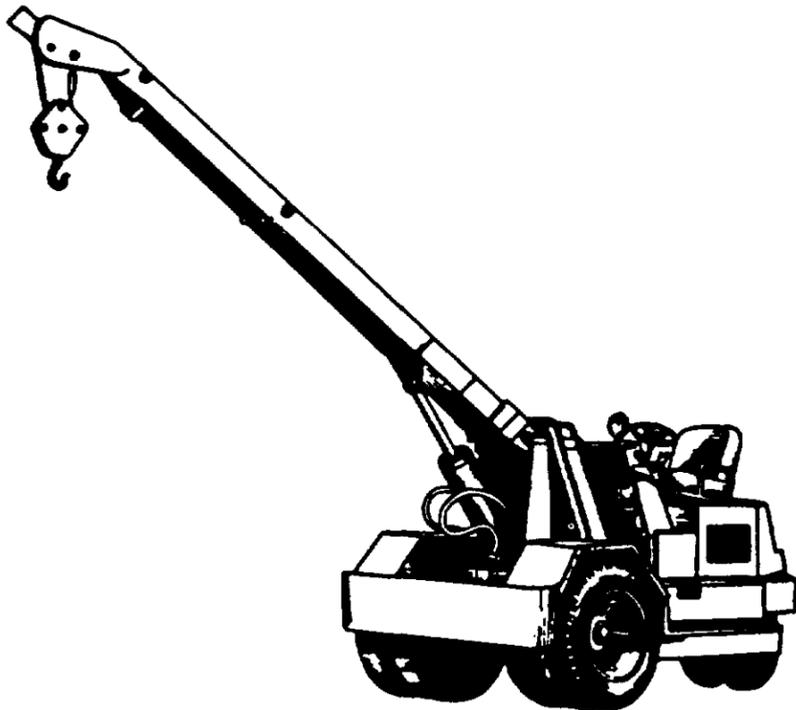


Figure 4-24. Crone truck, warehouse, gasoline.

are equipped with pneumatic tires for outdoor operation, and range in capacity from 6,000 to 20,000 pounds. Electric-powered crane trucks are equipped with solid-rubber tires for indoor operation, and have a capacity of 6,000 or 10,000 pounds (fig. 4-24).

*b. Application.* The warehouse crane truck is used to lift, swing, and lower loads that are too heavy or bulky or otherwise unsuitable for handling by other types of materials handling equipment. It may be used for loading and unloading flatcars, flatbed trailers, or gondolas. The warehouse crane truck is sometimes used to **transport** loads horizontally for short distances when sufficient overhead clearance is available (fig. 4-25).

#### 4-207. Pallet-Type Handlift Truck

*a. General.* The pallet-type handlift truck is available in two distinct designs—the hand-operated, hand-propelled model and the electric-powered, hand-operated model. The truck is equipped with two load carrying forks that can be raised about 4 inches to carry **palletized** loads. It is used to move pallet loads that do not have to be tied and where short hauls are required. It may be used for the movement of pallet loads in boxcars or into trucks, as well as for in process movements during shipping and receiving operations. It works well in conjunction with forklift trucks and can be operated where forklift cannot because of space limitations.

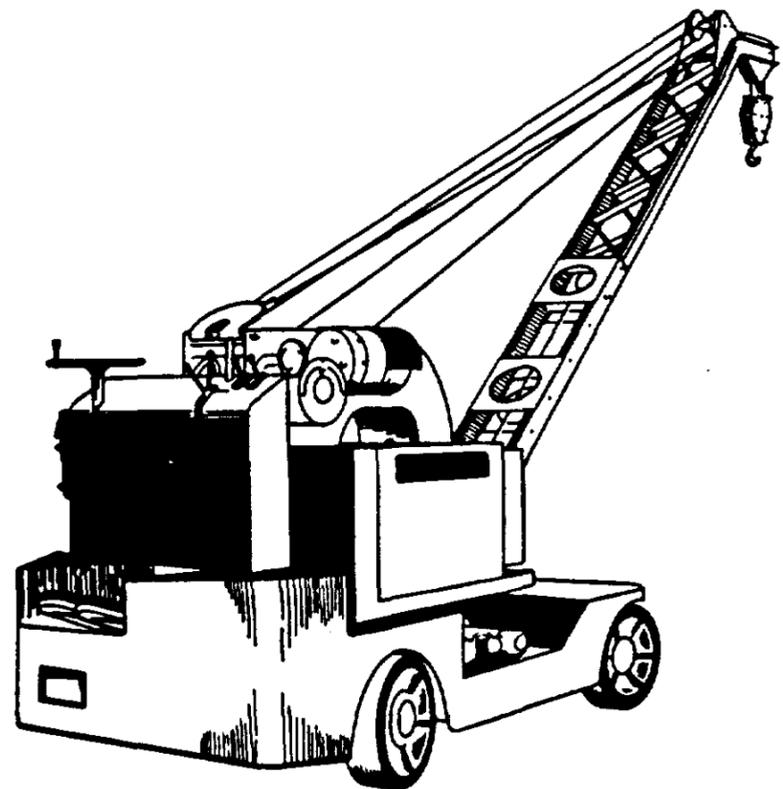


Figure 4-25. Crone truck, warehouse, electric.

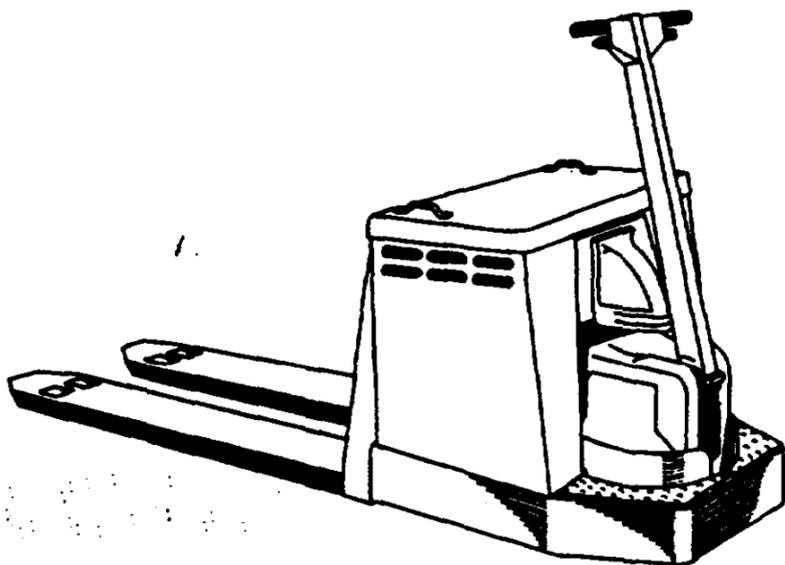


Figure 4-26. Truck, *lift, hand, electric, pallet type*.

*b. Standard items.* The following types of handlift trucks have been adopted as standard for the military services (fig. 4-26).

(1) Truck, *lift, hand, electric, pallet type*.

*Application.* This model is used whenever the distance the load is to be moved, the **size** of the load, the presence of grades or inclines along the route, **or** other considerations require the use of powered equipment.

(2) Truck, *lift, hand, pallet type*.

*Application.* This model is used whenever the operating conditions do not require a hand truck with the special characteristics of the powered model. It may be used to advantage in the loading of box cars, trucks, and aircraft (fig. 4-27).

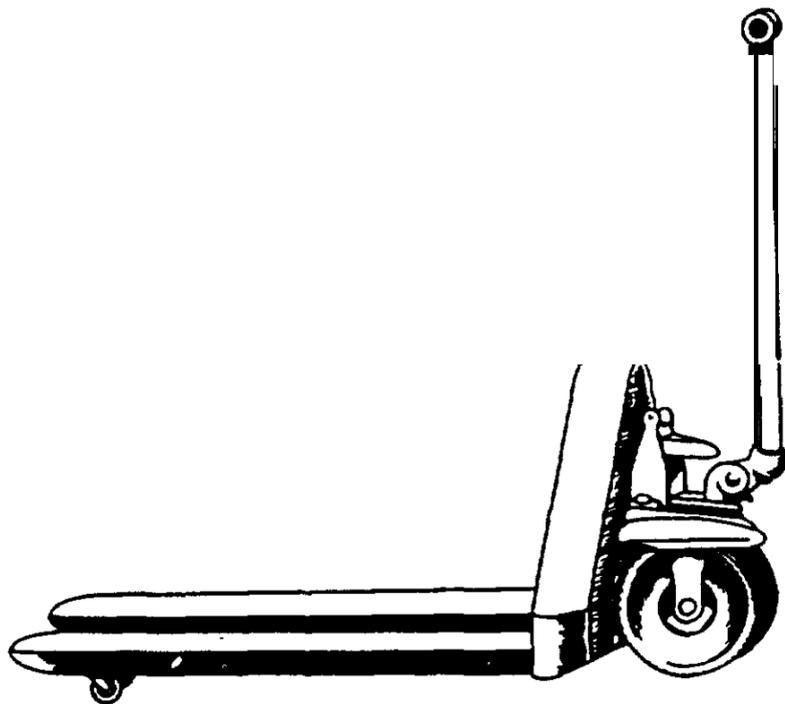


Figure 4-27. Truck, *lift, hand, pallet type*.

#### 4-208. Tiering Truck, Electric (Narrow-Aisle Type)

*Application.* The tiering truck is an electric-powered forklift truck of the straddle arm design. The forks on this truck are located between two outriggers, or straddle arms, that extend forward in a **plane** at floor level parallel to **that** of the forks to straddle the pallet load. Because the straddle arms have contact with the floor, they support the elevated load and **no** counterweight is required. The overall weight of the tiering truck is generally less than that of a conventional counterbalanced forklift truck of the same rated capacity. The tiering truck is more maneuverable than the standard forklift truck and can generally operate in 6-foot aisles. The standard tiering truck for the military services is the electric-powered type that has a load capacity of 3,000 pounds and a lifting height of 100 or 130 inches (fig. 4-27).

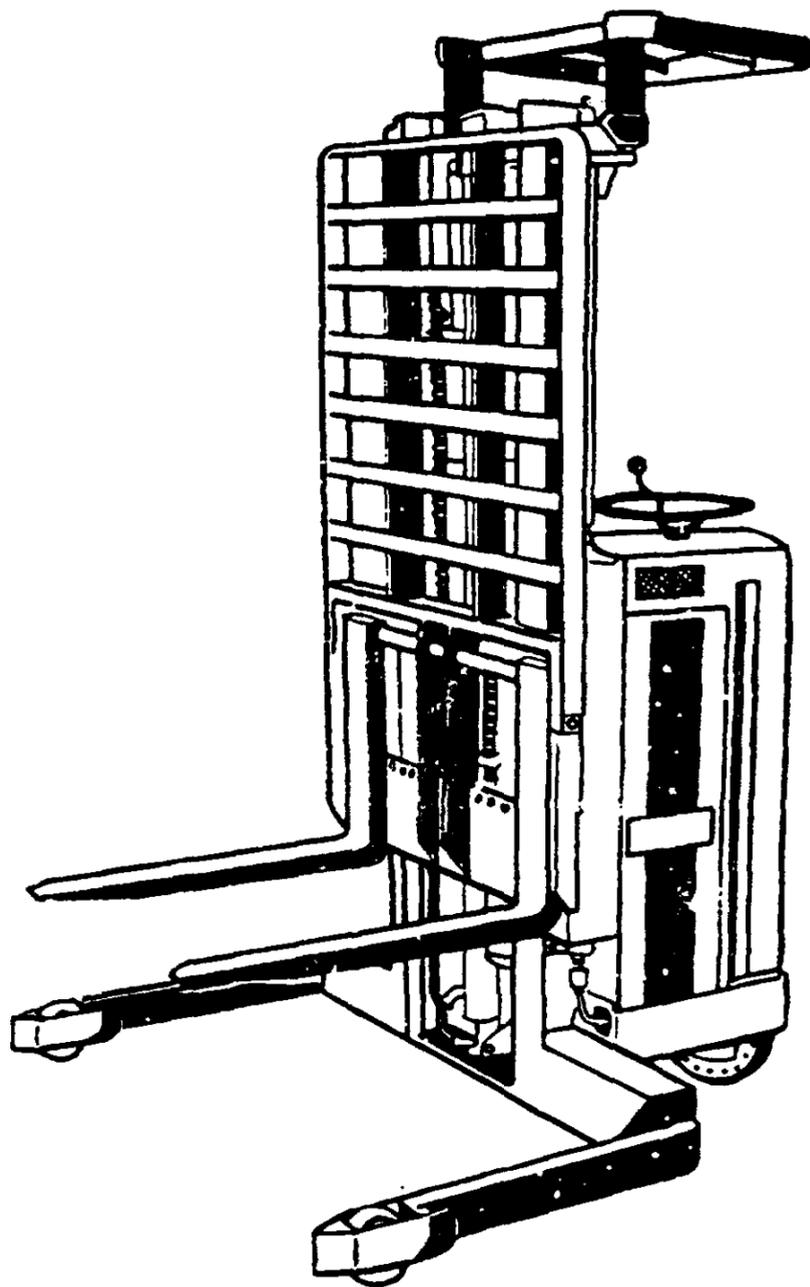


Figure 4-28. Truck, *tiering, electric, 3,000 pound*.



Figure 4-29. Trailer, platform, warehouse, 4,000- or 6,000-pound, towed by driverless tractor system.

#### 4-209. Warehouse Trailers

*Application.* A warehouse trailer is a load-carrying platform mounted on casters or wheels. Standard trailers are available in a wide variety of sizes and capacities, and may be equipped with solid-rubber or pneumatic tires. The caster-steering type has fixed rear wheels that carry about two-thirds of the load, and caster wheels at the front through which steering is accomplished. The caster steering-type trailer is produced in 4,000- and 6,000-pound capacities, similar to that illustrated by figure 4-29. The **fifth** wheel steering type has rear wheels mounted on a rigid axle and front wheels mounted on a center-pivoted steering axle with drawbar attachment. This type trailer is available in capacities of 6,000 or 20,000 pounds (figs. 4-30 and 4431). The selection of the size required for a specific operation may be based upon load capacity, load size, tractor

capacity, and the nature of the surface over which the **load** is to be towed. The fifth wheel steering-type trailer is more suitable for heavy loads or for operation over rough surfaces. The caster steering-type trailer is better suited to indoor operations.

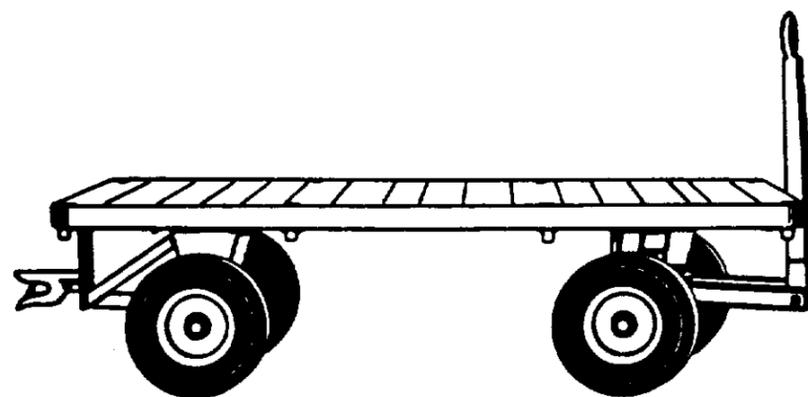


Figure 4-30. Trailer, platform, warehouse, 6,000-pound, pneumatic tires.

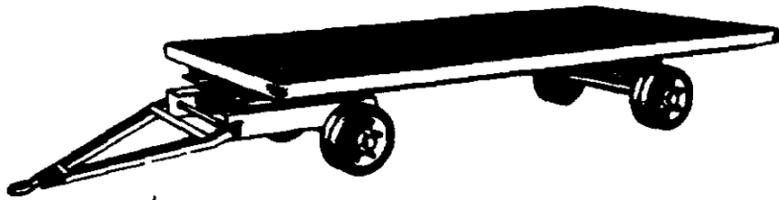


Figure 4-31. Trailer, *platform*, warehouse, 20,000-pound, *solid-rubber tires*.

#### 4-210. Hand Trucks

a. *General*. Hand trucks are useful in all types of storage installations, particularly where mechanical equipment cannot be employed because of space limitations. They are often preferable to and more economical than a piece of mechanical equipment for the movement of a single item.

b. *Standard items*. The following types of hand trucks have been adopted as standard for the military services.

(1) *Truck, hand, platform, four wheel.*

*Application*. The four-wheel hand truck may be used to advantage in breaking out retail issues for bins, carrying light loads, or for any operation involving short hauls with frequent stops. It may also be used in multistory warehouses and for small-lot stock picking. The truck may be equipped with solid-rubber tires or steel wheels. The solid-rubber tire type is of the hardwood deck, caster steer design, and has a capacity of 2,500 pounds. The steel-wheel type is of a steel deck, fifth-wheel design, and has a capacity of 6,000 pounds (figs. 4-32 and 4-33).

(2) *Truck, warehouse, double-handle type, two-wheel, solid-rubber tires.*

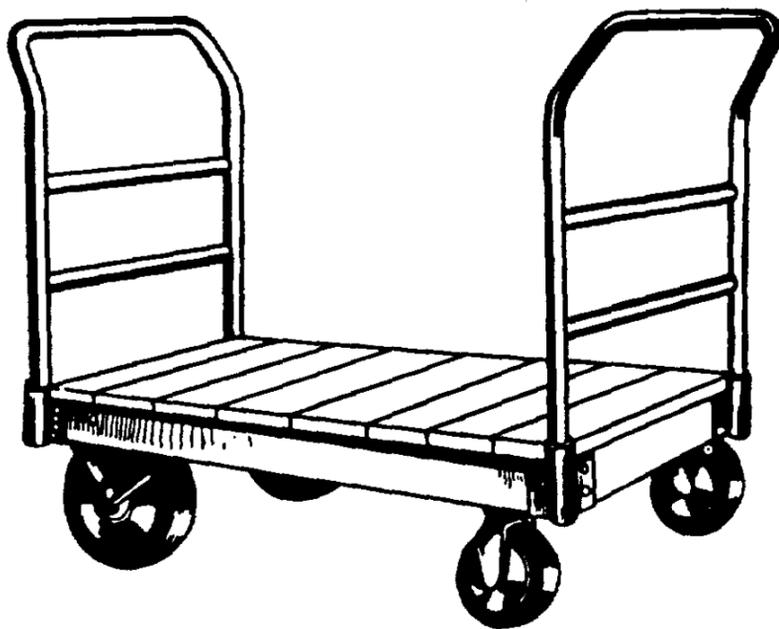


Figure 4-32. Truck, hand, platform, four wheel.

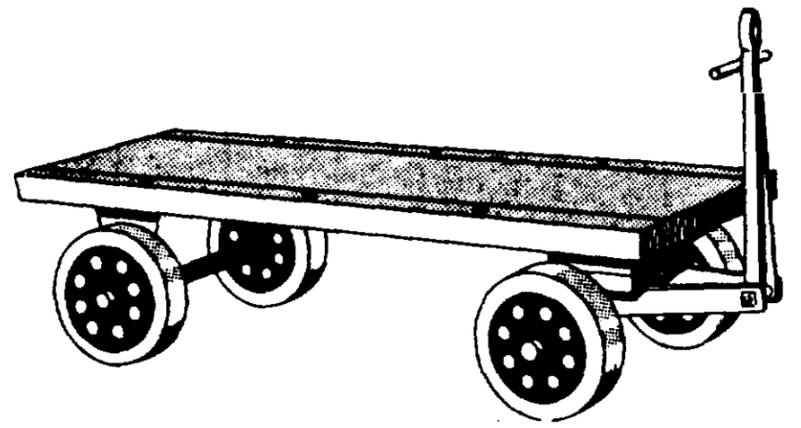


Figure 4-33. Truck, hand, steel wheels.

*Application*. The two-wheel hand truck consists of two handles, a platform on which the load rests, and a pair of wheels attached to the bottom of the framework. A blade extends at an angle from the bottom of the platform to retain the load, and two metal legs are located on the top corners of the platform to help bear the load when the truck is rested flat on the ground. The platform may consist of flat cross bars, which are used to handle boxes or crates, or curved cross bars, which are used for barrels or drums. The truck may be constructed of

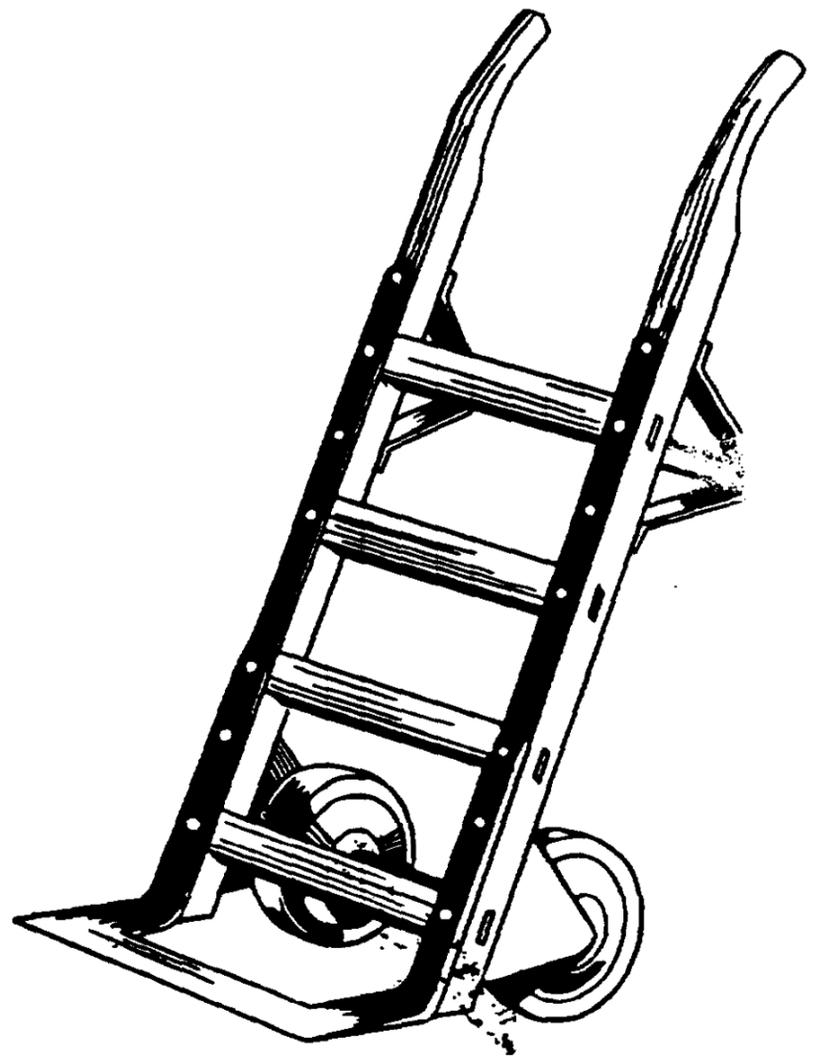


Figure 4-34. Truck, warehouse, double-handle type, y-wheel, solid-rubber tires.

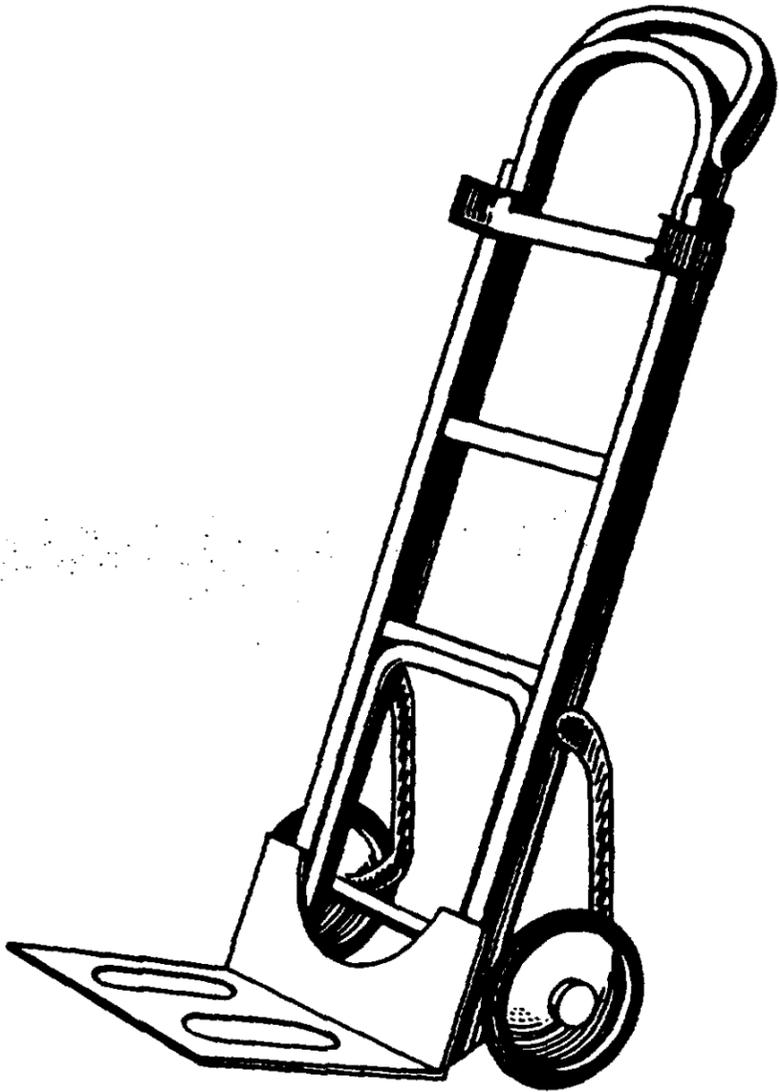


Figure 4-35. Truck, warehouse, utility.

wood or metal. The hardwood combination straight-and-barrel type is not illustrated. A magnesium, general-utility type hand truck is also available (figs. 4-34 and 4-35).

(3) Truck, stockpicker, multiple shelf, solid-rubber tires.

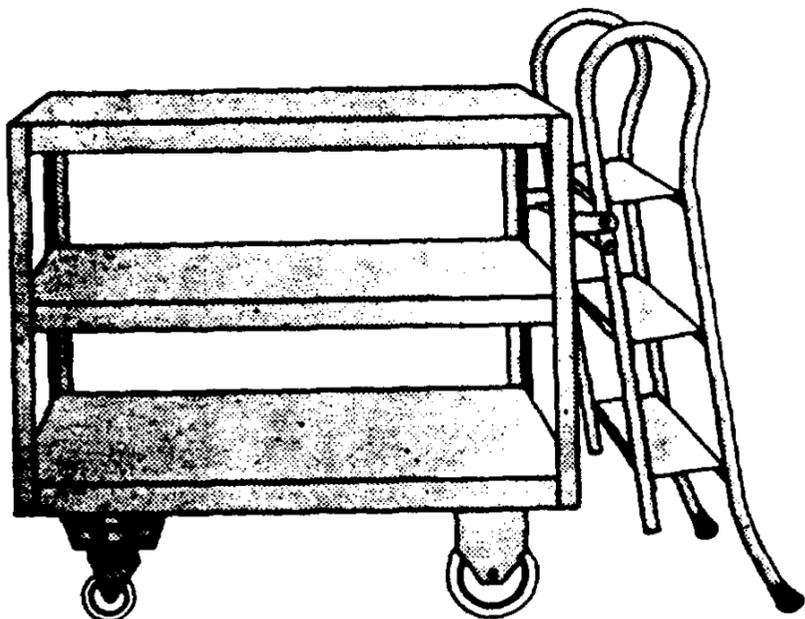


Figure 4-36. Truck, stockpicker.

*Application.* A **stockpicker** truck is a hand truck used for picking stock from retail shelves to fill orders. The warehouse employee pushes the truck into the aisles between the shelves and utilizes the truck shelves to carry the small retail issues in cardboard containers, paper envelopes, or tote boxes. Some models are equipped with a ladder to permit the stock picker to reach materials on high shelves safely (fig 4-36).

#### 4-211. Dolly Trucks

*Application.* The dolly truck is a frame mounted on wheels or rollers and is used for shifting heavy **loads** for short distances. Three standard types of dollies are available. The first is the general-purpose dolly with swivel wheels (fig. 4-37).

a. This dolly with a capacity of 4,000 pounds is used primarily to move **palletized loads** in and out of boxcar, highway trucks and trailers. Also used within boxcars to move loads to doorway area for pick up by forklift trucks when car is not alongside loading platform (fig. 4-38).

b. The advantages of the dolly are maneuverability, ease of operation, and suitability for use on truck and reefer floors. The **24** wheels in the central portion are placed slightly **lower** than **the wheels** at the ends. The wheels at the ends are held in position by springs, which **allow** them to move on their axles as the load is guided to its destination.



Figure 4-37. Dolly, general-purpose.

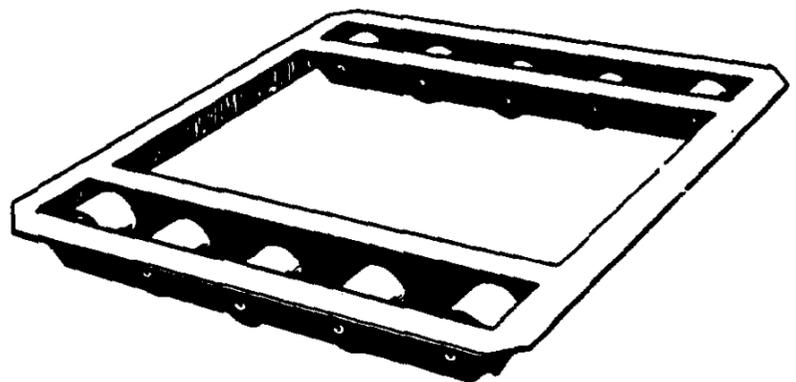


Figure 4-38. Doll/j, pallet rollers.

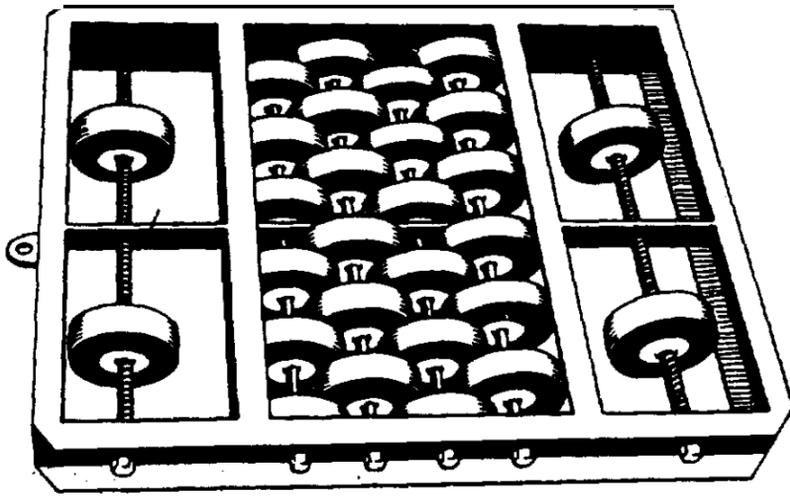


Figure 4-39. Dolly (reefer car).

The difference in height of center and end wheels permits a certain amount of rocking motion which aids in movement and guidance "of the pallet load. That is, the tilting effect allows the dolly to turn, and the center wheels (on offset axles) prevent lodging of wheels in slatted floors (fig. 4-39).

#### 4-212. Conveyors

a. General. A conveyor is a device for moving supplies in a fixed line of travel. Two basic types of conveyors have been adopted as standard for the military departments. The first is the gravity-type roller or wheel conveyor. The second is the portable, power-driven belt conveyor. The gravity roller conveyor is available in standard 10-foot sections, as well as in curved sections of 45° and 90°. The gravity wheel conveyor is available in standard 10-foot sections and in curved sections of 45°. The portable, power-driven belt conveyor is powered by a gasoline engine or an electric motor. The electric-powered model is available in sections of 20, 35, and 50 feet. The gasoline-powered model is available in sections of 60 feet. A telescopic power-drive model is also available.

b. *Standard items.* The types of conveyors listed and illustrated in this section should be regarded as standard for the military services. Not every type in use has been listed; however, this listing should not preclude procurement of other items when required in the interest of efficient and economical materials handling.

##### (1) Conveyor, gravity, wheel.

*Application.* The wheel conveyor can be used to best advantage for the handling of medium or light packaged materials, particularly in loading and unloading barges, trucks, or railroad cars. It is de-

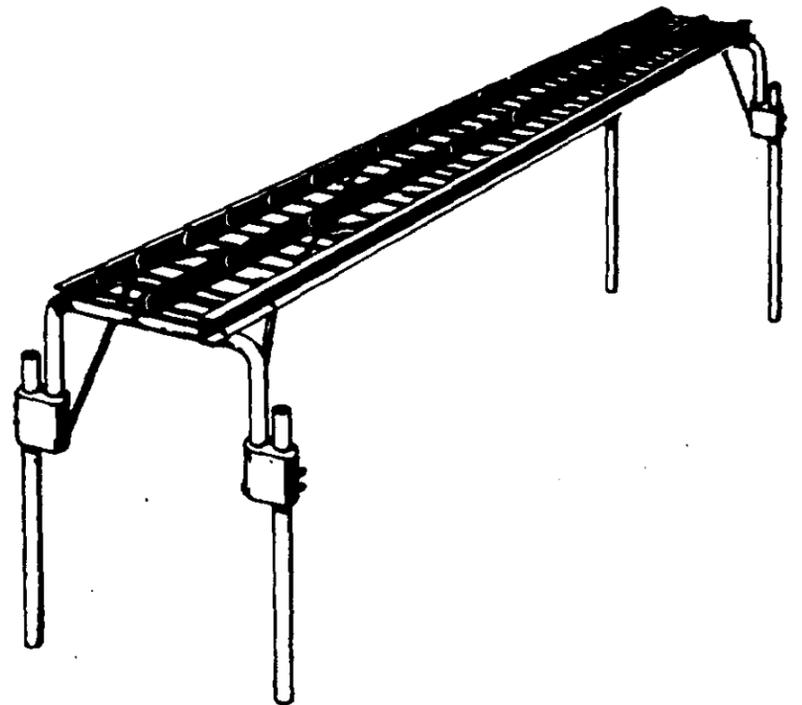


Figure 4-40. Conveyor, gravity, wheel.

signed to handle many different types of merchandise packaged in wooden or cardboard boxes with flat or **semiflat** surfaces. To obtain the best operation, the conveyor should have an average drop of 1½ to 3 inches per 10-foot section (fig. 4-40).

##### (2) Conveyor, gravity, roller.

*Application.* The roller conveyor can be installed with a slight incline to take advantage of gravity, or it can be installed level and the load pushed along manually. Several sections can be put together and developed into a continuous system for the movement of material. The conveyor can be used on piers or docks, in warehouses, in packing rooms, or wherever a steady flow of supplies is desired. It can be used to advantage for movement of packaged materials over gaps or drops that cannot be negotiated mechanically. A drop of one-half of an inch per foot is usually required to keep an object in motion on the rollers (fig. 4-41).

##### (3) Conveyor, belt, power-driven, portable.

*Application.* The power-driven belt conveyor consists of an endless belt mounted on a frame and driven by a pulley connected to a drive motor. The belt travels over a series of rollers or a sliding bed.



Figure 4-41. Conveyor, gravity, roller.



Figure 4-42. Conveyor, belt, power driven, portable.

It is used to transport materials over a **fixed** path of travel where inclines and declines **are** involved. It can be used to advantage where **it** is necessary to maintain the conveyor at a convenient working height above the floor for **long** distances. It can also operate **on a horizontal** path. The maximum angle of incline is usually limited to  $25^\circ$ . The belt conveyor can be used to load and unload cars, barges, or other carriers. It can also be used to handle packaged goods. It has proved useful for piling bags and packages, as well as for taking down packages from piles where the pallet method is not used because of lack of pallets or **forklift** trucks. The telescopic conveyor, which consists of floating, load-carrying members that can be adjusted to protrude varying distances from either or both ends of the **frame**, can be used for moving boxed or bagged material in and out of **railcars** or trucks (fig. 442).

(4) *Conveyor, gravity, accordion.*

*Application.* The accordion-type conveyor can be used as temporary bridging for aisles, as a temporary shipping platform, or for the loading of cars, trucks, or aircraft. It can be used to divert the flow of supplies to packing stations around areas where other types of conveyors cannot be installed. It can be easily and quickly attached to permanent or semipermanent conveyor installations to form a complete and continuous handling system (fig. 4-43).

(5) *Gate, gravity conveyor, hinged.*

*Application.* The hinged gate is a conveyor section that can be raised or swung to one side to provide a passageway from one side of a conveyor system to the other (fig. 4-44).

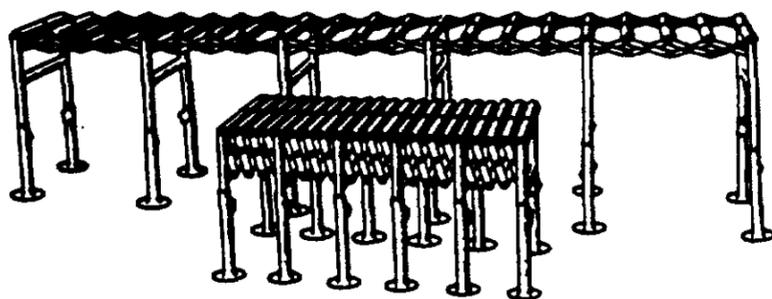


Figure 4-43. Conveyor, gravity accordion.

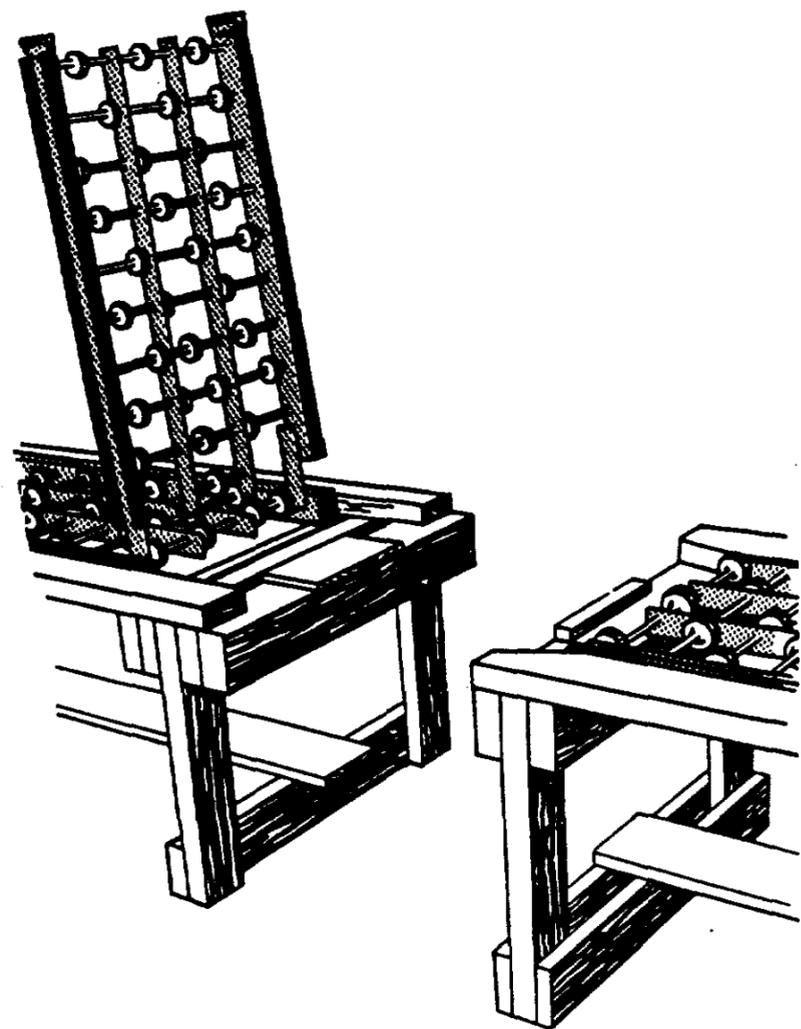
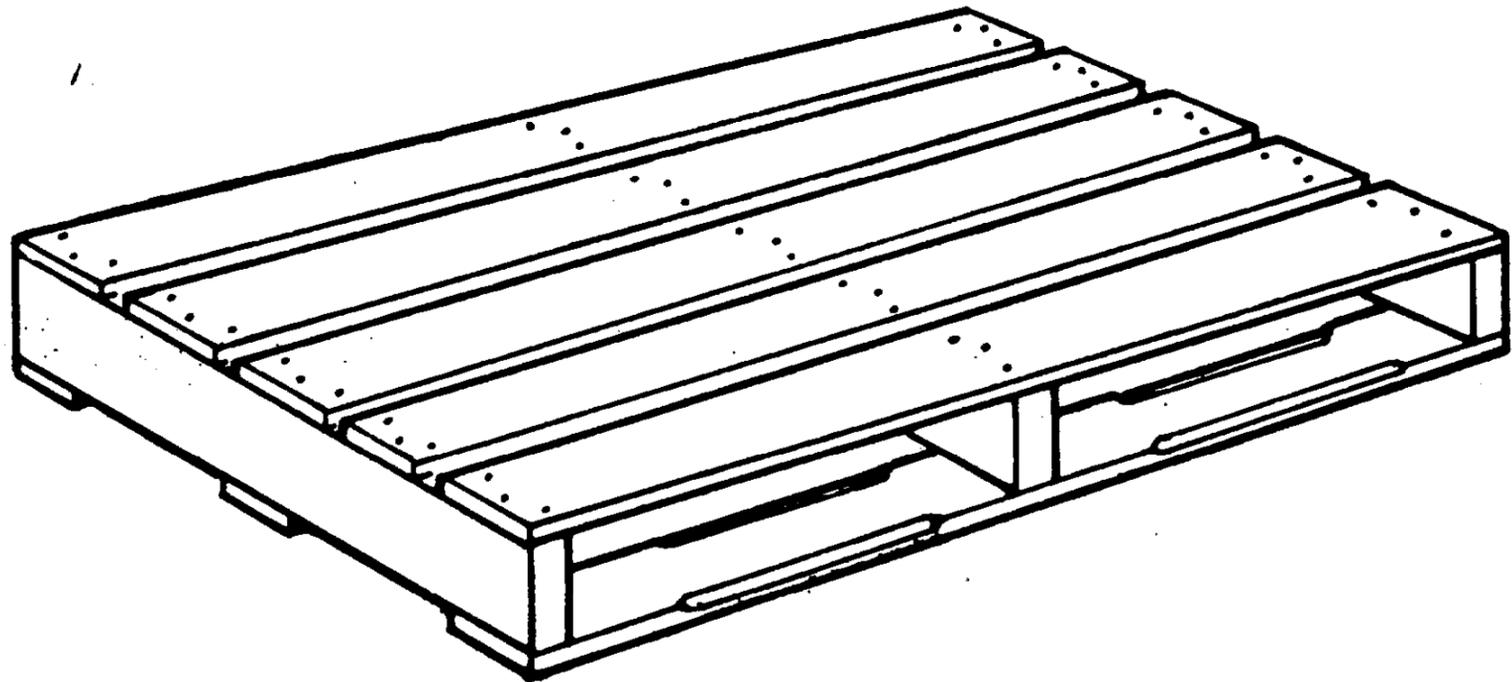


Figure 4-44. Gate, gravity conveyor, hinged.

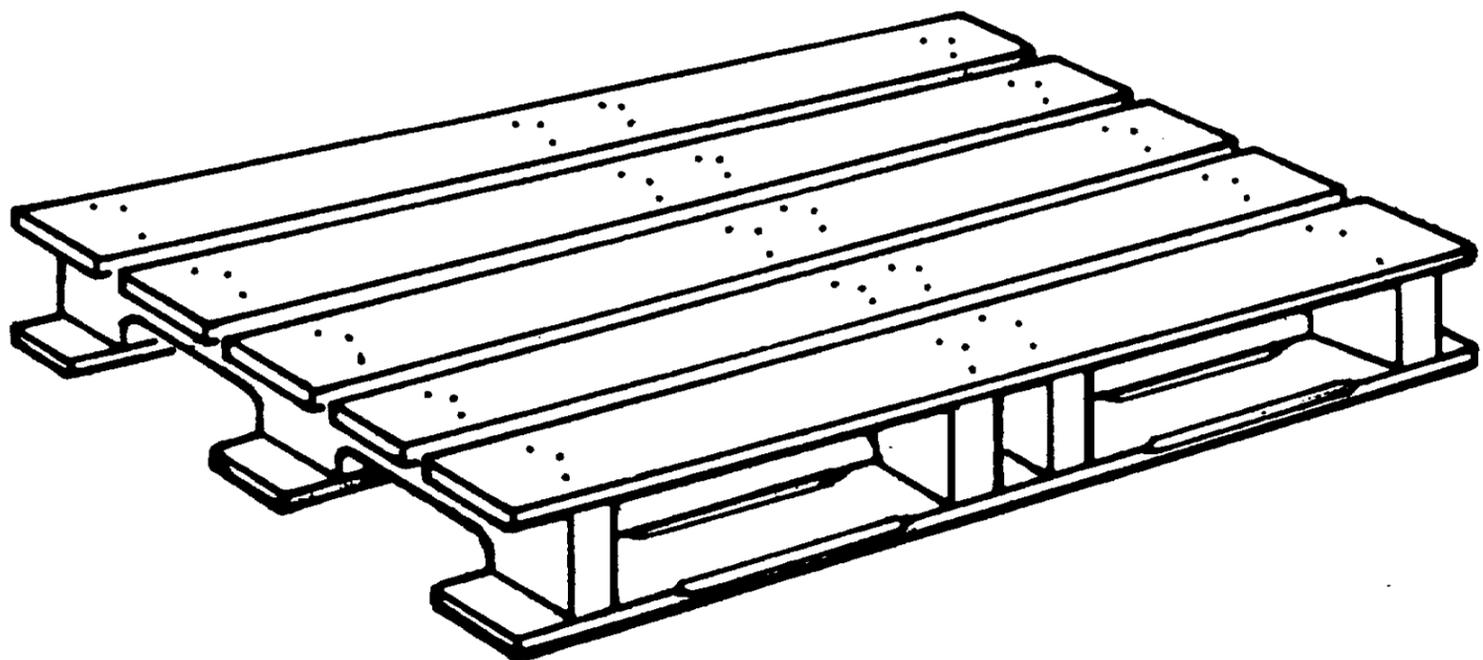
#### 4-213. Pallets

*a. General.* A pallet is a low portable platform constructed of wood, metal, or fiberboard, built to **specified** dimensions, on which supplies are loaded, transported, or stored in units. Flat pallets are either single faced or double faced. Single-faced pallets have one platform with stringers underneath on which the weight of the load rests. **Double-** faced pallets have two platforms separated by stringers. Pallets may afford two-way or four-way entry. The two-way entry pallet is so constructed that the forks of a forklift truck may be **inserted** from either the front or rear of the pallet. The **four-** way pallet is so constructed that the forks of a forklift truck may be inserted **from** any of the four sides. Flat pallets are constructed of either softwood or hardwood. Expendable pallets are four-way entry and are composed of either fiberboard, polystyrene or a combination of these. A box pallet is constructed with a framework and crossmembers extending up from the **pallet** platform, the front side normally being left open for loading or unloading.

*b. Application.* Figures 4-45, and 4-46, and 4-47 are hardwood pallets which permit transporting,



*Figure 4-45. Pallet 40 by 48 inches, flush-end, three-stringer, two-way entry, hardwood.*



*Figure 4-46. Pallet, 40 by 48 inches, wing-end, four-stringer, four-way (partial) entry, hardwood.*

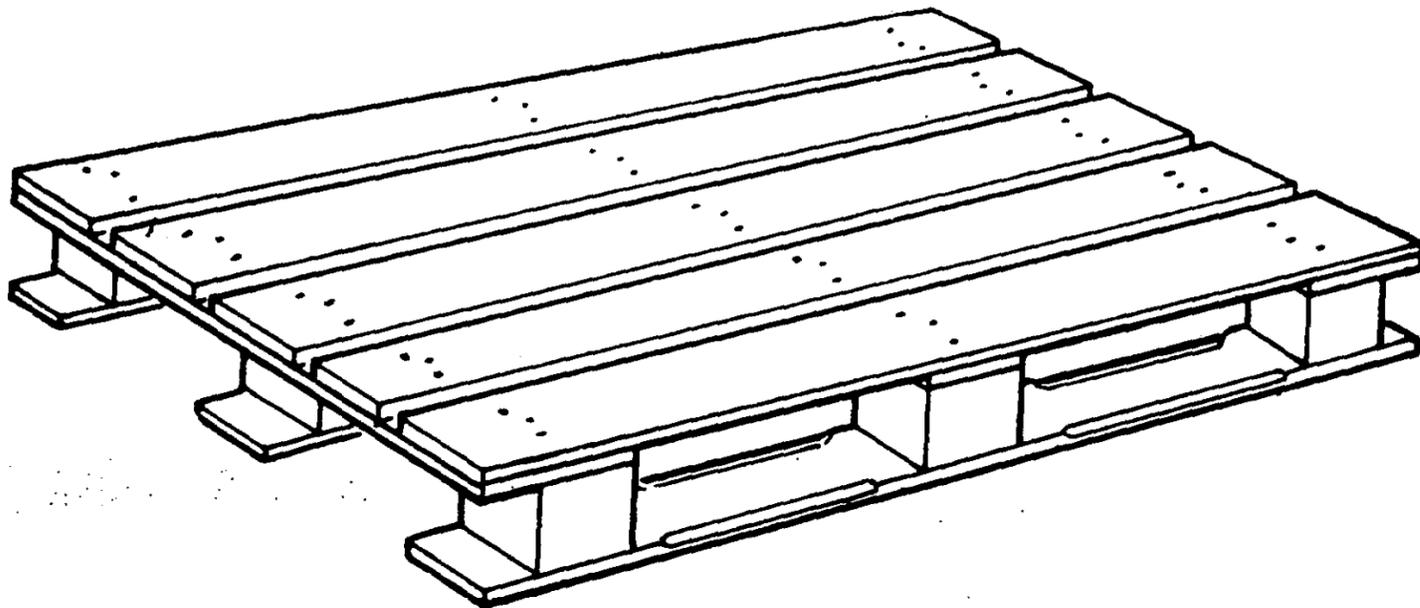


Figure 4-47. Pallet, 40 by 48 inches, wing-end, nine-post, four-way entry, hardwood.

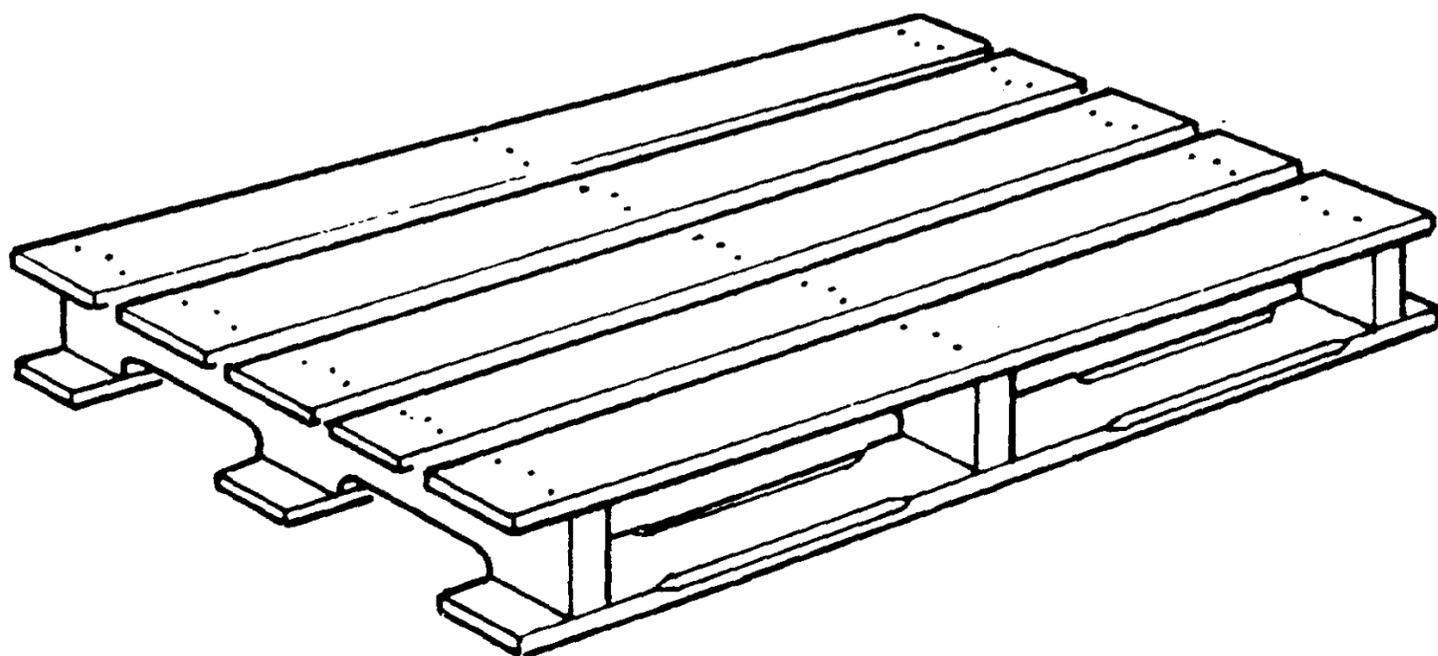


Figure 4-48. Pallet, 40 by 48 inches, four-way (partial) wing, softwood.

storing, or issuing of quantities of **material** with a minimum of manual handling. Material is placed manually on the pallet at time of receipt, and remains on the pallet for mechanical handling throughout the complete cycle of storage and issue operations. The efficiency of operation is greatly increased, since the pallet system of storage provides for the transportation of packaged items in *unit* loads and *increases* the volume and tonnage of materials which may be handled per manhour. Softwood pallets, type I, two-way, flush, and type H, two-way, wing are intended for use in storage operations. Type IV, four-way (partial) wing (fig. 4-

48) is intended for use in storage, except where **palletized** material is contained by means of pallet support sets, and for shipment worldwide **regardless** of the mode of transportation. The expendable buckboard **pallet** (fig. 4-49) used for air, CONUS, and Direct Support System (**DSS**) shipments interlocking load. The buckboard pallet stand (fig. 4-50) facilitates the movement of the pallet to the shrink tunnel. The box pallet (fig. 4-51) is used for storage of odd-sized items or weak containers, which will not support a superimposed load. The pallet support set (fig. 4-52) is recommended for use in lieu of the box pallet.

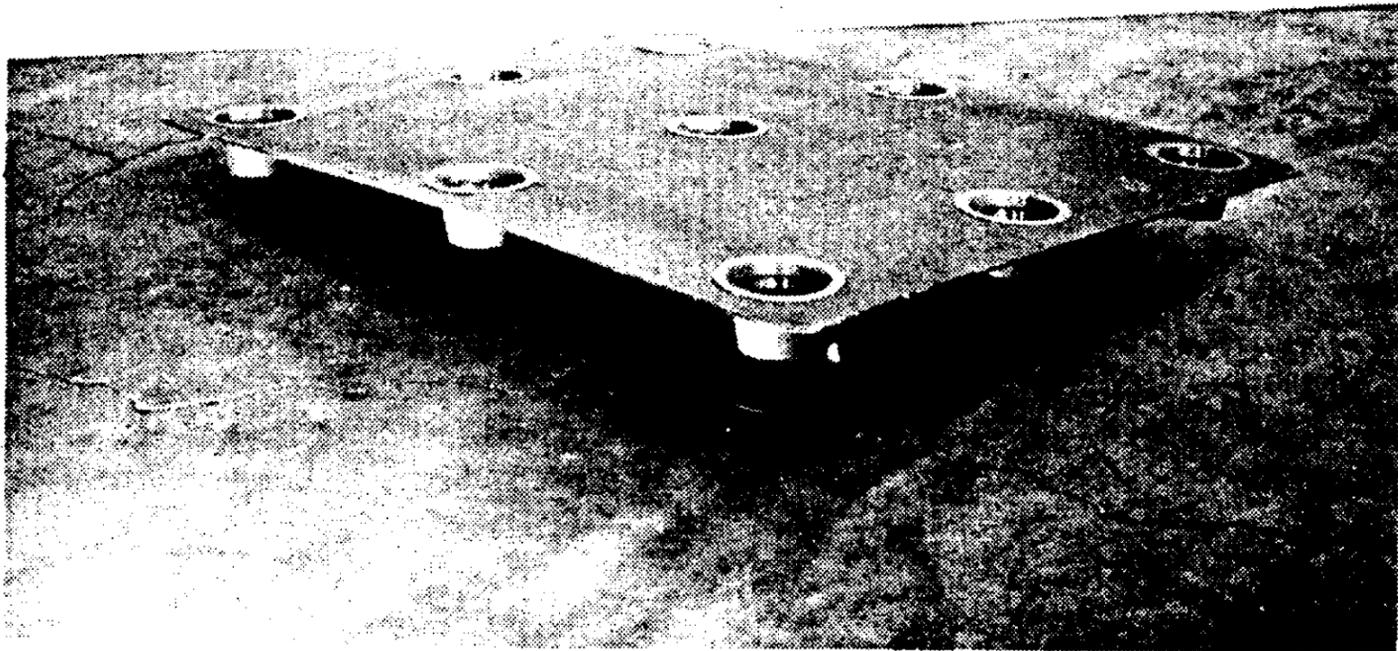


Figure 4-49. Pallet, buckboard, 40 by 48 inches, four-way entry, composed of polystyrene and fiberboard.

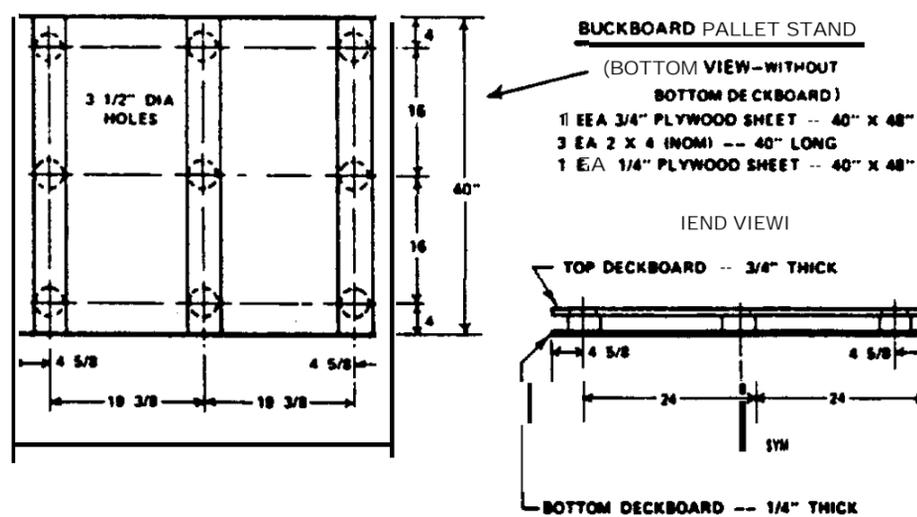
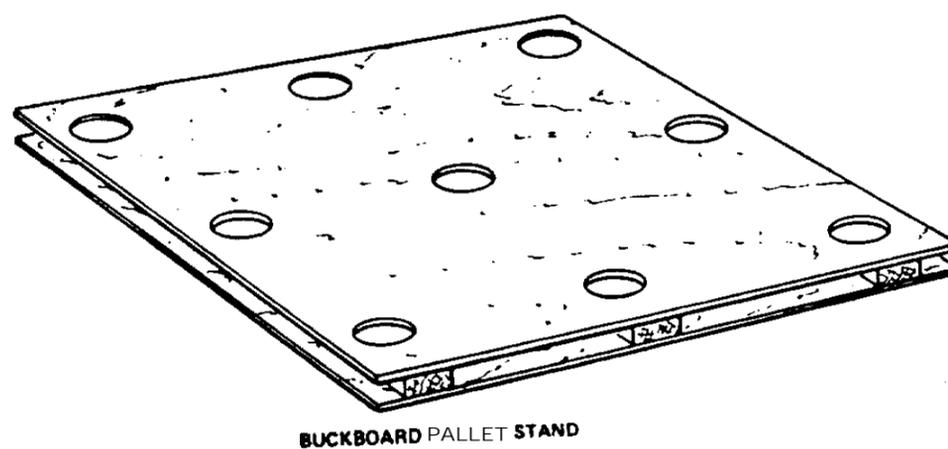


Figure 4-50. Buckboard pallet stand.

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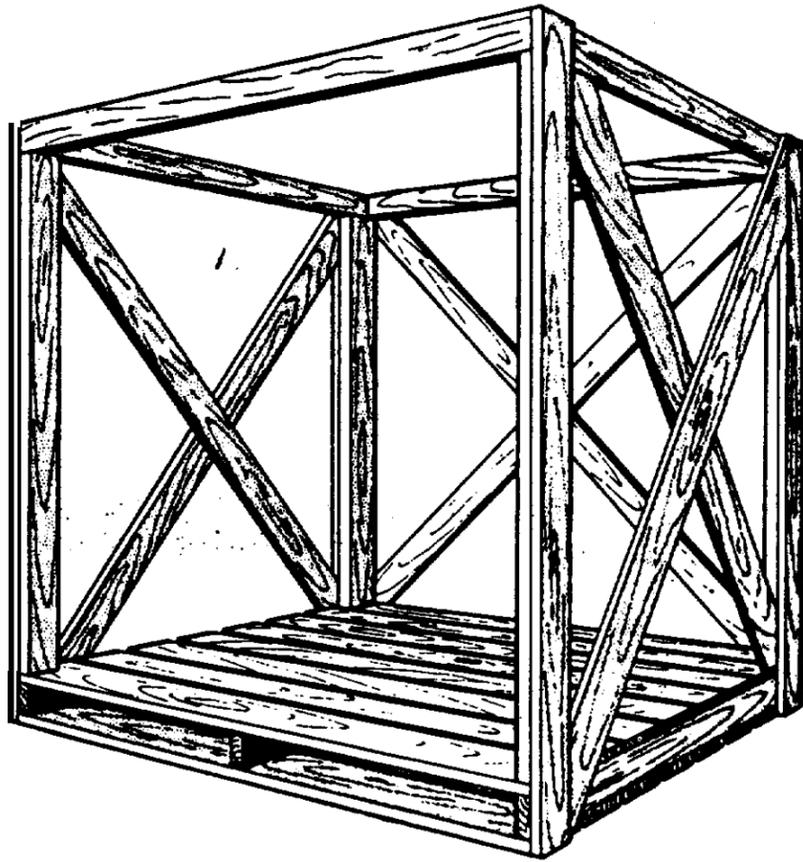


Figure 4-51. Pallet, box (may be constructed using flush or wing end type pallet)

#### 4-214. Storage Accessories and Aids.

*a. General.* Special devices, accessories, and attachments have been designed to handle materials in situations where conventional items of MHE are not adequate for efficient operation. No attempt has been made to include all accessories and aids used by the military services. The fact that an item is included is not to be regarded as authority for use at all installations. Similarly, the fact that an item currently in use has not been included should not be regarded as authority for discontinuance. Application and utilization are subject to the judgment and approval of responsible authorities.

#### *b. Pallet resources.*

(1) *Application.* Figure 4-52 shows a support set which is used to form a box pallet when assembled onto flat wood pallets, to allow for stacking of pallets containing irregular shaped commodities that are susceptible to crushing. Support sets are used on standard two-way entry flush type or four-way entry wing type pallets. Figure 4-53 shows the use of support sets for tire storage. Support sets

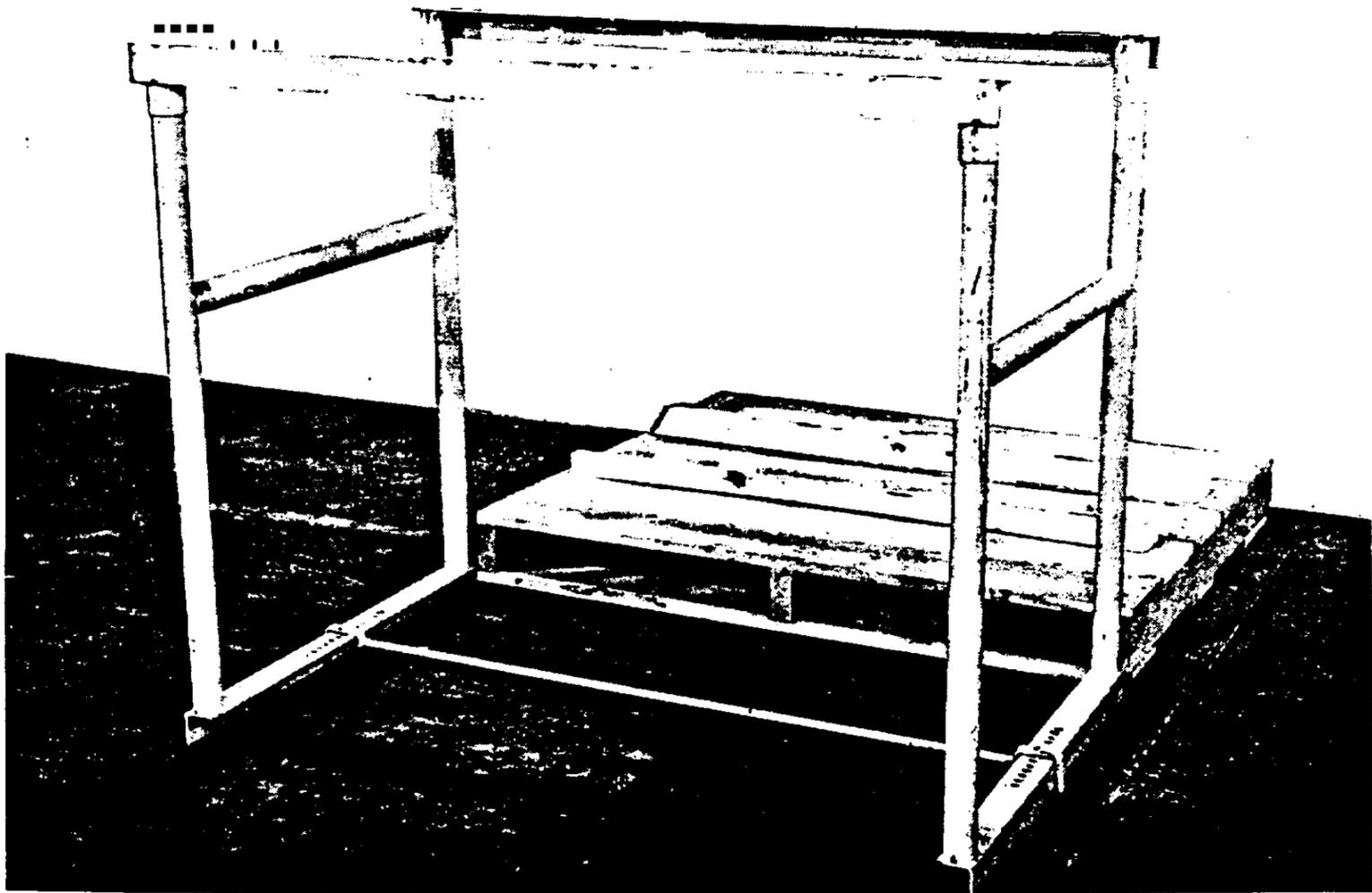


Figure 4-52. Support set, stacking, material handling pallet.



Figure 4-53. Support sets used for tire storage.

will not be used with pallets constructed of softwood.

(2) *Pallet rack.*

*Application.* Figure 4-54 shows the pallet rack which provides a support for pallets that is independent of lower loads. It is used where the material to be stored is not strong enough to support a superimposed load; is irregular in shape; is too small for bulk storage and too large for bin storage; or where it is desirable to remove pallets from a lower tier without disturbing upper tiers.

(3) *"Pallet sling.*

*Application.* Figure 4-55 shows a pallet sling which is used to handle a pallet for overhead lifting by a crane.

(4) *Safety pallet (OSHA 1910.178).*

*Application.* The safety pallet (fig. 4-56) is used both for maintenance work and for placing materials into or removing materials from storage. The safety pallet is handled the same as an ordinary pallet except it is secured to the forklift truck. Primarily, the safety pallet is used to elevate personnel and tools, and to permit warehouse personnel to safely store material in high racks when items cannot be

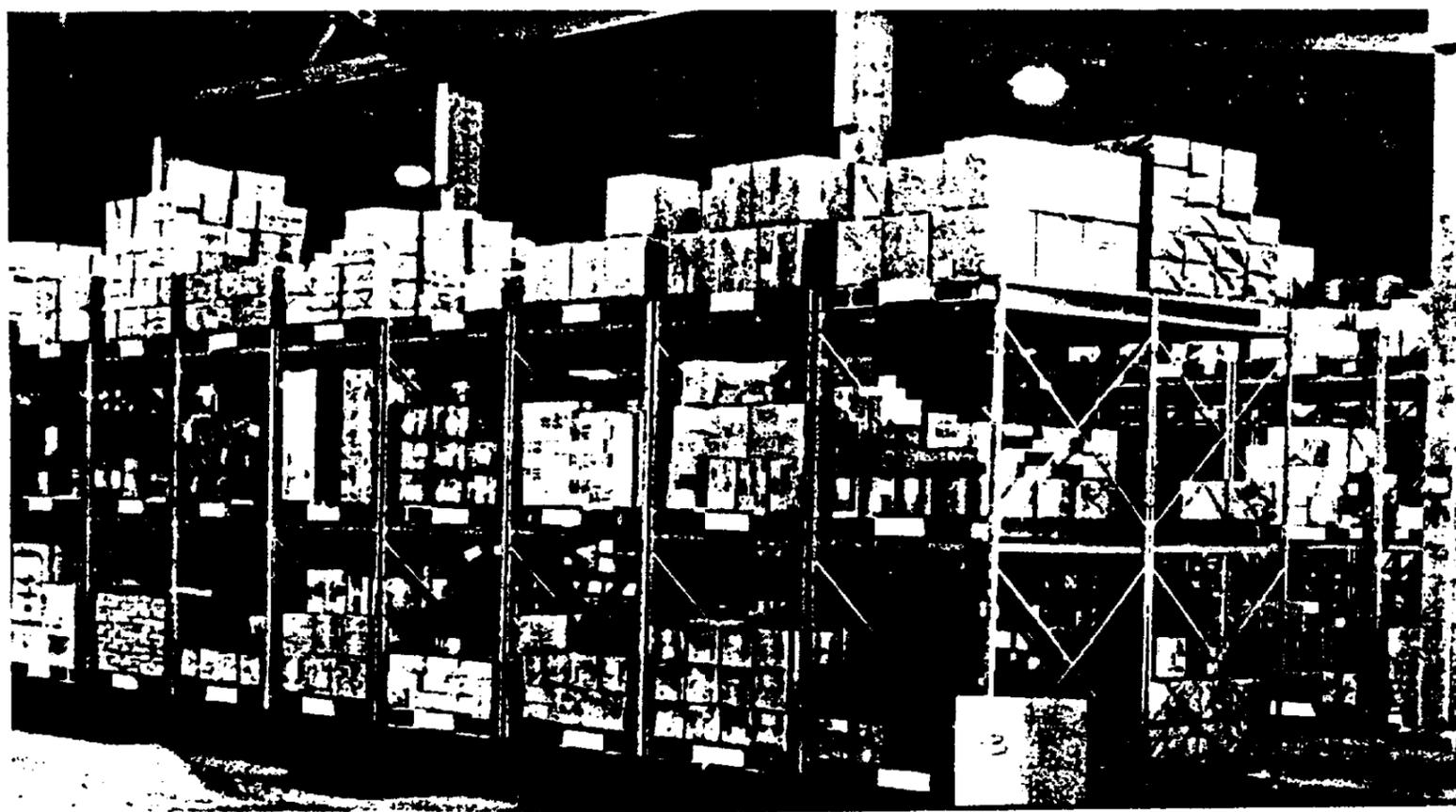


Figure 4-54. Pallet rack.

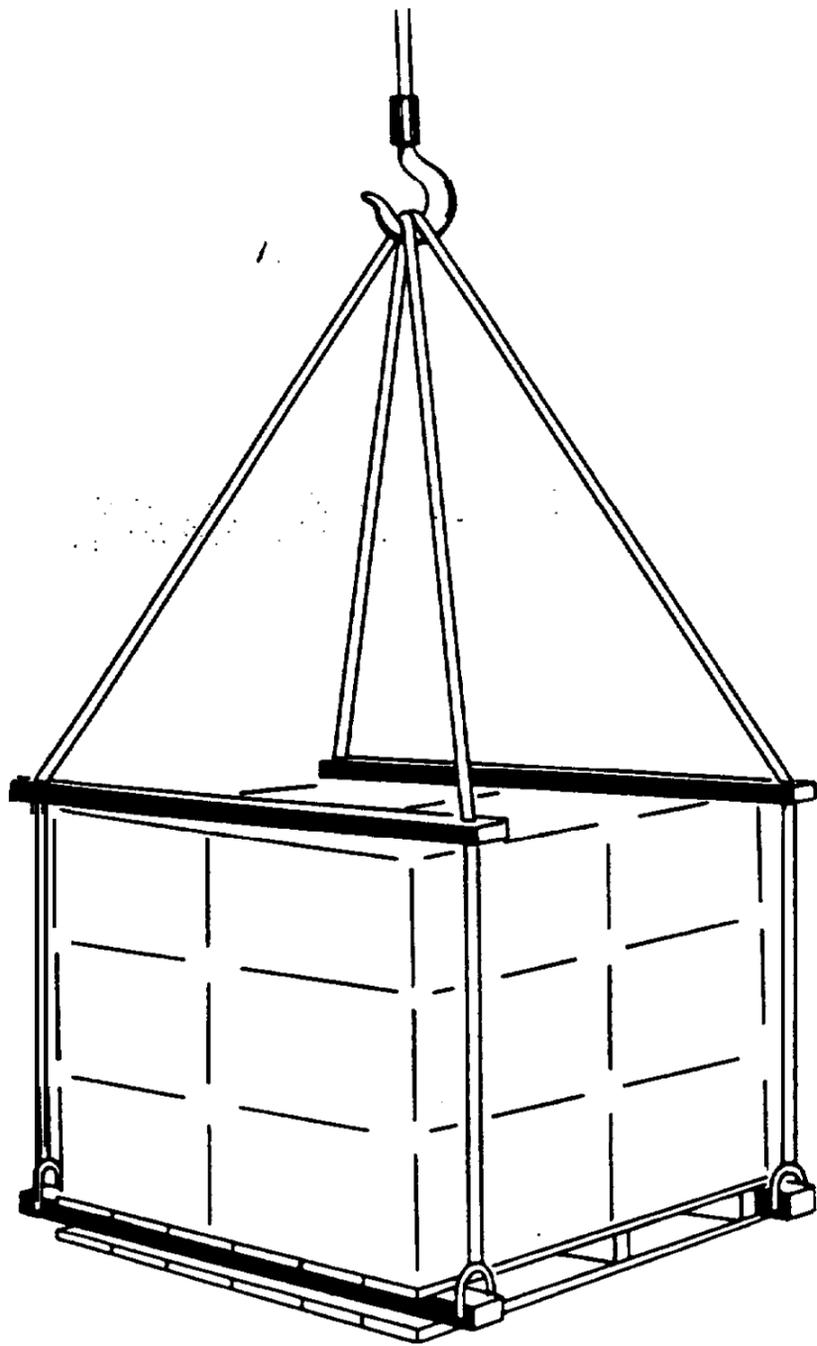


Figure 4-55. Pallet sling.

stored by forklift truck approaching at right angles due to narrow aisles. The entire pallet is painted yellow and is equipped with the following safety features (fig. 4-57).

(a) A high **coaming** to prevent tools or small items **from** falling off (1).

(b) An expanded metal **backguard** to protect personnel from moving parts of fork truck (2).

(c) Mitered corners (3).

(d) A handrail on background (4).

(e) Safety chains to enclose pallet area (5).

(f) Chains for securing pallet to fork truck

(6).

@Checker **plate** flooring to prevent **slippage** on pallet (7).

There are two types of safety pallets, type "A" and type "B." The type A safety pallet (fig. 4-56) is

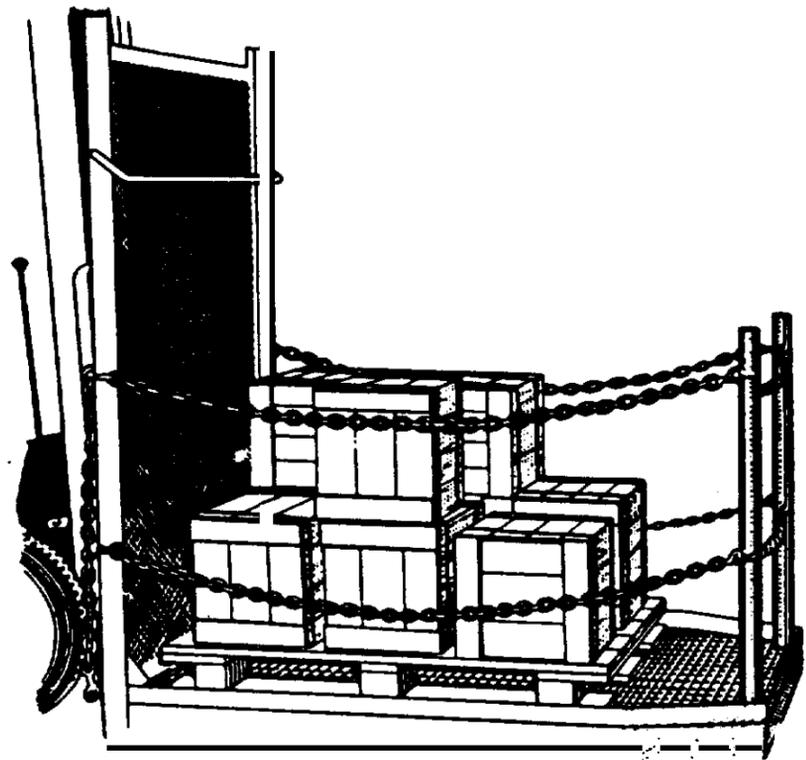


Figure 4-56. Safety pallet.

large enough to accommodate the average pallet and **provide** ample space from which a person can move materials safely into or out of storage. Fork extensions should be used with type "A" safety pallet (fig. 4-56) and, notice to this effect should be displayed prominently on the side of the pallet. The load carrying capacity of a fork truck rated at 24-

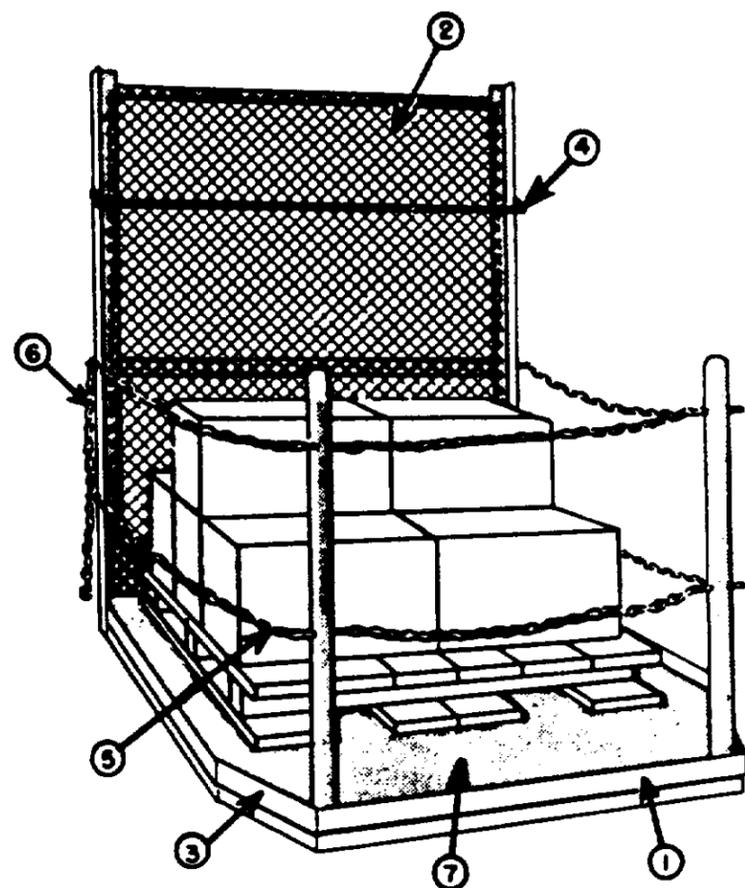


Figure 4-57. Features of the safety pallet.

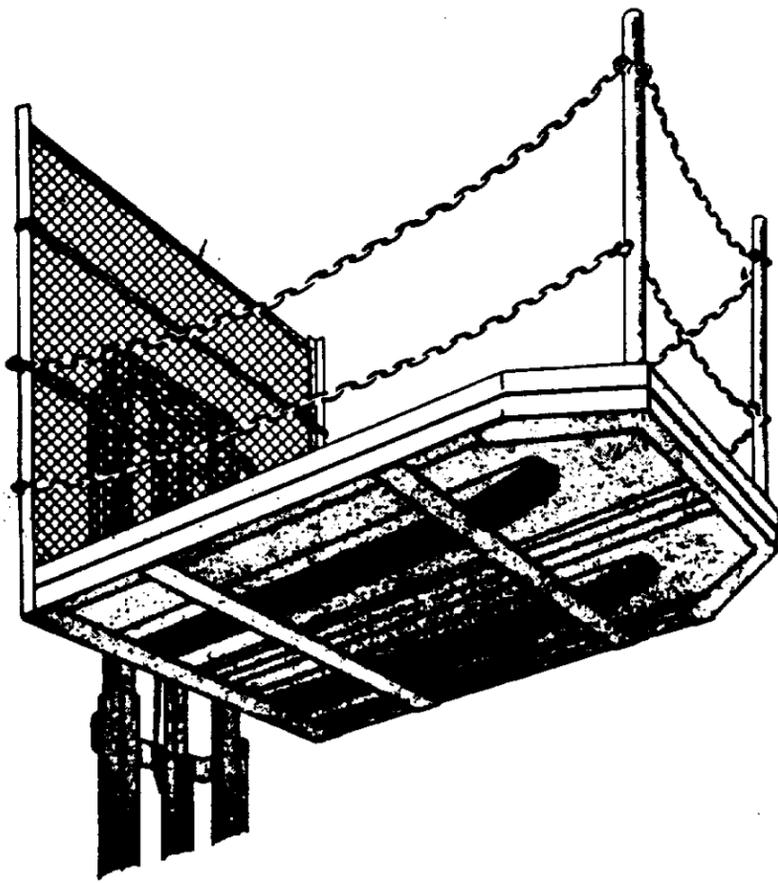


Figure 4-58. Extension forks used with the type "A" safety pallet.

inch load center is reduced by approximately 20 percent when handling loads of 60 inches long. This lower capacity must be considered when using the type "A" safety pallet. The type "B" safety pallet is similar to type "A," but smaller and more maneuverable in narrow aisles, a feature which is of value in maintenance work and in the movement of small lots of materials into and out of restricted storage areas. The specifications for construction of the type "A" and type "B" safety pallet are outlined in figure 4-59.

(h) In addition, such protection from falling objects as indicated necessary by the operating conditions shall be provided to protect personnel being elevated.

#### c. *Dunnage.*

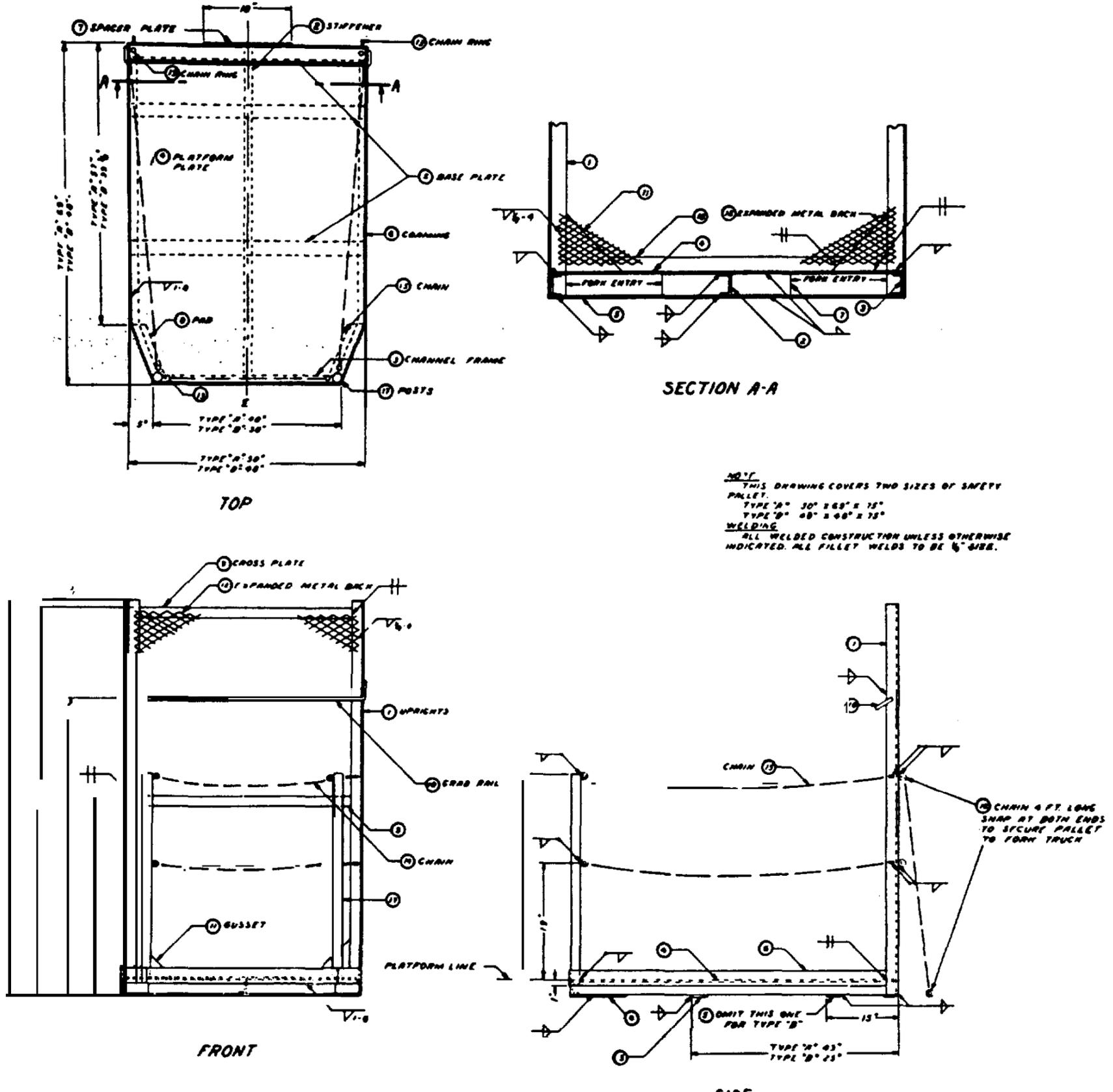
(1) *Application.* Dunnage is used to permit mechanical handling of and to protect stock from possible damage from water flows or dampness normally generated from the floor or ground area. In either covered or open storage, stock should be stored **on** pallets or dunnage. Skids on boxes or crates should be considered as attached dunnage for storage purposes. Usually, dunnage consumes less storage cube than a pallet. Dunnage may be cut from salvaged dimension lumber at little cost

and, therefore, should be used in lieu of and in the same manner as a pallet. Dunnage should be used at floor or ground level and, between units in the stack when one dimension of a stable container exceeds the width of a fork truck. Large boxed or crated units, crated or boxed engines, and other such commodities may be stored efficiently on **dunnage** (figs. 4-60 and 4-61). A supply of dunnage, cut into appropriate lengths, should be available in all storage areas in which portions of the material is to be stored on dunnage.

(2) *Vertical dunnage.* Vertical dunnage is lumber cut slightly shorter than the overall height of the load. When placed equidistant around the edge of the load or between containers in a vertical position, vertical **dunnage** stabilizes the load and prevents crushing of the containers by absorbing that part of the load which is in excess of the strength of the container. Also, pieces may be joined at right angles, placed at the four corners of the load, and held in position by strapping. The proper length of vertical dunnage is determined by the height of the pallet load. The friction of the loads upon each pallet bottom and the proper lengths of vertical dunnage that will support the load provide the required stability for the stack.

(3) *Horizontal dunnage.* Some form of horizontal dunnage must be used to build stable unit loads of **noninterlocking** items which will withstand handling, as a unit load, by mechanical equipment. Pallets often have been used for this purpose, by placing one or two courses of a hard-to-stack item on a pallet and placing the small unit loads into storage. In such storage, a stack 18 feet high may contain as many as 7 to 8 pallets. This is inefficient use of pallets and greatly reduces the quantity of stock which may be stored in a given storage cube. By the use of horizontal dunnage, stable **noninterlocking** items can be made into **full** unit loads, without any measurable increase in the size of the unit load due to dunnage. Double faced corrugated fiberboard, thin plywood, plain fiberboard, heavy wrapping paper, or similar materials may be used as horizontal dunnage. The type of horizontal **dunnage** to be used will depend upon the weight, shape, cutting qualities of the item to be **palletized**.

(4) *Horizontal binder block dunnage.* Another type of horizontal dunnage used for lateral binding of **palletized** loads is block or binder dunnage. This dunnage consists of short lengths of dunnage lumber, cut to any desired length, with short pieces of



**MATERIAL FOR ONE (TYPE A) SAFETY PALLET**

NO.	QTY	QUAN.	DESCR.
1	2		3" x 1/4" THK x 30" LBT
2	1		3" x 1/4" THK x 177" LBT
3	1		3" x 1/4" THK x 18" LBT
4	2		3" x 1/4" THK x 15" LBT
5	2		2" x 1/4" THK x 45" LBT
6	1		2" x 1/4" THK x 53" LBT
7	2		8" x 8" x 1/4" THK
8	1		EXPANDED METAL - 3/4" OPENING - 48" x 65" LBT
9	16		1/2" DIA. RD. SHAPED 3/4" I.D.
10	2		1/4" SIZE - 12 LINKS/FT - SNAP AT ONE END - 40" LBT
11	4		1/4" SIZE - 12 LINKS/FT - SNAP AT ONE END - 60" LBT
12	2		1/4" SIZE - 12 LINKS/FT - SNAP AT BOTH ENDS - 40" LBT
13	2		2" STD. PIPE 41" LBT
14	1		3-0" DIA. BAR SHAPED - 67" LBT

**MATERIAL FOR ONE (TYPE B) SAFETY PALLET**

PC NO.	NAME	QUAN.	DESCRIPTION
1	UPRIGHTS	2	2 1/2" x 1/2" x 1/4" L-74 3/4" LBT
2	STIFFENER	2	3" x 1 1/2" - 6 LBS. C - 40 1/4" LBT
3	CHANNEL FRAME	1	3" x 1 1/2" - 6 LBS. C - 158"
4	PLATFORM PLATE	1	1/4" THK - RIBBED OR DIAMOND PL. - 47 1/2" x 47 3/4"
5	BASE PLATE	2	3" x 1/4" THK x 60" LBT
6	COAMING	1	3" x 1/4" THK x 133" LBT
7	SPACER	1	3" x 1/4" THK x 18" LBT
8	BASE PADS	2	3" x 1/4" THK x 15" LBT
9	CROSS PLATE	2	2" x 1/4" THK x 44" LBT
10	BACK PLATE	1	2" x 1/4" THK x 51" LBT
11	SUBSET PLATE	2	8" x 8" x 1/4" THK
12	BACK GUARD	1	EXPANDED METAL - 3/4" OPENING - 47" x 65"
13	CHAIN RING	16	1/2" DIA. RD. SHAPED 3/4" I.D.
14	FRONT CHAIN	2	1/4" SIZE - 12 LINKS/FT - SNAP AT ONE END - 30" LBT
15	SIDE CHAIN	4	1/4" SIZE - 12 LINKS/FT - SNAP AT ONE END - 40" LBT
16	BACK CHAIN	2	1/4" SIZE - 12 LINKS/FT - SNAP AT BOTH ENDS - 40" LBT
17	POSTS	2	2" STD. PIPE 41" LBT
18	GRAB RAIL	1	3/4" DIA. - BAR SHAPED - 65" LBT

Figure .4-59. Safety pallet specifications.

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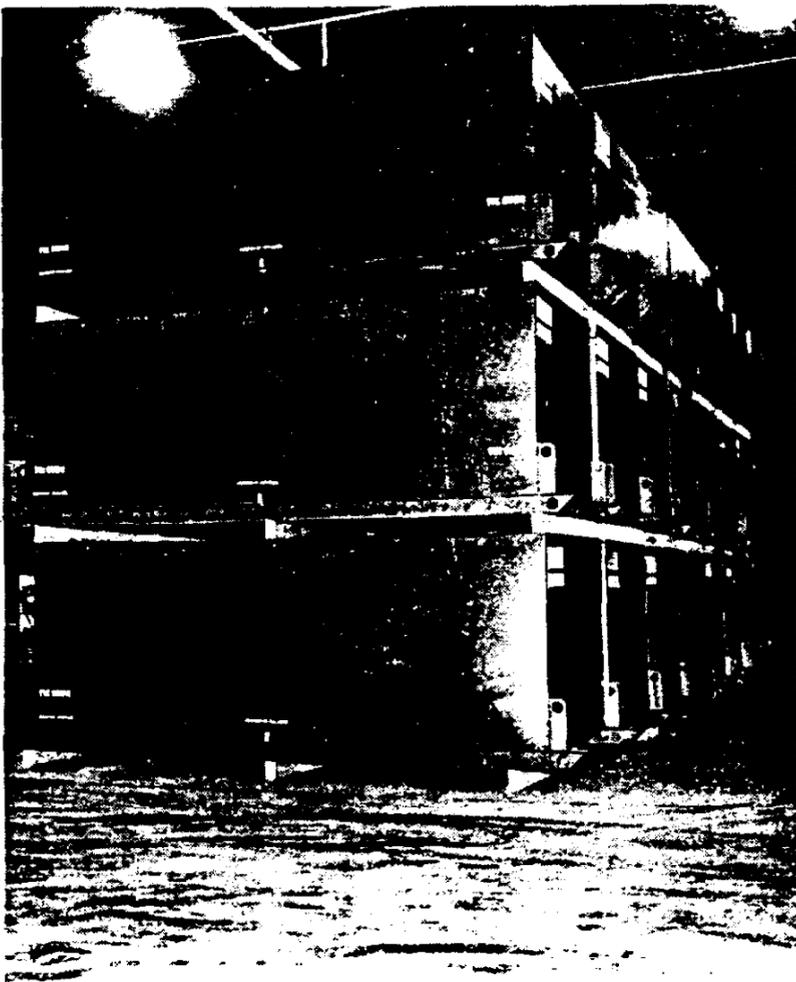


Figure 4-60. Dunnage used in the stacking of asphalt melters.

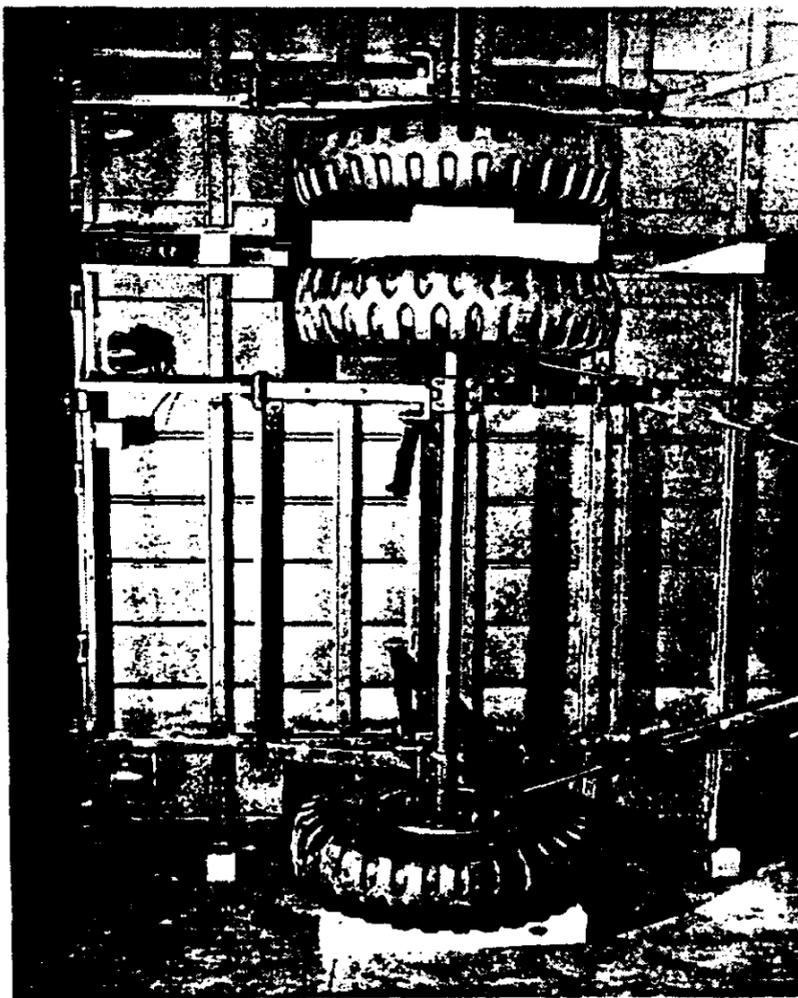


Figure 4-61. Dunnage used in the storage of trailers.

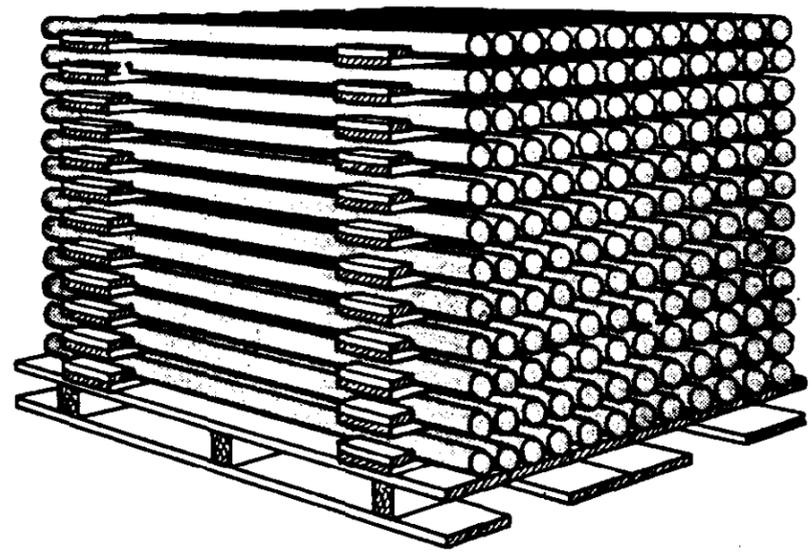


Figure 4-62. Binder block dunnage used in the storage of pipe

blocking secured to each end. This dunnage is particularly adapted to the storage of such items as soil pipe, lengths of large pipe, or similar items which require blocking to prevent rolling (fig. 4-62). Use of this type binder facilitates the removal of one or more layers of pipe from the pallet or stack at any time by use of the fork truck. Also, it results in safe unit loads and permits high stacking of this type of item.

d. Collars and notched spacers.

(1) **Carboy collars.** To stack glass carboys of acids and similarly packaged items, the superimposed weight of the upper pallets must be supported in such a manner that the weight will be carried by the protective crating around the carboy; this can be accomplished by the use of the wood collar (fig. 4-63). By the use of this collar, carboys can be stacked to permit maximum utilization of storage cube. Since all carboys are not identical in size or packaging, the dimensions of the collar will have to be determined by local requirements. However, care should be taken to assure that the outer edges of the collar rest directly above the sides of the carboy crate. The center member of the collar should be midway between the carboys and securely fastened, as this member supports the center stringer of the upper pallet. In ordering collars, the storekeeper should remember that a collar is not required on the top pallet.

(2) **Collars for compressed gas cylinders.** The valves on acetylene and similar type cylinders must be protected from the superimposed weight of the upper pallets; this is accomplished by the use of wooden collars (fig. 4-64). However, since this col-

*Dr*

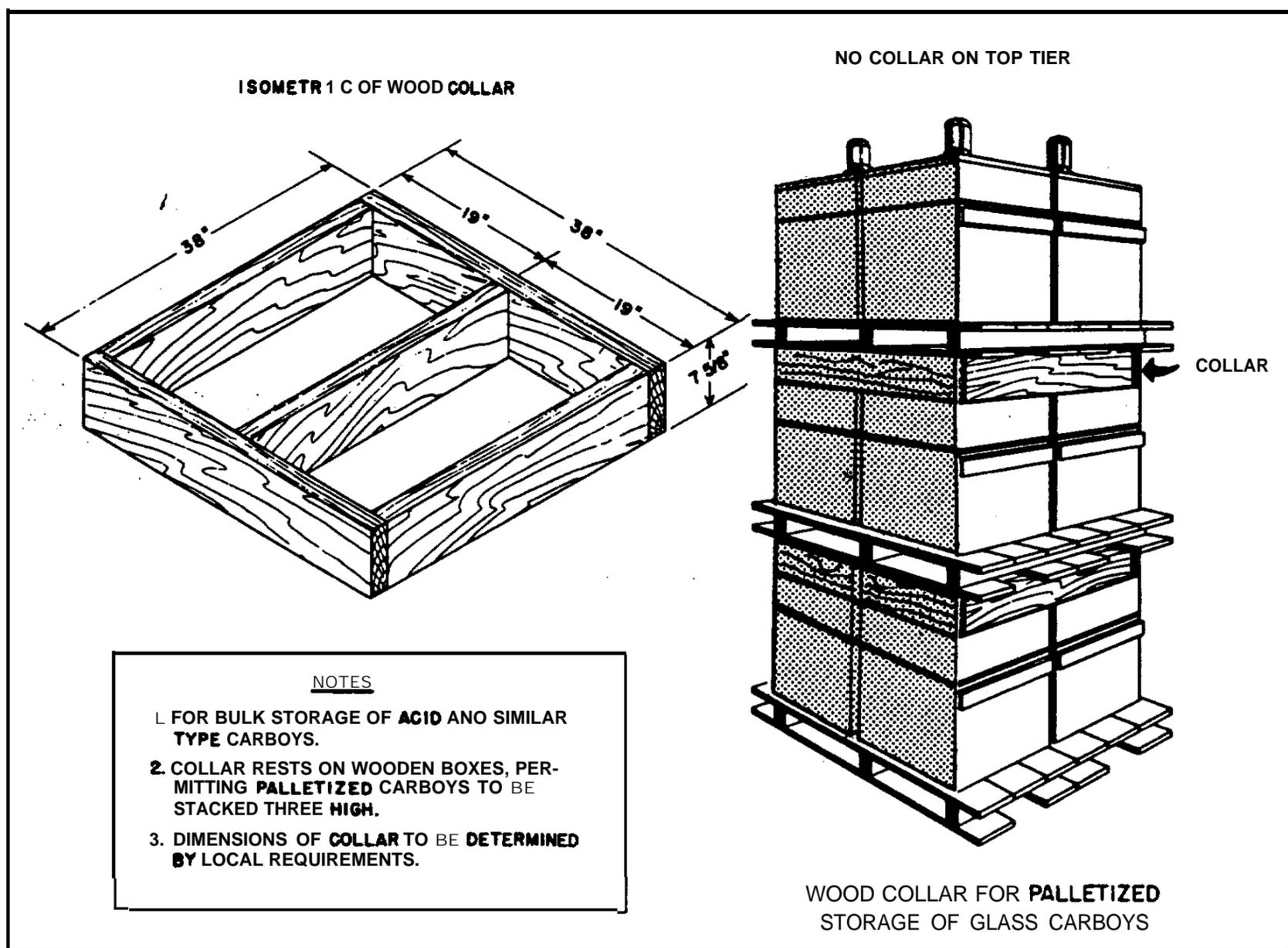


Figure 4-69. Collars used in the storage of glass carboys.

lar depends upon the cylinder, the neck of which has a slight slope, for support it is necessary that this unit be reinforced,

All cylinders palletized in an upright position must be bound with steel strapping to stabilize the load and, to prevent accidental tipping of a cylinder during transporting or stacking operations.

(3) **Notched** spacers. Notched spacers are used for the horizontal **palletizing** of compressed gas cylinders. Also, this spacer may be used to **palletize** short sections of large diameter pipe or similar items. The bottom segments of this type dunnage may be notched on the edge that rests on the pallet. Even though a flat surface transmits the entire weight of the load to the face of the pallet (fig. 4-65), notching the segments will not reduce the strength of hardwood dunnage below acceptable safety **factor** requirements. Notched spacers are recommended for smaller diameter cylinders. This method of **palletization** permits issue of single units

without disturbing the balance of the unit. When cylindrical items are **palletized** horizontally and must be transported long distances or over rough terrain, such units should be bound to the pallet with wire or steel strapping.

*e. Fork extensions.*

*Application.* Fork extensions are used to extend the forks of a forklift truck. The extensions, consisting of welded steel arms, can be slipped into place over the regular forks. Since the use of extensions moves the center of gravity of the load, it restricts the weight that can be lifted. This factor must be taken into account when the extensions are used to handle excessively large or bulky loads (fig. 4-66).

*f. Portable platform.*

*Application.* A portable platform is used to load and unload supplies at open sheds, open storage or

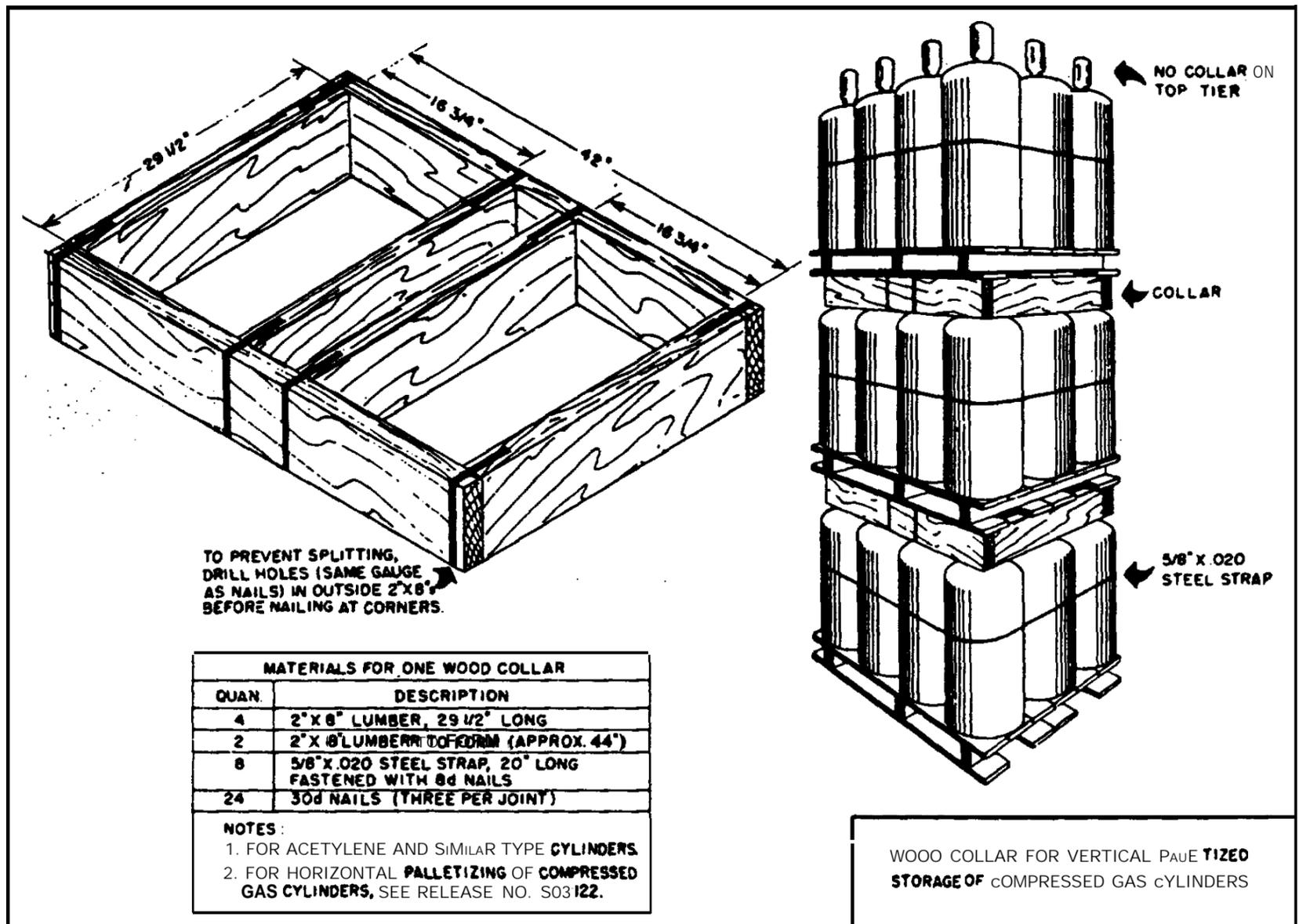


Figure 4-64. Wood collars for vertical palletized storage of acetylene cylinders.

wherever cars are being worked from ground level. It can be moved by a forklift truck and has slings for handling by a crane. One type platform is equipped with legs only. Another type is equipped with retractable legs, wheels, and pneumatic tires (fig. 4-67).

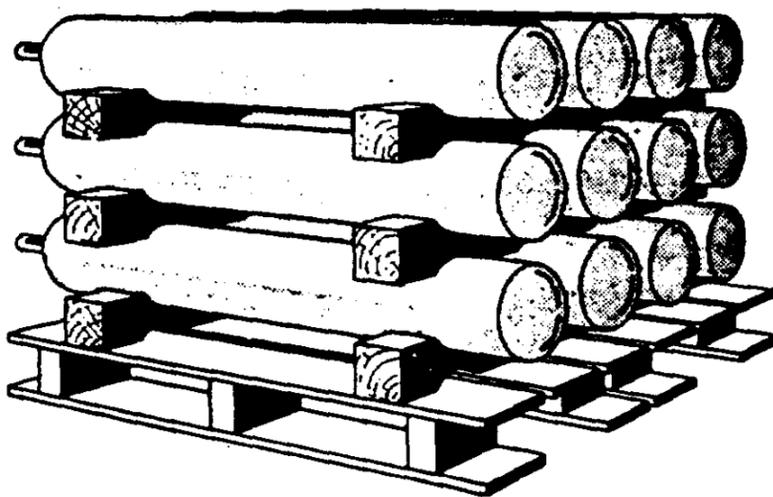


Figure 4-65. Notched spacers.

*g. Retriever trailers.*

*Application.* Retriever trailers are used to haul forklift trucks to and from maintenance shops at widely dispersed activities. There are two basic types of retriever trailers—the single-truck type

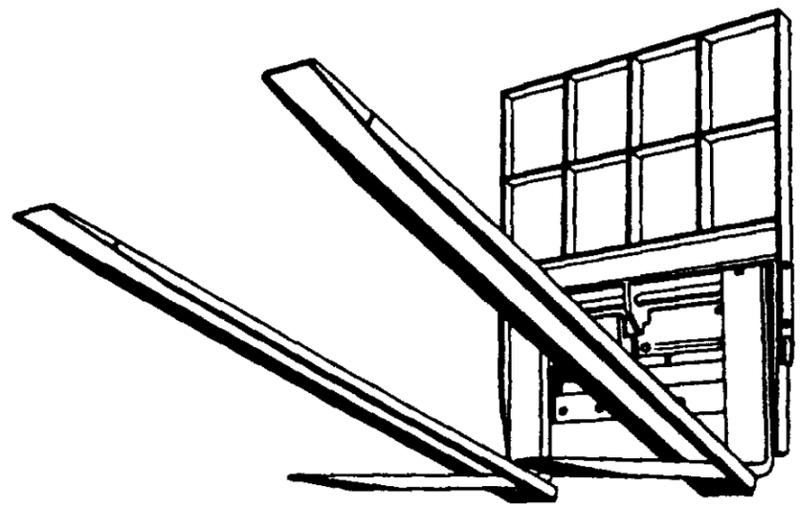


Figure 4-66. Fork extensions.

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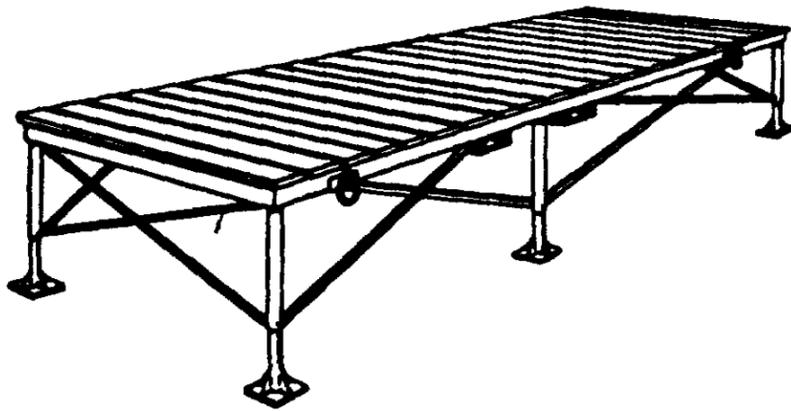


Figure 4-67. Portable platform.

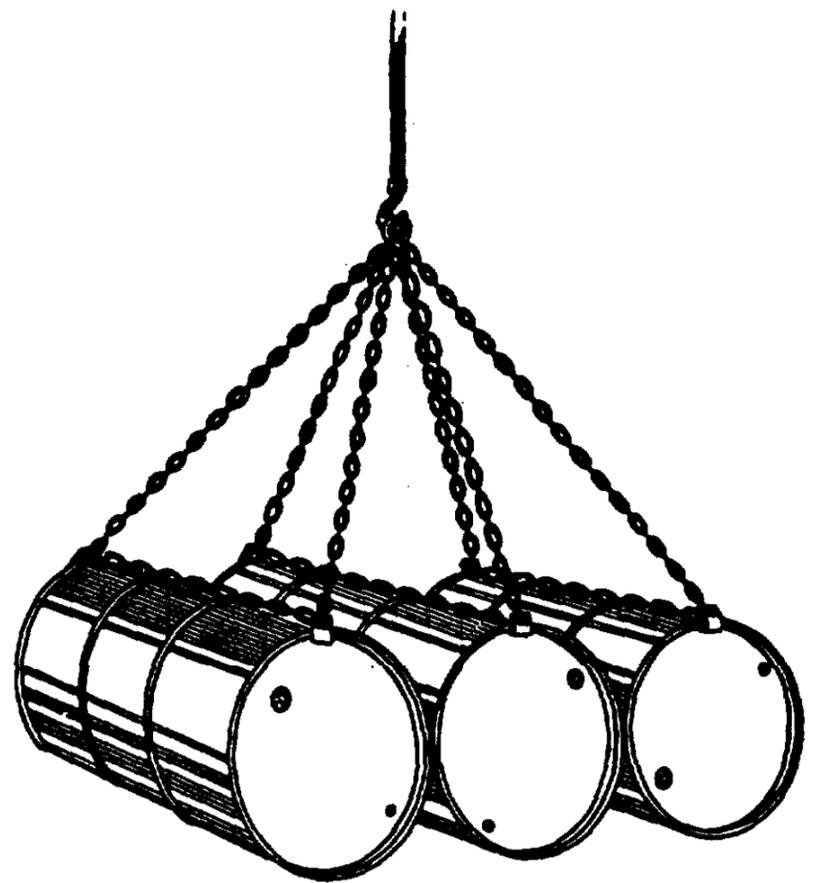


Figure 4-68. Drum-handling sling.

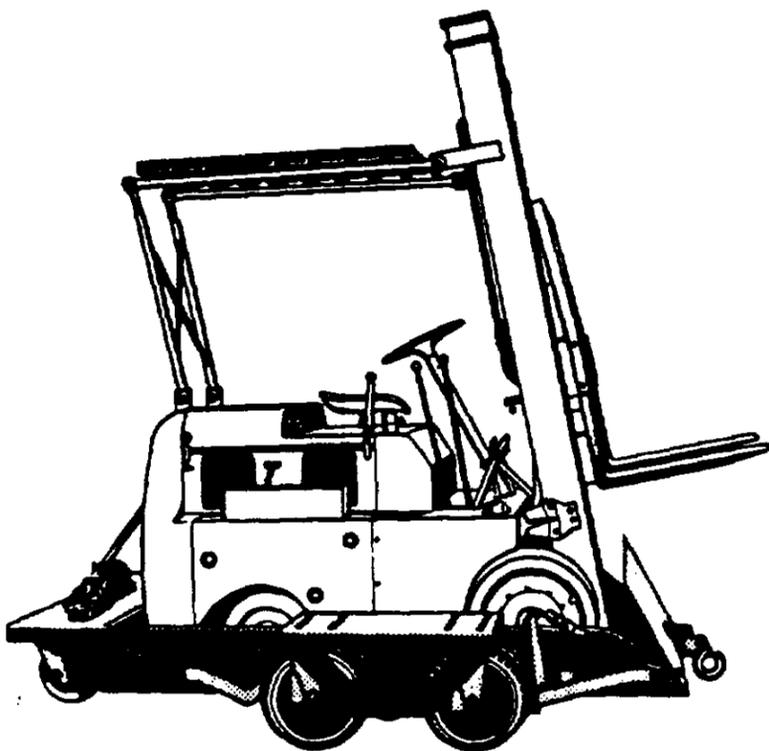


Figure 4-69. Retriever trailer, single-truck type.

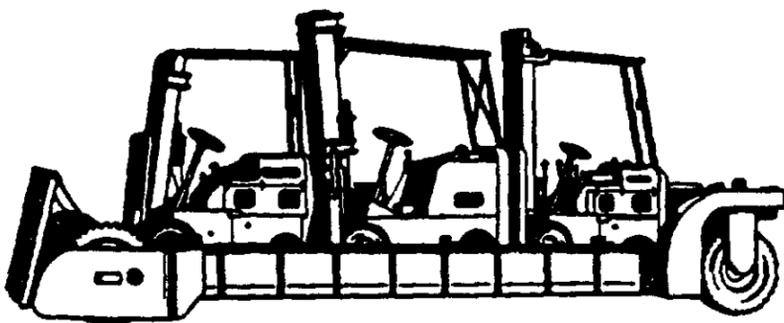


Figure 4-70. Retriever trailer, three-truck type.

and the three-truck type. The single-truck type retriever can be towed by a 4,000-pound or 7,500-pound gasoline tractor. The three-truck type retriever with a gross load capacity of 33,000 pounds must be towed by a 4,000- or 7,500-pound tractor, depending upon the grade and road surface (figs. 4-68 and 4-69).

#### h. Drum-bundling slings.

*Application.* The drum-handling sling is a device for picking up drums or barrels. It was designed for shipboard loading, but can be used with a crane truck for any drum or barrel-handling operation. The sling may be of the chain type, which is a series of chain loops and sliding hooks; or it may be of the frame type, which is a steel bar from which a series of sling hooks are suspended (fig 4-70).

#### i. Drum-handling attachments.

*Application.* The drum-handling attachment is a device capable of handling filled 55-gallon drums by means of a forklift truck. Three types of attachments are available. The **first** consists of a series of specially shaped and spaced forks that cradle the drums to be handled. This type of attachment handles three **filled** drums at one time. The second type of attachment, which is mounted on the regular

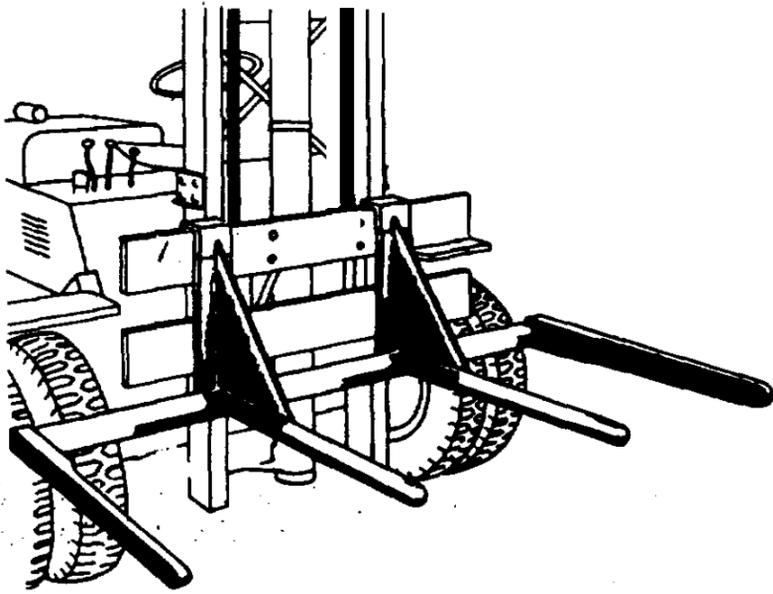


Figure 4-71. Drum-handling attachment.

truck forks, consists of side rails **from** which specially designed hooks are suspended at **front** and rear. The attachment is lowered over the drums **until** the hooks drop into position over the drum rims. This type of attachment handles two **filled**

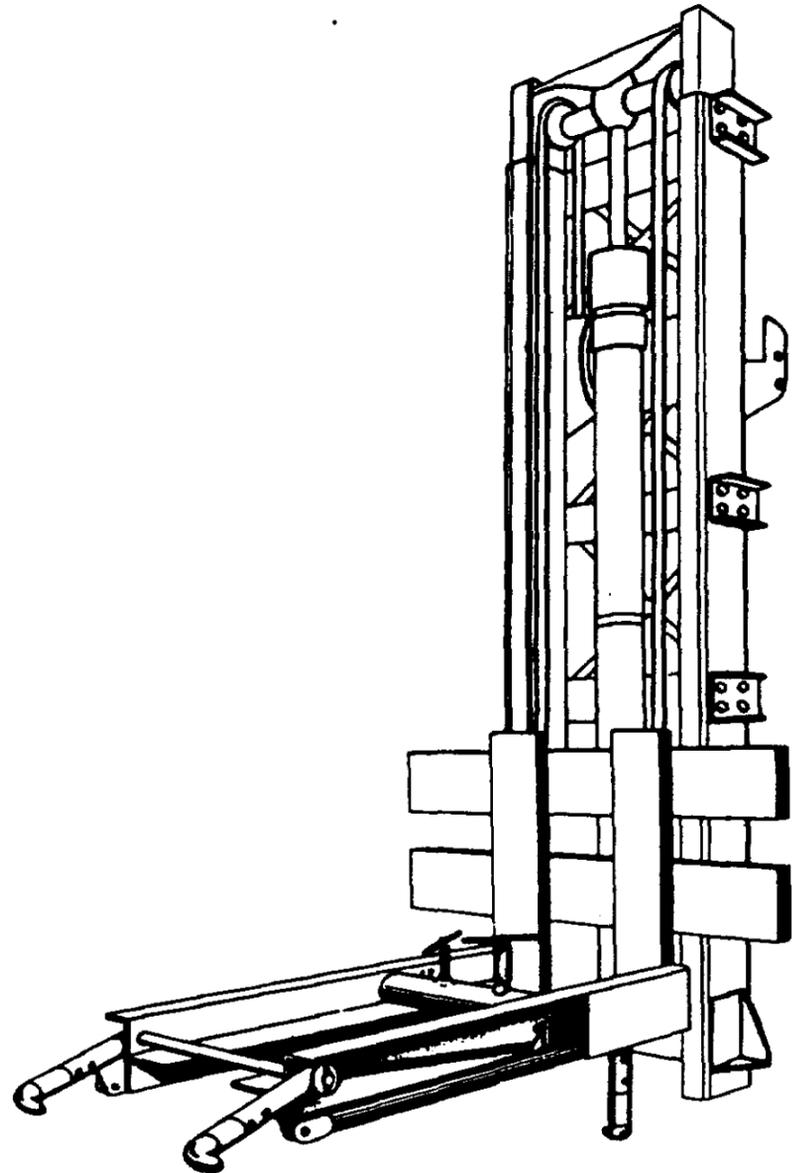


Figure 4-79. Drum-bundling attachment *single-drum type, horizontal carry.*

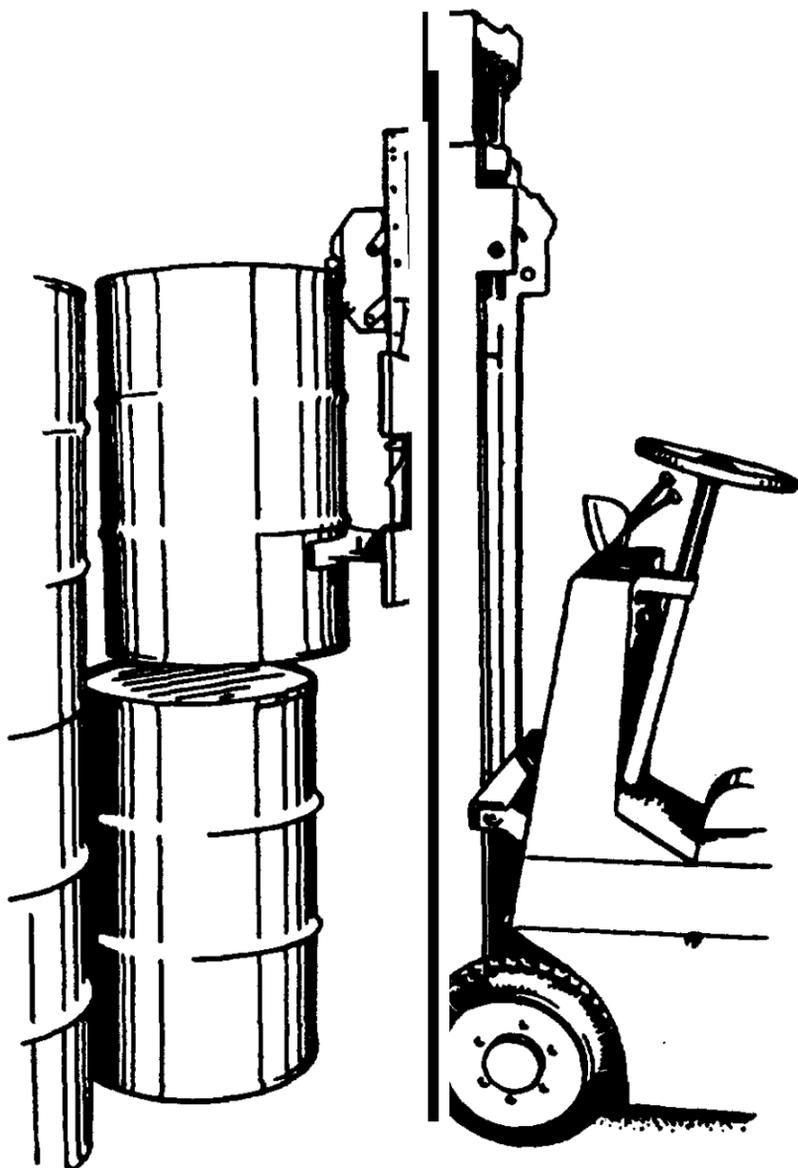


Figure 4-72. Drum-bundling attachment *single-drum type, vertical carry.*

drums at one time. The third type of attachment, which is vertically operated, handles one filled drum at one time (figs. 4-71, 4-72, and 4-73).

*j. Bridge plate rack.*

*Application.* The bridge plate rack is used to store bridge plates. Several types made of wood or metal are in use (fig. 4-74).

*k. Bridge plate.*

*Application.* The bridge plate is a metal plate used to span the gap and compensate for difference in height between truck and truck dock and rail car and rail dock. The bridge plate permits movement of MHE in and out of trucks and rail cars. These plates are usually equipped with chains or recessed lifting hooks for pickup positioning by a forklift truck (figs. 4-75 and 4-76).

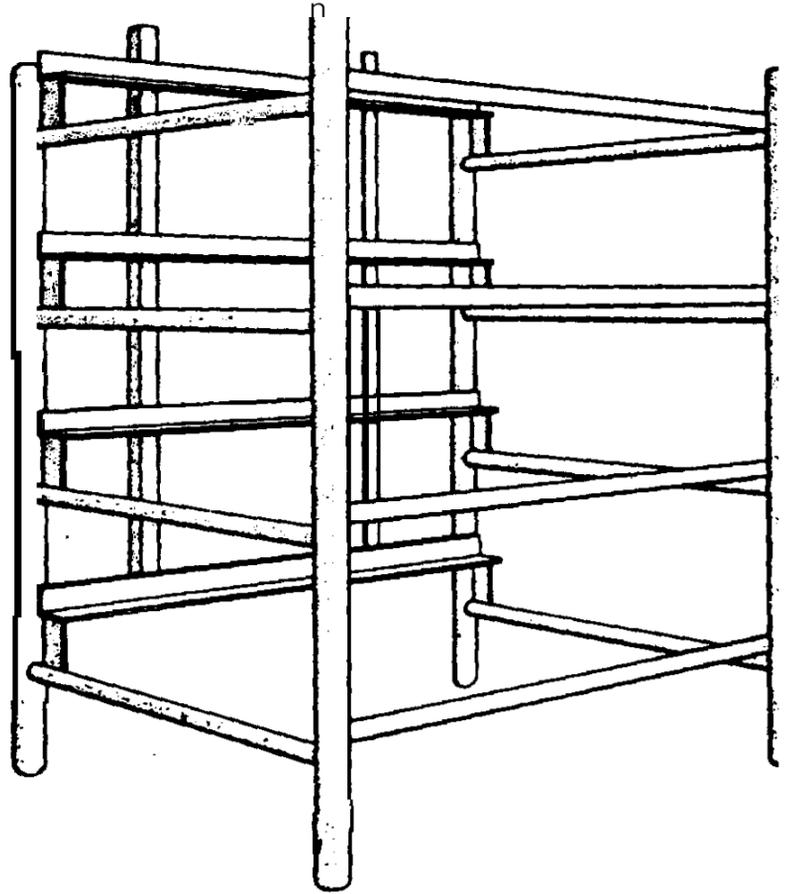


Figure 4-74. Bridge plate rack.



Figure 4-75. Bridge plate.

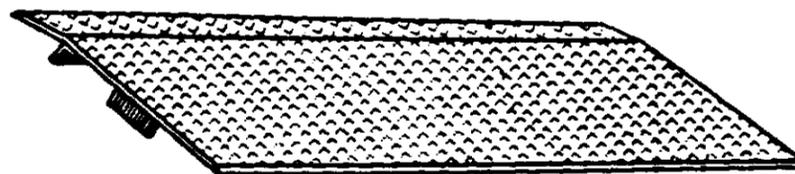


Figure 4-76. Bridge plate.

*l. Mechanically operated ramp.*

*Application.* The mechanically operated adjustable ramp is used at the truck dock. The ramp is **vertically** adjustable to the height of truck floors so that movement of MHE in and out of trucks is permitted. These ramps are either permanently installed in the dock or located in front of the dock (figs. 4-77 and 4-78).

*m. Flip ramp dockboard.*

*Application.* Used for truck loading and unloading. Manually operated **dockboard** mounted to the front of the dock (figs. 4-79 and 4-80),

*n. Mobile vehicle loading ramp.*

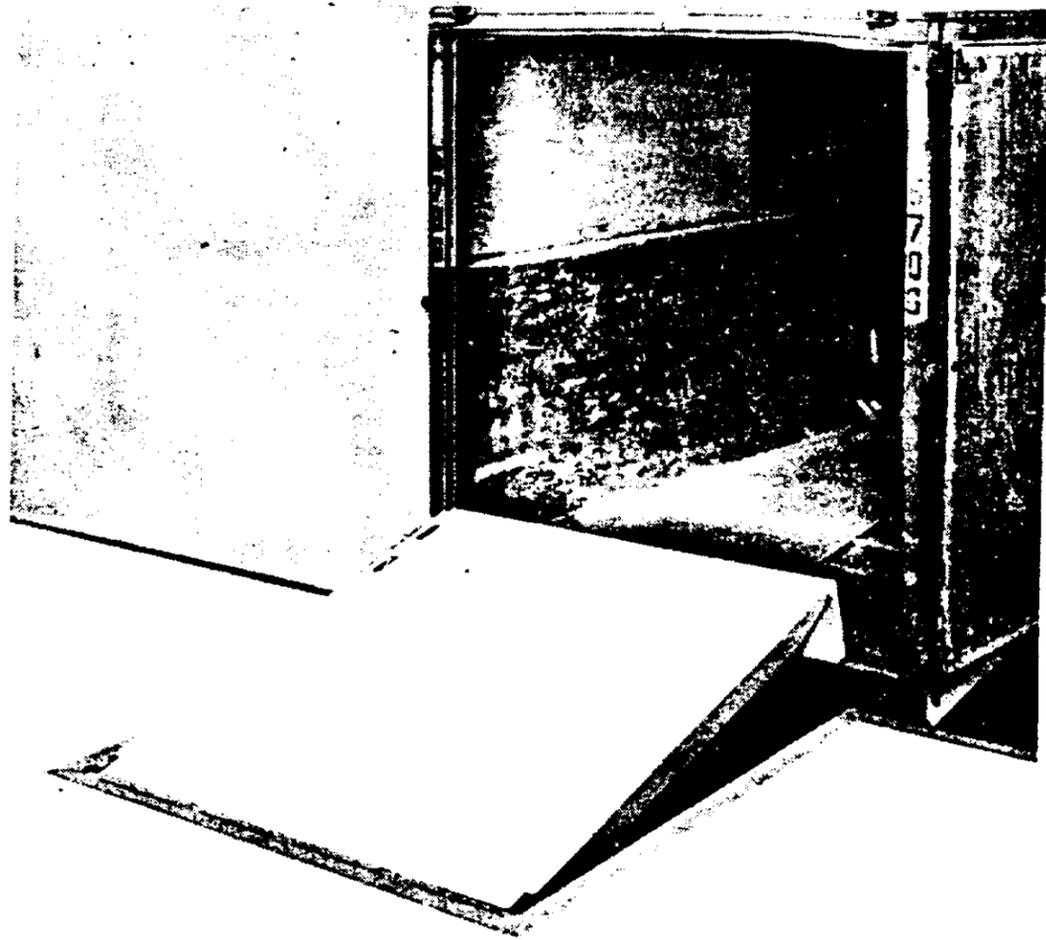
*Application.* Portable ramp used for loading and unloading with forklift trucks from ground level. A detachable tow bar is provided for towing (fig. 4-81).

*o. Bottom-dumping hopper.*

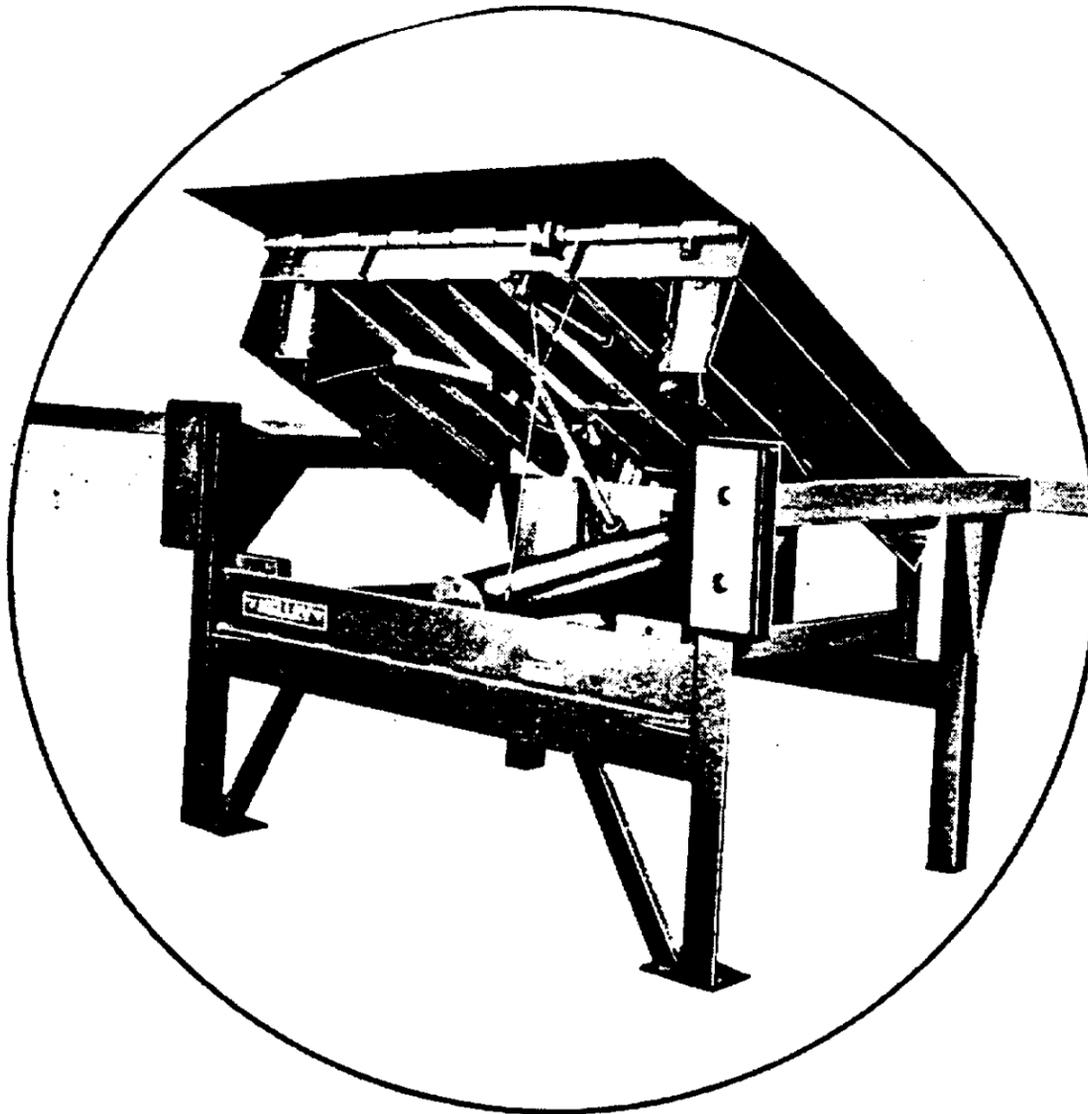
*Application.* The bottom- or **self-dumping** hopper is a forklift truck attachment that is used to load and unload bulk materials, small parts, or scrap (fig. 4-82).

*p. Ram.*

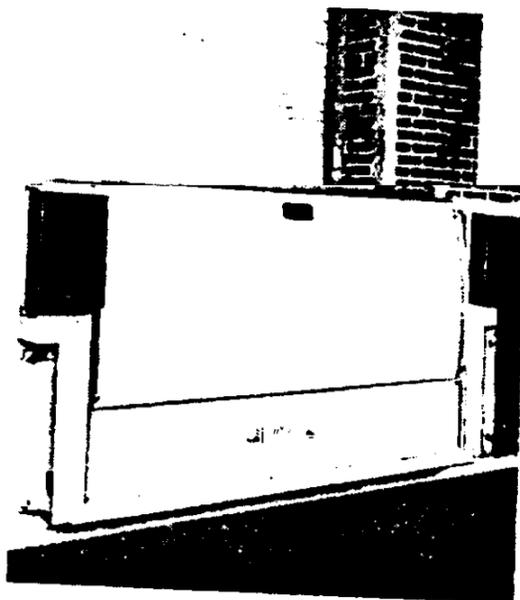
*Application.* The ram is a solid, pole-like device



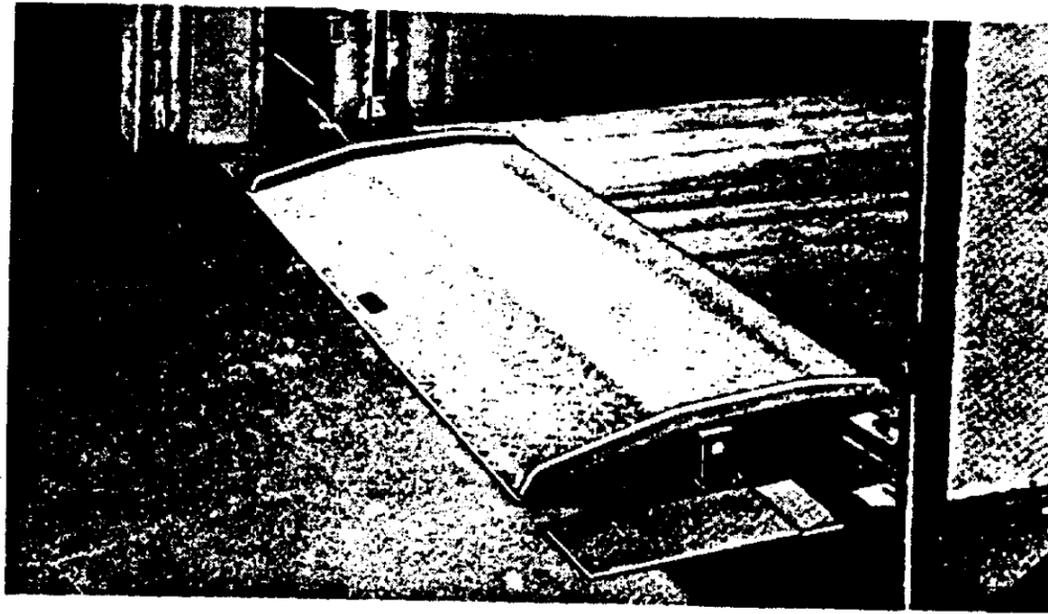
*Figure 4-77. Mechanical mmp recessed in the loading dock.*



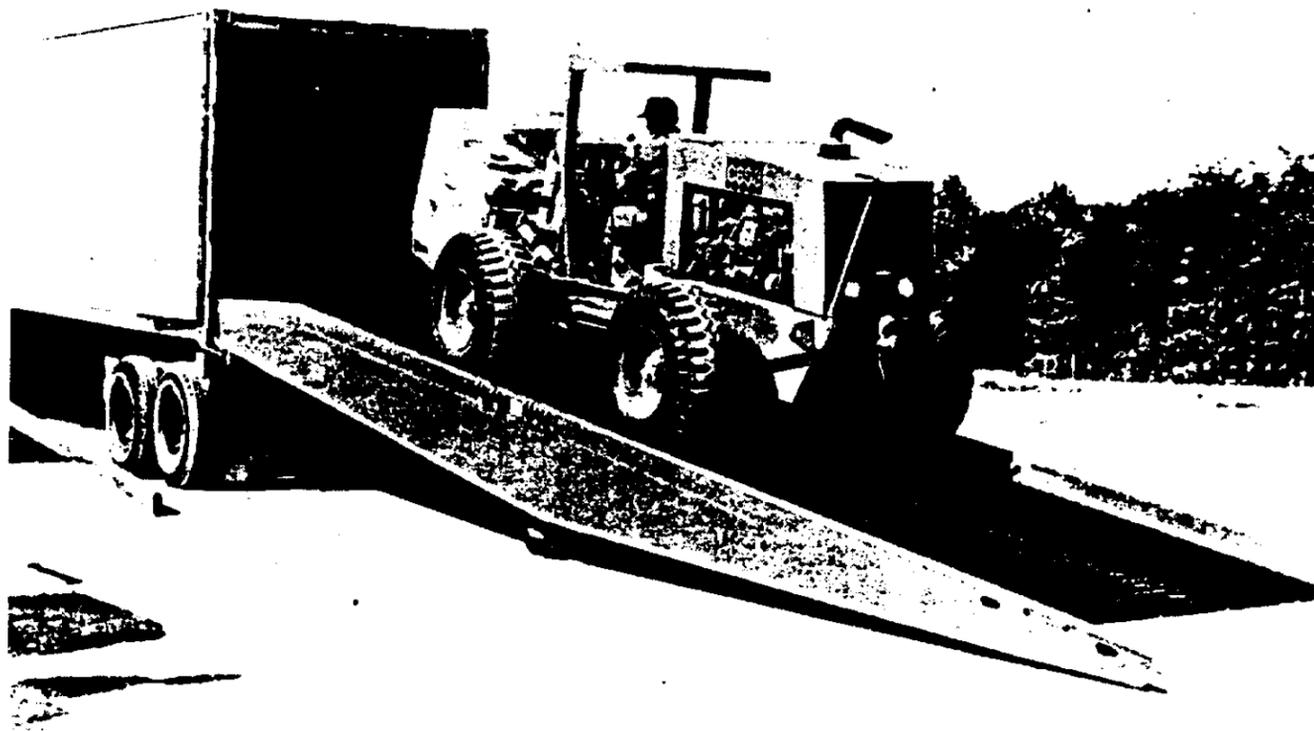
*Figure 4-78. Mechanical mmp mounted in front of dock.*



*Figure 4-79. Dockboard in stored position.*



*Figure 4-80. Dockboard in operating position.*



*Figure 4-81. Mobile vehicle loading ramp.*

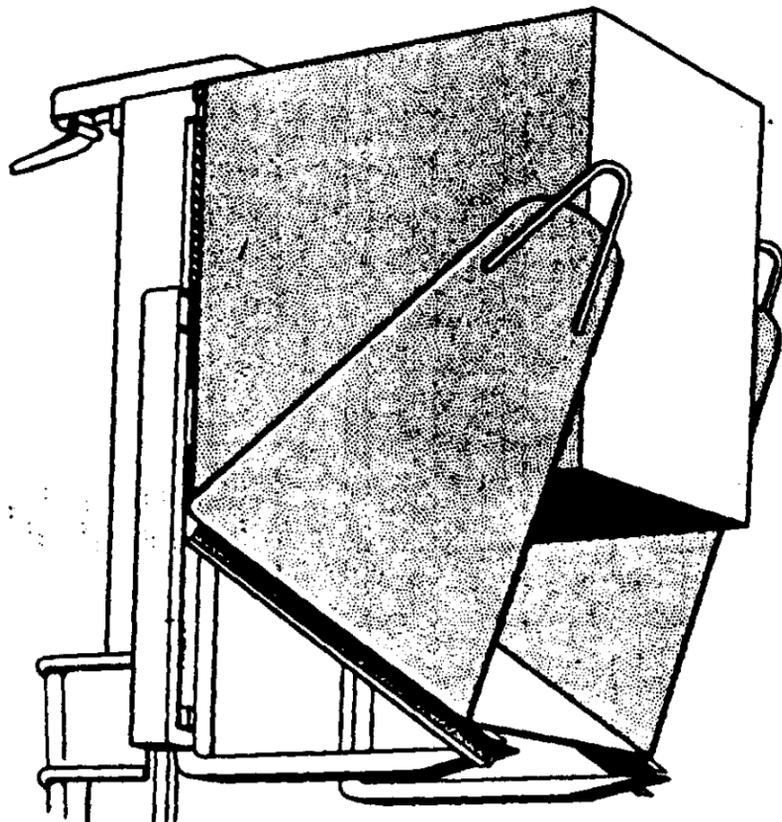


Figure 4-82. Bottom-dumping hopper.

attached to a forklift truck and used to handle coils of wire or cable, rolls of paper, or other cylindrical or open-center items (fig. 4-83).

*q. Lifting arm bar,*

*Application.* The lifting arm bar is a crane attachment used for handling wire coils (fig. 4-84).

*r. Crane boom attachment.*

*Application.* Converts forklift truck to mobile jib crane capable of handling bulky, irregular shaped

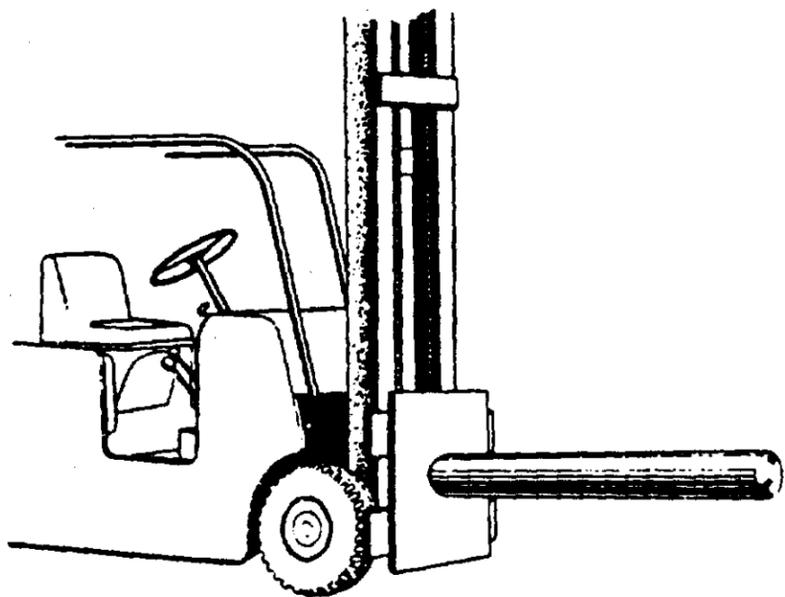


Figure 4-83. Ram.

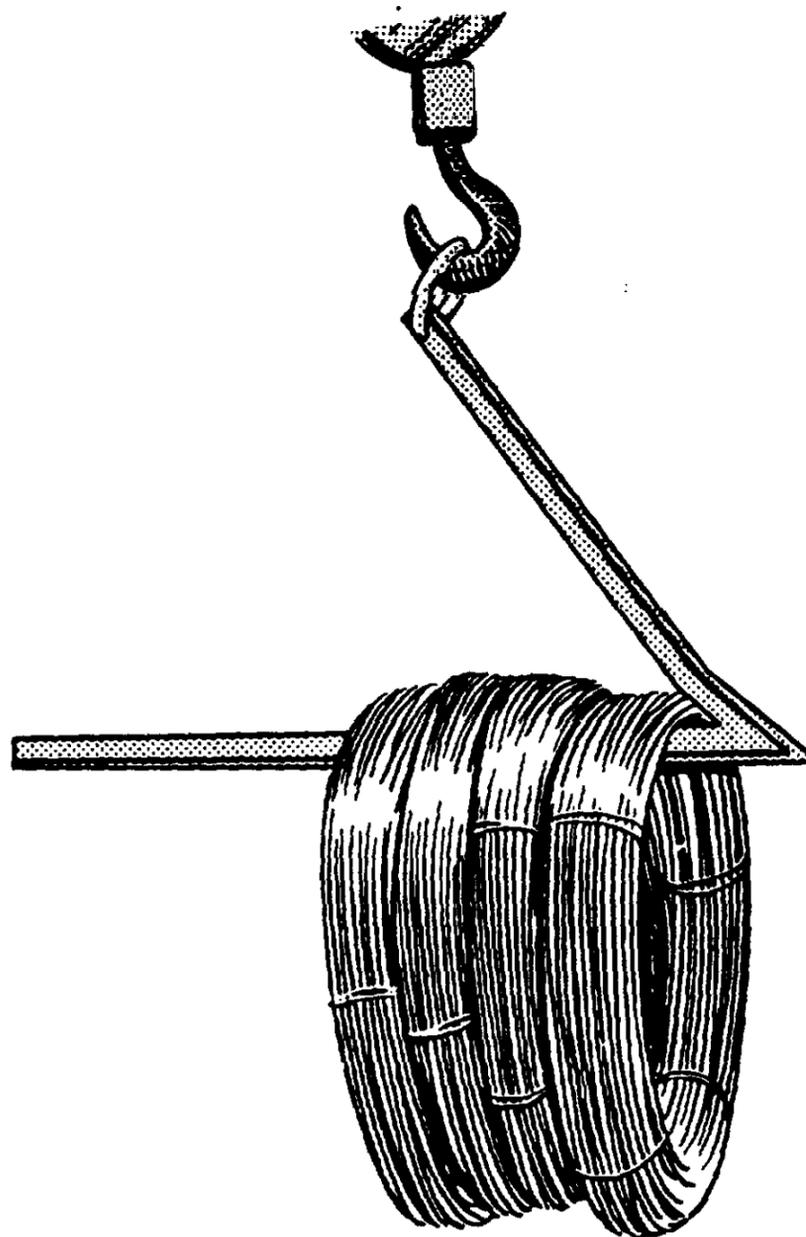


Figure. 4-84. Lifting arm bar.

objects, and is a valuable aid in maintenance work. The crane boom is raised or lowered with the standard lift mechanism (figs. 4-65 and 4-86).

*s. Clump.*

*Application.* The use of hydraulically operated clamp arms enables the fork truck to handle many objects that cannot be palletized satisfactorily. The clamp arms grip the load by squeezing it between the clamp faces. There are numerous variations of clamp arms made to handle different types of bags, barrels, cartons, bales, and other commodities. The clamping pressure required depends on the load and usually is regulated by the operator (fig. 4-87).

*t. Pusher.*

*Application.* The pusher or unloader can be used to place into position such items as boxes, crates, bales, bags, unit loads, and miscellaneous material.



Figure 4-85. Crane boom attachment.

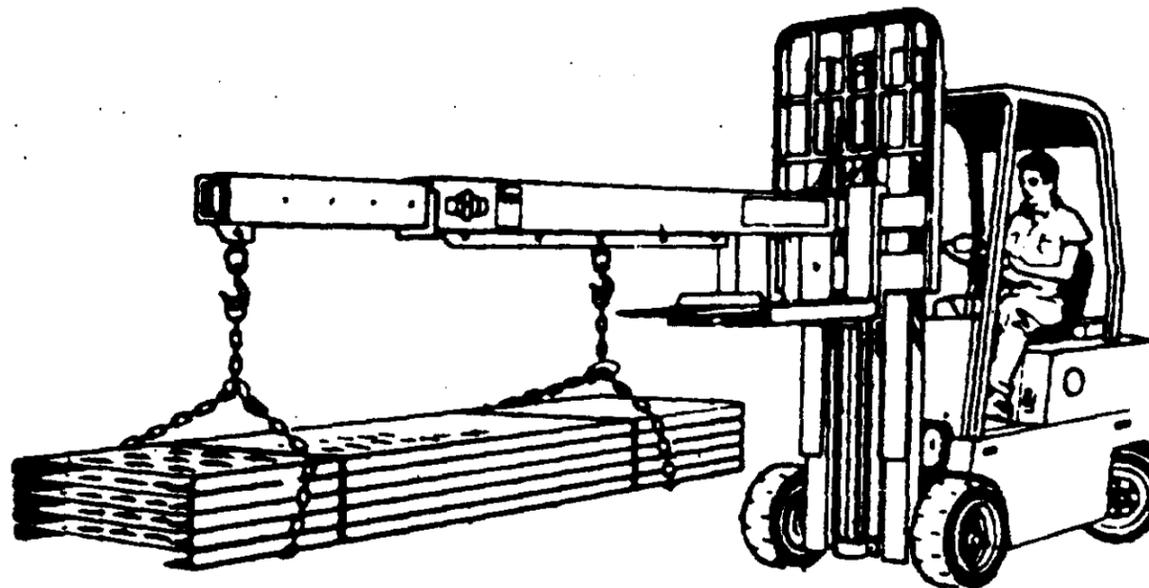


Figure 4-86. Crane boom attached to forklift truck.

The hydraulically operated pushing mechanism pushes loads from the forks of the truck (fig. 4-88).

*u. Load inverter.*

*Application.* The load inverter is especially **valuable** in activities where certain commodities like evaporated milk must be turned, when stored for long periods of time, at periodic intervals. The inverter **has** two sets of forks, upper and lower, plus a vertical stop to prevent the load from spilling while it is being inverted. An empty pallet is placed on the upper forks, the lower forks are inserted into the loaded pallet, and the load is revolved **180°** so that the empty pallet becomes the loaded pallet and the loaded pallet is emptied. Some inverters have adjustable forks **to** clamp the load during the inverting process (fig. 4-89).

*v. Revolving carriage.*

*Application.* The revolving carriage is generally made to rotate in a circle of **360°**. It is normally used in handling granular or liquid materials that are to be dumped from one container into another. The carriage is designed to accommodate forks and other attachments (fig. 4-90).

*w. Portable canopy.*

*Application.* The portable canopy affords protection for supplies and personnel during loading and

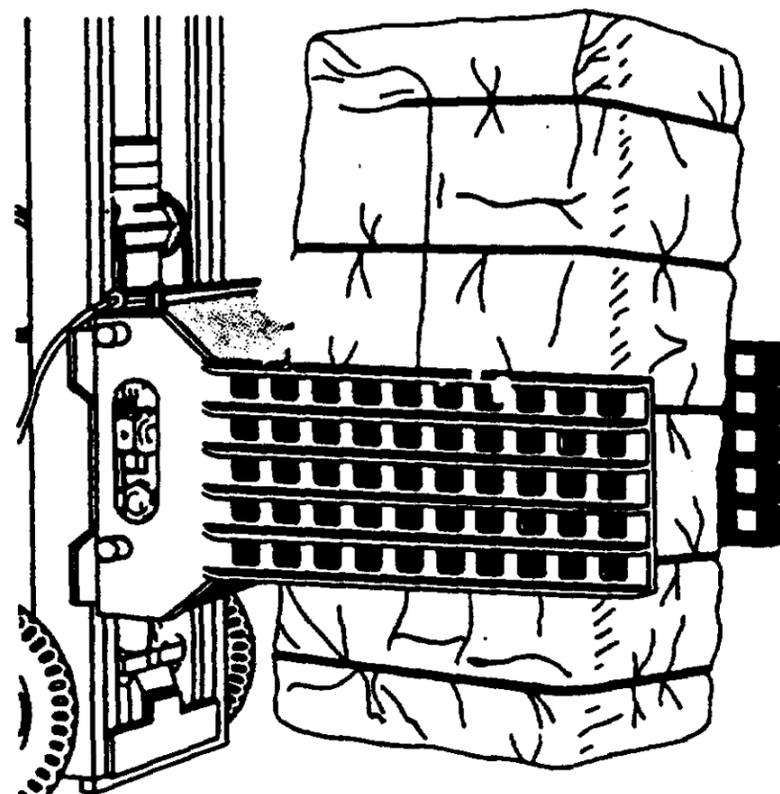


Figure 4-87. Clamp.

unloading operations in bad weather. The canopy can be stored in a warehouse aisle without interfering with operation of vehicles (fig. 4-91).

X. Car door opener.

Application. The car door opener is used to open the doors of rail cars. This allows one man to open the car door, and consists of a block, pawl, ratchet, and chain (fig. 4-92).

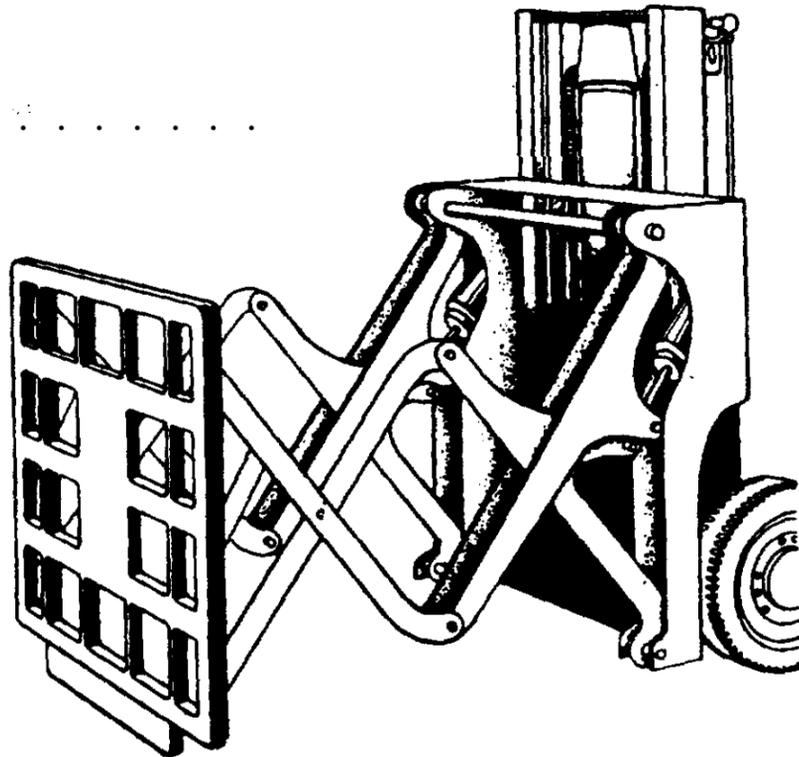


Figure 4-88. Pusher.

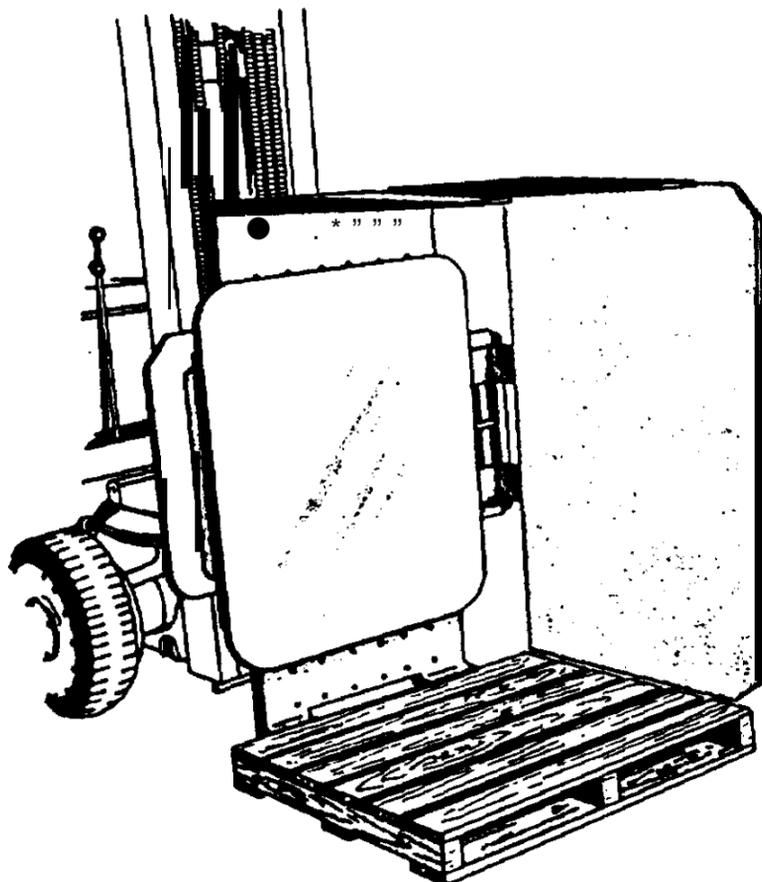


Figure 4-89. Load inverter.

y. Pallet pusher.

Application. The pallet pusher is used in loading vans where loading docks are not available or when two-way or four-way (partial) entry pallets are being loaded and positioned with the 40-inch dimension perpendicular to the length of the van. The attachment will not damage the mast of the work truck and provides a safe loading method when used under proper conditions. However, if the lack of dock level loading capability is the prevalent condition, a mobile ramp should be provided and used in lieu of the pallet pusher (fig. 4-93).

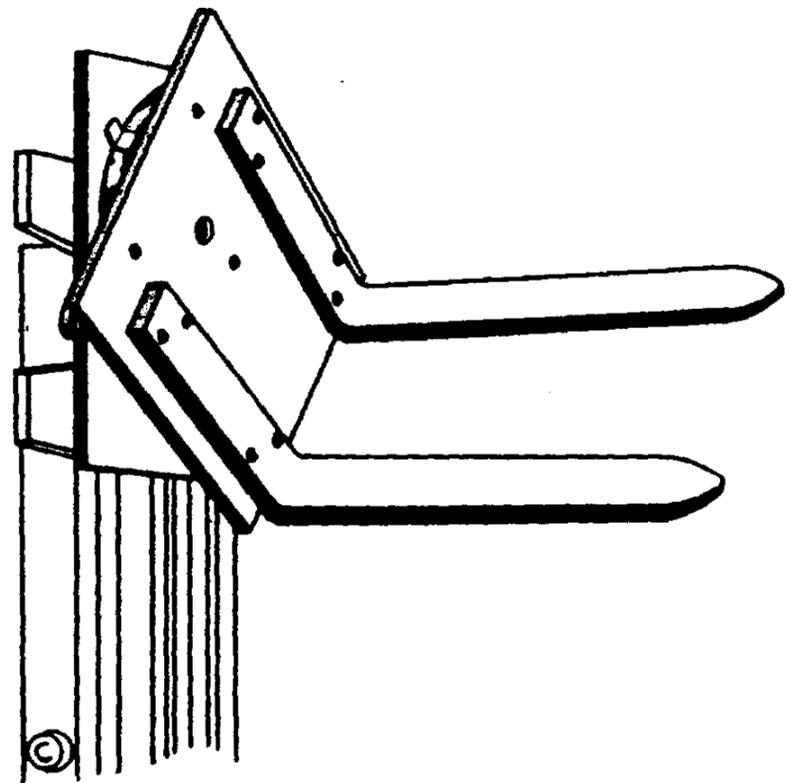


Figure 4-90. Revolving carriage.

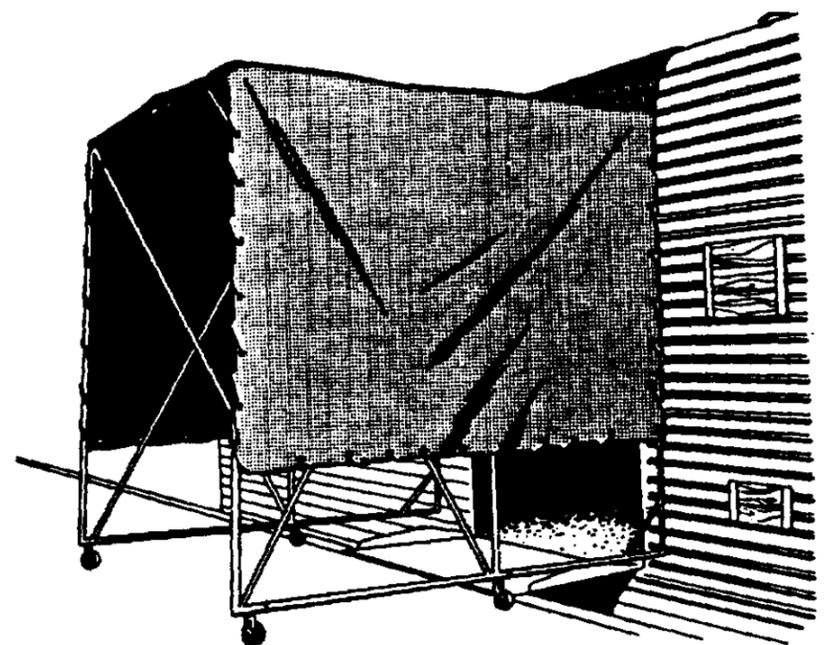


Figure 4-91. Portable canopy.

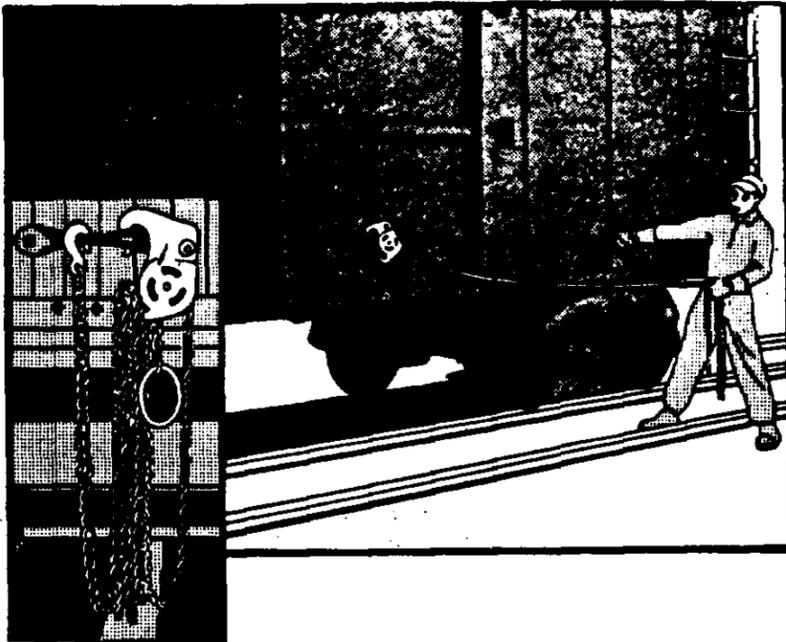


Figure 4-92. Car door opener, manual type.

z. **Cantilever racks.** Cantilever racks are made of steel and are generally used for storage of metal sheet, rod or bar stock. These racks are also useful for storage of **plywood** and other bulky items not susceptible to **palletization**. The height of a cantilever rack is normally limited only by the reach capability of MHE or the height of the warehouse. Rack specifications can be tailored with capabilities to meet individual storage requirements. **Supporting rack columns** are normally spaced from 4 feet to 6 feet apart. Arms vary from 2 feet to 4 feet in length and can be adjusted vertically on the columns to accommodate various types of material. Columns can have arms on only one side (single face) or on both sides (double face) (fig. 4-94).

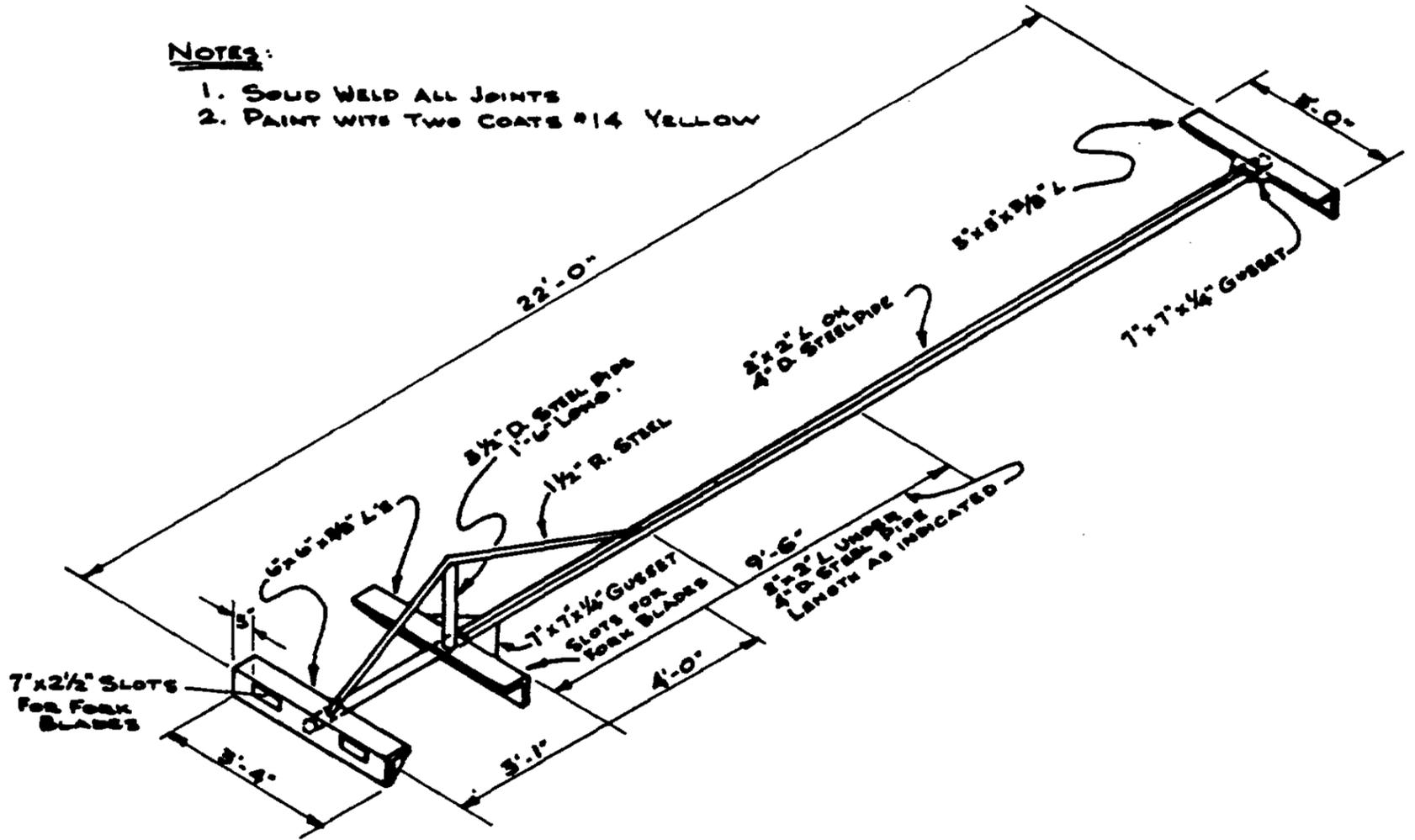


Figure 4-98. Pallet pusher.

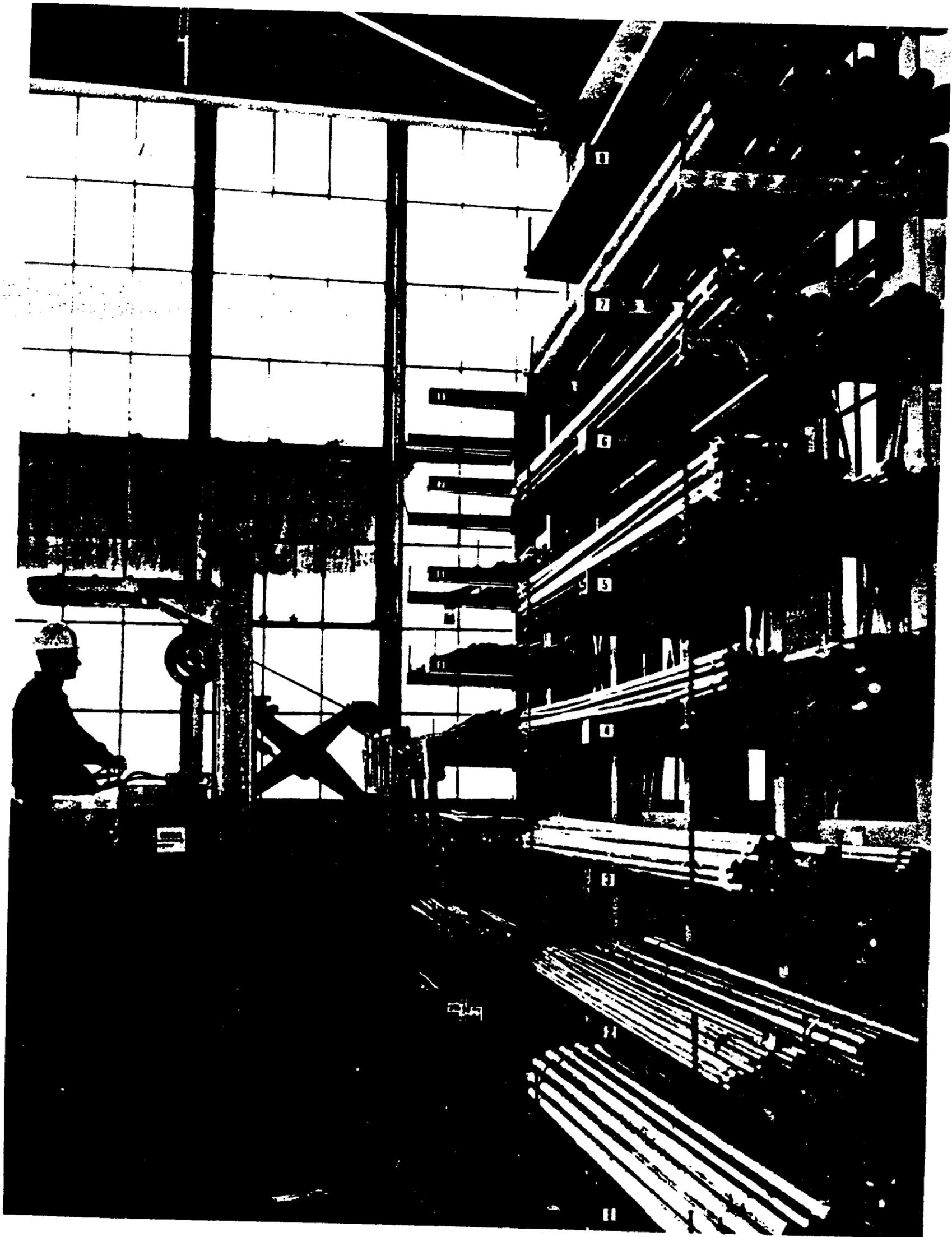


Figure 4-94. Cantilever rack (single face).

## Section 3. SELECTION OF MHE

	Paragraph
General selection factors -----	4-301
Building construction ----	4-302
Types of MHE power -----	<del>4-303</del>
/ Forklift truckload ratings -----	4-304
Warehouse tractor load ratings -----	<del>4-305</del>
Special equipment considerations -----	4-30s
Mechanical alterations -----	<del>4-307</del>
Safety considerations for MHE -----	4-308

## 4-301. General Selection Factors

a. The potential savings in terms of time, funds, and personnel resulting from the selection of the right type of MHE for an operation cannot be over emphasized. The selection of costly MHE should not be made without considering all operational factors including the cost and suitability of alternate types of equipment available.

b. When selecting equipment, the size, shape, weight, and container strength of the commodities to be handled should be considered. Examples of the application of MHE are as follows:

(1) **Palletized** supplies are handled by forklift trucks, sometimes in conjunction with tractor-trailer or dragline conveyors and warehouse trucks.

(2) **Small**, uniform sized commodities or containers are readily adaptable to **palletization** and handling as a unit by forklift trucks.

(3) Containers such as large bales, crates, or boxes may be efficiently handled and stacked by forklift truck and use of short dunnage or special fork attachment.

(4) Large items, such as appliances or equipment packed in boxes or crates, with cleats or runners nailed to the underside of the container, are generally adaptable to handling by forklift trucks.

(5) Cylindrical supplies with a hole through the center, such as **coils** of wire, can be handled by a forklift truck with a ram attachment.

(6) Heavy, bulky, and large irregularly shaped supplies are normally handled by cranes, crane attachments rigged on forklift trucks, heavy duty forklift trucks, or side loading forklift trucks.

(7) Small, flat-surfaced packages may be transferred in continuous flow over gravity or powered conveyor systems. Chutes and slides quickly deliver smooth-surfaced nonfragile packages, sacks, and bales to lower levels,

(8) Lumber, rails, etc., are handled speedily in large unit loads by heavy duty pneumatic-tired

forklift trucks, truck straddle carry, or side loading forklift trucks.

Note. Detailed information on applications for portable MHE is found in section 2 of this chapter.

## 4-302. Building Construction

a. The construction of the building used for warehousing purposes should be reviewed to determine the type of handling equipment which can be used. The construction may limit the amount, weight, and type of materials which may be stored. These limitations are imposed by the size and strength of the structure, and by certain safety and security measures. See chapter II, sections 2 and 3, and chapter VI for more information on limitations.

b. Equipment suitable for one-level operations may not be suitable for multilevel operations. Multistory operations generally are less economical than single story operations; therefore, most warehouses built in recent years have been single-story structures. Two example multistory operation restrictions are explained below.

(1) **Elevators**. Generally, elevators in operation were not designed for the use of mechanized handling equipment. In many instances the dimensions and the capacity of the elevator available will be inadequate to take the weight of the unit loads commonly used plus the weight of the equipment. For example, an electric fork truck capable of transporting a load of 3,000 pounds weighs nearly 4 tons; when loading an elevator with this equipment, this entire weight will be concentrated on the front edge of the elevator. Unless designed for this type of stress, even heavy capacity **elevators** will be strained.

(2) **Ramps**. The width and grade of ramps will be factors limiting the type and size of MHE which can be operated in the structures. Even a slight grade will require increased power to transport loads. Frequently, equipment capable of pulling or

carrying heavy loads up inclines will be too large for ordinary use in other storage operations.

#### 4-303. Types of MHE Power

**Gasoline**, diesel, LPG, or electric power is used to propel forklift trucks and warehouse tractors. The following factors help to determine the selection of the proper power drive.

a. *Ventilation of operating area.* Closely confined or poorly ventilated spaces such as upper floors of multistory buildings require the use of electric trucks to avoid the hazard of accumulated carbon **monoxide**.

b. *Flammable material.* Electric-powered fork trucks, **spark-inclosed** type, will be utilized for the handling of **flammable** material such as paint, oil, gasoline, and flammable gas.

c. *Fume absorbing materials.* Certain commodities, particularly fresh **fruits** and vegetables, will absorb and become tainted by the **fumes** from gasoline or diesel engines. Electric power is required to handle these commodities.

#### 4-304. Forklift Truckload Ratings

a. The fork truck pivots on the center of the drive axle; therefore, the weight of the load ahead of the **front** wheels must be counterbalanced by the weight of the truck. In accordance with the principles of leverage, the ability of the fork truck to lift a load depends upon the length of the load (the distance of its center of gravity from the center of the front axle of the truck) and the weight of the load. The capacity of the fork truck is stated in inch-pounds, which is the rated pounds capacity of the truck multiplied by the distance from the center of the **front** axle to the center of the rated load selected by the manufacturer. In general, trucks are rated by pounds and the distance from the heel of the forks to the center of gravity of the rated load (for instance, 4,000 **lbs** at **24-in** load center). To determine inch-pounds capacity, add to load center the distance from the center of the front axle to the heel of the forks, which can be obtained from the manufacturer's specifications or by measurement, and multiply the sum by the rated load weight.

b. For example, assume a rating of 4,000 pounds at 24 inches, with a measurement of 15 inches from the heel of the forks to the center of the front axle; result:  $4,000 \times (24 + 15) = 156,000$  inch-pounds. To determine the maximum weight which may be placed on a pallet of given size, assuming uniform

weight distribution on the pallet, add half the dimension of the pallet parallel to the forks to the distance from the center of the front **axle** to the heel of the forks and divide the sum into the **inch-pound** capacity of the truck. To complete the example, the maximum weight on a 40- by 48-inch pallet is 156,000 divided by  $(15 + 20)$ , which equals 4,457. However, the load weight may not be in excess of the weight of the rated load stated by the manufacturer. If the dimensions of the pallet used, parallel to the forks, is less than twice the rated load center, the rated pounds capacity is the capacity of the truck; therefore, the maximum load would still be 4,000 pounds. Bending of the mast channels as the load is raised, plus forward tilt action, will reduce the capacity of elevated loads by as much as 25 percent. Overloading of fork trucks is strictly prohibited. Among the effects of continued overload are damage to lift mechanism, excessive tire wear, and strain on the truck frame.

#### 4-305. Warehouse Tractor Load Ratings

a. Warehouse tractor capacity is stated in pounds drawbar pull, which is the motive force **exerted** at the coupling. The **drawbar** pull and pushing power of the tractor is figured on the basis of the engine torque, drive ratio, weight, and the traction of the tires. Although this pull is not the maximum load weight the tractor will draw, since under ideal conditions a tractor can pull a load equal to 20 times its drawbar pull, the maximum normal load weight should not exceed 10 times the **drawbar** pull which will **allow** for all technical and safety factors.

(1) *Tractive effort and resistance.* **Tractive** effort is the motive force (measured in **lbs**) exerted at the drive wheels of a tractor "to overcome the resistance to motion, Tractor resistance is the result of rolling friction between the wheels and the surface, expressed in pounds per ton of gross weight of tractor. The type of surface over which the tractor is to travel has an important bearing on tractive resistance. The following table of road resistance shows the comparative road resistance of some of the more common types of road surfaces:

*Table of road resistances*

<i>Type of road surface</i>	<i>Resistance in pounds per ton</i>
Asphalt (hard) . . . . .	28
Brick (glazed) -----	47
Brick (poor) -----	57
Brick (smooth) -----	40
Clay -----	200

Type of road surface	Resistance in pounds per ton
Concrete (poured) -----	53
Concrete road -----	36
Granite blocks -----	56
Gravel road -----	75
Ice and snow -----	40
Macadam -----	47
Macadam (poor) -----	75
Sand (loose, 3 in deep) -----	330
Sand road -----	275
Snow (hard) -----	50
Snow (soft) -----	6
Tarvia -----	47
Wood blocks -----	44
Wood planking -----	43
Wood planking (sticky surface) -----	57

(2) *Grade resistance.* Grade resistance is the resistance for movement on a grade, to be added to or subtracted from that required for level movement. Grade resistance amounts to 20 pounds per ton of gross weight of the tractor-trailer train and the combined load for each 1 percent of grade encountered. On upgrades the percent is added to the resistance; on down-grades the percent is subtracted. Percent of grade is determined by the feet of vertical rise per 100 horizontal feet.

b. *Estimating required drawbar pull.* The estimated drawbar pull in pounds and application of tractors used by the military are as follows:

Drawbar pull	Application
2,600 pounds -----	Inside warehouse
4,000 pounds -----	Inside and outside
7,500 pounds -----	Outside work, heavy

At times it may be necessary to make a rapid, reasonable accurate estimate of the drawbar pull required of the motive power unit of a tractor for the handling of loads on a level surface and also on grades. The following example will illustrate a fairly accurate method for this estimate:

*Step 1:* What is the drawbar pull required for a tractor-trailer for the following composition and conditions:

Weight of tractor -----	6,690 pounds
Weight of driver -----	170 pounds
Weight of 5 trailers at 500 tare each -----	2,500 pounds
Weight of net pay load -----	16,000 pounds
<b>TOTAL GROSS LOAD -----</b>	<b>25,360 pounds</b>
Equals -----	12.68 tons

*Step 2:* If the surface is level poured concrete, the value from the table to calculate drawbar pull is 53

pounds resistance per ton moved. The calculation then would be as follows:

$$12.68 \times 53 = 672 \text{ pounds}$$

{ Total load × Road resistance = drawbar pull  
tons                      pounds per ton                      required }

*Step 3:* If the train is required to travel up a 5 percent grade, then the road resistance of 53 pounds per ton would be increased by 20 pounds for each percent of grade. The calculation for this drawbar would be:

$$12.68 \times (53 + (*20 \times *5))$$

Total load × { Level road resistance } + { Grade resistance } × Percent grade  
tons                      pounds per ton                      pounds per ton                      per percent grade

\*These factors show the total grade resistance or rollback force in pounds per ton for a 5 percent grade.

OR

$$12.68 \times 153 = 1,940 \text{ pounds}$$

{ Total load × total resistance = drawbar pull  
Tons                      × pounds per ton                      required }

For this application, a tractor with a 2,600-pound drawbar pull would be satisfactory.

#### 4-306. Special Equipment Considerations

a. *Truck tiering electric (straddle type).* This truck eliminates the counterweight and the attendant increase in length by using outriggers which extend forward in a plane at floor level parallel to the plane of the forks. The truck can operate in 6-foot aisles, the forklift truck requires 10-foot aisles. However, the outriggers must straddle the bottom tier when the truck is positioning a pallet which necessitates the use of single wing pallets. Since it is not practicable to use single wing pallets for the bottom tier only and double wing pallets for the upper tiers, this truck is used in pallet rack areas where single wing pallets only can be used. The truck tiering is lighter in weight than the conventional forklift truck which permits its use on light construction and in elevators of limited capacity. The military services use a 3,000-pound capacity truck which is available in both riding and walkie type. A variation of these trucks provides for the forks to extend by mechanical means, thus eliminating the requirement to straddle the pallet.

b. *Warehouse crane.*

(1) Usually, the lifting and carrying capacity

of the warehouse crane is stated as the maximum weights which may be lifted at various boom angles. (If the boom is telescopic, maximum capacity is obtained with the boom at the shortest length.) As the boom is lowered toward the horizontal position, or as its length is extended, capacity decreases.

(2) A load **chart** showing the capacity of the crane **under** all circumstances, should be visible on the crane. These charts finished by the manufacturer will indicate clearly the safe load in pounds for maximum and minimum position of the boom and for at least two intermediate stations.

(3) If the crane has a **sluing** boom and if the load is to be moved only within the circumference of the **slue**, it is not necessary to move the crane. The boom is **slued** to the proper position and the load is ready for placing.

(4) If the crane has a rigid boom or if the load is to be carried farther than the **sluing** boom can reach, it is necessary to move the crane. The crane should not be moved until both the **load** and the boom are in proper position for traveling, in order to reduce the swing of the load.

c. **Fixed conveyor equipment.** In choosing a conveyor system, the initial cost; the length of time it will take to pay for **itself**; the cost of maintenance and operation; volume of items processed and the type of material handled by the activity contemplating the use of conveyor equipment must be considered. Through the use of conveyors, savings are achieved through the elimination of trailer train operation, elimination of **double** handling and in various other ways. An increase in production can be realized due to maintaining work rhythm; that is, workloads do not build up at any point but move to the next station in an even flow, reducing peaks and valleys to the minimum.

(1) **Power belt conveyor.** The powered belt conveyor consists of an endless belt mounted on a frame and driven by a head **pulley** connected to a drive motor. The belt travels over a series of rollers or a sliding bed. A takeup to adjust belt tension is provided. A belt conveyor can operate on inclines, declines, or horizontal paths. The maximum angle of **incline** on most materials is limited to approximately 25°. Small, **semibulky**, bulky, or individual items with flat, smooth surfaces that do not lend themselves to **palletizing**, or tote boxes and part baskets are transported on this type conveyor. Inasmuch as it is powered, this type conveyor may be used in conjunction with the dead roller conveyor

to transport material from floor level to working level, or moving material to the next processing point by the use of timing devices, deflectors and . . . . . controls, over a distance where gravity would not suffice. It can be used in single or double combinations to form a portable conveyor system. In addition, a telescopic system may be used when a definite location for loading or unloading facilities cannot be setup due to shapes and sizes of vehicles transporting cargo. That is, the conveyor could be extended or retracted. For example, different types of aircraft at air freight terminals, or various types of commercial trucks at receiving and shipping docks. The performance of a belt conveyor depends on the width of the belt, the type of material used for the belt, the supports and horsepower of the drive.

(2) **Overhead towing conveyor.** This conveyor consists of an overhead rail and chain mounted on rollers that run on the channeled rail. Loops are spaced as desired along the towing chain for the purpose of attaching material carriers. When the carriers are ready for movement, the carrier is positioned onto a loop of the moving chain and the carrier moves to its predetermined destination. This conveyor is used to deliver material in point to point processing and to and from production lines; for examples, from receiving to various stockrooms for storage and from storage to packing and shipping points. This type of conveyor conserves floor space as it does not require as much space as tractor-trailer operations. The selection of this system for any operation should be primarily based on volume of items or tons handled, or combination of the two, which must be great enough to justify its installation.

(3) **Subfloor conveyor.** The subfloor-type conveyor consists of a moving link chain with chain track imbedded in the floor. Retractable pins or pods are mounted vertically on front of platform trucks. When the truck is ready to be transported, it is placed over the chain and the pin is dropped. The truck is towed forward as the pin falls in the slot of the chain. The subfloor conveyor permits free travel of other MHE as there are no overhead obstructions to prevent use of high mast for trucks required for high stacking purposes. This conveyor is used for the same purpose as the overhead towing **conveyor**; that is, to deliver material in point to point processing and to and from production lines.

**4-307. Mechanical Alterations**

MHE is engineered and guaranteed by the manufacturers to perform specified functions. Mechanical alterations to power plants, hydraulic systems, operating levers, and controls, lifting and structural members and counterweights may seriously affect operation of equipment or endanger personnel. Alterations to MHE will not be effected prior to approval of the appropriate military service. Requests or recommendations to effect alterations will be addressed through normal channels and will include—

- a. Complete details of the proposed alterations,

including such photographs, blueprints, and engineering data as may be necessary.

- b. Reasons for the alteration.
- c. Anticipated improvements,

**4-308. Safety Considerations for MHE**

Chapter VI of this regulation provides overall safety guidance for storage operations. The following OSHA references are provided for specific equipment.

- a. 1910.178-Powered Industrial Trucks.
- b. 1910.179-Overhead and Gantry Cranes.
- c. 1910.180-Crawler, Locomotive, and Truck Cranes.

**Section 4. MHE REQUIREMENT FACTORS**

	Paragraph
General .....	4-401
Factors affecting equipment requirements .....	4-402
Planning the operation .....	4-403
Computing MHE requirements .....	4-404
Computing pallet requirements .....	4405
Considerations in requirements for fixed equipment .....	4406
Fleet management .....	4-407

**4-401. General**

A balanced operation provides for the optimum number of people and MHE to accomplish a specified workload. Too many laborers and not enough equipment will cause bottlenecks. On the other hand, too much equipment and not enough laborers will also cause bottlenecks. In both cases, either people or equipment will be idle part of the time. In a balanced operation, a smooth flow of work is accomplished and neither people nor equipment are idle. This section provides basic guidance in determining MHE requirements.

**4-402. Factors Affecting Equipment Requirements**

- a. If all supplies moving into storage were palletized loads, squared off for stacking, there would be little need for anything other than a forklift truck and driver. However, this is not always the case. Trucks and railcars are sometimes hand loaded and consequently must be manually unloaded. Figure 4-95 represents some other conditions affecting equipment requirements.

- b. Terrain features, location arrangement and design characteristics of buildings, extent of open storage area, and road and rail facilities are alle-

ments under the general heading of physical layout which influence equipment requirements.

- c. Equipment requirements are also influenced by mission responsibilities which determine the types of commodities handled and influence the types of handling equipment.

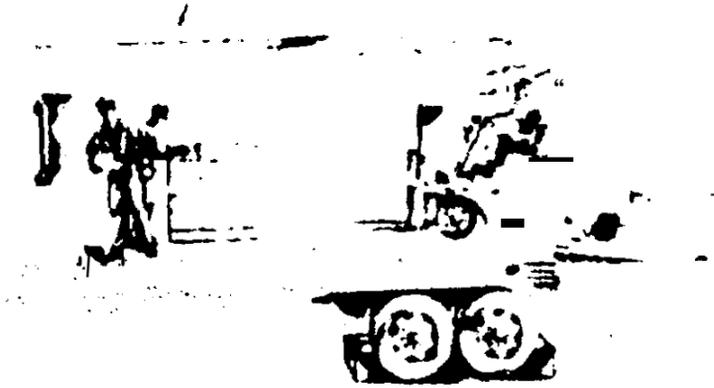
- d. The number of forklift trucks, conveyors, etc., are influenced by the workload. An increased workload may require increased usage and greater payload or an increase in the equipment fleet. A decreased workload will have the reverse effect.

**4403. Planning the Operation**

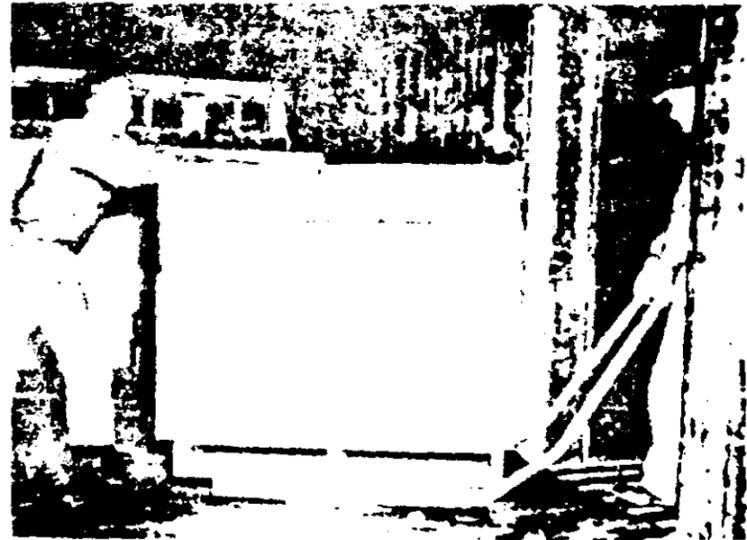
Effective planning should include factors of quantity, types and characteristics of equipment required, scheduling of use, economical travel ranges, and timing of the operations. See figures 4-96, 4-97, 4-98, 4-99, 4-100, and 4-101.

Figures 4-96 and 4-97 represent two examples of developing balanced operations. Figure 4-96 depicts a medium distance "in-between" haul wherein two tractors and four trailer trains keep pace with two lift trucks. Figure 4-97 depicts a shorter haul wherein only one tractor with three supporting trailer trains services two lift trucks. Determination of requirements will have been made by com-

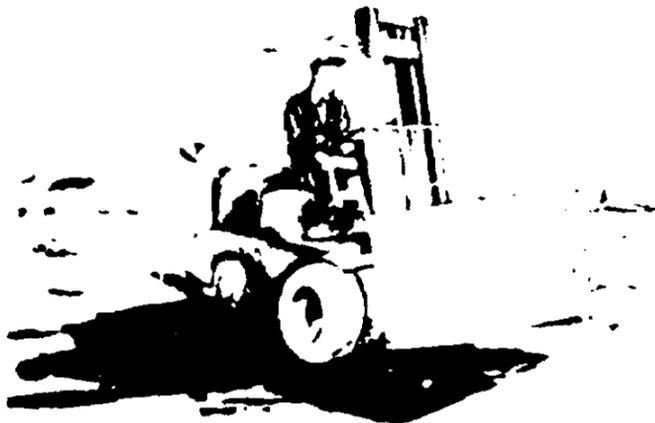
# VARIOUS CONDITIONS AFFECTING EQUIPMENT REQUIREMENTS



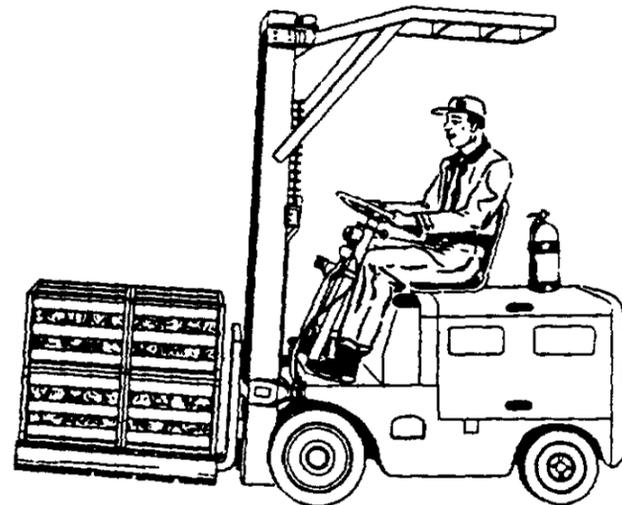
SHORT MASTED FORKLIFT TRUCK  
SERVICING LOW DOOR HIGHWAY  
VAN



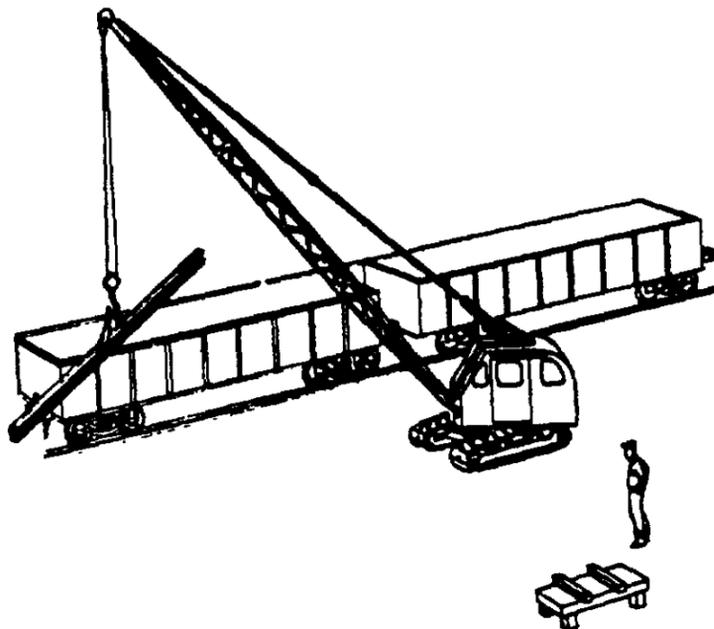
REEFER CAR OPERATION



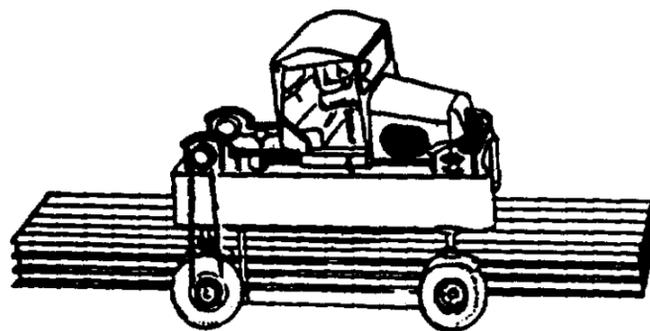
TERRAIN AND CLIMATIC  
CONDITIONS



ELECTRIC TRUCKS ARE NECESSARY  
FOR CERTAIN OPERATIONS



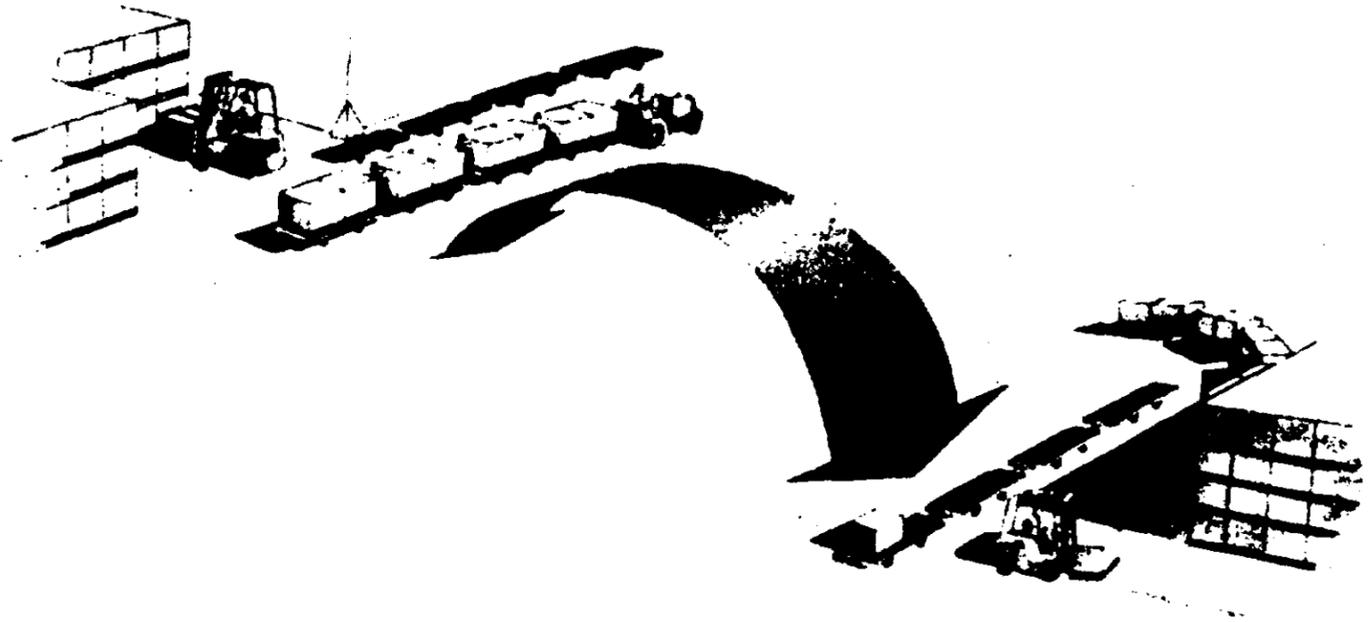
CRANE OPERATION UNLOADING  
GONDOLA CAR



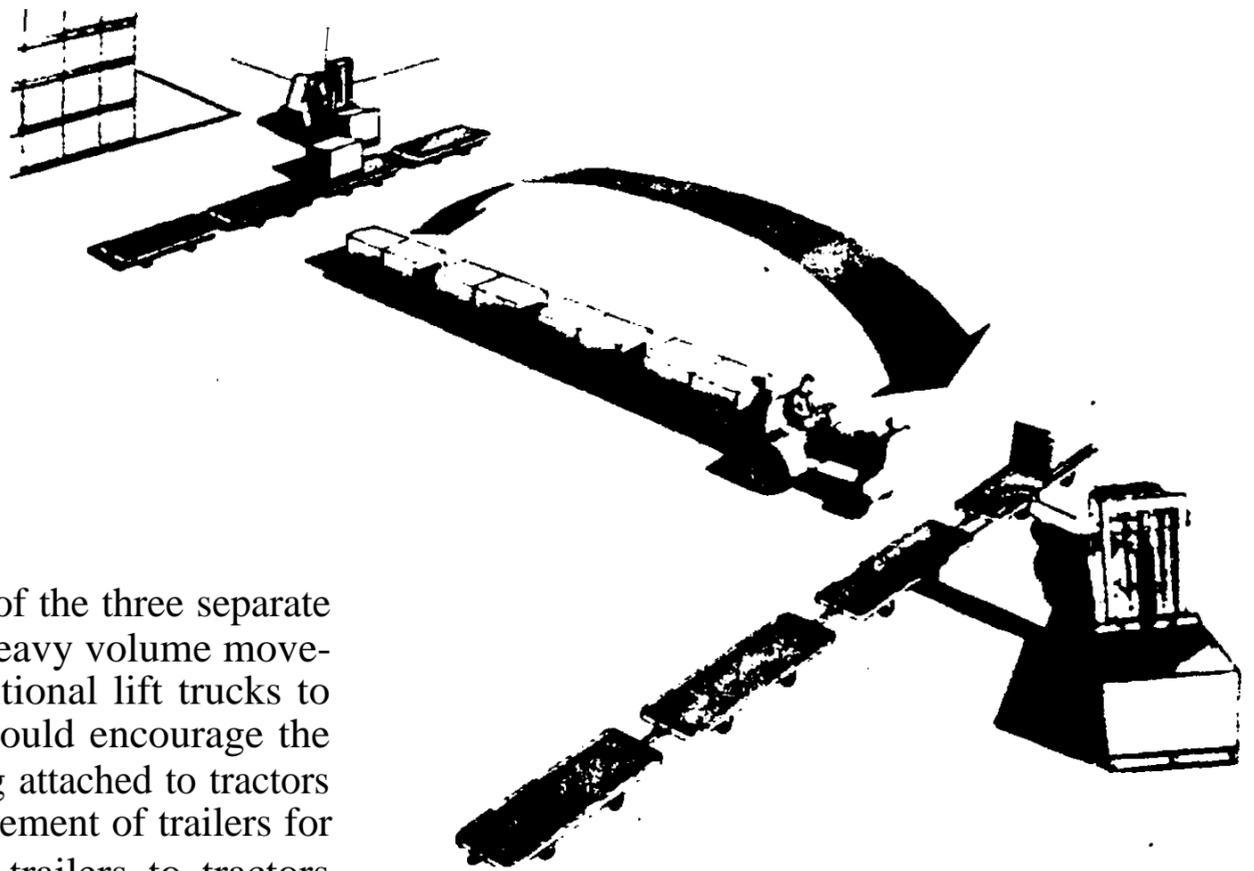
STRADDLE TRUCK CARRYING A  
LOAD OF UNUSUAL SHAPE

*Figure 4-95. Types of equipment that effectively serve supply operations under varying conditions.*

# OPERATIONS BALANCE



*Figure 4-96. Tractor-trailer rewarehousing operation.*



*Figure 4-97. Tractor-trailer shipping operation.*

puting timing studies of each of the three separate parts of the operations. In a heavy volume movement, the assignment of additional lift trucks to each end of the operations would encourage the possibility of trailers remaining attached to tractors to effect more convenient placement of trailers for lift truck services.. Ratio of trailers to tractors would then be equal, one train to one tractor. Ratio of trains to lift trucks **would** depend on the time consumed in the trains traveling between the two points as **compared** to the rate of loading or discharge by the lift trucks. In any case, the equipment

ratio adopted will be aimed to develop maximum production of separate pieces.

# IMPROVING TECHNIQUES

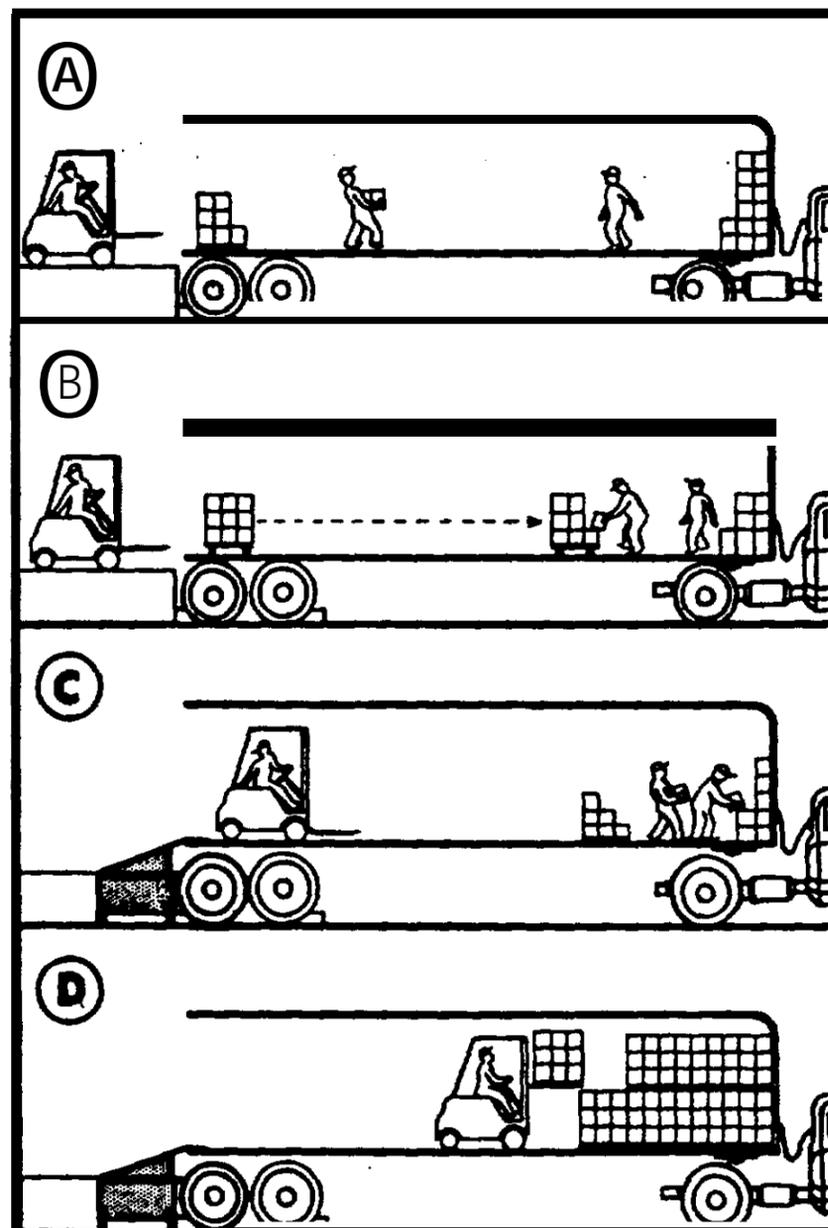


Figure 4-98. Graduated sequence of experienced operations improvement.

Regardless of the apparent acceptability of a materials handling method, the possibility of further improvement should **always** be considered. As a technique is improved the opportunities for reducing **labor** and equipment requirements are proportionately enhanced. Operations should be continually appraised for possible improvement. Acknowledging experience to be a factor of considerable magnitude to a storage operator, adoption of an attitude

such as "let's do it this way because we always have" can only penalize the **ability** to improve. An **open-minded** attitude regarding operational change is therefore, a must. Apparent benefits in progression of figure 4-98 are obvious. As each stage is implemented the complications of operations balancing have been simplified and the production potential and operational costs have been considerably affected.

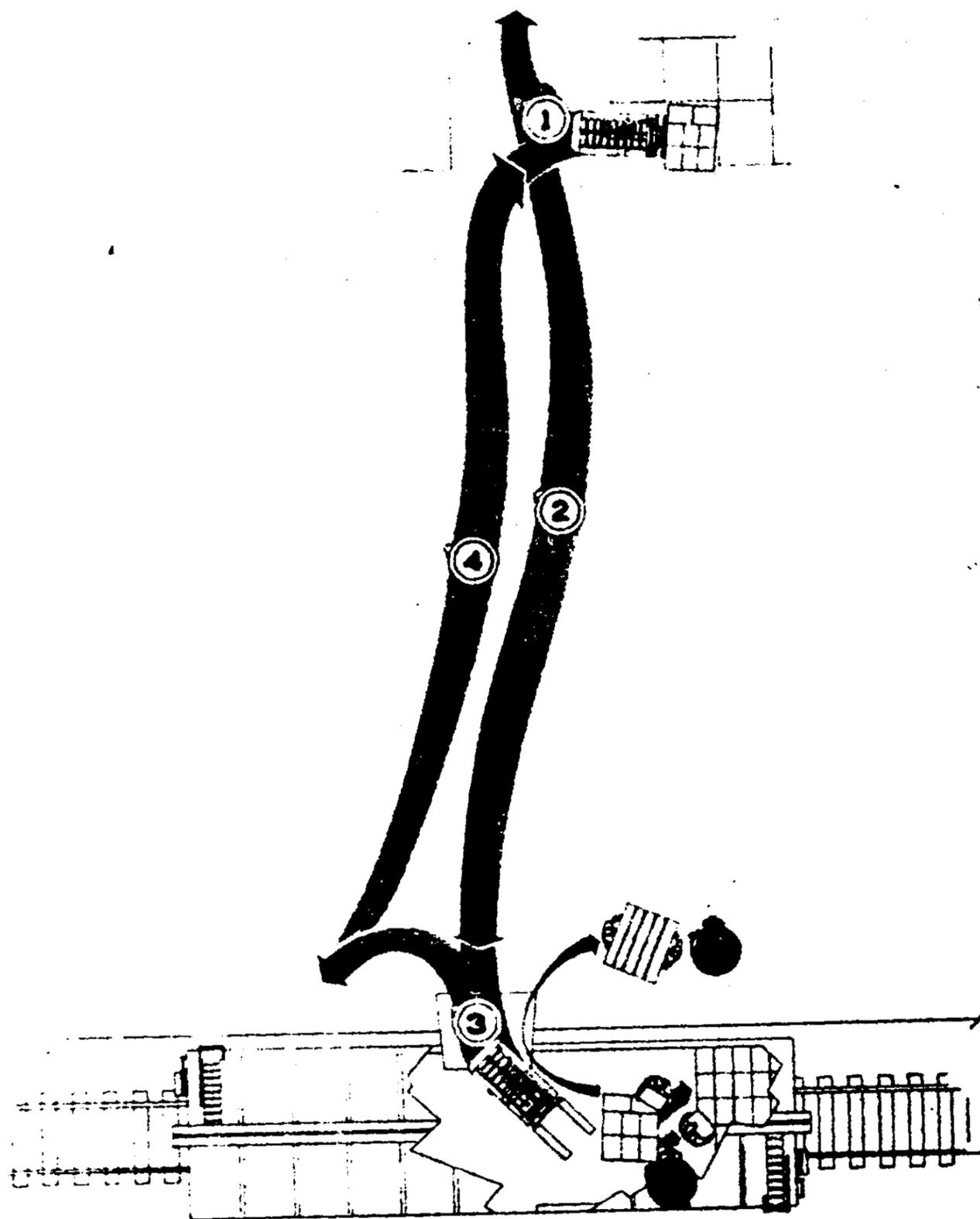
Relationship of distance traveled to time consumed at  
known travel speeds

Miles per hour	Ft traveled per second	Travel time expended (seconds)				
		50'	100'	150'	200'	250'
2	2.9	17.3	34.5	51.7	69.0	86.2
3	4.4	11.4	22.7	34.1	45.6	57.0
4	5.9	8.5	16.9	25.4	33.9	42.4
5	7.3	6.8	13.7	20.5	27.4	34.2
6	8.8	5.7	11.4	17.0	22.7	28.2
7	10.3	4.9	9.7	14.6	19.4	24.4
8	11.8	4.2	8.5	12.7	17.0	21.2
9	13.2	3.8	7.6	11.4	15.1	18.9
10	14.6	3.4	6.8	10.3	13.7	17.0
11	16.1	3.1	6.2	9.3	12.4	15.5
12	17.6	2.8	5.7	8.5	11.4	14.2
13	19.1	2.6	5.2	7.9	10.5	13.1
14	20.6	2.4	4.8	7.3	9.7	12.1
15	22.0	2.3	4.5	6.8	9.1	11.4

Note. Speeds at which equipment may operate should not exceed those allow-under other chapters of this regulation.

*Figure 4-99. Relative distance traveled for specific time elements as associated with miles per hour rates.*

# OPERATIONS TIMING'



*Figure 4-100. Example timing of a bulk shipping or receiving operation.*

In timing of equipment in depicted operation (1) **represents** that time expended in approaching stack from aisle, picking up or depositing load and backing out to aisle; (2) indicates the time required to travel from stack area to dock; (3) identifies that time consumed in entering car and either depositing or

picking up load and backing onto the dock and (4) indicates the time expended in travel from dock back to stack area. The labor timing is divided into two **parts**: (1) removing or placing supplies on pallets and (2) either **carrying** pallets to or **from car**, depending on **type** of operation.

# DOES YOUR EQUIPMENT BALANCE ?

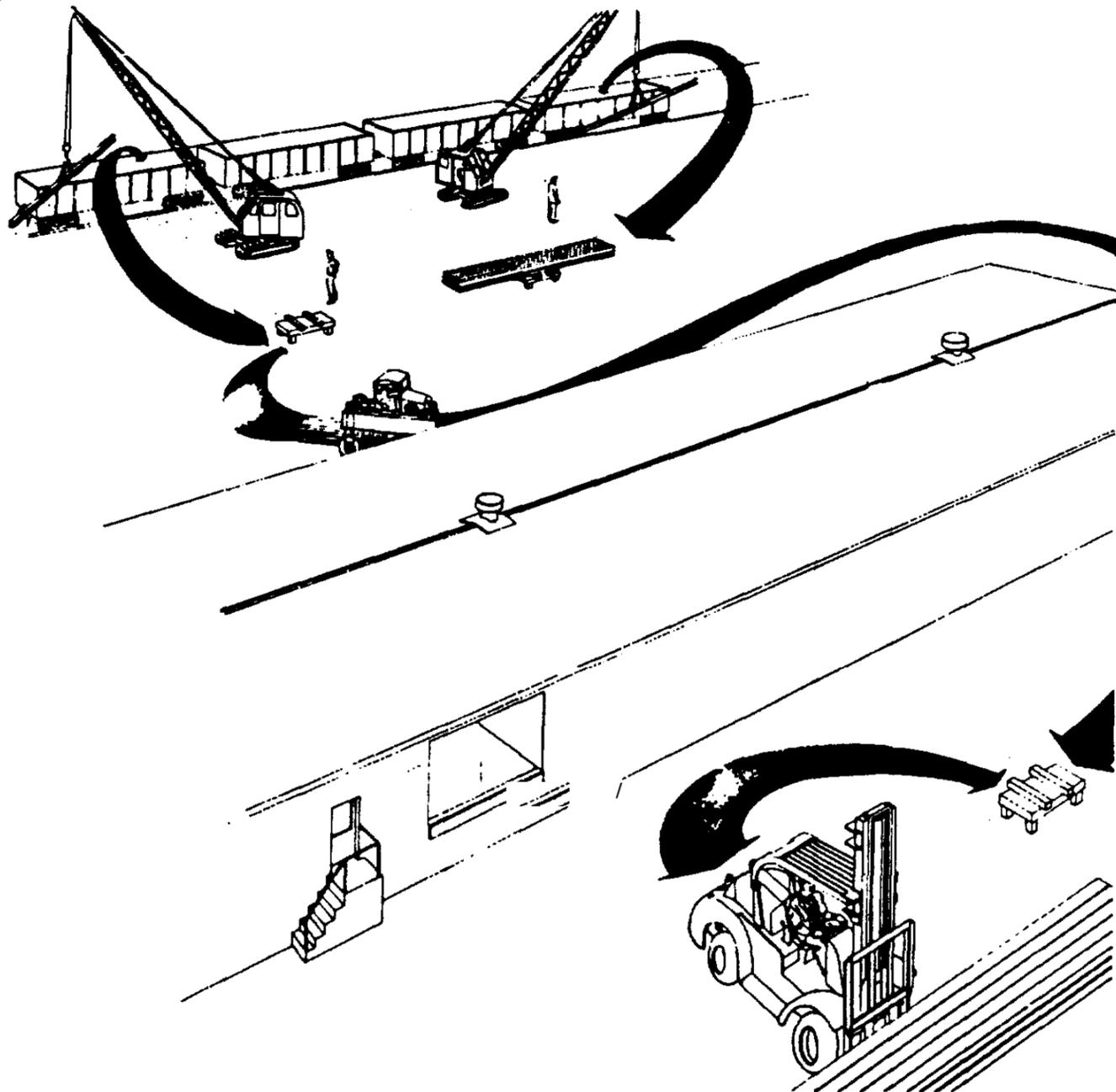


Figure +101. Open storage operation depicting receipt of odd-shaped items in gondola cars.

In a balanced operation all men and equipment units are synchronized to an acceptable producing pace. This figure depicts three separate equipment operations. Each must move in balance with productive capabilities of other units in this hypothetical operation. To attain this, two cranes are necessary to keep pace with one straddle truck and one lift truck. Separate timings of each segment have established pattern of equipment requirements. Considerations in timing are: (1) time expenditure for crane to discharge a unit load quantity from gondola car; (2) time expended by straddle truck in moving

unit load from off loading point to stacking point and (3) required time for forklift truck to stack supplies as deposited by straddle truck. Related time elements for each of these operations will form basis for equipment assignment. Illustration is intended to depict one method of handling a particular commodity. It is recognized that other equipment and/or methods may also apply.

#### 4404. Computing MHE Requirements

a. Several factors must be considered in determining the number of pieces of equipment to do a

particular job. The **first** is the volume, e.g., pallet loads, trailer trains, carloads, etc. The second is the number of units of the volume carried each trip, e.g., pieces, pounds, pallets, etc. The third is the average time used to accomplish a round trip for the equipment. **The** fourth factor is the time allotted to do the job. Figure 8 shows a formula which can be used to make a MHE requirements computation.

b. Example use of the formula in figure 8 is shown in the following situation

(1) Storage operations require 48 pallet loads of supplies to be relocated a distance of 250 feet. One **round trip** takes 5 minutes, and 2 hours is the time allotted. Two pallets are carried each **trip**.

$$R = \frac{48 \times 5}{2} \div 120 \text{ (rein)} = 1 \text{ fork truck}$$

(2) In the same operation, a requirement exists to move 192 pallets the same distance in the same time frame.

$$R = \frac{192 \times 5}{2} \div 120 = 4 \text{ fork trucks}$$

(3) A requirement exists to relocate 4,064 **pallet loads** a distance of 1,500 feet. Time allotted is 3

days. Since the distance is greater than 400 feet (max travel distance of fork truck) tractor trains are required. One tractor and four trailers carry eight pallets in a 20-minute round trip cycle. It takes 5 minutes for one **forklift** truck to load a train and 8 minutes to unload and stack.

Step 1. Compute pieces of equipment required.

$$R = \frac{4,084 \text{ pallets}}{8 \text{ pallets/train}} \times 0.33 \text{ hrs (20 rein)} \div 24 \text{ hrs} = 7 \text{ tractors}$$

Step 2.

$$\frac{7 \text{ trailer trains}}{1 \text{ trailer train}} \times 5 \text{ min} \div 20 \text{ min} = 2 \text{ forklift trucks for loading}$$

step 3.

$$\frac{7 \text{ trailer trains}}{1 \text{ trailer train}} \times 8 \div 20 = 3 \text{ forklift trucks for unloading/stacking}$$

The entire operation will take seven tractors, 28 trailers (4 trailers per tractor) and five forklift trucks with 12 operators to complete the job in 3 days.

# DETERMINING MOBILE MATERIALS HANDLING EQUIPMENT REQUIREMENTS

$$\text{FORMULA} - \frac{V \times T}{C \div AT} = R$$

## EXPLANATION:

- V** - Volume **or** size of the operation to be performed.
- C** - Units of **volume** carried per trip (pieces, pounds, etc.) by equipment.
- T** - Average expended time to accomplish a complete equipment trip cycle.
- AT - Allotted time to do the job.
- R - Equipment requirement.

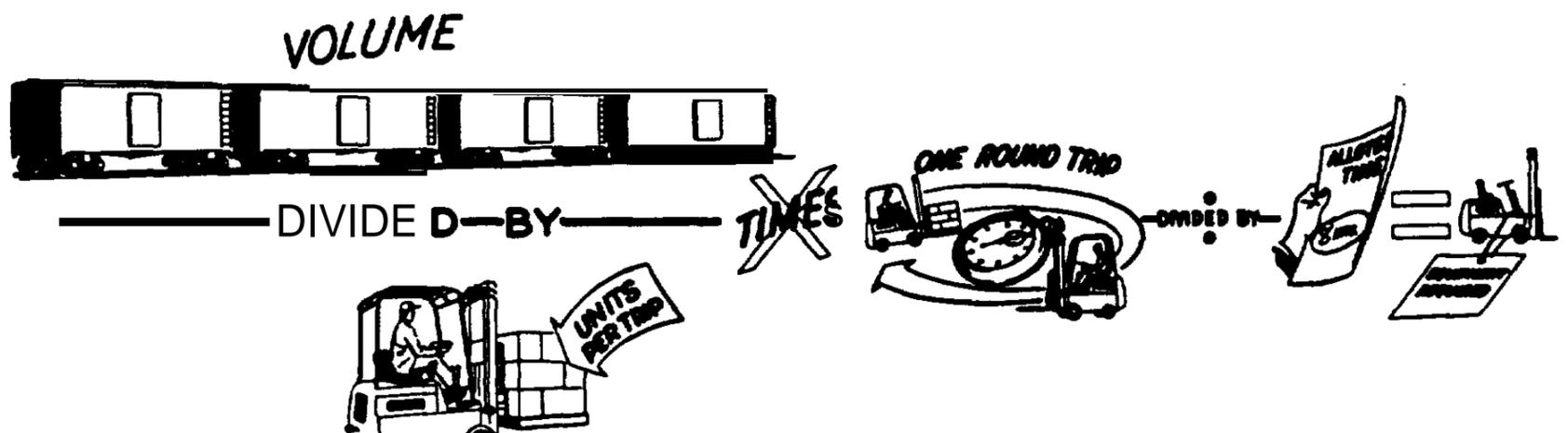


Figure 4-102. Formula to be applied in computing MHE equipment requirements.

**4-405. Computing Pallet Requirements**

a. The investment in pallets can be substantial and should be based upon definite requirements. The standard pallet is 40 x 48 inches. Allowing for overhang (roughly 25 percent), the square feet occupied by each **pallet** is approximately 16 (4 ft x 4 ft). If height permits stacking four pallets high, four pallets are required for each 16 square feet of net usable floor space.

b. Not all space is **usable**. Roof supports, aisles, mechanical equipment **required** for the building and **other structural losses** reduce **the** gross space to

net usable space which should be the basis for computing pallets.

c. Percent of occupancy is another consideration. Assuming a goal of 85 percent occupancy of net space is a target, the following is an example use of the formula shown in figure 4-103.

Compute the pallet requirements for 100,000 gross square feet of storage space, 70 percent net usable and 85 percent occupancy with stacking four pallet high.

$$R = \frac{(100,000 \times .70 \times .85)}{16} \times 4 = 14,875 \text{ pallets}$$

# DETERMINING PALLET REQUIREMENTS

$$\text{FORMULA } \frac{S \times H}{D} = R$$

## EXPLANATION

- S** - Net covered storage area, in square feet used for bulk storage.
- H** - **Average** stacking height in such storage areas expressed in pallet **courses** (pallet loads).
- D** - Square feet of floor area occupied by a pallet as determined by pallet size with 25% added to compensate for load overhang and clearance.
- R** - Quantity of pallets required.

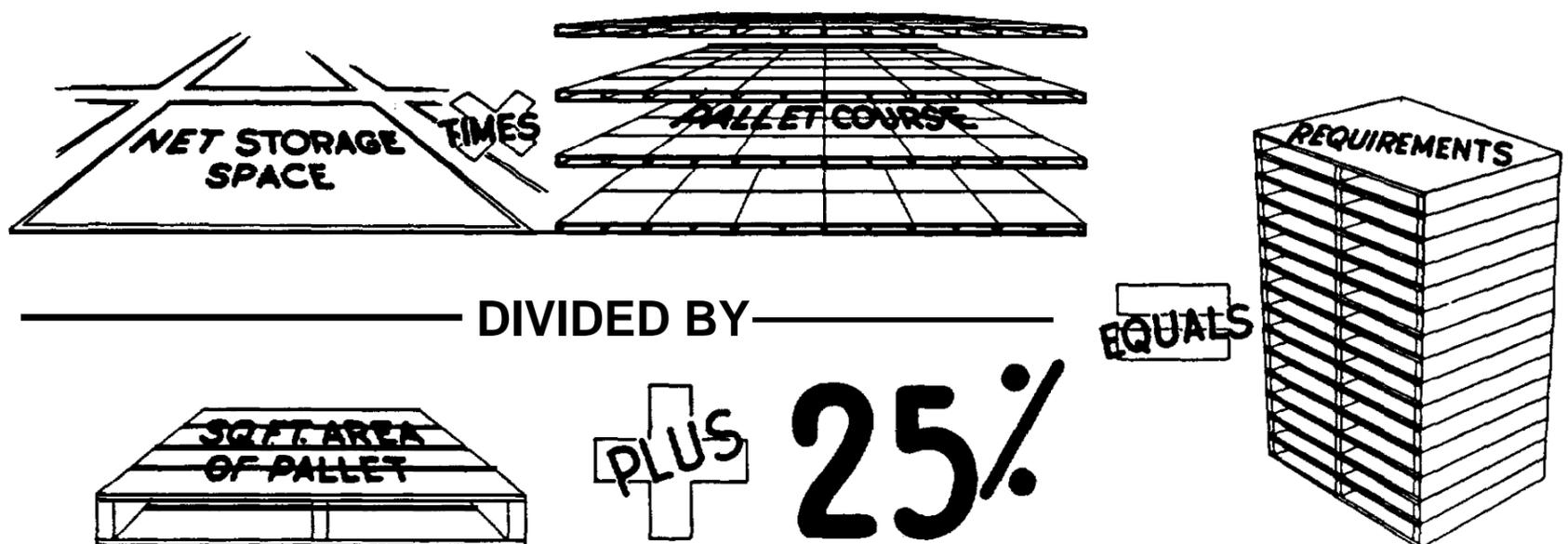


Figure 4-103. Formula for computing pallet requirements.

#### 4406. Considerations in Requirements for Fixed Equipment

a. Under certain operating conditions, fixed equipment constitutes the most economical means of material movement and should be utilized to the maximum extent practicable. In order to be able to compute requirements for fixed-type equipment, one must be thoroughly familiar with existing types and models and the conditions under which they provide the most efficient materials handling.

b. There is no set formula for computing requirements for fixed-type equipment. It is the responsibility of the storage managers to determine when and where the installation of fixed equipment will offer greater advantage than mobile types, and the particular type and characteristics which will best perform the desired handling at the desired speed.

c. While there are no common mathematical factors applicable to computing fixed equipment requirements, there are certain other factors which help determine the practicability of fixed equipment installation:

(1) A repetitive and somewhat continuous flow of material to, from, or through a common point or fixed path, i.e., processing, packaging and packing lines, baling operations, segregation lines, etc.

(2) Restricted operating space or other condi-

tions which do not permit the maneuvering of mobile equipment.

(3) The operation being performed requires separate handling of individual units or packages.

(4) **Multifloor** storage areas.

d. An area where fixed equipment is serving well is shown in figure 4-104. The absence of such equipment would require support from mobile equipment which would serve less satisfactorily. Fixed equipment offers constant service at unvarying capacity. In use of mobile equipment the operation is dependent on the equipment, arriving at a balanced time cycle. When either the mobile equipment cycle is interrupted or the operation flow fluctuates, production complications can result.

#### 4-407. Fleet Management

a. *Definition.* Fleet Management as distinguished from operational use of MHE encompasses overall determination of quantitative requirements at installation level, analysis of fleet utilization to determine effectiveness of the materials handling program, remedial action as required, proper maintenance for all MHE, and efficient distribution of MHE to job sites from a central control point.

b. *Post analysis.* A post-analysis of both requirements and utilization by using activities and at in-

## DON'T OVERLOOK ADVANTAGES OF FIXED EQUIPMENT

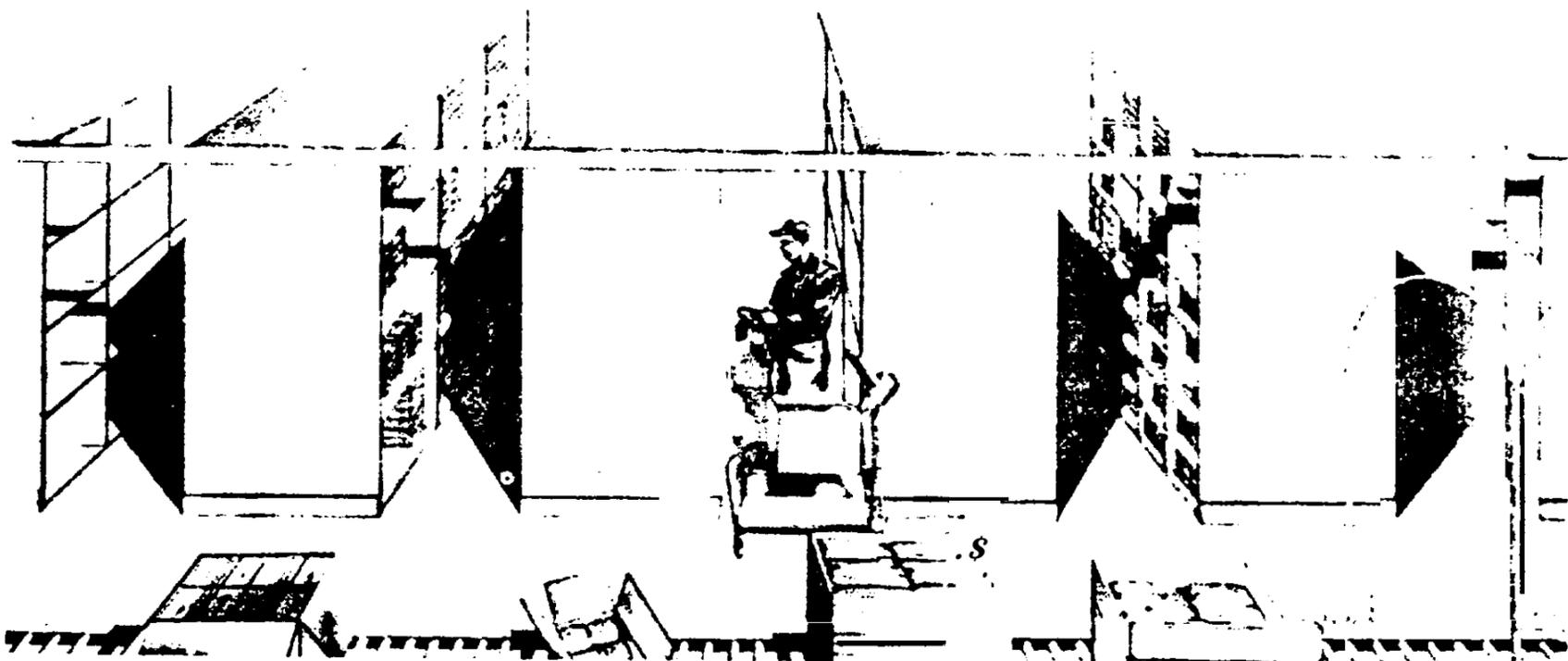


Figure 4-104. Fixed active roller conveyor line serves to good advantage in package transfer.

stallation fleet management levels will verify the adequacy or inadequacy of total fleet, pinpoint activities that constitute problem areas in materials handling utilization, and indicate the type of remedial action required. In each case proper analysis will result in an improved materials handling program, a close alinement of quantitative ceiling with workload volume, and a fleet complement containing the proper ratio of equipment by type and capacity necessary to accomplish supply movement.

c. *Maintenance.* Scheduled preventive maintenance, fleet population sufficient for replacement of equipment undergoing maintenance, and an effective program of first echelon maintenance by operators will result in a compact working fleet without the necessity of maintaining extra equipment which is in reality "excess" equipment. Maintenance should be performed in such manner and with such dispatch as to preclude the growth of a theory that "I need one piece of equipment but must order two due to the possibility of breakdown." Figure 4-105 emphasizes where the value of equipment is gained.

d. *Distribution.*

(1) In many operational areas the period of requirement for MHE service constitutes only a small part of the day. Under such circumstances, rather than the assignment of an equipment item for the full day, it is better practice to have the equipment

reported as being available for use to a central control office in order that further profitable dispatch can be accomplished. The office exercising control of equipment should maintain a means to visibly illustrate the location of equipment currently in use as well as unassigned equipment available for immediate dispatch. Such an aid for the control of equipment by location and using activity is illustrated in figure 4-106.

(2) Efficient control will generally result in strategic placement or dispersal of equipment. Equipment should be moved as required to satisfy operational demand as determined by workload conditions. Normal dispatch of equipment to user is for the accomplishment of a specific job; therefore, when the operation is completed, the equipment should become available for other use. However, this does not preclude the assignment of equipment, as required, to operations which need equipment periodically throughout the entire day. In each instance administrative control of equipment should remain vested in a central office responsible for MHE.

e. *Reports and reports procedure.*

(1) With due consideration to the fact that MHE is a service to the operations being performed and the full potential from each piece of equipment cannot be expected, a generally acceptable method

## EQUIPMENT - WHERE IS IT?

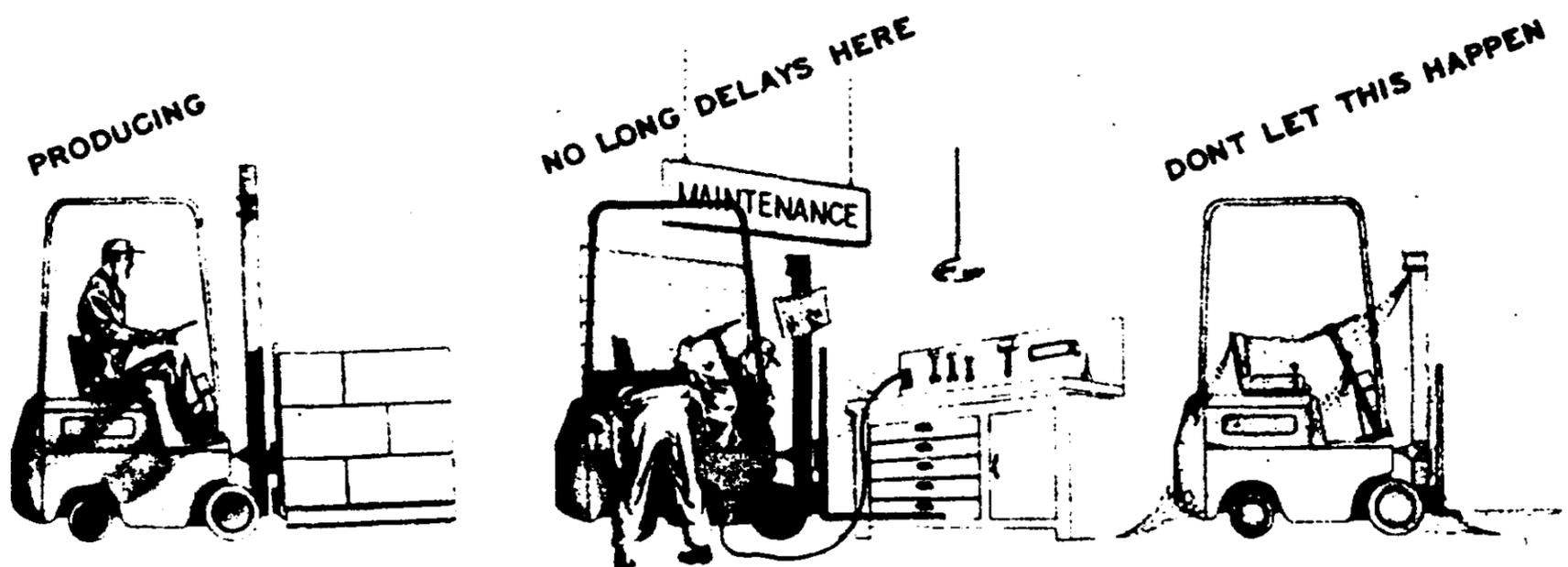


Figure 4-10.5. Equipment that is not producing is not "paying its way." Minimize "out Of use" time.

for analyzing equipment utilization and fleet quantity is the conversion of overall fleet activity to hours of operation expressed as a percentage of the utilization potential during an 8-hour work period. Each service has published instructions which represent minimum utilization expectations from the basic type of mobile powered MHE.

(2) The procedure outlined below provides a suggested means for the compilation and reporting of data pertaining to the utilization of powered MHE.

(3) The agency charged with the administration of the installation concerned is responsible for the allocation of powered MHE in accordance with the needs of each installation, for providing technical supervision and guidance in equipment utilization, and initiating remedial action where appropriate.

There should also be a central office of control, designated above installation level, who can—

(a) Monitor the program for the reporting of MHE utilization.

(b) Consolidate and analyze the data obtained from the reports.

(c) Prepare a consolidated summary report of MHE utilization as required.

(4) Each supply installation, in the discharge of assigned mission, is responsible for obtaining maximum efficiency in the operation of MHE. To accomplish this, compiled operating data must be detailed enough to furnish installations with utilization records by using units and still allow for recapitulation on a broader scale to furnish data to higher echelons. By so doing the information compiled can be used at any management level and the

MHE CONTROL BOARD																				
USING UNIT # 1	4-104	4-104	4-104	4-104	4-104	4-104														
	430	437	443	446	532	538														
USING UNIT # 2	4000 50P	4000 50P	2-104	4-104	4-104	4-104	4-104	4-104	4-104	4-104	4-104	4-104	4-104	4-104						
	31	44	307	407	410	416	419	444	455	463	477	534								
USING UNIT # 3	4-104	4-104	4-104	4-104	4-104	4000 50P	7500 50P	7500 50P	2-104	2-104	2-104	4-104								
	490	491	492	493	494	40	48	52	53	55	57	58	72	95	96	304	305	313	402	417
USING UNIT # 4	4000 50P	4000 50P	4000 50P	7500 50P	2-104	4-104	4-104	4-104	4-104	4-104	4-104	4-104	4-104	4-104	4-104	4-104	4-104	4-104	4-104	4-104
	25	39	55	55	201	412	461	503	508	503	C-30	C-33								
USING UNIT # 5	4000 50P	2-104	4-104	4-104	4-104	4-104	4-104	4-104	4-104	4-104	4-104	4-104	4-104	4-104						
	21	32	41	43	45	47	73	202	413	415	421	423	433	435	439	442	450	451	453	
USING UNIT # 6	4000 50P	4000 50P	2-104	4-104	4-104	4-104	4-104	4-104	4-104	4-104	4-104	4-104	4-104	4-104	4-104	4-104	4-104	4-104	4-104	4-104
	26	29	310	414	427	429	441	455	469	524	525									
USING UNIT # 7	4000 50P	4000 50P	2-104	4-104	4-104	4-104	4-104	4-104	4-104	4-104	4-104	4-104	4-104	4-104	4-104	4-104	4-104	4-104	4-104	4-104
	49	75	312	400	403	426	436	448	449	452	462	466	531	501	505	512				
USING UNIT # 8	2-104	4-104	4-104	4-104	4-104	4-104	GRANE	GRANE												
	200	408	418	542	511	524	C-4	C-5												
USING UNIT # 9	4000 50P	4-104	4-104																	
	24	535	539																	
USING UNIT # 10	4000 50P	4000 50P	2-104	2-104	2-104	4-104	4-104	4-104	4-104	4-104	4-104	4-104	4-104	4-104	4-104	4-104	4-104	4-104	4-104	4-104
	20	71	204	303	311	422	431	437	460	540	504									
USING UNIT # 11	4000 50P	4-104																		
	51	404																		
MAINTENANCE	4000 50P	4000 50P	4-104																	
	50	59	526																	
UNASSIGNED	4000 50P	4000 50P	7500 50P	2-104	2-104	2-104	4-104	4-104	4-104	4-104	4-104	4-104	4-104	4-104	4-104	4-104	4-104	4-104	4-104	4-104
	42	74	51	301	302	308	309	405	447	533	501	C-23	C-27							

Figure 4-106. Typical MHE control board. Removable cards identify, by number each, piece of equipment and the characteristics of the piece. Using units may represent any operational breakdown most suitable to exercise effective fleet control.

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# WHAT A MHE UTILIZATION REPORTING SYSTEM MEANS

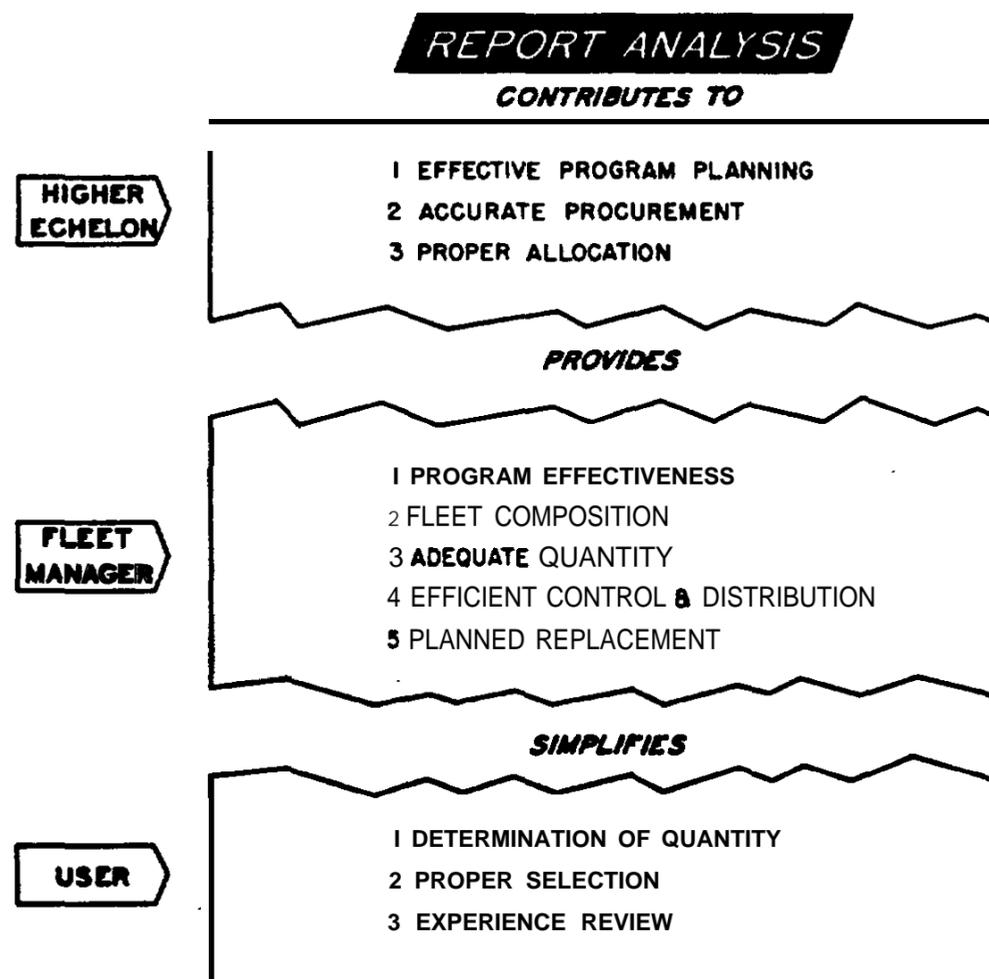


Figure 4-107. Value of an effective reporting system for MHE equipment.

analysis and the application of the information so gained will **result** in an effective materials handling program and establishment of materials handling fleet quantities at a level required for normal operations. Figure 4-107 illustrates areas of benefit.

Data should be compiled within each installation in the **office** responsible for the assignment of equipment **from** vehicle and equipment operational records, and maintenance shop records.

Section 5. ON THE JOB TRAINING COURSE FOR OPERATORS OF MHE

	Paragraph
purpose .....	4-501
<b>Vision</b> , hearing, and reaction tests .....	4-502
Physical <b>examination</b> . . . . .	4-503
Instructions on types of equipment . . . . .	4-504
<b>Fundamental</b> operational instructions for fork truck .....	4-505
Advanced training in fork truck operation .....	4-506
Fundamental operational instructions for industrial tractors .....	4-507
Course in operation of industrial tractor-trailer trains .....	4-508
Operational instructions for truck, straddle carry (or gantry trucks) .....	4-509
<b>Operating</b> rules .....	4-510
Examinations for fork trucks .....	4-511
<b>Examinations</b> for other equipment .....	4-512
<b>Grading</b> examinations .....	4-513
<b>Temporary</b> permits .....	4-514
Additional on-the-job training .....	4-515
Permanent <b>operator's</b> permit . . . . .	4-516
Renewal .....	4-517
Preparation of additional <b>training</b> courses .....	4-518

4-501. Purpose

The purpose of this section is to provide guidance to train personnel in the proper operation of MHE. The guidance provides a system of training, testing, and licensing of personnel.

4-502. Vision, Hearing, and Reaction Tests

a. These tests (properly administered) will ensure that operators of MHE possess at least minimum requirements for safe operation.

b. Equipment for these tests is available in the Federal supply system as driver testing and training device, portable (NSN 6930-00-526-3639). If the testing equipment cannot be obtained through supply channels, equivalent materials may be constructed locally, provided they are made to accurately measure the physical characteristics as prescribed (fig. 4-103).

c. The following instructions apply to measuring physical abilities and supplement the specific instructions accompanying the test equipment.

(1) Before giving any test, the administrator of the test must know the purpose of the test equipment to be used and the prescribed procedure. He/she should conduct a number of trial tests to become familiar with the test equipment.

(2) Prior to each test, he/she should explain the purpose and what the examinee is expected to do. Upon completion of testing, any physical limitations of the examinee should be explained and the compensating measures the examinee may take should be emphasized.

d. A visual acuity test determines whether the

examinee can see well enough to operate MHE safely. The minimum standard is visual acuity correctable to 20/30 in each eye. An individual whose visual acuity is 20/40, or poorer, will be referred to the installation medical examiner for decision on whether or not the individual's vision is sufficient for operation of MHE. Persons with sight in only one eye can operate industrial tractors in open areas, but not in warehouses. Sight in both eyes is required for handling ammunition and explosives.

e. A depth perception test, which is optional, determines how well the examinee can judge distances. The results of this test, if given, are used in counseling and training of the operator, although there is no minimum standard.

f. A field of vision test is given to determine whether the examinee can see to each side while looking straight ahead. A lateral range of 75° on each side of the focus line is the minimum standard acceptable. If the standard is not met, the examinee will be referred to the installation medical examiner for determination as to whether the individual's lateral vision is sufficient for safe operation of MHE. In the event an instrument is not available to test field of vision, a pencil can be used in this manner: have the person being tested look at an object straight ahead while the examiner, standing beside the person being tested and holding a pencil at eye level over the right or left shoulder, moves the pencil forward until the person can see it out of the corner of his eye. The angle at which the examinee first sights the pencil is noted. (Straight ahead is 0°.) Repeat for each eye.

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g. A color perception test determines whether the examinee is colorblind. The examinee will not necessarily be disqualified as an operator of MHE because of colorblindness. However, if there is any indication of colorblindness, the examinee will be given **information** on **traffic** lights, observation of other **traffic**, etc., which will enable the individual to operate MHE safely. For those activities lacking a colored light signal device, this test may be conducted by either the colored yarn test or color cards.

**h.** A reaction time test (eye to foot) measures how quickly an examinee's foot can be moved in response to driving conditions. Reaction time up to and including .60 second is acceptable.

**i.** A hearing test determines whether the examinee can hear well enough to operate MHE safely. The examinee should be able to hear conversation, spoken clearly and in a moderate tone, **from** a distance of 20 feet.

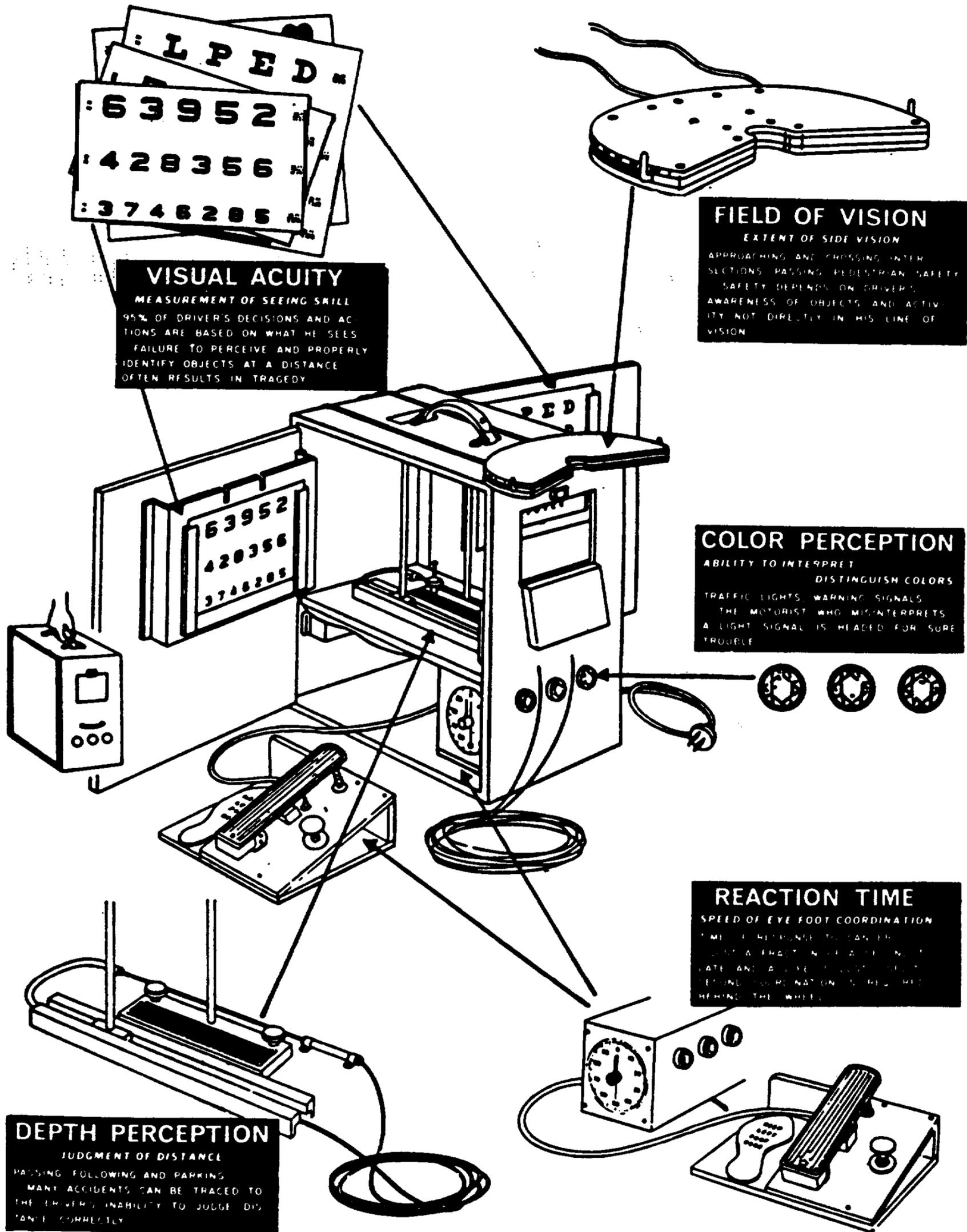


Figure 4-108. Driver testing and training device.

#### 4-503. Physical Examination

a. The physical condition of **all** trainees must be such that, in the opinion of the installation medical examiner, they are capable of performing their duties.

b. **Amputees** in good physical condition are acceptable as operators, when in the opinion of the installation medical examiner, they can perform in accordance with the physical requirements as established by the installation. The examination **report will include** a justification statement as to why the **missing limb will** not "present & safety hazard.

#### 4-504. Instructions on Types of Equipment

a. **Preparation.** A classroom should be provided. Illustrations for applicable types, and makes of equipment should be obtained. The illustrations can be of a size to be displayed to the entire class or may be smaller in size and be distributed to each trainee. These illustrations should show not only exterior views, but also cutaway views showing interior mechanism to be described by the instructor. Other visual aids, such as models, motion picture films, sound **film** strips, safety posters are **extremely** helpful.

b. **Discussion topics.** Classroom instruction should cover the following,

(1) Discussion of the fork truck and its relationship to the **palletization** of material, including the placement of material in storage, and the principles, handling methods, and procedures involved.

(2) Discussion of the fork truck and its uses as compared to those of other types of MHE, such as industrial tractors, tractor-trailer trains, cranes, industrial trailers, gravity conveyors, power-driven belt conveyors, hand trucks, pallet trucks, railroad cars and other commercial vehicles.

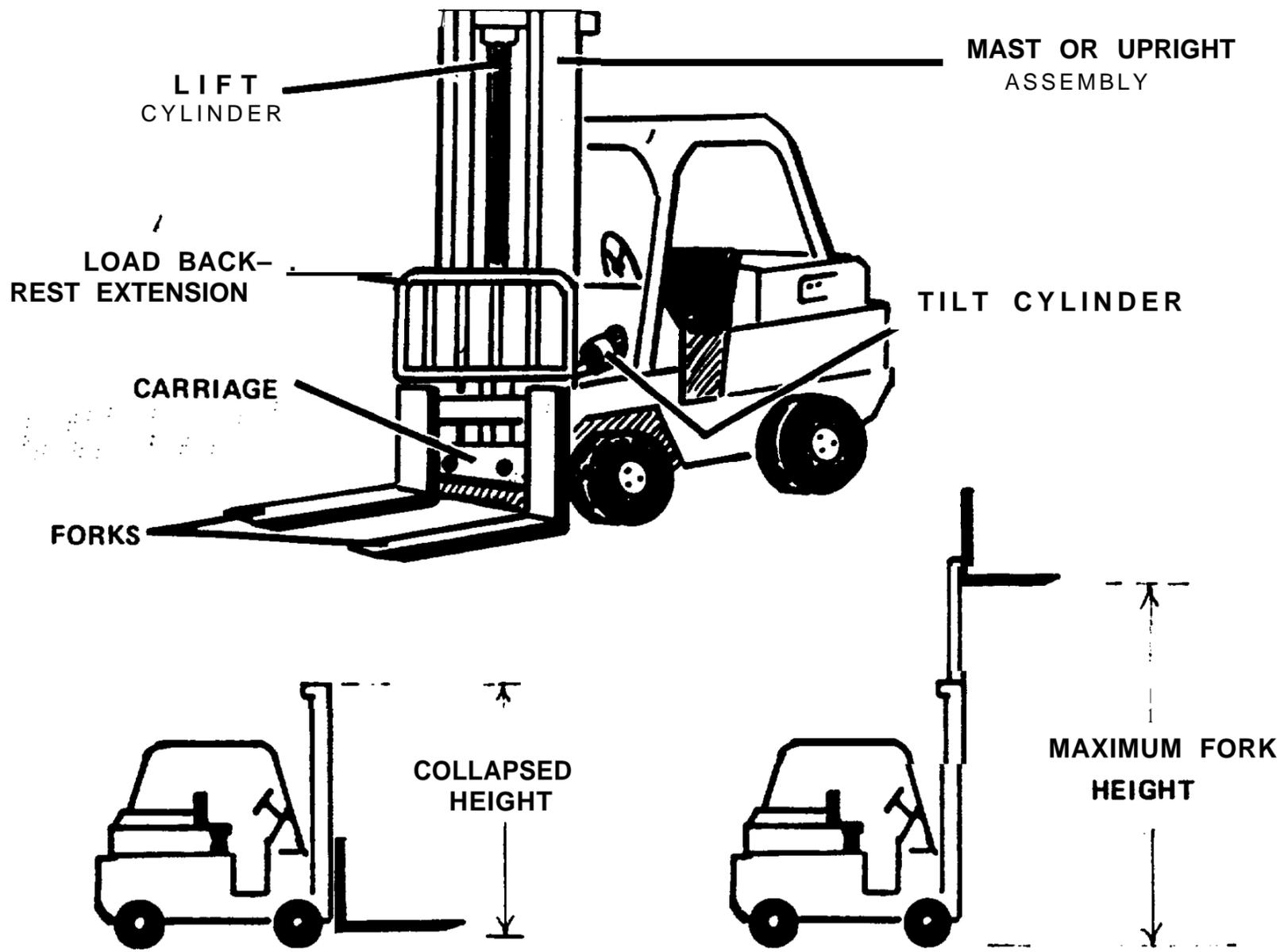
(3) Discussion of the operating performance, operating parts, and the maintenance program of fork trucks, both gasoline and electric. All **differences** between the types of machines occasioned by a different power source should be emphasized.

(a) Mechanical construction, weight, weight distribution and ability to **carry** a load, turning radius and principle, pivot or turning point, fork types, mast construction and operating principles. Figure 4-109 illustrates and explains the terms applicable to the forklift truck mast assembly.

(b) Operating parts, such as gauges for oil and gasoline, ammeter, ignition, brake, clutch, starter, speed control, directional travel control, steering, boom lift, and tilt controls;

(c) "Maintenance program, which includes regular and periodic **servicing** (or battery charging), washing, lubrication, cleaning, tire condition, hydraulic system (if any) and painting.

(4) An explanation of the results of misusing fork trucks. This could include **an** exhibition of worn and broken parts to illustrate the additional cost incurred as a result of improper operation of the equipment. The instructor should point out the **additional** dangers involved in operating equipment which has been damaged by misuse.



A. THE COLLAPSED HEIGHT IS THE DISTANCE FROM THE FLOOR TO THE TOP OF THE MAST WHEN THE FORKS ARE IN THEIR LOWEST POSITION.

B. THE MAXIMUM FORK HEIGHT IS THE DISTANCE FROM THE FLOOR TO THE TOP OF THE FORKS WHEN THE MAST IS FULLY RAISED.

C. THE OVERALL EXTENDED HEIGHT IS THE DISTANCE FROM THE FLOOR TO THE TOP OF THE LOAD BACK REST EXTENSION WHEN THE MAST IS FULLY RAISED.

D. FREE LIFT IS THE DISTANCE THE FORKS MAY BE RAISED BEFORE THE COLLAPSED MAST HEIGHT IS INCREASED.

Figure 4-109. The *mast or upright* is the elevating assembly of a *forklift truck*.

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(5) Review of savings effected by the use of mechanical equipment. The review should **emphasize** the saving of time in delivering needed supplies, earlier release of railroad equipment, saving of space by increased stacking height and more compact **storing/of** material.

(6) Discussion of safe loading practices, as **outlined** below;

(a) **Safe load.** Overloading of fork trucks is strictly prohibited. The truck will safely lift and **carry no more than** its rated **capacity**. Among the **dangers of** overloading are the possibility of **injury** to the operator, "damage to the cargo, damage to the pump and lift mechanism and excessive wear on the tires, engine, or electric motor.

(b) **Determination of safe loading.** A fork truck will tip forward if the load on the forks exceeds the lift capacity of the truck. The manufacturer has **established** the truckload rating (expressed in pounds of load" on the fork) and the allowable distance in inches **from** the heel of the forks to the center of gravity of the load. This distance is known as the load center.

(c) Some manufacturers specify a number of pounds capacity with a particular length of load. Others specify a number of pounds capacity at a given number of inches from the heel of the fork. Some give an inch-pound rating based on the distance of the load center from the heel of the fork, while others base their inch-pound rating on the distance from the center of the load to the center of the front axle.

(d) When a load is uniformly distributed throughout the length; that is, parallel to the prongs of the fork, the center of gravity will be located at half such length. When a load is not uniformly distributed throughout the length, care must be taken to determine the distance **from** the heel of the forks to the accurate center of gravity.

(7) Explanation of the details of warehousing procedures. The **instructor's** lectures should include a discussion of warehouse aisle widths, selecting and storing stock, methods of **palletizing** and stacking, **fire** aisles, alarm boxes, and sprinkler systems.

(8) Explanation of the appropriate OSHA requirements applicable **to** safe operations.

#### 4-565. Fundamental Operational Instructions for Fork Truck

a. **Preparation.** One fork truck should be provided for every two students. All fork trucks will

**be** equipped with overhead guards. The area selected for training should be level, with paved surface, and should be free of other traffic.

b. **Review of previous instructions.** Instructions should include a review of previous classroom discussions on the various controls, preventive maintenance, warehousing procedures, stacking methods, and safety rules pertaining to the operation of fork trucks.

c. **Operational condition of vehicle.**

(1) Before taking **his/her** place on the truck, the trainee will be instructed to check the following

Gasoline.

Water.

Oil.

Tires.

Fire extinguisher (when truck is so equipped).

Security of forks.

(2) After mounting the truck, the trainee **will** check the following

Horn.

**Parking** brake and foot brake.

Position of gear shift lever (should be in neutral).

d. **Instructor's demonstration.** The **instructor** should demonstrate to the entire class how to operate the machine forward and backward. The trainees at this point should be cautioned against traveling with the foot resting on the clutch pedal ("riding the clutch") as this results in the loss of tension in the clutch springs, allowing the clutch to slip and causing excessive wear. The instructor should take particular care to explain that forks should always be raised just high enough for safe clearance, yet low enough to **permit** a clear view ahead when traveling either with or without a load. If the load's size obstructs the operator's forward view, he/she should drive the fork truck in reverse.

e. **Trainee's practice.**

(1) **Basic operation.** The trainee should now drive the machine in a straight line forward and backward. The next operating practice should be circles or figure eights, performed at reduced speed. The instructor should closely **observe** the trainee as he/she performs these maneuvers.

(2) **Obstacle course.** After the trainees have performed the basic maneuvers, the instructor should have them set up an obstacle course constructed of empty pallets. The pallets should be placed on edge in a straight line and so spaced as to allow a fork truck to pass freely between them

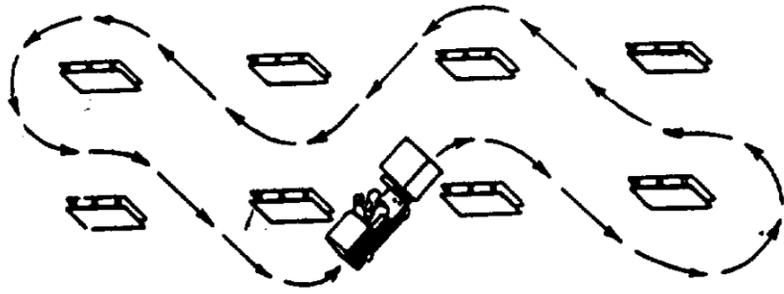


Figure 4-110. Obstacle course for operator training.

(fig. 4-110). In traveling over **this** course, the fork truck weaves in and out **between** the pallets. Each trainee should traverse this course until he/she has become proficient in moving between the pallets in free, easy curves. As each trainee performs, the instructor should emphasize the danger of sudden stops and starts or turns with the fork truck. Sudden starts and stops may cause the pallet loads to upset, thus endangering the safety of personnel and probably resulting in damage to the material. All turns should be made as gradually as possible. Long, slow turns allow the operator to gauge distances and accurately place loads without loss of time. Spotting loads in the warehouse is a maneuver which requires extreme accuracy. Adequate time should be allowed for the trainee to practice these maneuvers before proceeding with further instructions.

(3) **Operation in aisles.** The next step in the training course should be the operation of the truck in aisles. First, empty pallets are arranged to form aisles of a width normally used at the installation for the size of equipment used **for** training purposes with comers and intersecting aisles as shown in figure 4-111. The trainee should operate the fork truck up and down the aisles, both **forward** and backward. **If** two fork trucks are available, two trainees should perform this operation at the same time, thus learning to pass in aisles (fig. 4-112). Each trainee should then practice all that has been learned to this point. After an adequate practice period, the instructor should make a careful evaluation of the performance to date to determine which trainees are to be eliminated, retained, or given advanced training.

#### 4-506. Advanced Training in Fork Truck Operation

a. **Load hurdling demonstration.** The next period of instruction (before the trainee operates the

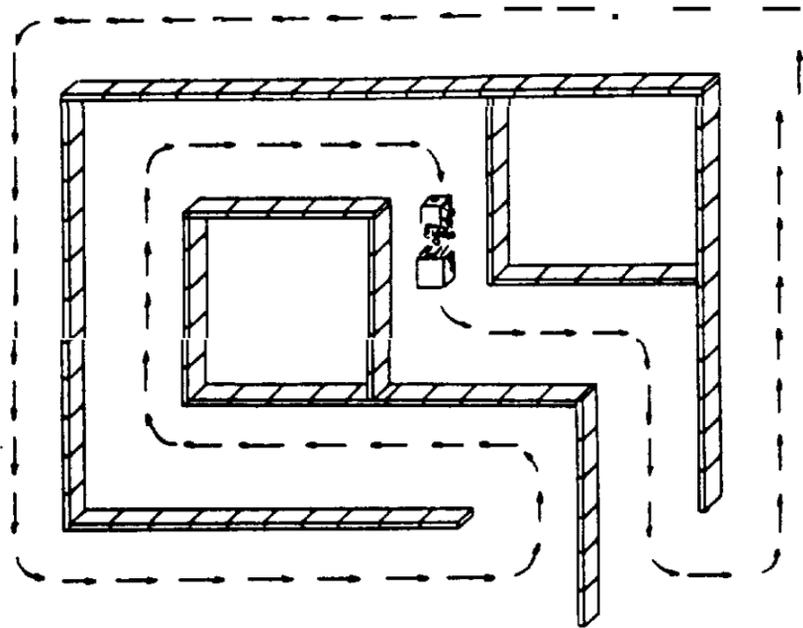


Figure 4-111. Practice aisles set up with empty pallets.



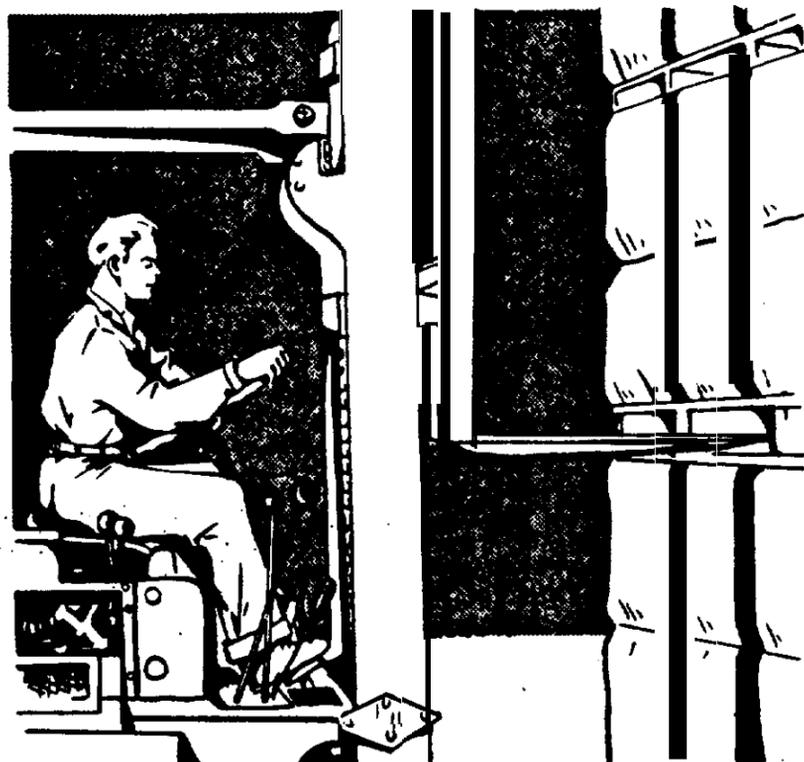
Figure 4-112. Experienced operators passing in an aisle.

machine with pallets) covers the following load handling operations in the sequence given:

(1) **Approaching a pallet (fig. 4-113).** Aim the forks of the truck to enter between the top and bottom boards of the pallet, at an equal distance **from** the center stringers.

(2) **Inserting forks.** The forks of the truck should be inserted into the pallet as far as they will go. It is important that the operator have the load as close to the heel of the fork as possible.

(3) **Lifting and moving the pallet.** The trainee should be instructed how to apply the lift control



*Figure 4-113. Approaching a pallet. Forks must enter at an equal distance from the center stringers.*

to lift the pallet from the floor, apply the tilt control to tilt the mast back and then apply the travel controls to move the machine forward or backward.

(4) **Lowering the pallet.** The trainee should be shown how to lower the pallet to the floor and then tilt the mast to a vertical position so that the forks can be removed easily.

(5) **Using the mast tilt.** Demonstrate how the tilt is used to-

(a) Lean the load against the back rest for stability during movement.

(b) Position loaded pallets during stacking.

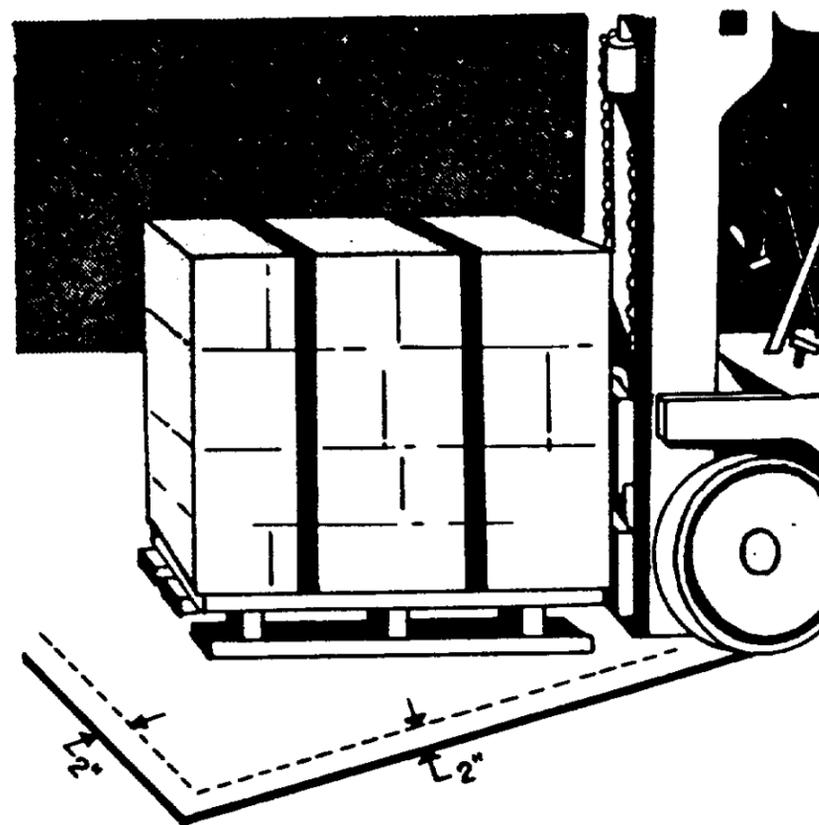
b. **Load handling maneuvers for trainees.**

(1) **Lesson one**

(a) The trainee lifts a pallet load with the fork truck and, after making a turn around the training area, spots the load on a right angle drawn on the floor (fig. 4-114). **One swing is all** the maneuvering that is permitted to place the load. The instructor should demonstrate each operation before turning the fork truck over to the trainee. Upon completion of a maneuver by the trainee, the instructor should point out those actions that were performed correctly and make appropriate comments on those that were not. In the problem of spotting a pallet load at a right angle in one maneuver, the instructor will point out that extra backing and shifting causes the greatest loss of time in fork truck operation. If operators are trained to spot a load on the first approach, this time loser

will be eliminated. The one-swing maneuver is accomplished by having the eye follow the path of the drive wheel on the inside of the turn. As the center of pivot of the machine lies on the line formed by the drive axle, it is obvious that the drive wheels are the key to the actual spotting of the load. After several attempts, each trainee should be able to spot a load on the right angle with no more than 2 inches of lost space.

(6) **The next step is** to spot a pallet load adjacent to another. This also must be performed in one swing of the machine. The fork truck approaches the stack (pallet load on the floor) by crossing in front of the stack rather than by approaching from the opposite side toward the stack (fig. 4-115). If the stack is approached from the opposite side, the pallet load will move away from the stack when the fork truck is turned to set the load down, leaving as much as 6 inches lost space. By crossing in front of the stack—the correct way—the load will travel toward the stack with no loss of space. It should be observed that in this position the fork truck is turning to straighten out the load. When the fork truck turns, the back of the truck moves to the right and the load to the left and the load can be spotted directly in line with the stack, with no loss of space. Test refers to truck B coming from left (fig. 4-115).



*Figure 4-114. In one maneuver the trainee spots a pallet load on a right angle drawn on the floor. This must be done with no more than 2 inches of lost space.*

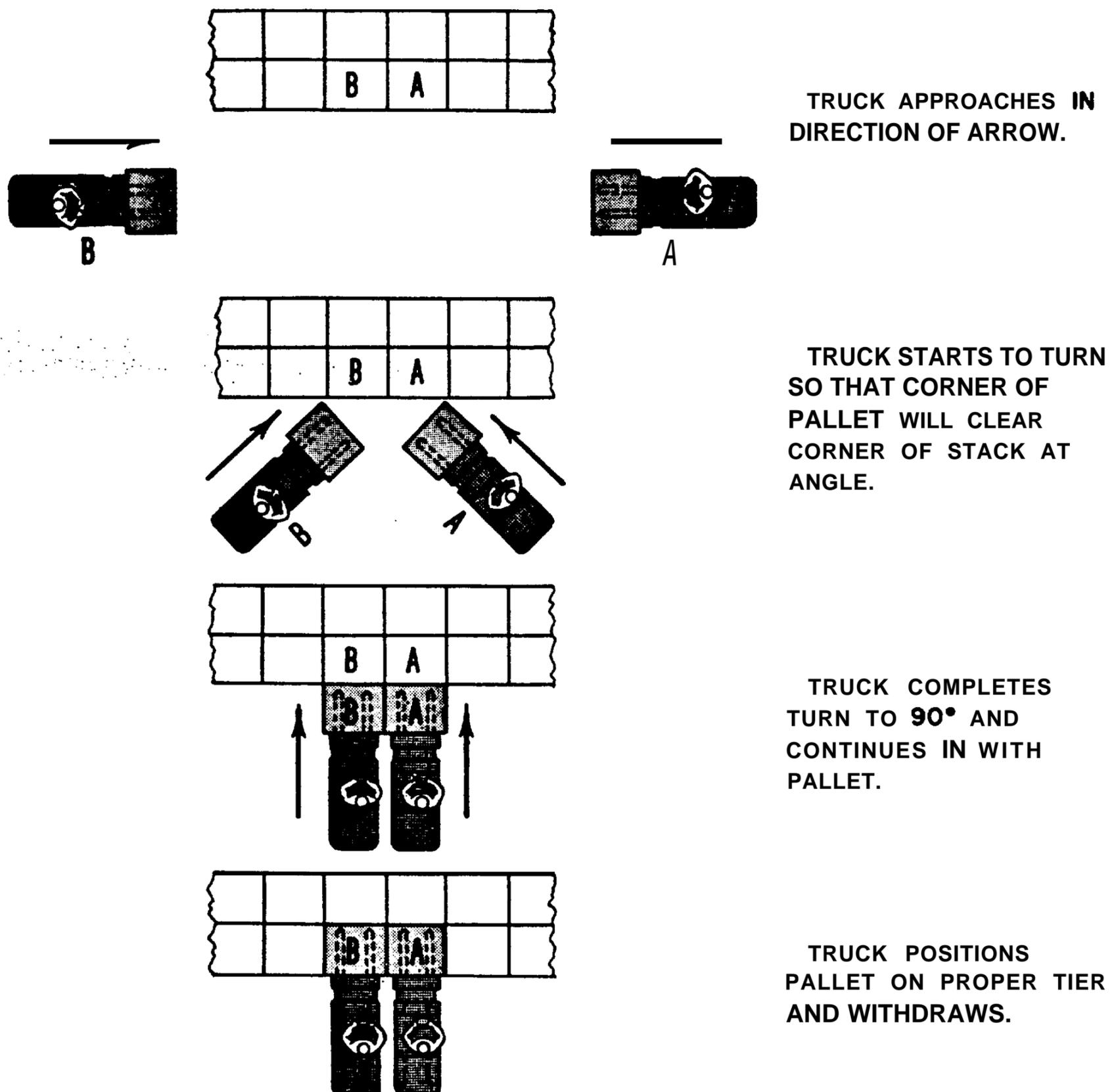


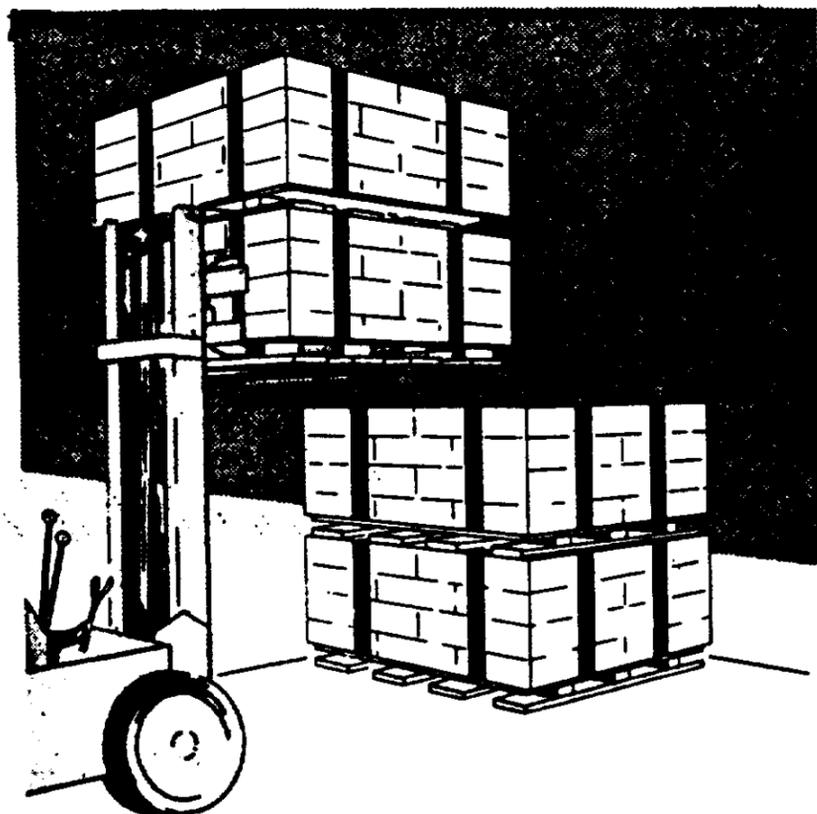
Figure 4-115. After crossing in front of the stack, the operator spots a pallet load adjacent to another.

(2) Lesson two.

(a) This lesson is designed to acquaint the trainee with the fundamentals of tiering. The trainee is shown how to tier first one pallet load upon another and then place a double pallet load on top of the first two with an error of no more than 2 inches in any direction (fig. 4-116). Raising a load into position for stacking while the fork truck is in motion is forbidden. Such a practice is dangerous because it obscures the operator's view while traveling in a forward motion. The performance of two

simultaneous operations (**steering and lifting**) **endangers** safety and limits operating efficiency. Operators should bring the machine to a stop up close to the stack before raising the load to tiering position (fig. 4-117).

(b) The next step pertains to the tiering of a double pallet load adjacent to the stacks. This should also be accomplished with one swing of the truck and with an error of not more than 2 inches on any side. In carrying double pallet loads, the truck is operated in reverse so that the operator



**Figure 4-116.** A double pallet load must be tiered with an overhang of no more than 2 inches in any direction.

will have an unobstructed view. A fork truck has the same speed in reverse motion as it does in forward motion. At this point the trainee can be instructed in the proper method of operating loaded fork trucks up and down ramps. A loaded truck, moving in a forward direction, can negotiate a slight downward grade (not to exceed  $5^\circ$ ) safely when the mast is tilted back. However, a loaded fork truck will be driven up in forward motion and down in reverse motion on all ramps.

(3) *Lesson three*

This lesson is a continuation of the trainee's practice in tiering pallet loads. In the previous lessons, there was no limit to the radius of turn permitted the beginner. To get the feel of the truck and to accustom his/her eye to its travel, he/she was allowed unlimited space for maneuvering. Now, however, warehouse aisles should be simulated by the placement of pallet loads in two straight lines. The two stacks should be placed to form an aisle 14 feet wide. The trainee should now be instructed to do the same tiering done in the previous lessons in this limited aisle space. As the trainee progresses, the aisle width can be reduced to the width normally used at the installation.

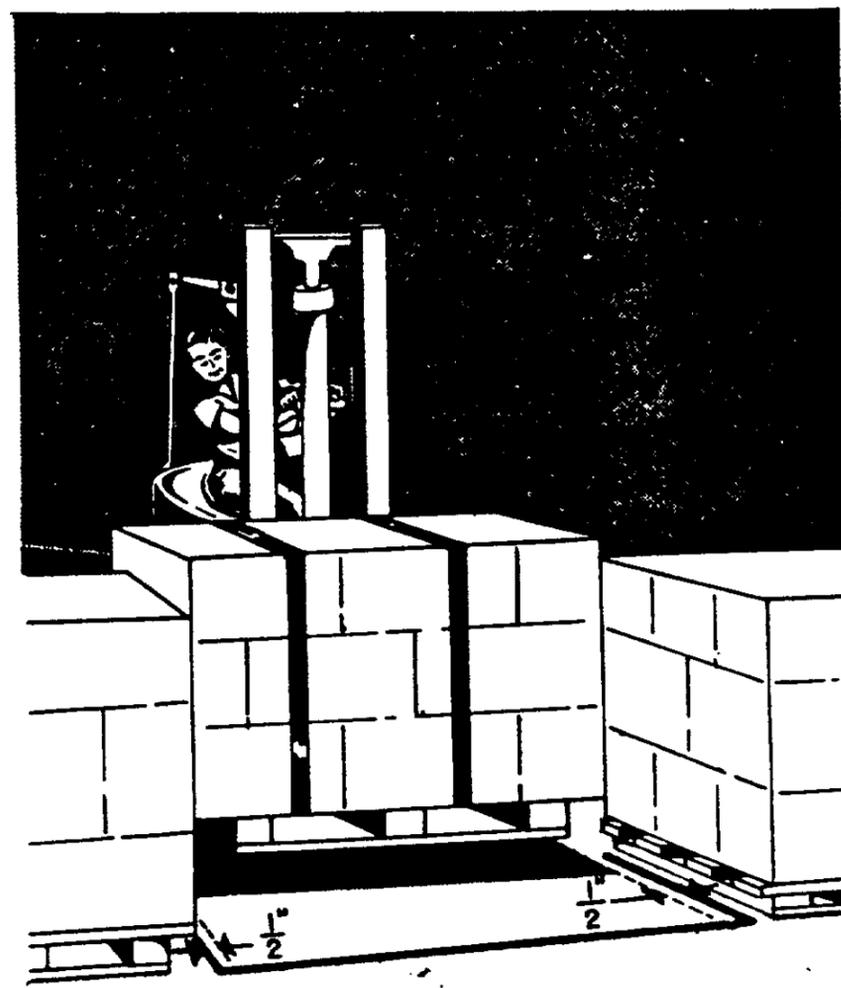
(4) *Lesson four*.

This lesson is designed to teach placement and handling of loads in limited spaces. The trainee should

now be ready to place a pallet load between two other pallet loads with only  $\frac{1}{2}$ -inch clearance on either side of the load (fig. 4-117). This is to be accomplished without stopping the fork truck. For the first few attempts, additional clearance may be provided. In the next operation, the trainee makes a similar maneuver, except that he/she turns off a 14-foot warehouse aisle and into another aisle which is not more than 4 inches wider than the pallet load. Since the space is only an inch or two wider than the pallet load, the truck's line of approach must be at a right angle to the line of stack. Making this turn from a 14-foot aisle requires considerable practice, and the trainee should completely master this maneuver before going on to the next lesson.

(5) *Lesson five*.

This lesson is a continuation of lesson four. The trainee is required to back through the space between two pallet loads with only 1-inch clearance on either side of the load. It is a difficult maneuver and must be performed often in warehousing operations. The trainee must learn that, as the fork truck is traveling backward, he/she must give equal



**Figure 4-117.** The trainee must be able to take a pallet load between two other pallet loads with only  $\frac{1}{2}$  inch clearance on either side.

attention to both the rear of the machine and to the pallet load, which are in opposite directions from the operator. In backing into the space, the operator should look to the rear to make certain that the fork truck **will** be properly centered. He/she then looks **forward** to assure proper pallet clearance. In this exercise of driving between pallet loads, the operator of a fork truck that has the seat on the left side should never be concerned with the right side of his/her load once it is certain there is sufficient clearance. Conversely, on trucks which **the operator drives from** the right side of the machine, he/she will give attention to the right side of the pallet load. On seated center control trucks, he/she can give attention to either side.

(6) *Lesson six.*

This lesson is designed for final examination of the trainee. Standard warehouse conditions are simulated as nearly as possible in the training area and the trainee will tier and untier a set of pallet loads according to the rules learned in the previous lessons. Tiering eight pallet loads on a run of about 100 feet should be done in approximately 12 minutes before the trainee is qualified for an operator's permit (fig. 4-120).

(7) *Lesson seven.*

(a) A course in railroad **carloading** will be given to those trainees selected for these lessons. A **preliminary** to the course should be a short talk on the subject. The trainees then should be taken to a loading or unloading operation so they may observe the procedure (fig. 4-1 19). The function and use of bridge plates should be pointed out and the method of securing and moving them should be explained.

(b) For practice in operation, a boxcar doorway, bridge plate, and boxcar wall should be marked out in the practice area by means of pallets (fig. 4-120). The trainee should demonstrate the ability to drive in and out of a boxcar in the practice area before proceeding to an actual boxcar. After proving capable, the trainee should be taken to a location where he/she can drive in and out of an empty boxcar with no load on the forks except an empty pallet.

(c) Following this practice, the trainee should be taught to place 40 by 48-inch pallets for unit load shipment in a standard boxcar floor layout marked on the practice area floor. Actual pallet loads of unbreakable goods should be used if possible and a half car should be worked two tiers high in the practice area. After the trainee has demonstrated the ability to unload a boxcar on the practice floor, he/she should unload merchandise **from** an actual car in a fairly quiet location under the supervision of a competent operator.

(d) Instruction in actual car loading should include the following

1. *Bridge plate placement.* Make certain the bridge plate between the boxcar and the loading **platform** cannot **slip** or slide. It **should be** securely fastened to prevent accidents. Inspect car floors to be sure the floor is strong enough to carry the combined weight of the truck and its load.

2. *Necessity for caution.* When entering or leaving the boxcar, the fork truck operator should drive over the bridge plate slowly and carefully-especially when loading. Fast operation at this point can cause accidents and damage. A fork truck with two or more speeds should always be operated in low speed when entering or leaving the

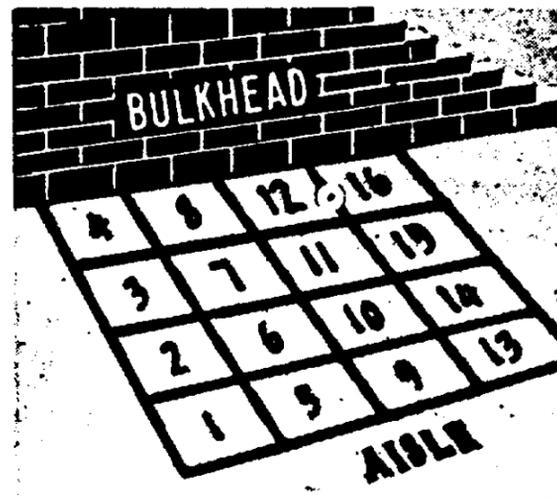
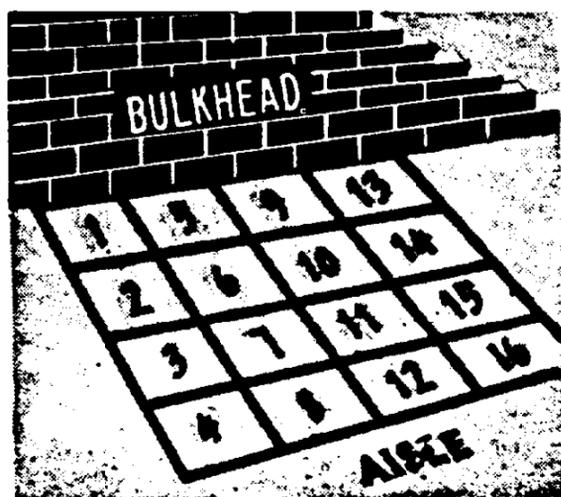


Figure 4-118. Typical floor pattern. Proper **stacking** procedure is **shown** at left. The numbers indicate the sequence in which columns are **stacked**. Sequence for the removal of pallet loads is **shown** at right.

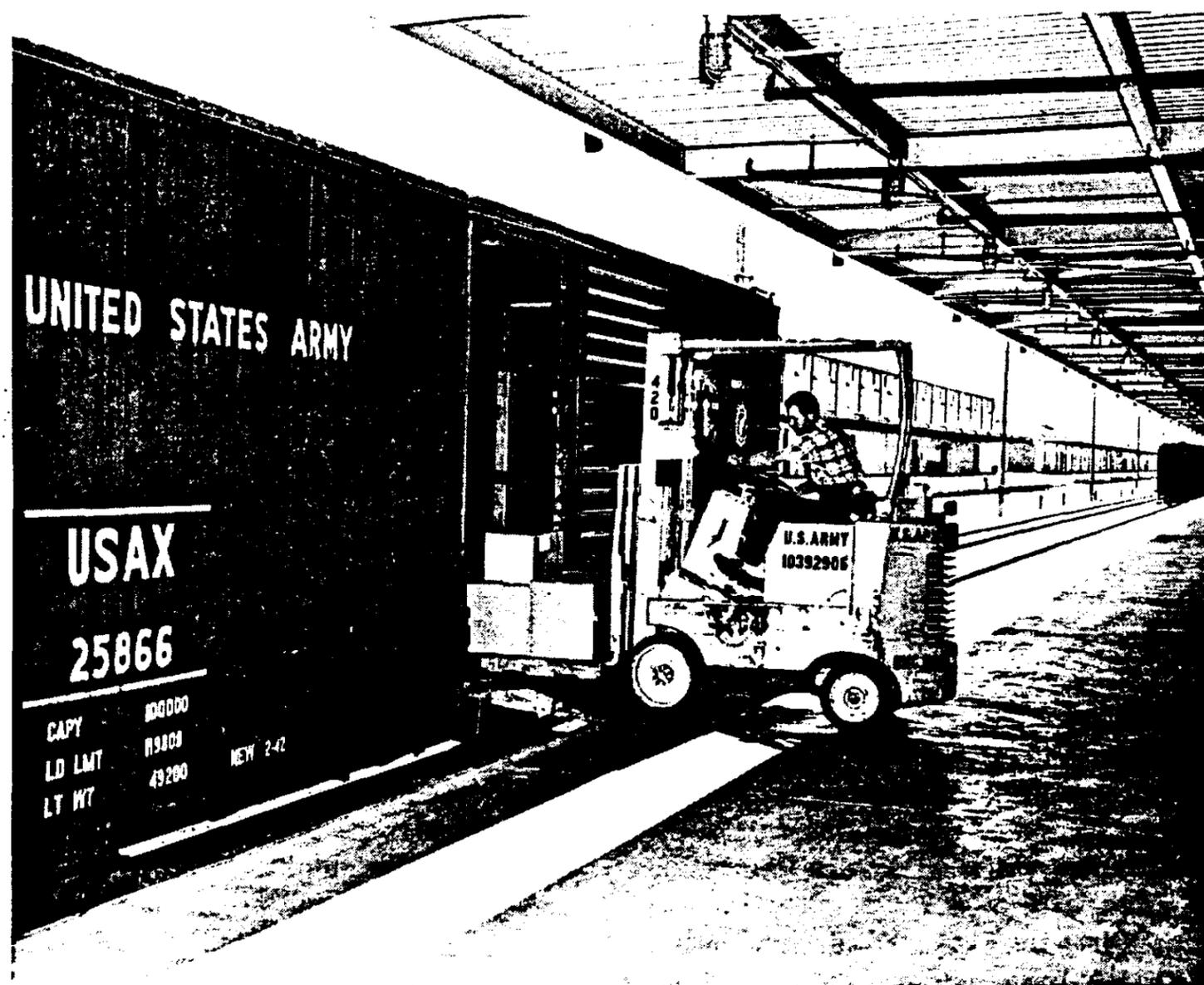


Figure 4-119. Loading a freight car.

boxcar with a load. By keeping the truck in low speed, the operator will be less likely to slip the clutch, thus preventing undue wear on clutch lining and facings. Boxcars are not always level with the loading platform. Sometimes they are higher, sometimes lower. This irregularity effects the method of loading and unloading with the fork truck. The following are considered good practices:

a. If the boxcar is level or **higher** than the platform, the operator should drive **FORWARD INTO THE BOXCAR WITH THE LOAD AND DRIVE OUT BACKWARDS**.

b. If the freight car is lower than the unloading platform, the operator should **BACK IN WITH THE LOAD AND DRIVE OUT FORWARD**.

**3. Handling loose containers.** When unloading loose containers, the operator should place the pallet as near to the boxcar door as possible, with fork entries placed in the proper position for

easy pickup by the fork truck. Commodities are removed from the doorway **first** and **palletized** outside of the boxcar. After a sufficient number of containers have been removed, the remainder can be **palletized** on the boxcar floor. Again, care should be exercised to see that the fork entries are in the proper position. When containers in the **center** section of the boxcar have been removed, the unloading should continue towards the ends of the car. Pallets can be loaded at each end of the boxcar **simultaneously**. **In** such an operation, the fork truck operator should take the pallets **first** from one end and then the other, alternately.

**4. Handling palletized loads.** If the loads in the boxcar have been shipped **palletized**, the fork truck operator can work directly into the car and bring out one load at a time. **In** this type of operation, it is sometimes possible to have two trucks unloading the same boxcar without interfering with each other.

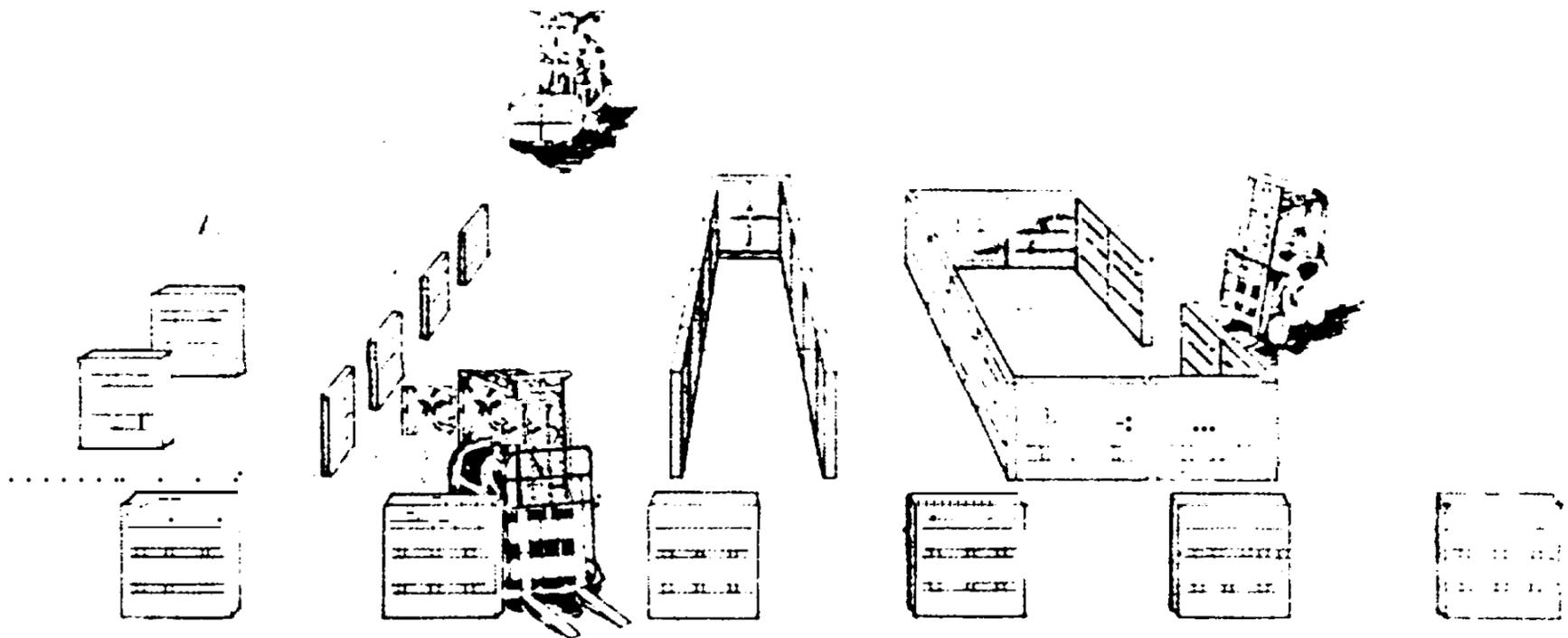


Figure 4-120. Practice area for carloading operations.

**5. Handling large items.** The following is a suggested procedure for the loading of large cases that have been stored on short dunnage.

a. Drive the loaded truck into the boxcar.

b. Place the case in the desired position.

c. Set the case down on a two-by-four to permit the forks to be withdrawn.

d. Withdraw the forks of the truck to within about 2 inches of the edge of the case.

e. **Lift** slightly to withdraw the **two-by-four**.

f. Set the load on the **floor** of the boxcar and back the truck away.

This procedure is reversed for the unloading of large cases from boxcars.

#### 4-507. Fundamental Operational Instructions for Industrial Tractors

a. **Preparation.** In beginning the course on the operation of industrial tractors and tractor-trailer trains, the instructor should show the same film as shown for fork trucks, and should make the following preparations.

(1) Provide one piece of equipment for every two students. The same training area, maze and obstacle course, as used for training fork truck operators can be utilized (fig. 4-110).

(2) Provide, if possible, one or more tractors representing each model used at the activity for the

appropriate **periods** of instruction. If two or more types are equipped with identical controls, only one example of these types will be necessary. As mechanical operation of the tractor is all that is to be explained during the preliminary period, it is not necessary to have the trailers available.

(3) Point out to the trainees that operating a tractor is similar to driving an automobile. **Functions** of controls and preventive maintenance checks should be explained in the same manner as for fork trucks.

(4) Before mounting the truck, the trainee will be instructed to check the following

- Gasoline.
- Water.
- oil.
- Tires.
- Fire extinguisher (when truck is so equipped).
- coupling.

(5) After mounting the truck, the trainee will check the following

- Horn.
- Parking brake and foot brake.
- Position of gear shift lever (should be in neutral).

(6) Explain in detail the differences between the operation of electric-driven tractors and gasoline-driven tractors.

#### b. **Elementary driving.**

(1) *Instructor's demonstration.* Elementary

driving instructions should be given on a four-wheel tractor. **Sitting** beside, the instructor on an auxiliary seat **provided** for the purpose, the trainee watches as "the instructor performs and explains each phase of the operation. The initial drive should include several **starts and stops**. After several maneuvers, the instructor will ask the trainee to tell how to operate the controls.

(2) **Training operation.** After the instructor is **confident** the trainee can handle the tractor safely, he/she **permits him/her** to operate it. The instructor **should closely observe** the trainee make solo maneuvers **around** the training area. **When** the trainee has stopped, the instructor should point out any **errors** that were made in operation.

c. **Obstacle course driving.**

(1) **Instructor's demonstration.** After each trainee has satisfactorily "completed the solo ride, the instructor drives over the obstacle course to demonstrate the **proper** method of maneuvering the **tractor** over this course.

(2) **Trainee operation.** The **trainee** then takes control of the tractor and drives over the obstacle course, stopping to setup any pallets **he/she** knocks over. The instructor watches closely as the trainee drives and discusses the good and bad points of each trainee's operation. The trainee should drive over the obstacle course as many times as the instructor thinks **necessary**.

#### 4-508. Course in Operation of Industrial Tractor-Trailer Trains

a. **Preparation.** Since the principal use of the tractor is to haul trailers, the instructors next step is to demonstrate the operation of a tractor-trailer train. A sufficient number of trailers for this demonstration should be added to the equipment being used in the training area.

b. **Elementary driving.**

(1) **Instructor's demonstration.** The instructor **should couple together** a tractor-trailer train of the **maximum length permitted by local activity rules**. He/she first drives it straight forward and then in long sweeping curves to demonstrate how each trailer turns in a smaller radius than the one preceding it. He/she further demonstrates by operating a train of appropriate length over the obstacle course. Also, the instructor should operate a train in aisles established by pallets set on edge in the training area to show how, in making a sharp turn,

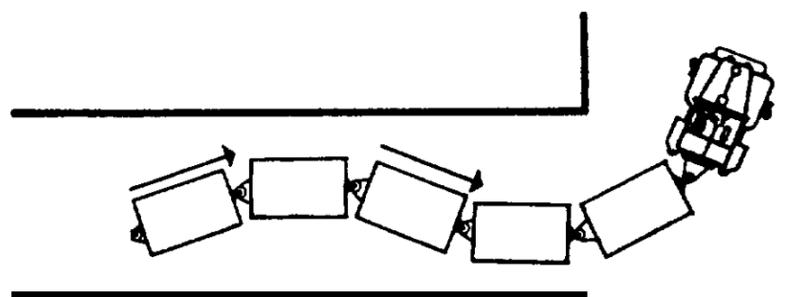


Figure 4-121. Right way to turn corners with a tractor-trailer train.

it is **necessary to veer to the right** before turning to the left and vice versa (fig. 4-121).

(2) **Trainee operation.** After the instructor's demonstration, each trainee should haul first one empty trailer, then two, and so on-adding one at a time until the maximum number permitted is reached. Each trainee **should** practice maneuvering a train of the maximum length **permitted**, repeating the maneuver practiced with the tractor itself. That is, "the trainee should first practice starting, **stopping**, and turning in a clear space first with one trailer, and then with several. Then, he/she should operate the train through the maze and the obstacle course.

c. **Driving loaded trains.** Before starting, the trainees should inspect each trailer to see that it is properly loaded. A smooth, slow start is essential when the tractor is pulling a loaded trailer train. The trainee should be instructed to:

(1) Drive on the right side of aisle to permit other tractors or trucks to pass.

(2) **Slow down** when approaching a corner and, in **turning** swing wide to allow for the clearance of the last trailer.

(3) Stop and shift into the lowest gear before going up or down a ramp; do not shift into higher gear until the entire train has cleared the ramp.

(4) Learn to **properly** position and park the **trailer train** perfectly on the first try since the train cannot be backed into position.

(5) Always park the train **at** the side of an aisle, leaving as much aisle space as possible for other **traffic**.

(6) Execute a smooth, slow stop so that the trailer loads are not jarred.

d. **Uncoupling tractor-trailer trains.** After the tractor-trailer train reaches its destination, the tractor should not stand idle while the trailers are being unloaded. Instead, the operator should uncouple the tractor **from** the trailers, pick up the previously unloaded trailer train and return again to pick up a loaded train.

#### 4-509. Operational Instructions for Truck, Straddle Carry (or Gantry Trucks)

*a. Preliminary instructions.* At the beginning of the course, the instructor should display and discuss appropriate illustrations of the straddle truck. Before starting the equipment, the instructor should point out to the trainee the "necessity and method of checking gasoline, water, oil, tires, battery, parking brake and foot brake, drive chains, position of hoist shoes, lights, horn, position of gear shift lever (should be in neutral), and position of hoist lever (should be in 'neutral).

*b. Instructor's demonstration.* The instructor should now demonstrate to the trainee how to drive forward and backward.

*c. Turning.* The truck straddle carry is equipped with four-wheel steering. Although steering the truck when it is carrying a long and awkward load can be very difficult the instructor should, in the preliminary instruction, merely make certain that the trainee knows the operation of the steering mechanism.

*d. Using the hoist.* Because power to operate the hoist comes from the truck engine, the engine must be running while the shoes are raised or lowered. The hoist is controlled by switch buttons or by a lever, which is moved to the "raise" or "lower" position. An automatic cutout is provided to release the power and apply the brakes when the load is bound in the truck or when the shoes reach the extreme upper and lower positions. A booster level is provided to furnish additional power for the hoist when needed. If the truck is equipped with swinging shoes, the swinging action may be controlled by a separate lever or it may be automatic with the raising and lowering of the shoes.

*e. Training area and equipment.* A large outdoor area should be used as a training area for truck straddle carry operations. Because the truck is designed principally as a lumber carrier, a lumber storage yard would be ideal as a training area. The only other equipment needed will be several unit loads of lumber, placed on bolsters in such a way that they may be handled by the truck (fig. 4-122). In the handling of the load, the shoes of the truck engage the ends of these bolsters. One short and one long load should be available for use in training. The trainee practices first with the short load and later with the long one in order to gain experience in maneuvering the truck under difficult conditions.

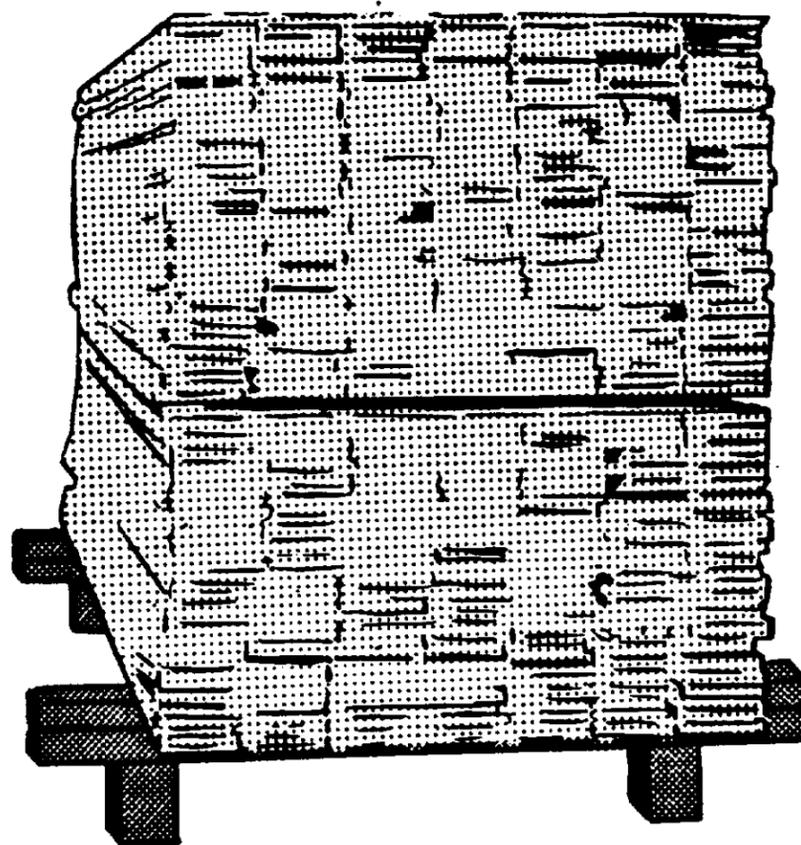


Figure 4-12.2. Material carried by truck straddle carry is usually stacked on bolsters.

*f. Elementary operation.* Under the instructor's supervision, the trainee should start the truck properly and drive it slowly around the training area. Following the instructor's direction, the trainee should start and stop the truck, drive forward and backward, turn left and right, and maneuver it into various positions.

*g. Training with hoist.* After the trainee performs the elementary operations satisfactorily, he/she should practice use of the hoist. The trainee should then practice this operation until thoroughly familiar with the use of all controls. He/she should be cautioned to abide by all safety rules governing the operation of truck straddle carry.

*h. Picking up the load.* Before the truck can pick up a load, the load must be properly stacked on bolsters. This stack must not be too high or too wide for the truck to handle and its weight must not exceed the maximum capacity of the truck. Before the truck is driven over a load, the hoist shoes must be swung outward. The truck must be driven carefully over the load and stopped so that the hoist shoes are midway along the sides of the load. Then with the gear shift lever in neutral, the hoist shoes are swung into contact with the bolsters on which the load is stacked and the hoist is engaged. (If the swing of the shoes is automatic with the hoist, or if the truck has rigid shoes, the engagement of the

hoist will raise the load.) If necessary, the booster lever **is** used to assist in raising the load.

i. **Moving the load.** When the load is securely in position, the truck may be moved either forward or backward as desired. When the load is to be **carried** a considerable distance, the truck should be driven forward. The truck must be driven only over solid ground. Hitting an obstruction may spill the load or seriously damage the truck. A truck carrying a load which extends ahead or behind the **truck may be** difficult for the trainee to maneuver. **For this reason,** the trainee should first practice moving relatively **short** loads. Also, the new operator must be cautioned not to stop the truck abruptly. A sudden stop can cause the load to slide out from the carriage and result in serious accidents.

j. **Placing the load.** The trainee should next practice placing **the load** in various positions designated by the instructor. The truck must be at full stop before the load is spotted. Loads must never be dropped to the ground, but must be lowered gradually under power. If the truck is equipped with swinging shoes which do not swing out automatically as the hoist is lowered, the shoes must be swung outward before driving away from the load. The trainee must avoid placing the load in such a position that he/she cannot drive the truck away from it. As an illustration, a careless operator may maneuver the truck into a limited space, lower the load, and then find that he/she cannot back the truck far enough to turn it and drive away.

k. **Special handling jobs.** The training should be completed with practice in handling the truck for special jobs and under unusual circumstances that might be encountered. If extremely long pieces of lumber are occasionally carried by the truck, or if it must at times operate in unusually restricted areas, trainees should practice operation under these difficulties and should understand the problems and dangers involved.

#### 4-510. Operating Rules

During **training** sessions, operating rules applicable to individual types of equipment should be stressed. The operating rules listed in this paragraph are examples of typical rules.

a. **All equipment.** The following operating rules are applicable to all materials handling equipment:

(1) No truck or tractor can be safer than the person who is operating it. For this reason, only authorized, properly trained and licensed persons

will be permitted to operate industrial trucks and **tractors.**

(2) As soon as the operator **goes** on duty, **he/** she should check the condition of the equipment. **Operators** will be required to inspect the brakes, steering apparatus, horn, oil, gas, and water. Defects noted should be reported immediately to the supervisor. The operator will have authority to refuse to move an improperly loaded truck or tractor or one which is not in safe mechanical condition.

(3) Insofar as practicable, each operator should be assigned to a specific truck or tractor and should be held responsible for it. No equipment will be operated by anyone other than the person to whom it is assigned.

(4) Operators will not permit their equipment to be operated by unauthorized, unlicensed personnel.

(5) No engine will be left running while the operator is off the truck or tractor or when parked within a building. The engine should be stopped and the hand brake set.

(6) Equipment will be taken out of the building to obtain gasoline. Under no circumstances is it permissible to refuel gasoline-driven vehicles inside of warehouses. During the refueling operation, **smoking** is prohibited in the area.

(7) Gasoline tanks will not be filled while the engine is running.

(8) Before restarting an engine, all spilled **gasoline** will be cleaned up.

(9) Fire extinguisher must be on hand when filling gasoline tanks. All operators should know how to use a fire extinguisher.

(10) Inspect **all** loads to be moved; do not overload; do not move a questionable load; avoid carrying loose material; refuse to move unsafe loads.

(11) Each operator must know the load capacity of his/her machine.

(12) Be sure the load is well balanced before moving.

(13) Speeding, stunt driving and "horseplay" will not be permitted.

(14) Keep three truck or tractor lengths behind other vehicles.

(15) Speed in warehouses will not exceed 5 miles per hour.

(16) Keep feet inside of running line of truck or tractor.

(17) Drive to the right whenever possible.

(18) Slow down at cross aisles and **intersec-**

tions, sound horn or gong before proceeding. When vision is obstructed by doors, corners, and elevators, sound horn or gong.

(19) Come to a stop and sound horn at exits.

(20) Sound horn when approaching pedestrians, but do **not** use horn unnecessarily. Use horn only as a signal.

(21) Do not start, stop, *or* **turn** trucks suddenly.

(22) Approach elevators at a right angle; stop 5 or more feet **from** the elevator gate and wait for a signal from the elevator operator before entering.

**Keep hands** and, feet away **from** controls when on **the elevator**.

(23) Face in the direction you are traveling; never back up without **first** facing in that direction.

(24) Slow down on wet or slippery floors.

(25) Avoid bumping into objects, especially in backing.

(26) Do not park on railroad tracks or in **no**-parking areas.

(27) Do not use the reverse control for **brake**; do not run battery beyond its rated capacity.

(28) Do not spin the wheels or race the engine.

(29) Do not ride or slip the clutch.

**(30)** Keep the machine clean.

**(31)** Do not drive with wet or greasy hands.

(32) Pushing one piece of machinery with another in order to get it started is strictly prohibited, except under the direction and in the presence of the, supervisor.

(33) Do not attempt to enter a building through a partially opened door. The door will be fully opened before proceeding.

(34) Rail cars will not be pushed or pulled **with** MHE except rail car mounted cranes or other equipment designated for this purpose.

**(35)** Push poles **will** not be used to move or place materials or objects of any **kind**. **Approved devices adopted by the activity for use in materials handling by industrial tractors are exempt from this rule.**

*b. Fork trucks.* The following operating rules are applicable to fork **trucks**:

(1) Operators **will** not fix or adjust any mechanical parts. This rule may be modified at installations where no repairman **is** employed and where a specific operator is known to have competence to make minor adjustments. If a fork truck is not running properly, the supervisor should be called immediately.

(2) Check the security of overhead safety guard and back rest.

(3) **Never** use **the fork truck** tow **loads** for which it is not intended; use the right truck for the job.

(4) No passengers will be allowed on fork trucks.

(5) **It is not permissible for anyone to "ride" the load being handled by a fork truck. This includes "riding" a load being raised or lowered.** If a person must be lifted to reach stock or material, he/she will stand on a **safety** pallet (equipped with guard rails) placed on the forks; the supervisor must give the order and assume responsibility.

(6) Rest forks **on** the ground or floor when machine is not in use.

(7) When going down a grade or ramp with a load, back down; go forward up a grade or ramp. .

(8) When **traveling** empty or loaded, be sure that the forks are raised just high enough to avoid any obstructions on the floor, yet low enough to permit a clear view ahead. Mast should be tilted backward.

(9) **No counterweighting** of the fork truck to increase lifting capacity will be permitted.

(10) Forks should always be the same distance **from** the center of the supporting cross bar.

(11) Check the load before moving or lifting to make sure that **no** material will fall.

(12) Balance the load and tilt the mast backward to prevent tipping.

(13) Never permit anyone to stand under **sus**-pended loads.

(14) Watch out for **others**; make sure that all is clear before setting down a load.

*c. Industrial tractors.* The following operating rules are applicable to industrial tractors:

(1) Weaving the train is dangerous and will not be permitted.

(2) Operators must not attempt to haul excessive loads that cause wheel slippage and loss of traction.

(3) When negotiating a turn into a road or aisle, allow sufficient time to get into position to make the turn and allow for proper clearance of the last trailer.

(4) Operators and supervisors should limit the height of the load on the first trailer behind the tractor. The height will not obstruct the rear view of the operator nor create a hazard to the operator in the event material accidentally shifts or falls.

(5) When a permanent passenger seat is provided, one passenger may be carried. No person will be allowed to occupy a temporary seat or ride on any part of the machine.

(6) No person will be permitted to ride on the trailer **train** to hold the load in place.

*d. Trucks straddle carry.* The following operating rules are applicable to trucks, straddle carry.

(1) Carry the hoist shoes up to avoid striking any obstruction when the truck is not loaded.

(2) Drive only on solid ground.

(3) **Drive** cautiously at all times because of limited visibility directly in front of and to the right of the truck.

(4) Avoid sudden stops, especially when truck is loaded.

#### 4-511. Examinations for Fork Trucks

*a. The following tests should be included in the operational examination for fork truck trainees:*

*Test 1.* A circle with a 16-foot, 3-inch radius is made by placing pallets spaced 4 feet, 6 inches apart (fig. 4-123). The trainee travels the circle twice with forks lowered and empty, weaving between pallets, first going forward, then backward. One point should be deducted for each pallet displaced. For a perfect operation the trainee is credited 10 points.

*Test 2.* In this part of the examination, the trainee picks up pallet loads one at a time **from** the supply area and places them in a row along a line drawn on the floor. On completion of this operation he/she returns the loads to the supply area. A possible score of 16 points is based on the trainee's ability to maneuver the fork truck properly and place pallet loads in a neat manner.

*Test 3.* The trainee is required to maneuver through a congested area similar to that shown in figure 4-124. He/she operates forward and backward through this maze of pallets. One point is deducted for each pallet displaced. Total possible score is 14 points.

*Test 4.* An aisle **52 inches wide and 40 feet long**, constructed of empty pallets set on end, is set up in the training area (fig. 4-125). The trainee is instructed to travel the entire length of the aisle with a loaded pallet, then set the load down, back the truck up about 30 feet, move forward, pickup the load, and back out the entire length of the aisle.

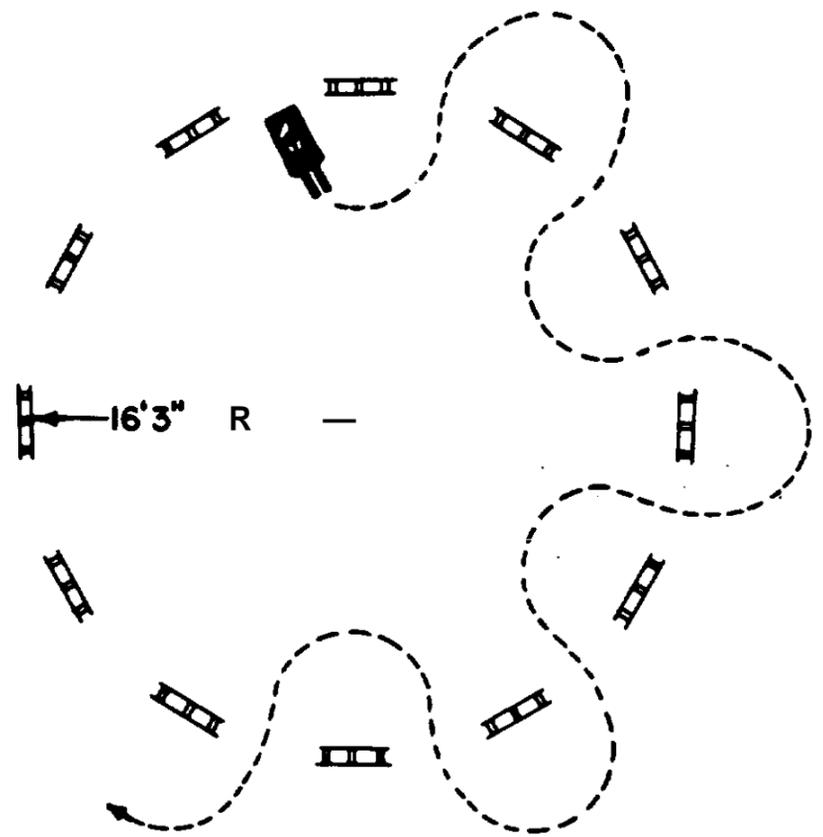


Figure 4-123. In this operational test the trainee weaves in and out between pallets placed in a circle having a 16-foot, 3-inch radius.

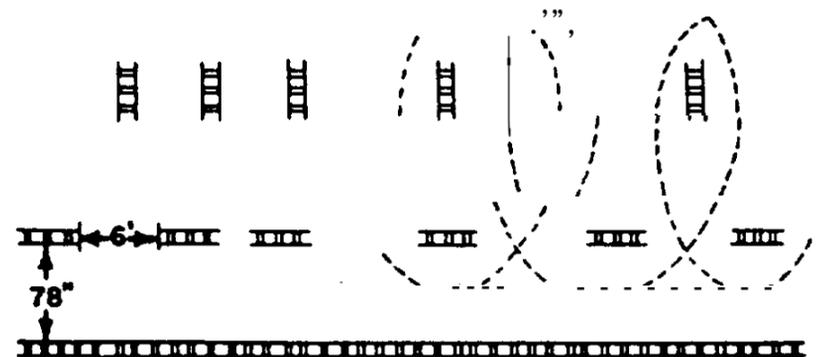


Figure 4-124. Prospective operators maneuver through a maze of pallets.

Two points are deducted for each pallet displaced. Total possible score is 10 points.

*Test 5.* This test consists of placing two pallets with cylinders in a simulated boxcar made of empty pallets. The pallets to be used will have a plywood top, on the center of which is painted a circle 10 inches in diameter (fig. 4-126). The trainee is instructed to place both pallets side by side in the car without disturbing the simulated box car or overturning the cylinders. If pallet walls are misplaced or cylinders toppled, the operator must first right them and then proceed with the test. Two points are deducted for each pallet displaced or cylinder toppled. Total possible score is 10 points.

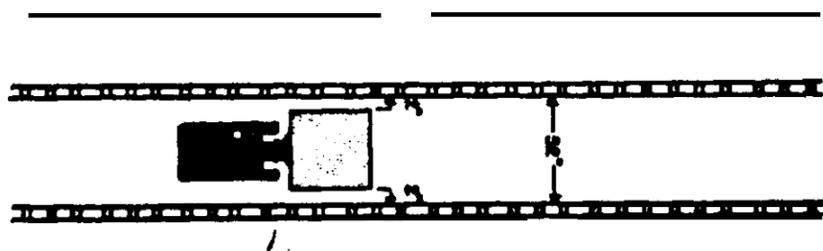


Figure 4-125. An aisle constructed of empty pallets set up in the training area.

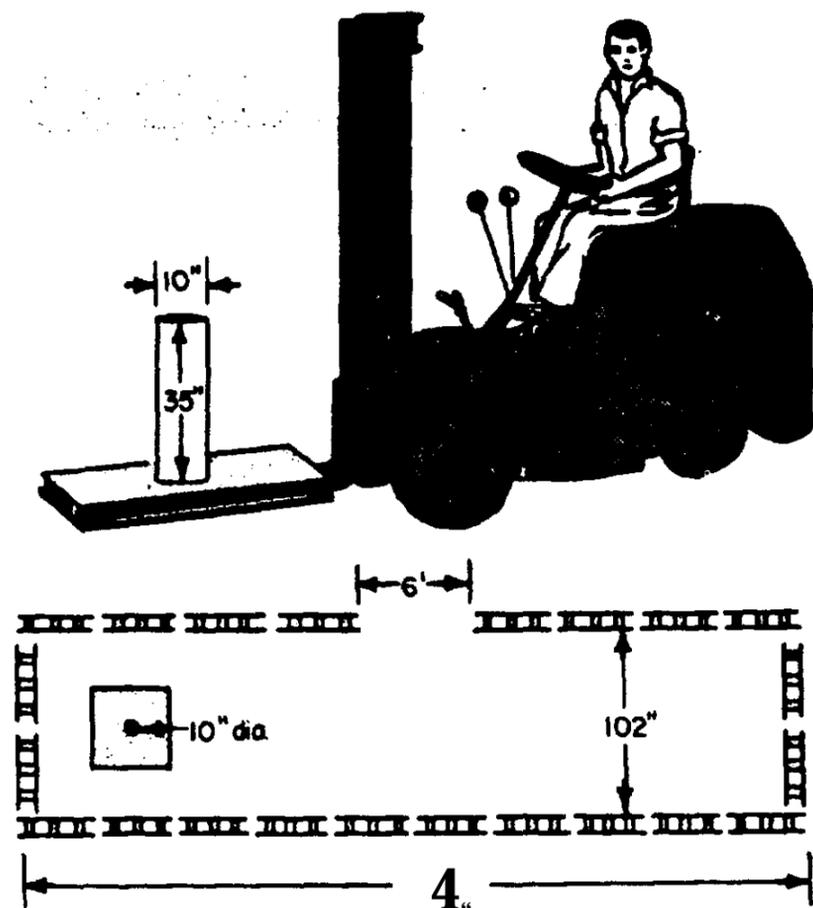


Figure 4-126. Another test consists of placing two pallets with cylinders in a simulated box car.

**Test 6.** In this operation the trainee will store loaded pallets in two tiers, three pallet loads high. Trainee is required to drive in at either end of the storage area and pace pallets on right angle lines. No instructions other than the reminder to tier according to previous training should be given. Two points should be deducted for each pallet placed more than 2 inches out of line. Total possible score is 20 points.

**Test 7.** This test, to be devised by the instructor, should be designed to summarize the operator's ability, care, safe operation, and efficiency in maneuvering the fork truck about the training area. The time element should be considered an important factor in the test. If the trainee consumes an excessive amount of time in maneuvering properly, he/she should be graded accordingly. Total possible score is 20 points.

b. Written tests adaptable to particular types of operation may be developed as deemed appropriate by the service agency concerned.

The following score sheet can be setup for grading the trainee on the operational examination:

TEST 1—10%	
Pallets displaced:	
Forward	..... ( ) @0.5 _____
Reverse	..... ( ) @0.5 _____
TEST 2-16%	
Pallets out of line	..... ( ) 2.0 _____
Improper approach to place pallet	.. ( ) 0.5 _____
Improper direction to remove pallet	( ) "0.5 _____
Excess backing, etc.	..... ( ) 2.0 _____
TEST 3—14%	
Pallets displaced	..... ( ) @1.0 _____
Encounters difficulty	..... 4.0 _____
TEST 4-10%	
Pallets displaced:	
Forward	..... ( ) @2.0 _____
Reverse	..... ( ) @2.0 _____
TEST 5-10%	
Pallets displaced	..... ( ) @2.0 _____
Cylinder toppled	..... ( ) @2.0 _____
TEST 6-20%	
Improper approach	..... ( ) @0.5 _____
Improper leaving	..... ( ) @0.5 _____
Quality of storage	..... 10.00 _____
cost lost	..... ( ) @2.0 _____
Forward = high load	..... ( ) @2.0 _____
TEST 7—20%	
Poor starting technique	..... 1.0 _____
Poor driving position	..... 1.0 _____
Rides clutch	..... 2.0 _____
Stalls engine	..... 1.0 _____
Clashes gears	..... 2.0 _____
Races motor	..... 1.0 _____
Too (slow-fast) operations	..... 4.0 _____
Careless operation	..... 4.0 _____
Inefficient operation	..... 4.0 _____
Total deductions	_____
Grade	_____

**4-512. Examinations for Other Equipment**

An operational examination similar to the one given for fork trucks can be used. The operational test diagram and the fork truck test score sheet also can be used with slight modifications. This test score sheet should be prepared in a manner to provide for a perfect score of 100.

**4-513. Grading Examinations**

A grade of 70 should be established as a passing score for the examination. When the trainee has obtained a passing score, he/she should be issued

a temporary operator's permit (para 4-514). Those items on which the trainee failed should be included as part of the student's additional **on-the-job-training** (para 4-515). At this point training films should be shown for the second time selecting the **films** appropriate **for** the permits granted.

#### 4-514. Temporary Permits

Upon satisfactory completion of the training course a Temporary **Operator's** Permit should be issued to **cover** a 30-day probationary period. The temporary **permit will contain a 30-day expiration** date following the date of issuance. The form of temporary permit **will** be the US Government Motor Vehicle Operator's Identification Card (US Civil Service Commission Standard Form 46) clearly stamped or otherwise marked with the word "Temporary" to distinguish it **from** a permanent permit." Operators holding temporary permits may be issued a large badge of a distinguishing color so that supervisors and qualified operators **can** recognize the trainee as a new operator and assist him/her with suggestions and advice.

#### 4-515. Additional On-the-Job Training

*a. General.* During the **30-day** probationary period, the new operator should continue training. He/she can be assigned to an occasional class period with an instructor, or the instructor can carry out the training during routine inspection on **all** new operators at their work. This on-the-job training has two objectives: to increase the operator's proficiency and to qualify **him/her** for use on additional MHE.

*b. Increasing proficiency.* To increase the new operator's proficiency, the instructor requires the trainee to perform various difficult maneuvers with the truck or tractor-trailer train and shows **him/her** the safe and simple manner of operating under all circumstances. The instructor should stress constantly the importance of safety and preventive maintenance. On-the-job training with the fork truck also should consist of practice with various attachments to the fork truck, designed for specific jobs. **Only** skilled operators should be trained in the use of attachments.

*c. Qualifying operators for additional equipment.* If the operator's training has been exclusively in the fork truck during the 30-day probationary period, he/she should receive training in the operation of the tractor-trailer train so that

**in an emergency he/she will be available as a tractor operator. Tractor operators who show a high degree of skill and efficiency should be considered for training as operators of fork trucks.** Even though no additional operators of fork trucks may be needed at the moment, the activity should maintain a pool of trained or partially trained operators who can carry on in an emergency. In the event the activity is in need of operators for trucks, straddle carry, cranes, or similar equipment, the new **operators** of MHE can be tested on this equipment during their 30-day probationary period. Those who show a high degree of aptitude for assignment to these more difficult types of equipment can be given additional training until they **are qualified** operators. Training films should be shown as appropriate.

#### 4-516. Permanent Operator's Permit

**If at the end of the 30 days, the operator has proved satisfactory,** a US Civil Service Commission Standard Form 46 properly completed and signed by the issuing official will be issued to the operator. The permit will show any restriction such as glasses required, hearing aid required, or other. The permit will also indicate qualification in explosive handling in accordance with the requirements and safety regulations of each military service. The operator will be instructed to carry the permit when operating equipment. Each operator may be issued, in addition to the permit, a badge of distinguishing color indicating that he/she is an authorized operator of industrial trucks and tractors.

#### 4-517. Renewal

Every operator holding a US Civil Service *Commission Standard Form 46* **will be required to have it renewed within 30 days prior to the expiration date specified on the permit. Upon application for such renewal, the operator will be required to satisfactorily complete a physical examination. Operators holding nonstandard permits with a specified expiration date will be issued a standard permit within 30 days prior to the expiration date. Operators holding nonstandard permits that do not bear an expiration date will have their permits replaced with standard forms with the least practicable delay.**

#### 4-518. Preparation of Additional Training Courses

**The training data and test factors in this regulation**

cover the training of operators for the major types of material handling equipment utilized within the military supply system. It is realized, however, that a training program is required for each of the various types of MHE in use. Therefore, it is suggested that as Requirements occur for the training

of operators for MHE not specifically covered in this regulation, that the activity utilize the data . . . . . contained in this regulation and data compiled by . . . . . the activity to prepare a training program and test procedure applicable to the equipment for which training is required.