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WAR DEPARTMENT

TECHNICAL MANUAL

WATER TRANSPORTATION STEVEDORING, AND STOWING

JULY 18, 1942

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Changes 1
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TECHNICAL MANUAL

WATER TRANSPORTATION, STEVEDORING, AND STOWING

CHANGES No. 1

WAR DEPARTMENT,
WASHINGTON, October 29, 1942.

TM 10–381, July 18, 1942, is changed as follows:

10. Tonnage calculations.

* * * * * * *

e. A group should average 16 tons weight and measurement per hour per group, **depending upon conditions and locality.**

[A. G. 062.11 (10–6–42).] (C 1, Oct. 29, 1942.)

FIGURE 6.—**Heavy lift** being slung over ship's side. Note chain hoists.

[A. G. 062.11 (10–6–42).] (C 1, Oct. 29, 1942.)

12. Hatches.—*a.* Hatches are not of standard size. The forward hatches and aft hatches may vary in size on the same ship. A vessel of approximately * * * and speedy handling.

* * * * * * *

[A. G. 062.11 (10–6–42).] (C 1, Oct. 29, 1942.)

FIGURE 10.—Trailer being hoisted to be **placed on lighter.**

[A. G. 062.11 (10–6–42).] (C 1, Oct. 29, 1942.)

FIGURE 11.—An 80-ton boom, blocks, tackles, kingpost, etc.

[A. G. 062.11 (10–6–42).] (C 1, Oct. 29, 1942.)

15. Booms.—Effective cargo handling * * * two or three groups of men. **In many instances it is possible to work two gangs in one hatch. However, their efficiency is lessened, except in extremely large hatches, due to the timing of the drafts. A safety net, which is a valuable protective appliance, will also retard the activities of two gangs. Climatic conditions will affect the efficiency of the men.**

[A. G. 062.11 (10–6–42).] (C 1, Oct. 29, 1942.)

16. Long booms.

* * * * * * *

Booms of 40-ton capacity or over should be placed at one forward and one aft hatch.

[A. G. 062.11 (10–6–42).] (C 1, Oct. 29, 1942.)

FIGURE 13.—Trucking small pieces of freight from **sideport of a vessel.**

[A. G. 062.11 (10–6–42).] (C 1, Oct. 29, 1942.)

25. Winches.

* * * * * * *

b. Cargo winches.

* * * * * * *

(2) *Operating instructions.*—**Generally,** in the operating instructions, * * * called the left side.

(*a*) *To drain cylinders and throttle of condensation.*—Before **and after** operating the winch * * * the throttle and cylinders are ready for operation. **(For training purposes only.)**

* * * * * * *

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(3) *Lubrication.*—The lubrication of winches is of prime importance and should be done regularly. **(For training purposes only.)**

* * * * * * *

[A. G. 062.11 (10–6–42).] (C 1, Oct. 29, 1942.)

FIGURE 21.—**Kingposts** at left. Ship's booms picking up bales at right.
[A. G. 062.11 (10–6–42).] (C 1, Oct. 29, 1942.)

FIGURE 22.—Cases correctly slung, **but bight should be between the two top cases.**
[A. G. 062.11 (10–6–42).] (C 1, Oct. 29, 1942.)

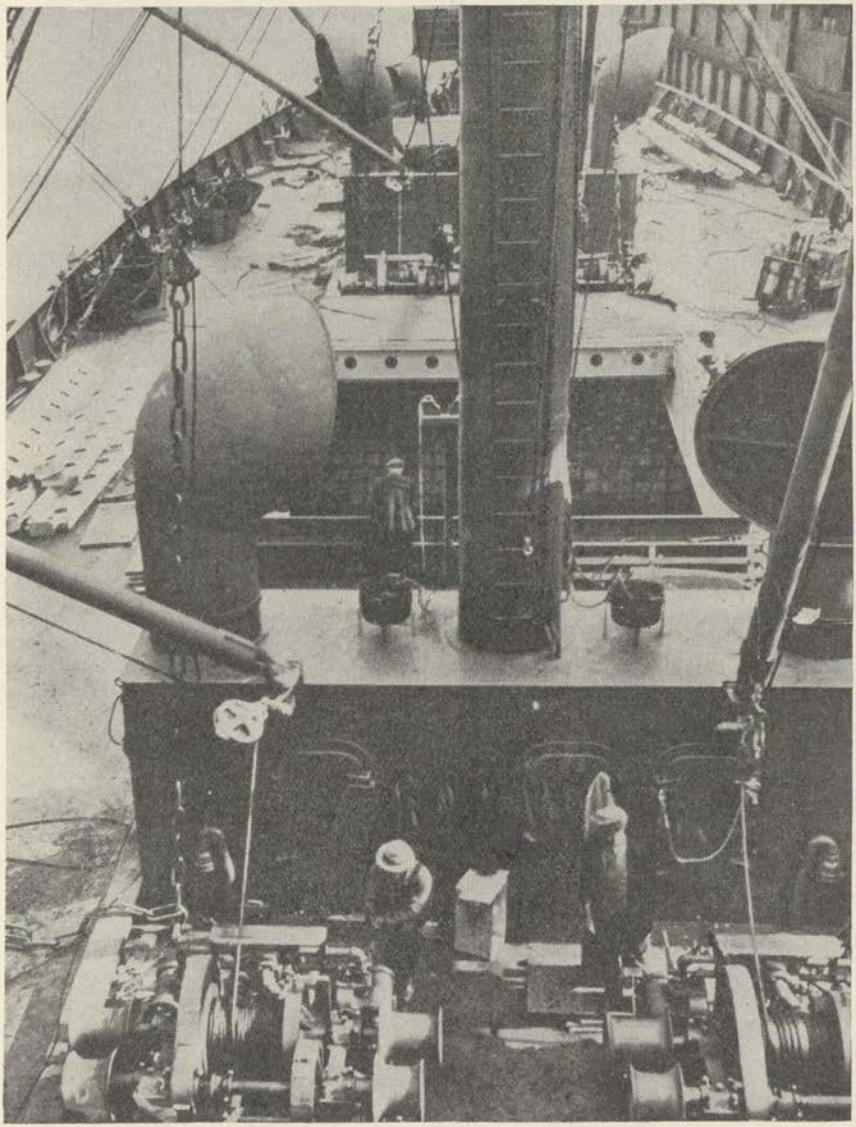
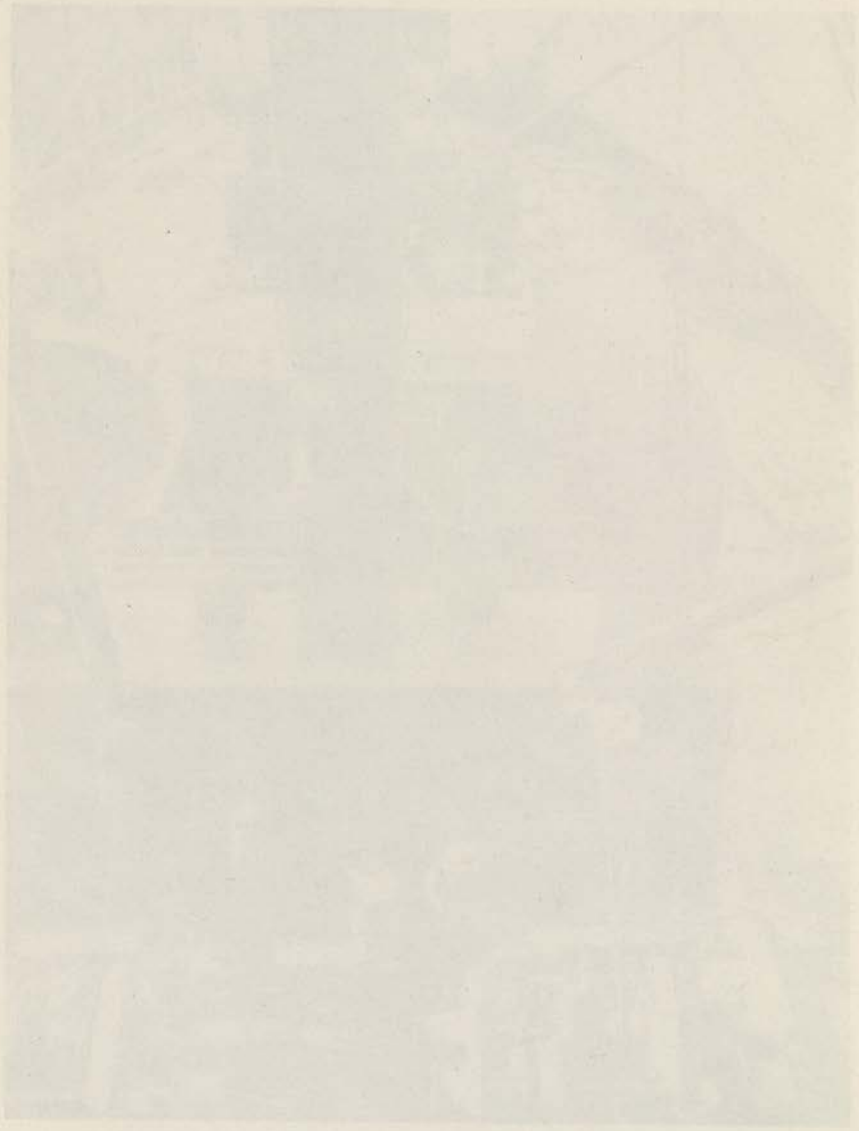
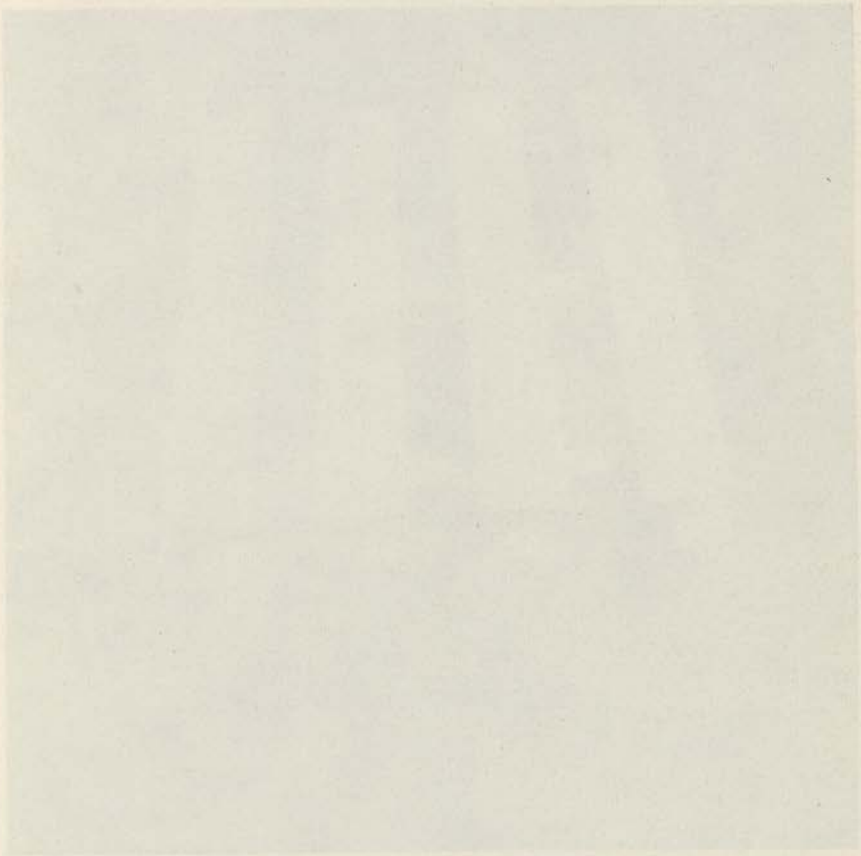


FIGURE 23.—**All five hatches being worked, two winches in foreground.**
[A. G. 062.11 (10–6–42).] (C 1, Oct. 29, 1942.)





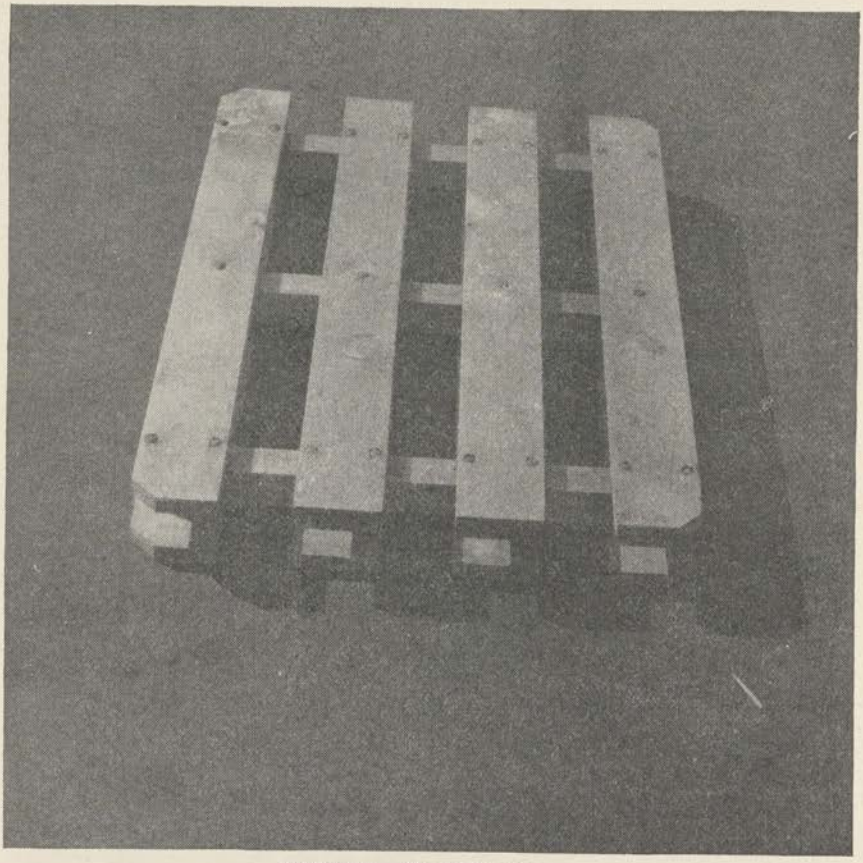


FIGURE 26.—"Cooty" pallet.
[A. G. 062.11 (10–6–42).] (C 1, Oct. 29, 1942.)

FIGURE 35.—Heavy lift in hold.
[A. G. 062.11 (10–6–42).] (C 1, Oct. 29, 1942.)

60. Heavy duty equipment.—Heavy lift equipment * * * or pontoon cranes. Large packages do not recur at any one ship's berth sufficiently often to make it pay to have a heavy duty crane on the wharves. It would necessitate * * * make it more mobile.
[A. G. 062.11 (10–6–42).] (C 1, Oct. 29, 1942.)

FIGURE 37.—Lower deck of modern pier showing chute. Pier floor is level with freight cars.
[A. G. 062.11 (10–6–42).] (C 1, Oct. 29, 1942.)

FIGURE 38.—Fork lift picking up load on "cooty" pallet.
[A. G. 062.11 (10–6–42).] (C 1, Oct. 29, 1942.)

FIGURE 39.—Careless job. Slings should have spreaders or be cleared from edge of body.
[A. G. 062.11 (10–6–42).] (C 1, Oct. 29, 1942.)

72. Discharging.—The stevedore will break out and discharge cargo, either on dock * * * not more than breast high.
[A. G. 062.11 (10–6–42).] (C 1, Oct. 29, 1942.)

FIGURE 53.—Floating crane to pier.
[A. G. 062.11 (10–6–42).] (C 1, Oct. 29, 1942.)

100. List of equipment normally in stock to load or discharge a five-hatch ship, with five groups, for general and bulk cargoes.

No. for each hatch	*Item*	*Total*
*	* * * * *	*
5	20-, 30-, 40-, and 50-foot lengths, 1-inch plow-steel wire for heavy lifts, at least four tucks in splices, with eye in each end, five of each	25
1	**Save all,** 2-inch rope about 20 by 25 feet with about 5-foot lashings on long side	5
*	* * * * *	*

[A. G. 062.11 (10–6–42).] (C 1, Oct. 29, 1942.)

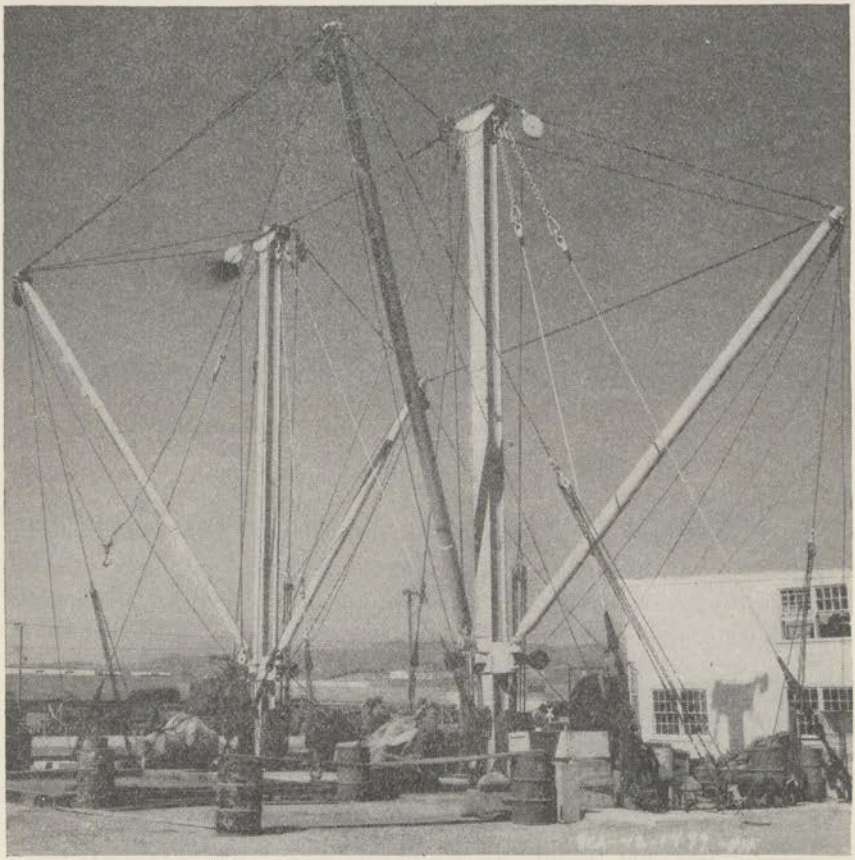


FIGURE 56.—**Modern type Sampson post cargo gear of one hatch set-up used for training.**
[A. G. 062.11 (10–6–42).] (C 1, Oct. 29, 1942.)

FIGURE 57.—Draft of cargo on "cooty" pallet being taken aboard by **pallet bridle.** The picture also shows method of securing **save all.**
[A. G. 062.11 (10–6–42).] (C 1, Oct. 29, 1942.)

FIGURE 60.—Heavy cargo hook, hand forged.
[A. G. 062.11 (10–6–42).] (C 1, Oct. 29, 1942.)

114. Vises.—Riggers', splicing. Federal Specifications GGG–V–436.

[A. G. 062.11 (10–6–42).] (C 1, Oct. 29, 1942.)

120. General.—A signalman must be * * * as occasion arises. The signalman takes a position where he can be clearly seen by the **winchman** at all times during operations.

[A. G. 062.11 (10–6–42).] (C 1, Oct. 29, 1942.)

FIGURE 75.—**A group of blocks, tackles, booms, kingposts, and spreaders for almost any job.**
[A. G. 062.11 (10–6–42).] (C 1, Oct. 29, 1942.)

137. Chocking.—*a.* Any commodity in barrels * * * or thirty additional. Therefore, a short **tapered** piece of wood is placed under each end * * * stanchions and ventilators.

* * * * * * *

[A. G. 062.11 (10–6–42).] (C 1, Oct. 29, 1942.)

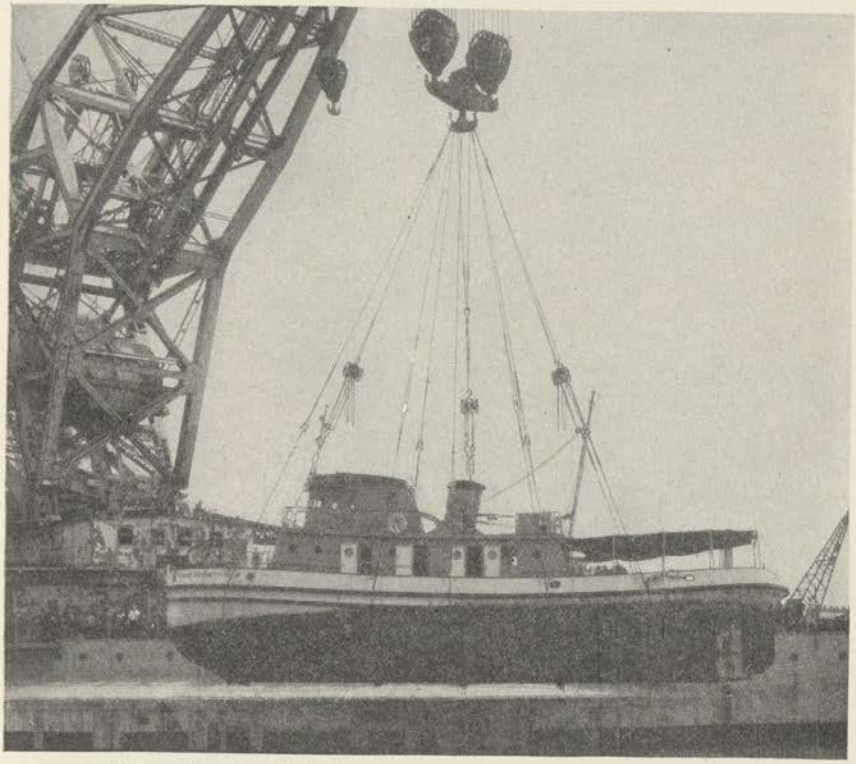


FIGURE 79.—**A study in heavy lifting. Approximate weight 200 tons.**
[A. G. 062.11 (10–6–42).] (C 1, Oct. 29, 1942.)

145. Check questions.

* * * * * * *

e. If empty space **exists,** is adjacent cargo being properly braced or secured so that the cargo will not shift?

* * * * * * *

[A. G. 062.11 (10–6–42).] (C 1, Oct. 29, 1942.)

FIGURE 87.—**Narrow apron allows for only small loads. Slow loading from pier side. Pontoons would improve this condition.**
[A. G. 062.11 (10–6–42).] (C 1, Oct. 29, 1942.)

FIGURE 89.—**Cargo on "cooty" pallet and fork lift truck.**
[A. G. 062.11 (10–6–42).] (C 1, Oct. 29, 1942.)

FIGURE 92.—**Rolls of paper being tiered.**
[A. G. 062.11 (10–6–42).] (C 1, Oct. 29, 1942.)

FIGURE 96.—**Faulty chaining. Another chain should be placed on cab end.**
[A. G. 062.11 (10–6–42).] (C 1, Oct. 29, 1942.)

APPENDIX I

TERMINOLOGY

* * * * * * *

Boom horse.—A circular device of iron made into the boom band **for** the sheet block to travel on.

Boom irons.—Bands or withes at the end of a yardarm through which a **studding sail** boom is rigged out.

* * * * * * *

Fore and aft.—**In line** with the keel.

* * * * * * *

Freeboard.—The distance (in the center of a vessel's length) from the top of the **main** deck to the water.

* * * * * * *

Gangway.—A passageway aboard or ladder **from one deck to another.**

[A. G. 062.11 (10-6-42).] (C 1, Oct. 29, 1942.)

APPENDIX IV

SPECIFICATIONS FOR HASTY REFITTING OF A CHARTERED STEAMSHIP FOR TRANSPORTATION OF ANIMALS

* * * * * * *

2. Deck covering.—Decks to be properly cleaned * * * countersunk 1 inch deep and plugged. The sheathing in passageways to be laid lengthwise of the passage on the 2- by 4-inch stringers laid athwartship at all stanchions.

[A. G. 062.11 (10-6-42).] (C 1, Oct. 29, 1942.)

APPENDIX V

BIBLIOGRAPHY

* * * * * * *

Barr Shipping Company, New York. Rescinded.

* * * * * * *

Eugene H. Lederer, Lt. Colonel, Q. M. C., photographs. **Prepared subject matter and changes.**

Olivier E. Ragonnet, 1st Lt., Q. M. C., photographs, subject matter. Rescinded.

[A. G. 062.11 (10-6-42).] (C 1, Oct. 29, 1942.)

BY ORDER OF THE SECRETARY OF WAR:

G. C. MARSHALL,
Chief of Staff.

OFFICIAL:

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

U. S. GOVERNMENT PRINTING OFFICE: 1942

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TECHNICAL MANUAL
No. 10-381

WAR DEPARTMENT,
WASHINGTON, July 18, 1942.

WATER TRANSPORTATION, STEVEDORING, AND STOWING

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CHAPTER 1

ORGANIZATION AND EQUIPMENT FOR HANDLING CARGO

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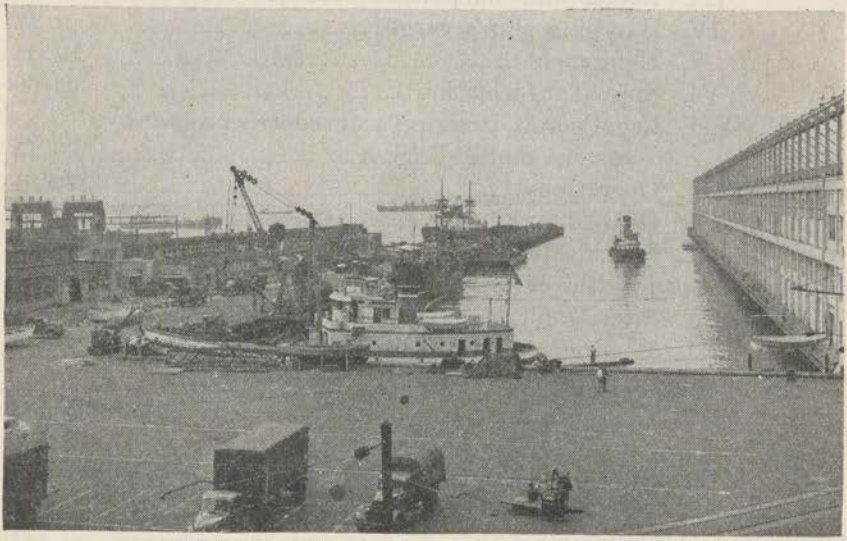

FIGURE 1.—A typical American pier.

SECTION I

GENERAL

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Stevedores	1
Responsibility	2
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Training	4
Formation	5
Organization	6
Location	7
Cooper and gear men	8
Tool locker	9
Tonnage calculations	10
Handling of cargo	11

1. **Stevedores.**—*a.* A stevedore is one who is skilled in the safe and economical loading of a sea-going vessel. The commercial term

"stevedore" is properly applied only to a "master stevedore," one who is capable of formulating and carrying out a plan for stowage of a vessel. He is a man of wide knowledge of commodities, equipment, and ships; is exceedingly practical and has great ability to

FIGURE 2.—General view of cargo awaiting shipment.

secure quick results, and is a good organizer and director of men or longshoremen. For convenience and clarity the term "stevedore" is to be used throughout this maunal in lieu of the term "longshoremen."

b. Physically the stevedore should be of stocky build, strong and robust. He should be good natured and able to work with others in a cooperative spirit. A stevedore is a man of man's strength and endurance. The strictest kind of military discipline is necessary to maintain an efficient organization under all kinds of climatic conditions in which a stevedore must labor. Ships must be loaded.

2. Responsibility.—The stevedore's responsibilities commence when the cargo is placed within the length of a vessel's loading tackle or ship length. From this point, the cargo must be moved with the greatest amount of speed and safety. When the vessel docks, the greatest amount of speed is necessary to clear the landing space so that there will be no congestion or stoppage in the flow of supplies from the pier to the stowage area.

3. Military discipline.—The instructor must be impressed with the fact that strict military discipline is of utmost necessity.

4. Training.—*a.* There is no other place except in the combat zone wherein the lives of men depend more upon the coordinated actions of their fellow soldiers than in the line of movement of a ship's cargo. Therefore, the stevedore must be instructed in teamwork. It is suggested that all personnel be rigorously trained in the field of sports, not only to toughen muscles, but to teach each man the need of cooperation, teamwork and the faculty of being able to make quick decisions. These are really the important qualifications of a soldier stevedore.

b. Vessels must be loaded at all hours of the day or night in every kind of weather, with rain or snow, in north temperate zones and in torrid zones. Therefore, the stevedore groups should be trained as distinct units. Their services should be none other than strictly stevedoring functions. All military administrative services should be performed by others rather than the soldier of the stevedoring group, yet the strictest military discipline should be maintained.

5. Formation.—The fundamental principles which form the platoon into a tactical organization should be adhered to in the development of a stevedore platoon. The basic unit is a stevedore platoon whose function is to work one hatch; therefore, this principle must be maintained and enlarged to cover a larger number of hatches. If a ship has five hatches, it may be necessary to use five separate platoons to work these five hatches at the same time. A vessel may dock any hour of the night and it may be necessary to unload it at once. It is imperative that the stevedore platoon be ready to proceed on the order to unload. The stevedore platoon or battalion must proceed to carry out such an order as an efficient unit.

6. Organization.—*a.* The stevedore may be either skilled or unskilled. The stevedore is classed as pier worker, hold worker, or deck worker; there are winchmen and drum-end men and gangway men. These are formed into groups with a leader. These groups or platoons are divided into—

(1) Header, who is boss over the hold.
(2) Two winchmen, for running winches.
(3) One deckman, hatch tender, or signalman.

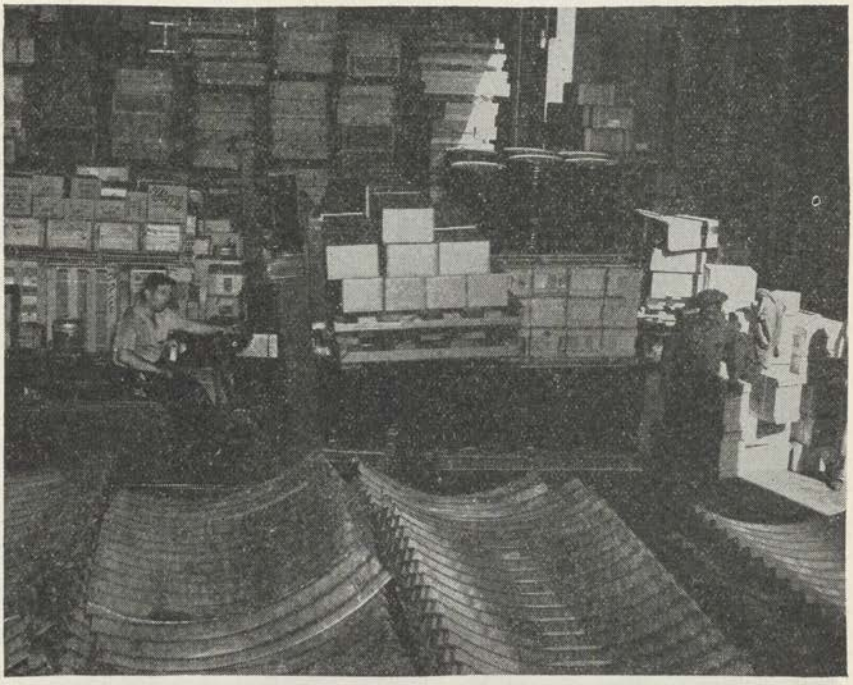

FIGURE 3.—Perishable cargo awaiting shipment inside warehouse.

(4) Two hook-on men (pier), who hook on and unhook draft or cargo.
(5) Eight holdmen, for loading and unloading slings or drafts in ships hold.
(6) Six piermen, for removing cargo from ship or from pier's edge.

b. Additional men should be added as needed to increase speed and efficiency. A group should number at least 26 men and should be worked as a unit. Sometimes it may have to be enlarged, depending upon the trucking distance on the pier or wharf. It should be commanded by a lieutenant with a sergeant as an assistant, and two corporals, one as boss of hold group and one as boss of pier group.

7. Location.—The stevedore platoons or battalions will perform services at the ports of embarkation and debarkation.

8. Cooper and gear men.—In addition, one man should be trained as a cooper to repair broken containers such as wooden cases, boxes, etc. Two gear men are needed to be custodians of all gear. They are responsible for examination and repair of gear and keeping it in good condition. If additional equipment is needed to handle unusual items of cargo, one gear man contacts the pier superintendent and gives him

FIGURE 4.—Lift trucks, wire slings, chain slings, pallets, hand trucks, rope nets, blocks, wire nets, wire on reels, turnbuckles, differential chain hoists.

all the information necessary in plenty of time so that he can provide the gear without causing delay in loading or unloading. If delay is caused by some mishap, the superintendent arranges to transfer his group to another hatch.

9. Tool locker.—A section of the pier is set aside for a tool or gear locker where all gear and equipment is stored in charge of a sergeant. After a cargo is loaded or discharged, all gear should be assembled, inspected and placed in the tool locker under supervision of an officer. (See list of gear equipment.)

10. Tonnage calculations.—*a.* To find group-hour tonnage, divide total tonnage by product of hours worked and number of groups.

Example: 520 tons, 2 groups, 26 men to a group, 5 hours per man.

$26 \times 5 = 130$ hours $\times$ 2 groups $= 260$ hours.

$520 \div 260 = 2$ group-hour tons.

b. To find hatch tonnage, divide hours worked by groups.

Example: $130 \div 2 = 65$.

c. To find man hours, multiply group hours by number of men in group.

Example: $130 \times 26 = 3380$.

d. To find tonnage per man hour, divide tonnage by man hours.

Example: $520 \div 130 = 4$.

e. A group should average 16 tons weight and measurement per hour per group.

11. Handling of cargo.—*a.* Vessel cargoes may be handled—

(1) Through the hatches or deck openings.

(2) Through the side ports or side openings.

(3) Without using any openings, in case of deck loads.

b. Deck loads do not present problems of handling that are greatly different from those of loading and unloading through hatches or

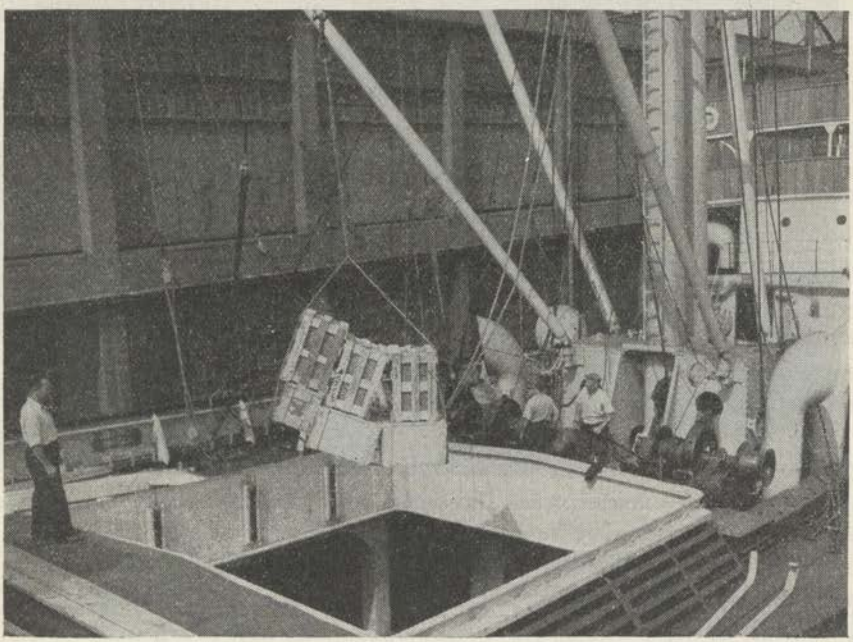

FIGURE 5.—Cargo being lowered into the hold through a hatch.

FIGURE 6.—Cargo being slung over the ship's side. Note chain hoists.

FIGURE 7.—Cargo in hold to be lifted through hatch.

side ports, but it is important that they be properly stowed and firmly lashed. They must be carefully secured against the actions of the unknown forces of the sea.

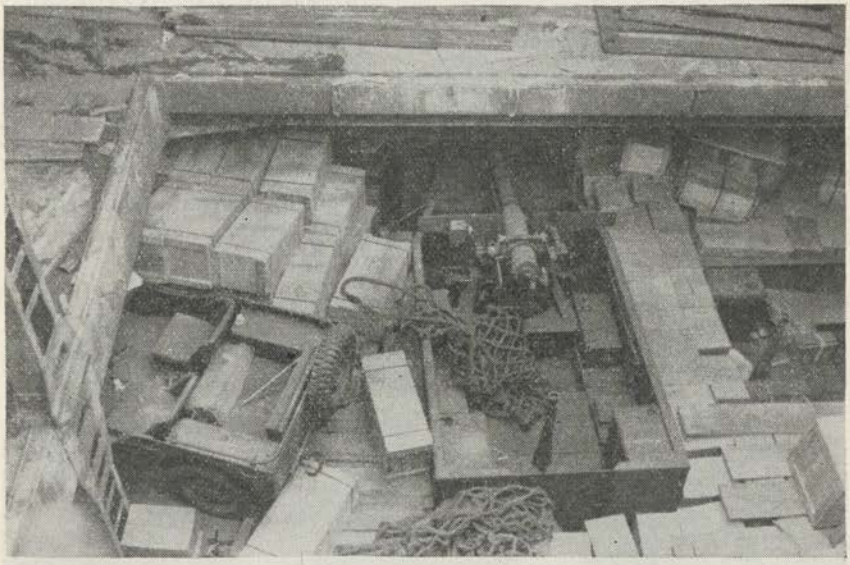

FIGURE 8.—A messy hold.

SECTION II

HATCHES

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Hatch and loading 13
Winch control 14

12. Hatches.—*a.* Hatches are not of standard size. The forward hatches and stern hatches may vary in size on the same ship. A vessel of approximately 9,000 dead-weight tons should have main hatches of 17 feet in width, and as long as possible. Length is more important than width when stowing large guns and long steel below decks. New ships are being constructed with long and wide hatches, the largest hatch being 50 feet long and 20 feet wide. Cutting back between-deck hatches as much as 14 feet has proved advantageous in handling long steel and other cargo where the length of the pieces interferes with economical and speedy handling.

b. Two or three groups may be worked at a hatch, depending upon the number of winches to each hatch. Two groups may be worked by having two winches at each end of the hatch, or by having three winches at one end and working one gang offshore and one inshore.

13. Hatch and loading.—Several steamship lines at New York work three groups in some hatches, by using two winches and two

dock booms for handling cargo in one end of the hatch. At the opposite end of the hatch, two winches and two ship's booms are used. Some ships have six winches grouped around the mast, working with three booms per hatch thus giving a flexible and effective operation. An adequate number of fast-working winches lose much of their value if suitable booms are not supplied for each hatch. The usefulness of winches is decreased still further if antiquated cargo-handling equipment is used on the pier. Winches should be placed close enough to-

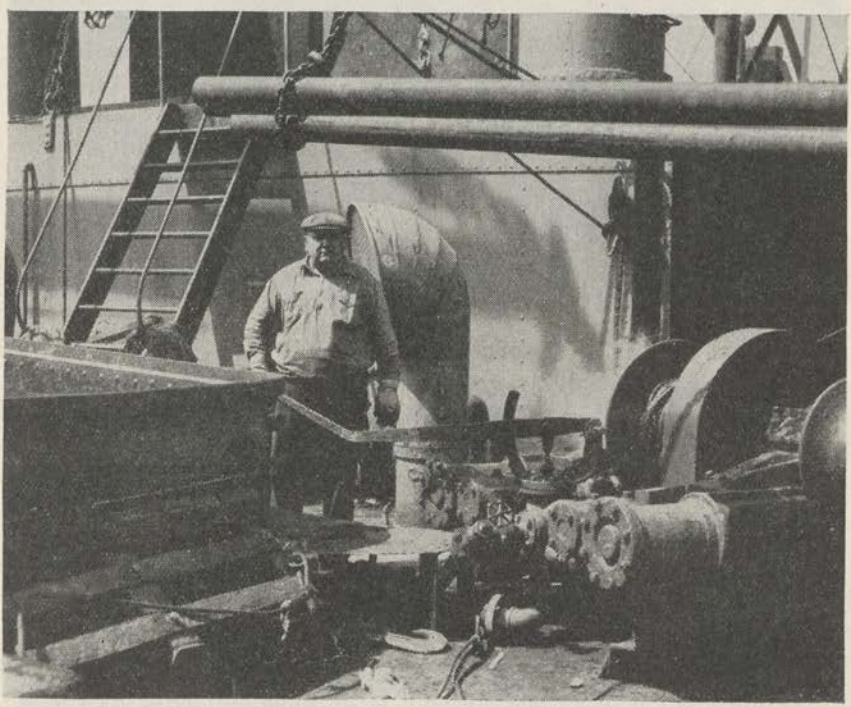

FIGURE 9.—The man at the throttle.

gether to permit one man to drive two winches. The preponderance of evidence shows that one-man operation is faster and safer.

14. Winch control.—A winch control should be located so that the winch driver has a clear view of the operation in the hatchway as well as on deck. When deck loads such as lumber are carried, the winches should be located upon platforms elevated above the deck so that the winch drivers may receive orders properly, operate the winches effectively, and thus facilitate stowage of the deck cargo.

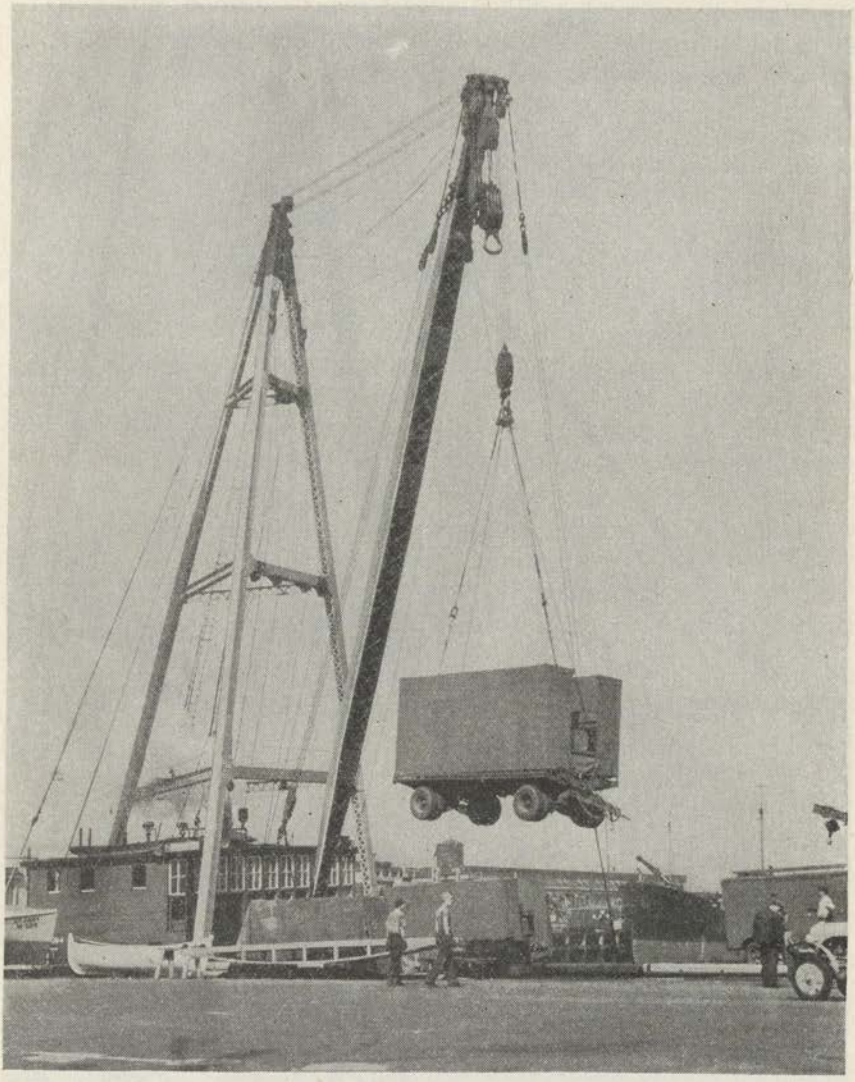

FIGURE 10.—Army Air Forces trailer being hoisted on barge to be taken to transport for shipment.

SECTION III

BOOMS AND SIDEPORTS

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Speeding operations with sideports	17

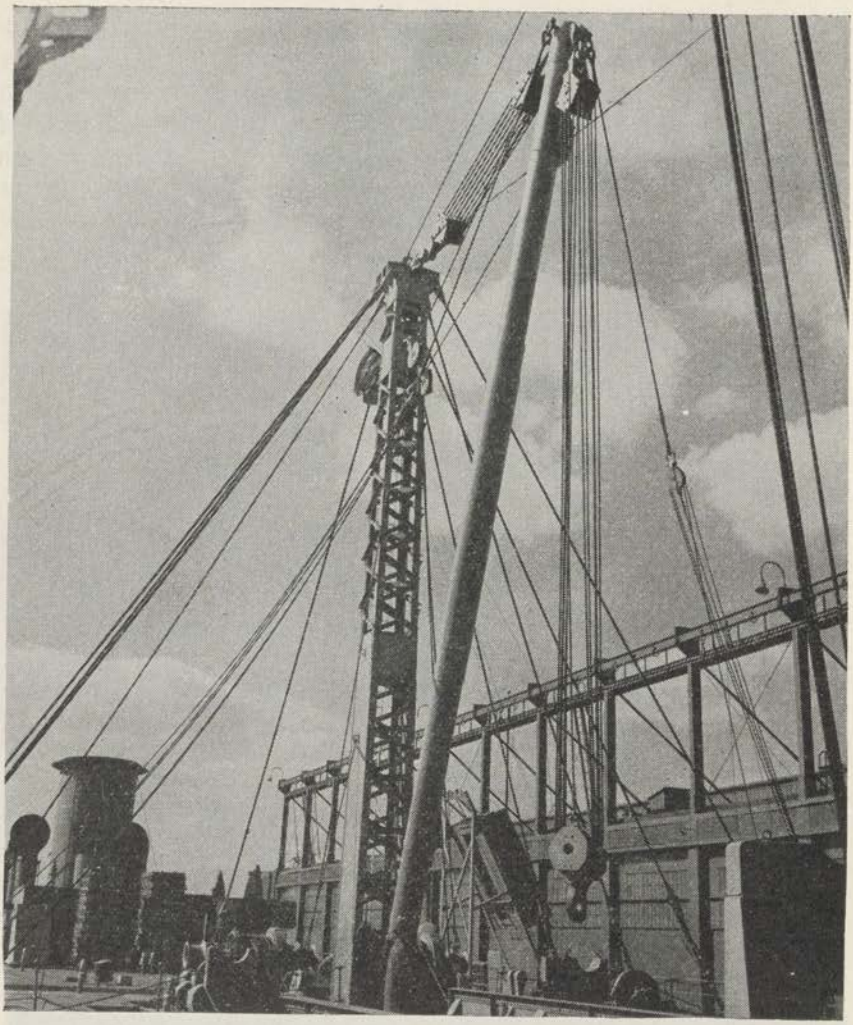

FIGURE 11.—An 80-ton boom, blocks, tackles, kingport, etc.

15. **Booms.**—Effective cargo handling requires sufficient booms, long enough to operate 25 or 30 feet overside at the larger hatches, and to work two or three groups of men. Two groups can be worked in hatches of the larger type without hatch congestion, or interference of gear. Two groups will do from 175 to 200 percent more work than one group. This is dependent upon the lay-out on the pier and conditions within the ship. In the largest hatches three groups may be worked by using three booms at each end of the hatch, and by using booms or cargo masts on the dock.

16. Long booms.—Long booms facilitate working cargo where there is more than one railroad track alongside the ship; also handling cargo from high wharves, and from and to car floats and lighters. Some ships have booms of the following sizes:

Hatch No.	*Location*	*Number of booms each*	*Length in feet*
1 and 2	Outside on king posts	1	47
1	Inside on mast	2	37
2	Inside on mast forward	2	41
2	Inside bridge, bracket aft	1	41
6	Outside on king post	1	47
6	Inside on mast	2	30

Forty-ton booms should be placed at one forward and one aft hatch.

17. Speeding operations with sideports.—A ship with deck area sufficient for five hatches may work ten groups and discharge 400 tons an hour, and with four sideports in addition the discharging can be increased to a maximum of 600 tons an hour, because the number of cargo-handling openings is increased from five to nine. For operating all openings, hatches and sideports in an effective manner, it is necessary to keep the pier floors free so that the ship loads may be landed without congestion. Sideports, furthermore, facilitate the use of conveyors.

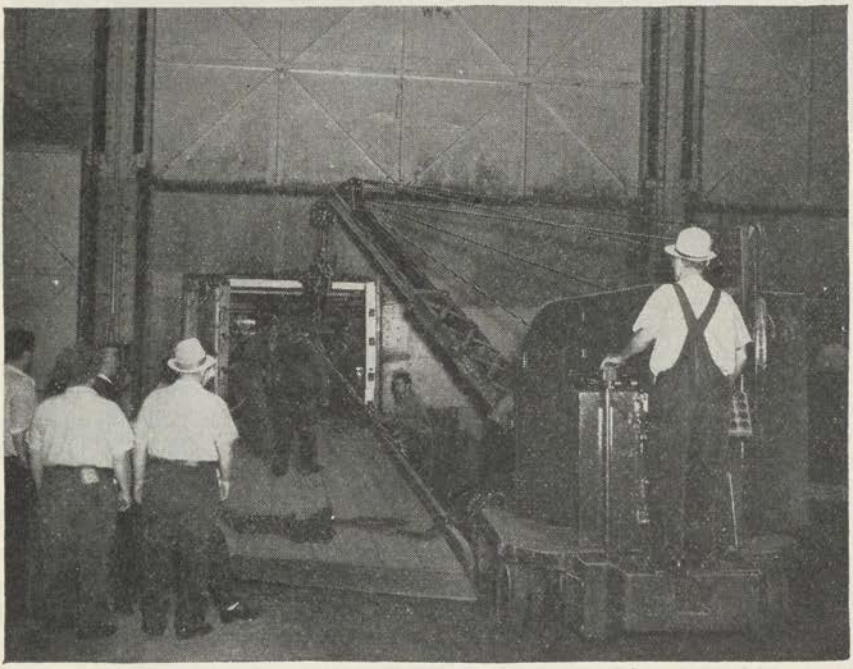

FIGURE 12.—A mobile crane lifting an unloading ramp into place to unload cargo.

SECTION IV

HANDLING SHIP'S CARGO

Paragraph
Operation 18

18. Operation.—*a. General.*—In handling the cargo of a ship two things are to be desired, speed and economy. Speed is economy because *a ship in port is a liability* and is *an asset only when at sea.* Sometimes increased cost of handling cargo is offset by increase in speed. Sometimes reductions in cost of handling are purely illusionary because the reduction of handling expenses is accomplished with

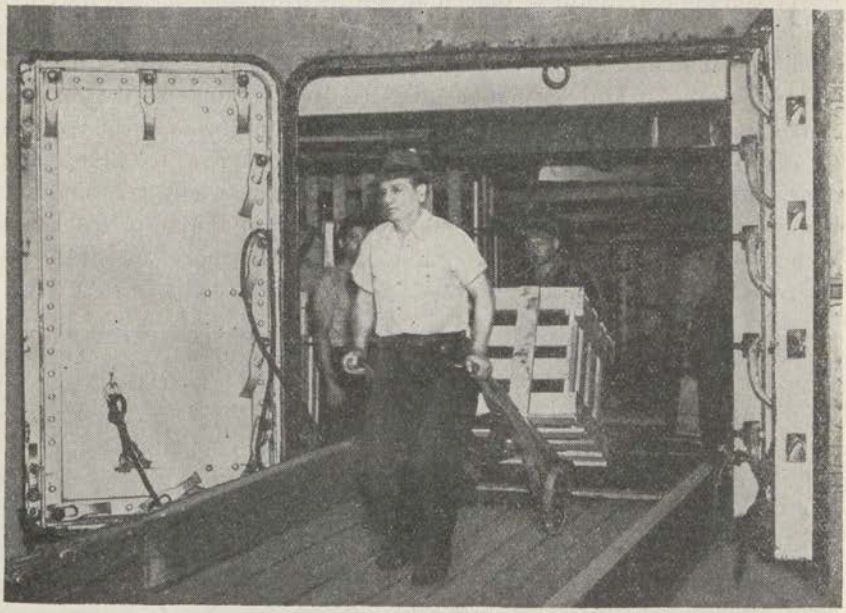

FIGURE 13.—Trucking small pieces of freight from a transport.

a lengthening of time of the ship in port. Usually it is possible to reduce handling and speed up the "turn around" of a ship by the same methods. In a study of the situation, however, the time element as well as economy of operation must be kept in the foreground. Speed without haste is the stevedore's slogan.

b. Sideport discharge.—This movement is generally accomplished by stevedores with hand trucks passing back and forth between the vessel and shore along a gangplank. Portable conveyors are also a great aid in handling many classes of cargo such as bagged or baled cargo.

c. Sideports and water level.—The variation in the water level due

to tides or river conditions greatly affect the grade of the gangplank and the efforts demanded of the men to move the goods up the incline. At Boston and elsewhere tide variations have been hard to meet. To accommodate the coastwise trade with sideports, wharves have been built with adjustable ramps, and mechanical aids to the stevedore have been installed.

FIGURE 14.—Electric tractor with trailer.

SECTION V

EQUIPMENT

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19. Conveyors.—A conveyor is defined as a machine for carrying material in a continuous stream from its receiving end to the delivery point or points.

20. Reno conveyors.—Reno conveyors are quite generally used in the ramps of all coastwise steamer wharves.

21. Portable conveyors.—Another machine which has been put on the market and is gaining in popularity for sideport transfer of cargo is the portable conveyor. A section operated by its own electric motor, driven by a plug and cable connection with the main power line, is pushed from the wharf into the vessel. The conveyor is simply a moving gangplank. It has an advantage over the Reno type in that the stevedore does not need to pass to and fro between ship and wharf, but may work at each end of the animated gangplank. The use of portable conveyors is increasing. Many of the Army supply bases

FIGURE 15.—Handling steel.

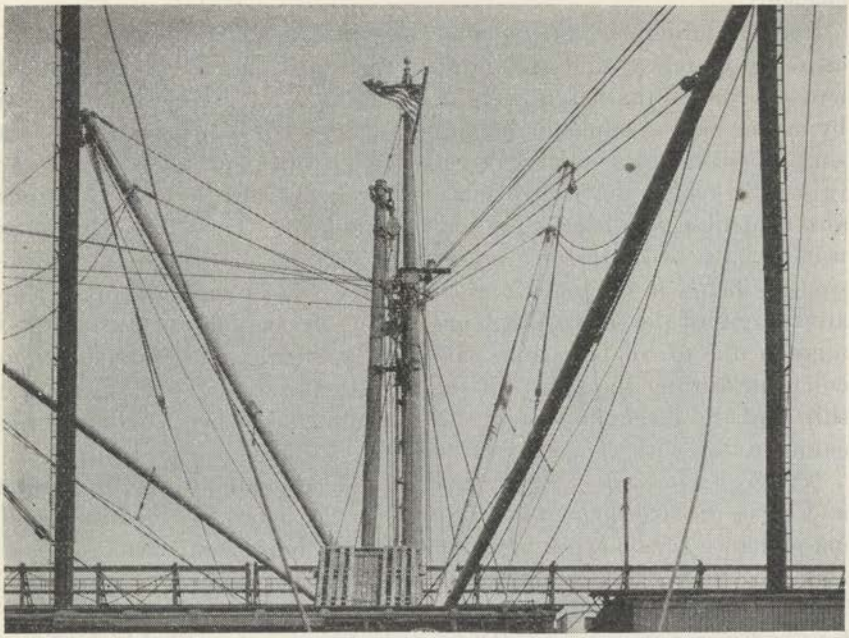

FIGURE 16.—Boom cluster. The 50-ton boom at rest against the mast.

are equipped with these portable electric belt conveyors of different makes.

22. Gravity roller conveyors.—At the port of Charleston, S. C., the Army supply base has a number of gravity roller conveyors and electric-driven belts in the usual 30-foot lengths and longer. In discharging Pacific Coast canned goods and shingles these are used together from ship side across the transit shed to cars 280 feet distant. In loading and discharging seaboard vessels and barges, as well as box cars, frequent use is made of gravity roller conveyors. These, in short lengths, are also used in the hold of ships to distribute cargo to the wings.

23. Ship's tackle.—All modern cargo steamers carry their own unloading machinery. There has been a rapid development in the hoisting equipment, winches, masts, and gear of steamships during the past few years.

24. Hatch masts.—Hatch masts are usually constructed to carry a cluster of booms of 5-ton lift. Certain vessels with large hatches (27-feet) have also one or two 10-ton and sometimes a 20-ton boom to each hatch. There has been an increasing tendency in new vessels to build two masts connected by a bridge. This construction is considered efficient.

25. Winches.—*a. Steam winches.*—Steam winches have been increasing in power and reliability. Standard equipment consists of two winches to the hatch, a right-hand and a left-hand one, operated by one or two winchmen who stand between the winches and move a simple steam valve control lever. An upward motion of the lever raises the load, a downward motion lowers the load. The operations also control a powerful brake to hold the load. These steam winches usually have two cylinders and operate on a drum with an axle extension 16 inches in diameter (called a drum end or niggerhead). Disadvantages of the steam winch are loss of efficiency in the steam transmission due to condensation, particularly during cold weather; difficulty in keeping the steam fittings tight, due to the working of the ship and the large amount of steam piping necessary to connect the engine rooms with the deck winches.

b. Cargo winches.—(1) *General.*—There are many different designs and types of cargo winches. To furnish the details of operation and maintenance of all types of winches would require much more space and time than would be consistent with the purpose of this manual. The simplicity and reliability of most winches make successful operation and maintenance easy. Steam winches are controlled by a throttle and a reverse system operated by a single lever. The lever is lifted to hoist a load and pushed down to lower a load. To rest or hold a

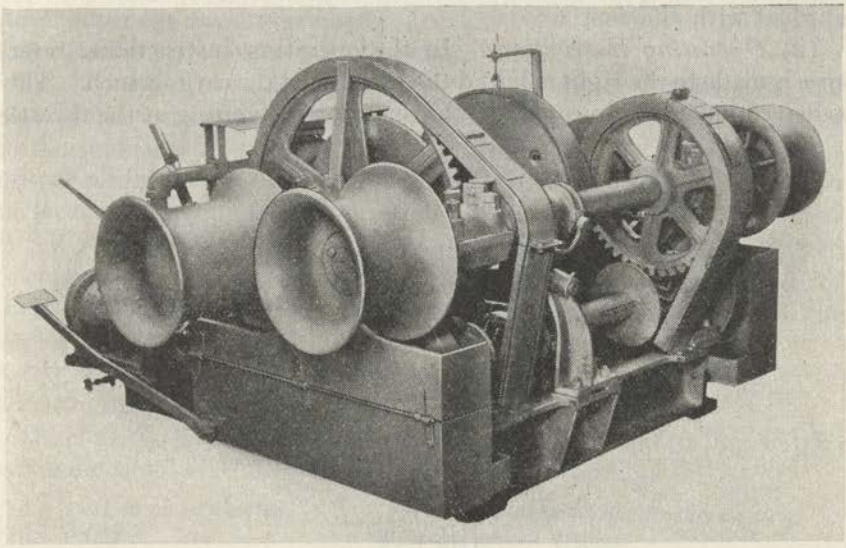

FIGURE 17.—Seven by twelve steam-operated winch.

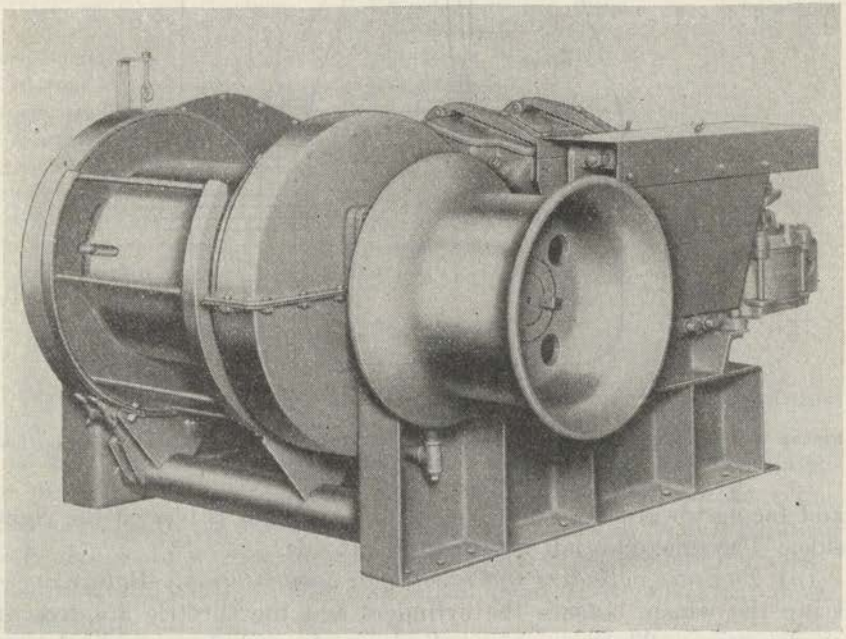

FIGURE 18.—Electrically operated cargo winch.

load, the lever is returned to its neutral position, and the brake is applied with the foot.

(2) *Operating instructions.*—In the operating instructions, reference is made to the right side and the left side of the cargo winch. This is determined as follows: When the operator is standing at the throttle

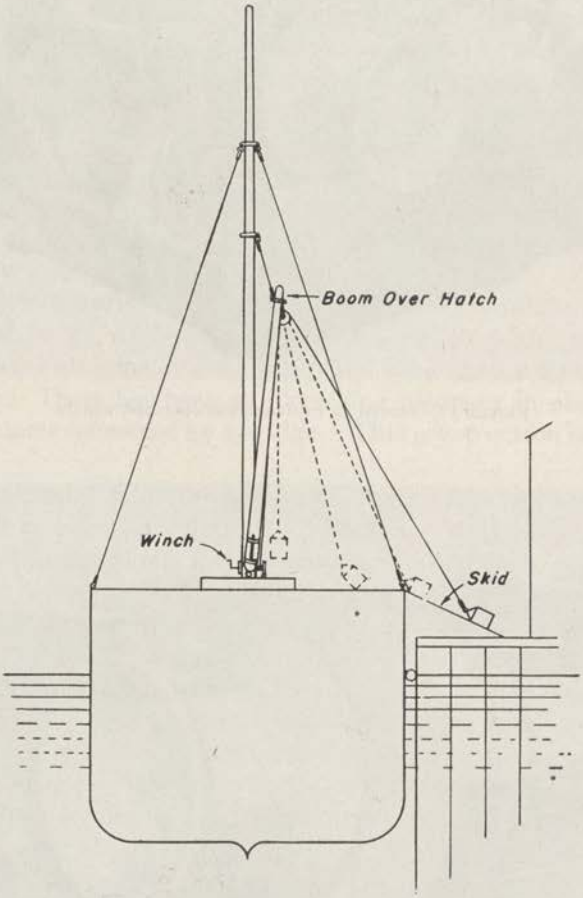

FIGURE 19.—Skid method of loading, using ship's winch, one boom and skid. This method is slow and causes damage to goods.

and facing toward the gears, the side to his right is termed the right side. The side to his left is called the left side.

(*a*) *To drain cylinders and throttle of condensation.*—Before operating the winch, be sure the cylinders and the throttle are free of condensation. There are two cylinder cocks and three pet cocks attached to the underside of each cylinder, and one pet cock on the

throttle body. Open all of these cocks to insure proper drainage. After drainage is complete and all cocks have been closed, the throttle and cylinders are ready for operation.

(*b*) *To raise the load in low gear.*—The operator must shift the clutch lever until clutch lever pawl engages the quadrant notch farthest to the left side of the winch. This engages the jaw clutch with the proper pinion to rotate the drum for low-speed operation. The throttle lever is then pulled upward to raise the load.

(*c*) *To raise the load in high gear.*—The clutch lever must be shifted to engage the pawl in the quadrant notch farthest to the right side of the winch. The throttle lever is then pushed downward to raise the load in high speed.

(*d*) *To lower the load.*—All lowering of loads is done entirely by operating the throttle accordingly.

(3) *Lubrication.*—The lubrication of winches is of prime importance and should be done regularly.

Part to be lubricated	*Method of application*
Plain bearings	Pressure grease fittings.
Slides and guides	Compression grease cups.
Ball and roller bearings	Pressure grease fittings.
Roller chains	Hand oiled.
Electric motor ball bearings	Pressure grease fittings or compression grease cups.
Electric motor bearings, plain	Ring oiled.
Wire rope and open gears	Brush or swab.
Worm gear and transmission	Enclosed (bath).
Roller path or roller axles	Oil cup or pipe.
Silent chain	Drip feed.
Crane-truck axle gears	Enclosed (bath).
Steam cylinders	Forced feed or hydrostatic lubricator.
Air compressor cylinders	Forced feed or hydrostatic lubricator.
Truck journal boxes	Waste packed.
Derrick bottom:	
Roller bearing type	Hand oiled.
Ball and socket type	Hand oiled.

For Diesel engine or gasoline engine use SAE grade. In temperatures below 32° F. use next lighter grade of the same brand lubricating oil.

c. Electric winches.—The advent of the motor ship has stimulated the use of the electric winch. The electric winch does not have the disadvantages of the steam winch, but the electric equipment is exposed to the danger of wetting by salt water, which often renders it useless. Also, a steam winch can be controlled under slow movement more satisfactorily than an electric winch.

26. Brake adjustment.—The foot-operated brake should be kept properly adjusted. This adjustment is done in the following manner:

The dead end of the brake band is pin-connected to a T-bolt. This T-bolt is threaded and screws into a nut welded to the bed frame. To take up the wear of the brake lining, it is necessary to remove the pin connecting the band end to the T-bolt. Then rotate the T-bolt as required to take up the wear on the lining. Assemble the disconnected parts and check for clearance between the brake lining and the brake drum. This clearance should be kept to a minimum, just sufficient to prevent dragging on the brake drum when the brake is in the released position, and should be kept as uniform as possible around the brake surface.

27. Single fall and skid.—In handling cargo by this method a hook is thrown onto the wharf, attached to the rove of the draft, and the draft dragged up an incline to the deck of the ship. When it swings across the hatch opening it is checked by a stevedore with a rope. It is then lowered into the hold. This method is suitable only for loading, and for certain kinds of cargo. The cargo is liable to damage by this method; consequently it is not generally used.

28. Burton tackle.—The Burton system (also called in England the union purchase) uses an up-and-down fall running through a block in the peak of a boom fixed above the hatch and a burton fall running through a block fixed at the peak of a second boom, swung outboard past the gunwale and above the wharf. Both whips (also called falls, runners, cables, or ropes) are attached to a single hook. There are the following movements in discharging:

a. The deck winch operating the up-and-down fall lifts the draft out of the hold above the hatch coaming.

b. At this point the winch operating the burton fall begins pulling the load, and as the rope is wound in the up-and-down rope is payed out until the draft crosses the deck to a position above the wharf.

c. The up-and-down fall then lets go entirely and the burton fall lowers the draft at the wharf.

29. Cargo mast.—Since many American piers are too narrow for the use of cranes, the cargo mast has proved to be a successful compromise. This equipment consists of mast 75 to 80 feet above low water extending alongside of pier shed and carrying a girder. A block and tackle, with a line from a drum hoist on the pier to the hook, is attached to this girder by a shackle bolt and stirrup. A ship's boom and hoist operates another line to the same hook; both ship's tackle and pier tackle work together. There are three movements the same as described for burtoning with two cargo masts. The movement made is without lost motion and by the shortest route possible. The cost of the installation is low, the saving in time is

great. Operating two hoists and employing two operators makes the cost greater than the cost of operating the crane. The cargo mast operates at 40 to 120 cycles an hour.

30. Rope sling.—The simple rope sling is made by splicing together the ends of a rope. This endless rope is laid on the floor of the wharf or hold; the cargo is piled on it to a convenient size or

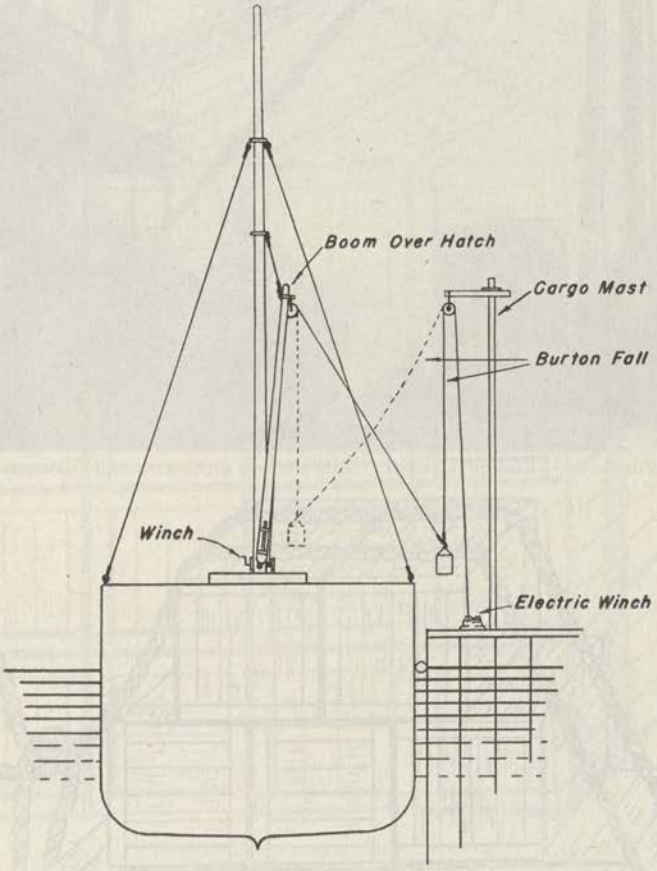

FIGURE 20.—Standard method of loading or discharging, using mast ship winch and electric pier winch.

weight, usually not exceeding 1,000 to 1,500 pounds. Care must be taken that one end of the sling is longer than the other. The long end, called the rove, is then passed through the shorter end, called the bight, which is drive down tight with a piece of dunnage or a short piece of pipe kept for the purpose. The hook is then put into the rove and the draft lifted.

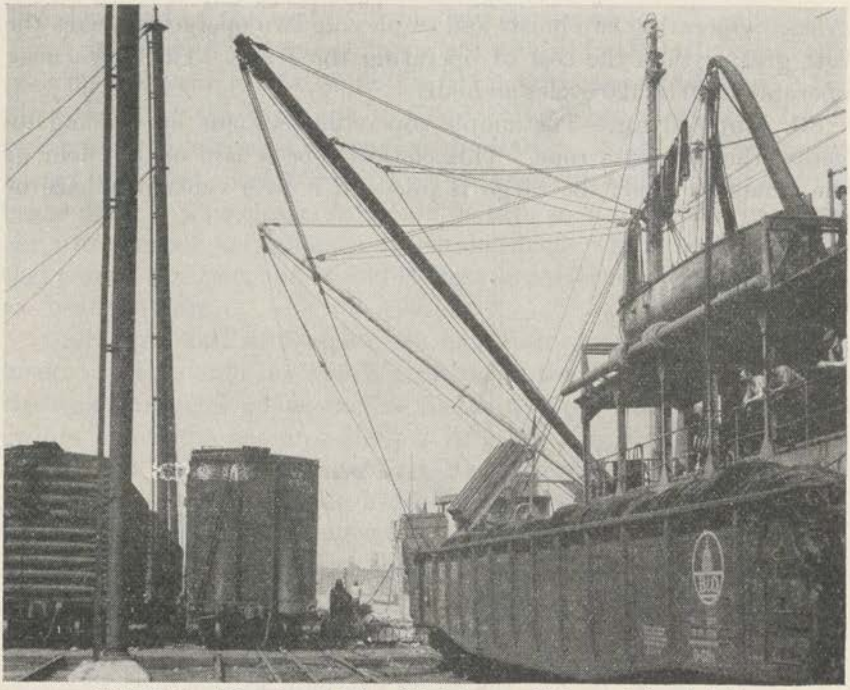

FIGURE 21.—King pins at left. Ship's booms picking up bales at right.

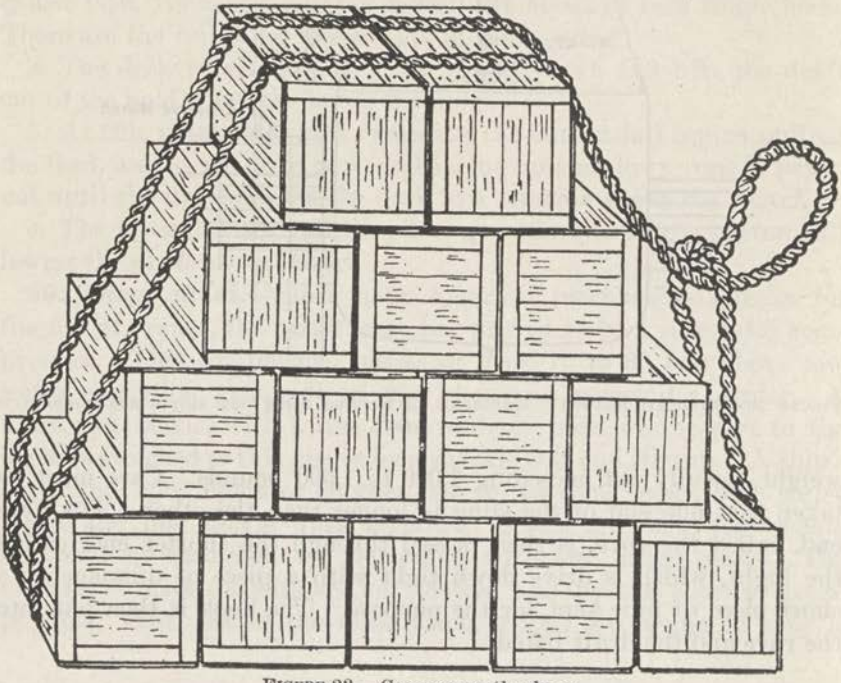

FIGURE 22.—Cases correctly slung.

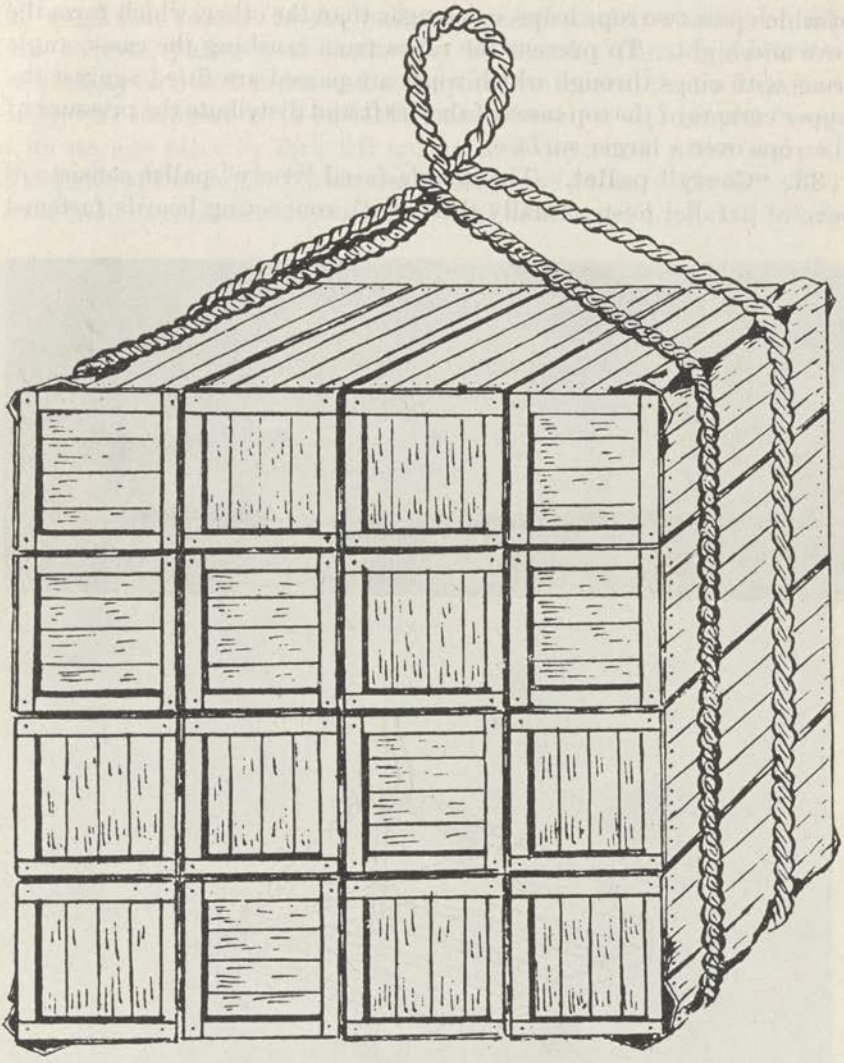

FIGURE 23.—Cases incorrectly slung.

31. Web sling.—This sling consists of a canvas covering, 1½ to 3 feet wide, sewed over a rope web. Its purpose is to prevent the pressure of the rope from cutting bags of flour, sugar, coffee, and other soft, bagged material by distributing pressure over a larger surface of the draft.

32. Platform, tray or airplane sling.—This sling is used for fragile cases of uniform size, such as canned goods, eggs, crates of apples, and other fruits. It is a stout platform, through the corners

of which pass two rope loops, one longer than the other, which form the rove and bight. To prevent the ropes from crushing the cases, angle irons with rings through which ropes are passed are fitted against the upper corners of the top cases of the draft and distribute the pressure of the rope over a larger surface.

33. "Cooty" pallet.—The double-faced "cooty" pallet consists of several parallel joists, usually three, with connecting boards fastened

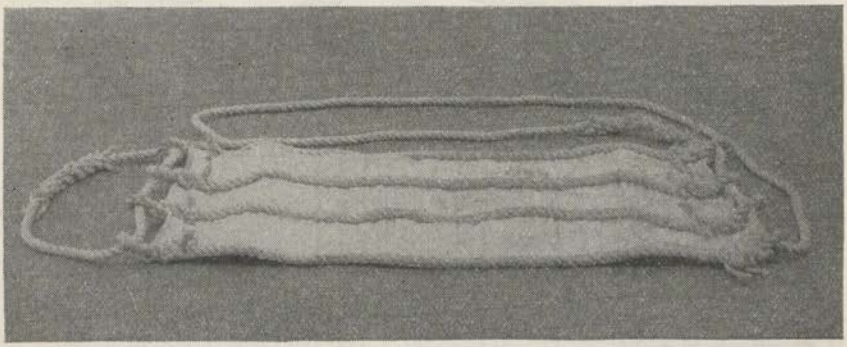

FIGURE 24.—Flour sling.

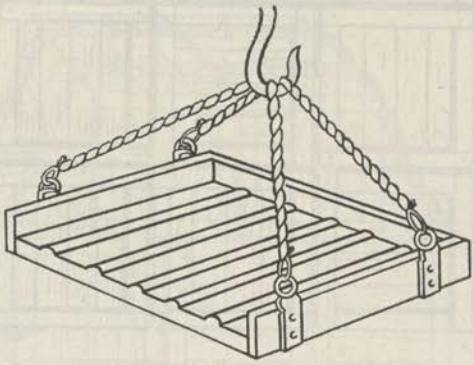

FIGURE 25.—Airplane sling.

to opposite sides. The material to be handled is placed on the pallet. A fork lift truck can then be used to handle the pallet and the material upon it. The fingers of the fork are inserted between the upper and lower connecting boards, one on either side of the center joist. The fork can be raised or lowered, thus enabling the handler to raise or lower the pallet and its load. As the fork is mounted on a power-driven truck, the pallets and their loads can be moved to any point

the truck can reach. If the pallet is loaded so that the top of the load is level, pallets and loads may be tiered. Thus, material on pallets may be tiered and stored or may be transported to new locations easily. If material is to be loaded on a vessel, it can be picked up at its storage place by fork lift trucks, and deposited, pallet and all, at the side of the ship. By the use of slings the pallet can be deposited in the hold of a vessel. Should the vessel be sideport loaded, the fork

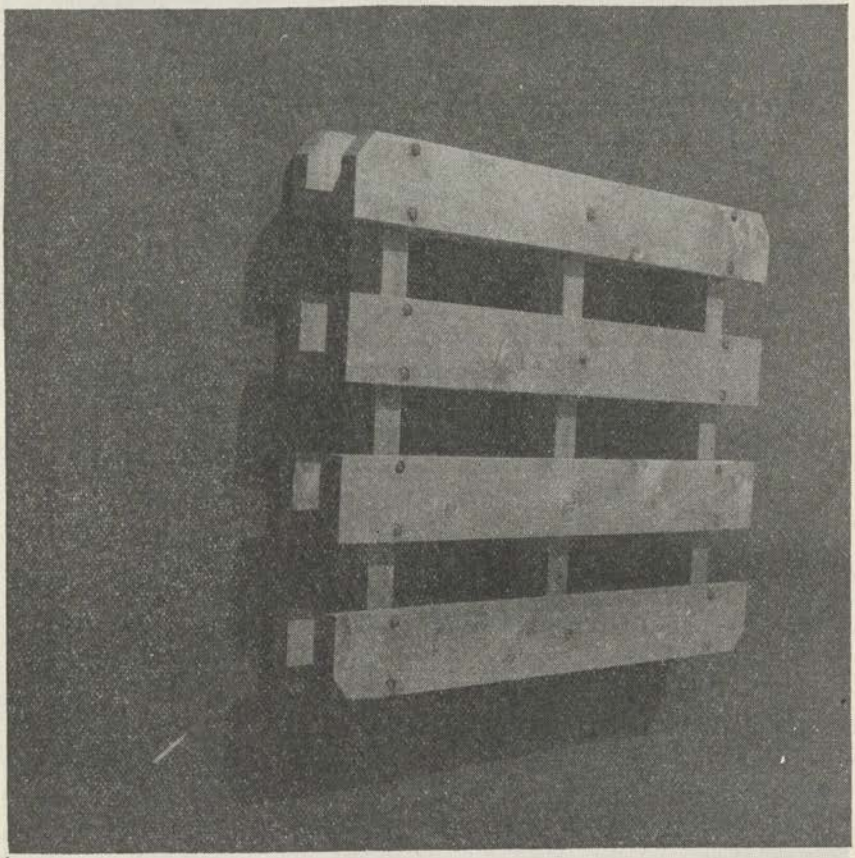

FIGURE 26.—"Cooty" pallet.

lift trucks can carry pallet and cargo directly into the ship and deposit both in the hold if tide level permits. The reverse of this process can be used in unloading.

34. Net sling.—The net sling is a rope net some 15 feet square, the opposite corners of which are alternately longer and shorter, in each case forming a rove and a bight. The cargo to be lifted is piled in the center of the sling and the hook passed through the two roves.

35. Magnets and chain slings.—Rails, structural steel, pipe, etc., are handled usually by chain slings; sometimes by magnets. Nails in kegs can be handled by magnets, but transferring rails by magnet is a hazard. If the current is interrupted by any accidents the rails

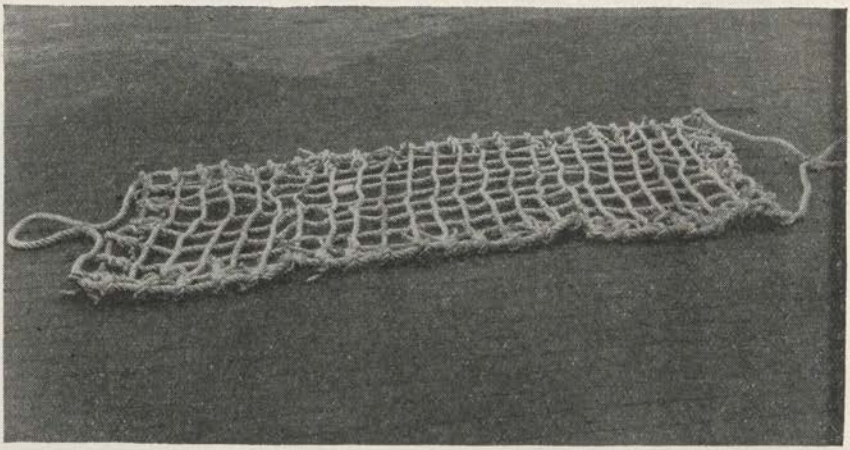

FIGURE 27.—Manila rope net sling, 17' x 6'.

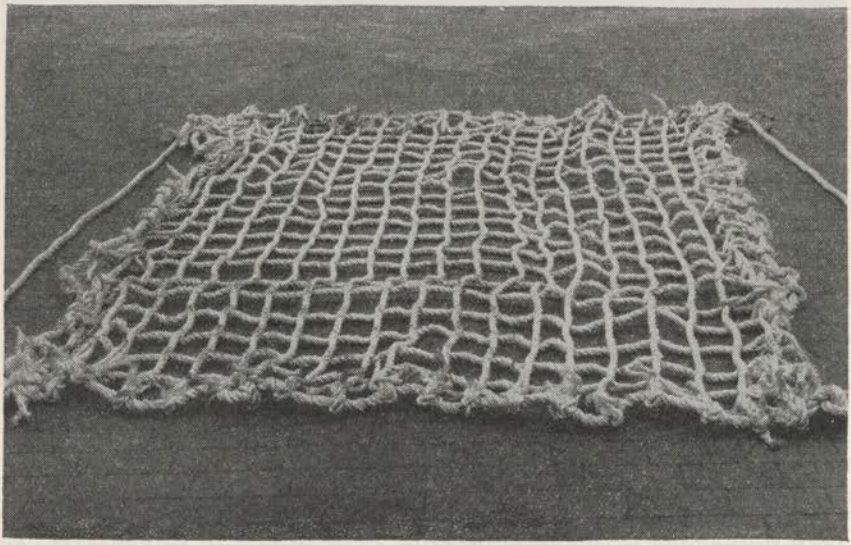

FIGURE 28.—Manila rope net sling, 12' x 12'.

may go through the bottom of the ship. In using magnets great care must be taken to insure continuous current. Barrels are handled by cant hooks and are usually slung "married," that is, in pairs.

36. Cranes.—*a.* The great aim in all terminal facilities is to decrease the length of time required for a ship to be in port. Increase in loading and discharging speed may sometimes be accomplished through additional numbers of men, but this is not always the case, because of congestion resulting at the two points of deposit—the points where the drafts are picked up or put down on the wharf, and in the hold of the ship. Various methods are used to increase the area of the point of deposit to enable more men to work simultaneously.

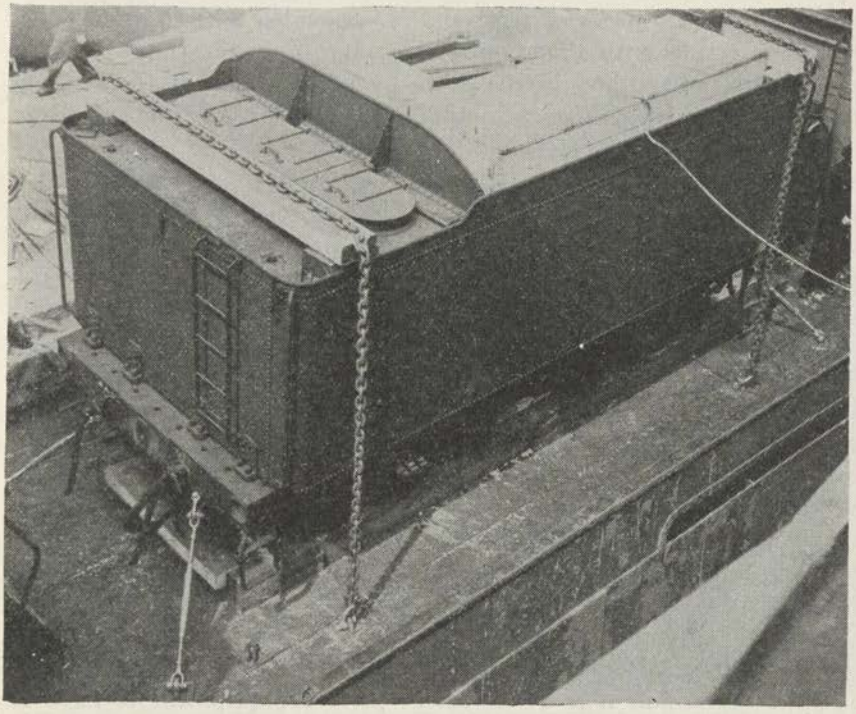

FIGURE 29.—Chain ties.

b. It has been insistently maintained that the European ports have been successful in increasing the speed of transfer movement and in increasing the working area through the use of wharf cranes. Formerly these cranes were hydraulic, but practically all modern installations are of the electric type. Cranes have been used in European ports for many years.

37. Crane types.—Not only transfer between ship and wharf, but every type of heavy lifting requires some sort of assistance to manpower. There are various types of cranes and derricks that should

be thoroughly understood. It is, therefore, necessary at this time to review the outstanding types in order to have clear mental pictures and exact terminology for further discussion.

38. Timber stiff-leg derrick.—This type is the simplest form of hoisting machine. It is often used in building construction and derives its name from a vertical leg held in position by two anchored bracing timbers. At the foot of the leg is stepped a boom on some sort of universal joint to permit its movement in any direction. The peak of the boom is connected to the top of the mast, or stiff-leg, by a block and tackle, which controls the angle of elevation of the boom. From the peak of the boom is suspended a block and tackle, double or triple, with a free pulley carrying the hook, the rope being passed through pulleys in the boom and at the foot of the stiff-leg to the driving mechanism, which may have as motive power, steam, electric, or gas winch or even an old mule.

39. Shear-leg derrick.—A shear-leg derrick has a double mast spread at the bottom like a pair of scissors with the blades of the scissors spread somewhat, and the two points stuck into the ground and hinged with the diagonal member movable so as to rack the masts backward and forward.

40. A-frame derrick.—This is similar to a stiff-leg derrick. There are two vertical members joined together by crossbraces similar to the letter "A," held in position by struts and operating a boom similar to the stiff-leg. This type is most frequently used on lighters.

41. Guy derrick.—This derrick is similar to the stiff-leg, but the vertical member of mast is held in place by guy ropes attached to a spider plate and shackles fixed to the masthead top iron. These guy ropes are anchored at a convenient distance to give vertical rigidity to the mast. This type of derrick is used for temporary work, such as erection of buildings. The usual type has a 90½-foot boom of steel structure. It may be quickly rigged for any job where there is open space, and it is a convenient piece of equipment to have at any port.

42. Locomotive crane.—As the name implies, this is a crane mounted on standard-gage railroad trucks, and can move over standard tracks as a locomotive. Locomotive cranes are usually used for heavy duty, lifting from 10 to 50 tons. The boom, from 40 to 60 feet in length, is hinged, and may be lifted and lowered, that is, luffed. It may be slewed, that is, moved sidewise or racked. The entire mechanism may be constructed so that it will revolve on a circular track base. A locomotive crane may be fitted with a hook, an electric magnet, or with any type of bucket, clamshell, orange-peel, etc. The advantage of the locomotive crane is its mobility and versatility. It is

particularly useful in handling materials in open storage. However, because it is so short of stature it cannot reach over the sides of vessels unless they have low freeboards or are settling low in the water.

43. Tower crane.—This crane is a type of lifting device mounted on a tower. The vertical member or mast that carries the luffing tackle is usually a short triangular or four-sided lattice-steel pyramidal tower. The boom is usually similar to that of a locomotive crane or guy derrick—a luffing and racking boom. The crane may revolve

FIGURE 30.—Tractor crane, 10-ton capacity, showing weighted hook block to facilitate overhauling, and winch tread (independently operated) for miscellaneous applications.

upon the supporting tower, in which case it becomes a traveling revolving tower crane. Revolving tower cranes are frequent in shipyard equipment.

44. Hammerhead crane.—For extra-heavy duty, the tower crane is supplanted by the hammerhead crane, used in fitting out basins of shipyards and navy yards. The hammerhead crane is a horizontal bridge cantilever construction supported on a steel tower. The cantilever arm has its weights and a percentage of the maximum load counterbalanced by heavy counterweights of concrete or cast iron.

This solid block of counterweights gives it the appearance of a hammer, from which it derives its name. The hammerhead crane at the Philadelphia Navy Yard, one of the largest in the world, has a capacity of 350 tons.

45. Pontoon crane.—Any crane mounted on a float or lighter, or pontoon, comes under this category and is listed under floating equipment. Heavy lifts are handled better by heavy-duty derricks or cranes on lighters than over a general merchandise wharf.

FIGURE 31.—Heavy duty crane, 80 tons capacity. Runs on railroad tracks.

46. Goose-neck crane.—This crane is one frequently found in floating equipment and consists of a slanting mast which is given a greater angle of inclination from the perpendicular near the peak. Upon analysis, it is a "leaning-tower" crane, with a fixed jib. This type is fitted with a clamshell or orange-peel bucket. It is most frequently used in bunkering coal-burning ships. The port at Havre France, has 150 pontoon goose-neck cranes used for bunkering coal and for general cargo transfer with the ship berthed off the wharf to admit the equipment.

47. Gantry crane.—This is the most important type of crane used in wharf equipment. These are called gantry cranes because the crane mechanism is mounted on a gantry. The word gantry means to span, and the gantry is any form of structure that spans. The type of

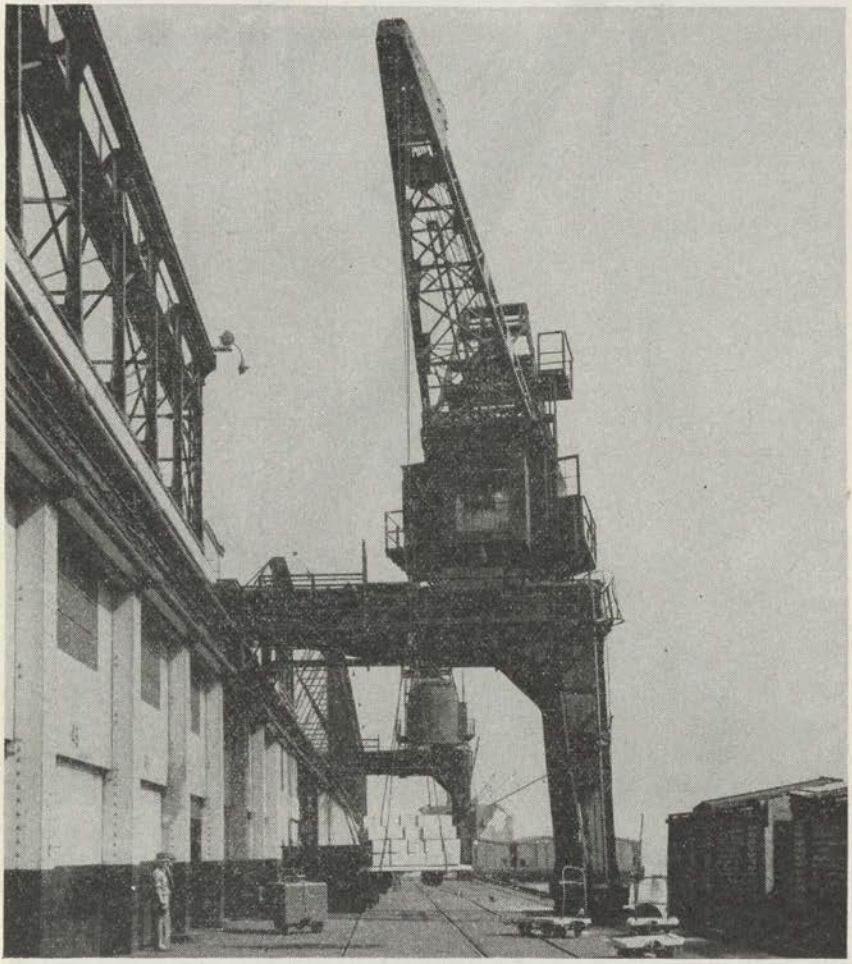

FIGURE 32.—Movable gantry, one leg on the pier and one riding a track along the face of building.

gantry gives its names to the crane as well as the type of crane itself. The usual gantry jib crane used in port terminal work may be called by various names, such as "wharf crane", "dock side crane", etc.

48. Full-arch gantry or portal crane.—As its name implies, has all legs on the ground, and runs on two tracks in the same plane.

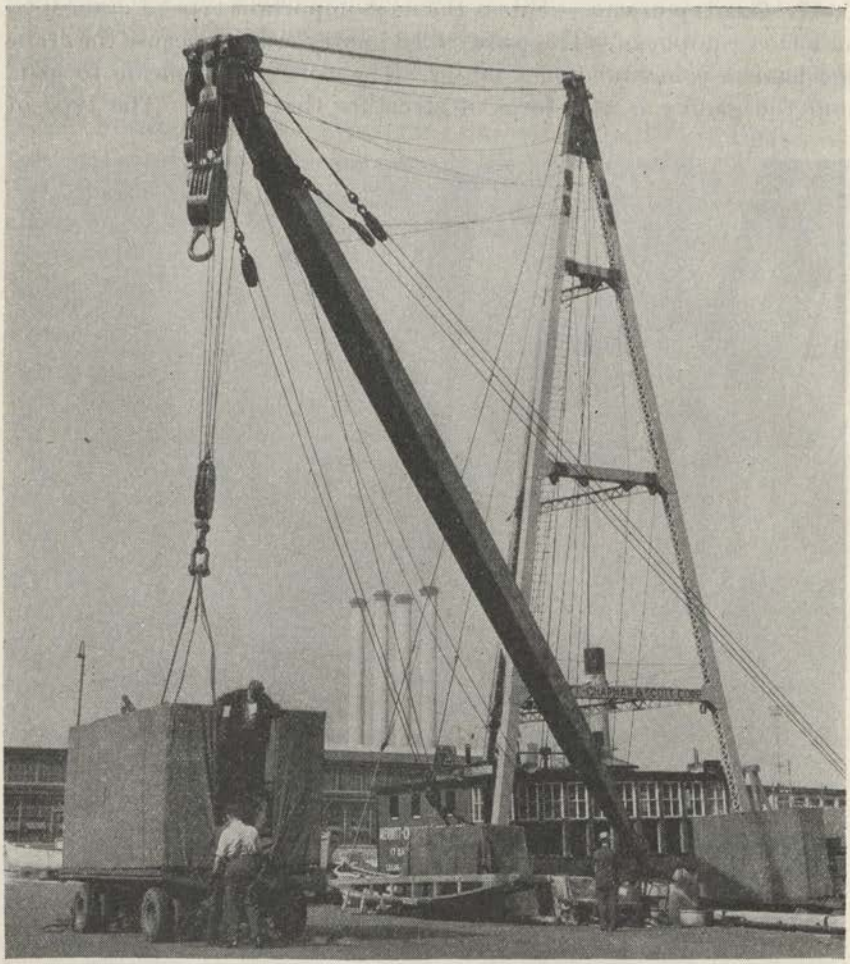

FIGURE 33.—Cables being attached to Army Air Force trailer for hoisting on barge.

49. Semiportal or half-arch gantry.—This crane has one leg on a track on the wharf and the inshore end of the gantry travels on a rail built into the front of the wharf shed. This type has been installed in the Norfolk, Philadelphia, and Boston supply bases.

50. Types of cranes mounted on gantries.—The crane mechanism is usually of the revolving or rotating or full-circle slewing type, all terms meaning the same thing. Sometimes they are called twirlers. The crane can rotate or slew in any direction in a full circle on a circular track rail. There are two distinct types of jibs, or booms: the cantilever type, either fixed, as in the case of the big hammerhead crane at Philadelphia, or moved by jack screws as in the case

of the pontoon crane at Norfolk; and the boom type, with a boom similar to that of a guy derrick in which the boom is luffed, that is, lowered or raised by blocks and cables. The cantilever type is illustrated by the cranes at the Boston Army Supply Base, or the Galveston type.

51. Light duty cranes.—Wharf cranes for general cargo should not have a greater capacity than 3 tons, and many engineers prescribe a 1½-ton crane. The continual starting and stopping of a wharf crane requires much electricity, and much wear and tear on brakes results from stopping the mass of a crane built for heavy lifts. As general cargo is handled in slings which seldom weigh more than 1,000 to 2,000 pounds, a 2-ton crane should be sufficient for rapid work in transferring general cargo. The fine art in crane structure is to build a crane with all its members of such perfection that there is not a point carrying excess material for the duty designed. The greatest difficulty in the United States is the tendency of stevedores and crane operators to abuse a crane by attempting to lift more than the designated capacity, and by making sudden starts and stops. Considerable lifts may be managed by fast, light-duty, wharf cranes by hitching two together with union purchase.

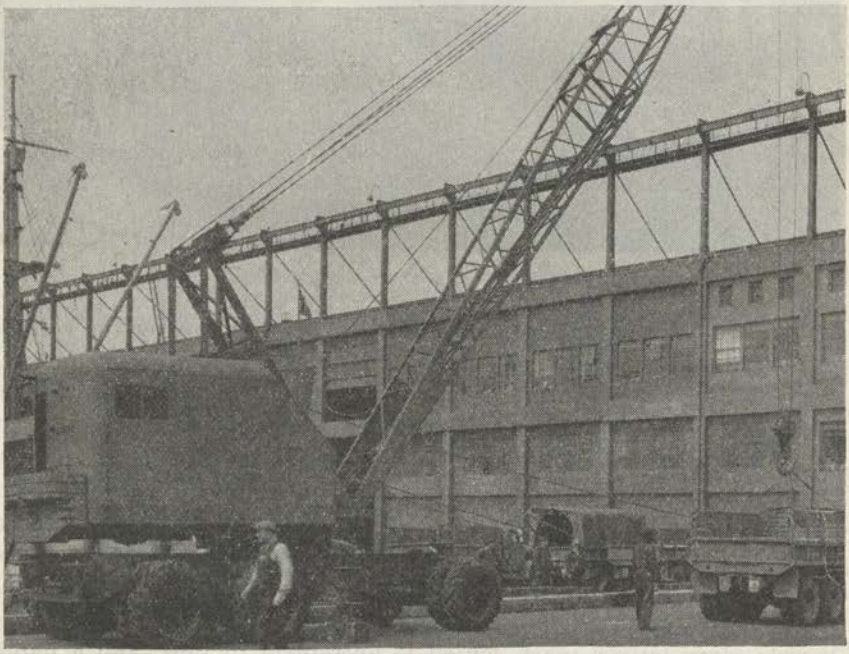

FIGURE 34.—Slinging 5-ton truck.

52. Heavy duty cranes.—Heavy duty cranes are essential to every port for general use or in connection with a special service. Such a crane is mounted on an open wharf, with railroad tracks. Ships are either brought to the wharf for loading or the heavy drafts are transferred to lighters, and with a floating derrick of large capacity are towed alongside the ship at its berth.

53. Roof cranes.—Light duty cranes of the usual luffing or revolving types are frequently mounted on the roof of a warehouse or transit shed in Europe, particularly in the English harbors, but are not common in the United States or elsewhere.

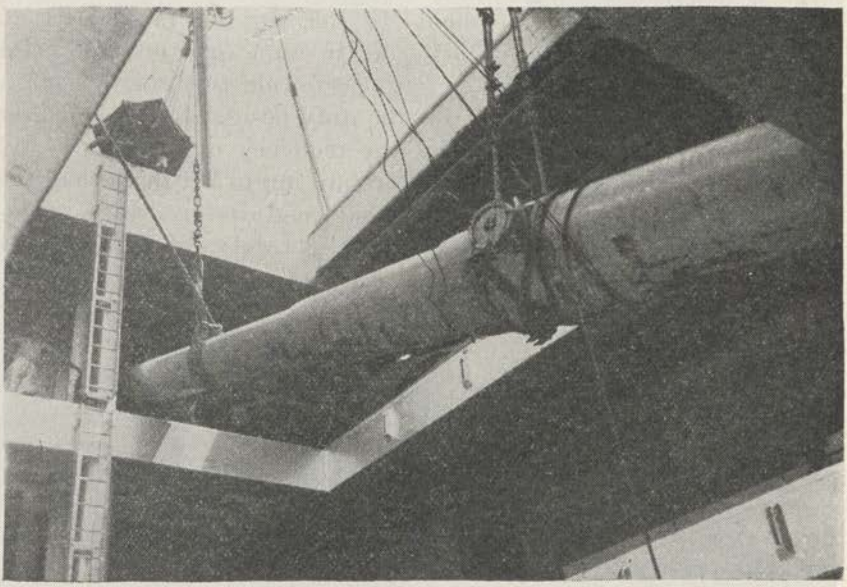

FIGURE 35.—Heavy lift above decks.

54. Relative merits of dockside cranes.—Wherever the volume of freight and available space warrant it, gantry cranes are economical and efficient transfer machinery. It is often argued that the reason European ports use cranes is that the freight cars are open, and that the Americans do not use cranes because of the prevalence of boxcars. This is like saying that it is warm in summer because there is no snow. The fact that the cranes are used extensively is the reason for the prevalence of the open freight car. One reason for the use of the crane is the fact that a large proportion of water transportation by barges makes unloading machinery on shore necessary. The barges carry only a mast, which is unstepped in port, and a hand-operated hoisting drum. Another potent reason is the fact that the

equipment is supplied by municipal port authorities not looking to a large return on invested capital. A final reason is that the quay has more room back from the water's edge than the pier. Piers of the usual New York type, by their very nature, are not capable either of accommodating cranes or furnishing them with sufficient tonnage to make them economical. The difference in the tonnage transferred per linear foot of improved quay here and abroad is due partly to the nature of pier traffic, which allows a longer idleness of berthing space at piers than at public quays. The width of aprons at the Brooklyn base is only 5½ feet, which obviously would not permit installation of cranes.

55. Number of cranes required.—The number of cranes required depends on the amount of freight which will pass over the quay.

56. Shipside moving platform.—The problem of clearing the point of deposit on the wharf to prevent cargo from "hanging" has been solved in certain places by installation of a moving platform conveyor of considerable width. This is built of strong slats carried by two chains running over sprockets and driven at a slow speed by an electric motor and reduction gears. A draft of discharged cargo, deposited on the conveyor, has moved away and into the shed by the time another draft is outturned from the ship. This practice, however, has many disadvantages, such as excessive wear and tear of the conveyor from hard usage, and the difficulty of making up hand-truck loads of packages going by on the moving platform.

57. Large drafts on platforms.—The more general method has been to increase the size of the draft, as at Manila, by placing the draft with the sling onto a platform. This is picked up by a platform-lift, electric storage battery truck and trucked away to a place in the shed or at the boxcars. Congestion occurs when large sling loads of packages must be broken down into handtruck loads and removed piecemeal by the wharf group. Before such loads are out of the way the next draft is hanging. When the whole draft is trucked away at once, one electric truck operator can replace several hand-truckers and clear the point of deposit with one motion. The "cooty" pallet is very efficient on piers or wharves for general cargo, in that the electric lifting truck can pick up a load by simply pushing the forks between the slats.

58. Shipside railroad cars.—At European ports, gantry cranes, spanning 30 to 40 feet from the water's edge to the shed floor, span two or three sets of railroad tracks between the shed and the water. These tracks are in addition to the tracks at the back of the shed. The position of these tracks has given rise to the supposition that cargo is usually loaded directly between car and ship. This was

previously shown not to be the case. Some freight, however, is loaded this way. Wherever the commodity is in large and heavy or bulky packages such as machinery, structural steel, logs, automobiles, etc., the loading does take place from car to ship. All such commodities are moved on flat cars or gondola cars from the point of origin to within reach of the crane for loading. However, it is uneconomical to have wharf cranes of greater capacity than 5 tons; usually they are about 3-ton capacity. Very heavy pieces are loaded and unloaded by derrick lighters. The waterfront tracks are intended

FIGURE 36.—Tiering heavy load.

for particularly heavy-duty loading as stated. When this kind of freight is not being delivered or forwarded from the water's edge the tracks are kept clear in order not to interfere with movement of the cranes. The first and last consideration is speed in unloading the ship. After a ship has left the berth, cars may be brought to the water side as well as the land side of the transit shed and loaded from the shed door.

59. Crane handled barge cargo.—*a.* After a steamer has discharged its cargo and has gone, barges and lighters come alongside

the wharf to take on their freight. In forwarding freight by lighter and by barge, cranes are now able to perform a great service. After a steamer has left, taking its tackle with it, there is no equipment to load the small craft. The cranes on the wharf are kept busy in the intervals of unloading ships by handling cargo between the transit shed and the small vessels. This seems to be one of the best uses of the crane.

b. The economy of the crane is increased by the fact that it is used not only for the short time an ocean ship is discharging or loading, but also during the time in between, while serving the craft which collect or distribute the cargo of a ship. Wharf cranes for general cargo have been introduced at ports in the United States as an addition and supplement to cargo mast equipment.

60. Heavy duty equipment.—Heavy lift equipment is essential at any port. It has become general practice to handle heavy lifts, pieces of 5 tons and upwards, by means of floating derricks or pontoon cranes. Large packages do not recur at any one ship's birth sufficiently often to make it pay to have a heavy duty crane on the wharves. It would necessitate heavier construction for the full length of the wharf over which the crane may occasionally operate. Therefore, it is more feasible to place a heavy duty crane on a pontoon and make it more mobile.

61. Transfer and handling of packages of uniform size.—Terminals which handle a large tonnage of freight of the same kind lend themselves readily to labor-saving machinery. There are two classes of specialized freight; package and bulk. Illustrations of uniform package freight are coffee, sugar, seed, rice, etc., in bags; paper in rolls; crates of fruit; bananas in bunches; cottonseed cake; leaf tobacco in 800 pound hogsheads, or tierces; and many other commodities of similar character in containers of uniform size. Bulk materials are coal, ore, petroleum, grain, or any materials in liquid form or comparatively small pieces not packed in containers. The two groups present two different mechanical problems.

62. Ship cargo telescope conveyor.—This conveyor is similar to any portable and horizontal continuous-motion belt. The conveyor is lowered bodily into the hold and hooked onto the hatch coamings for support. The length extended is 45 feet, and the length collapsed is 29 feet. Its width overall is 5 feet 6 inches and the depth overall is 4 feet 6 inches. It weighs 3½ tons and can be handled by the ship's boom. The difficulty in operating such conveyors in holds of ships has been the fact that the angle of rise is so nearly

perpendicular that packages roll off the conveyor. This factor has been overcome by various types of slats or slack pockets.

63. Advantages of continuous motion transfer.—The main advantages of continuous motion applied to the transfer movement are speed of operation, and the lifting, transferring, and lowering of each unit individually without injury due to pressures in the sling or banging of the draft against ship, shed, or wharf deck. This type of cargo-handling machinery should have a self-contained mechanism, traveling along a wharf apron on a gantry or mounted directly on crane tracks, and should be capable of adjusting its

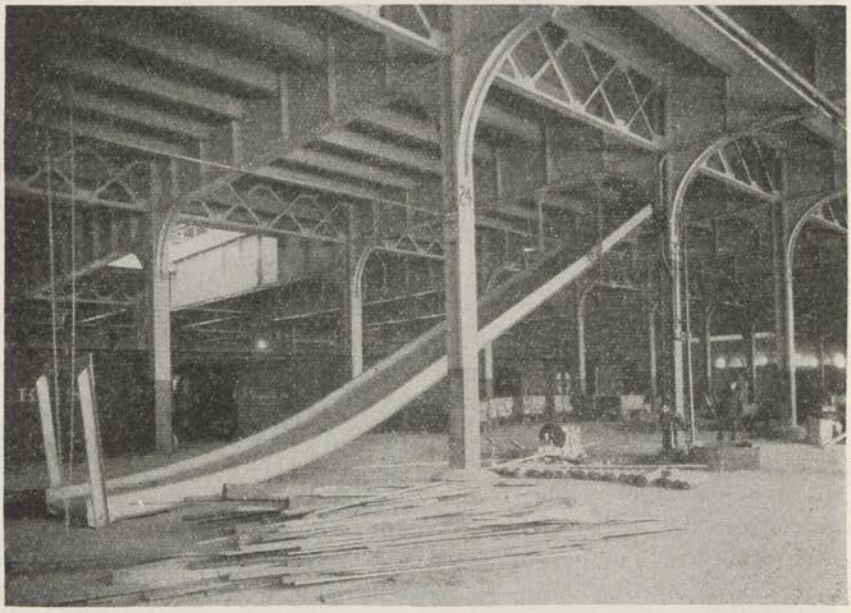

FIGURE 37.—Lower deck of modern pier showing chute. Pier is level with freight cars.

marine leg to the various depths of hold and changing water level without delay or undue manual labor. Even at the expense of frequent renewals of belt material, the conveyor method effects large savings as compared with the method of hoisting by slings.

64. Spiral chute.—A spiral chute for gravity handling of comparatively small packages has come to be part of the equipment of Rome piers.

65. Horizontal conveyors and tiering.—*a.* After the cargo has reached the deck of a wharf it can be handled by efficient machines which have been devised to take care of its further movement. It

has been pointed out that the chief expense at the terminal is in what is called "handling," that is, moving across the pier, tiering, then breaking down the tier, loading into drays or railway cars, and moving to the warehouse. For use on general cargo with wide variations in size, weight, and shape of parcels, the fork tractor and the "cooty" pallet have been developed.

b. It must be borne in mind that tiering is necessary if, for instance, a cargo of coffee for a ship is to be held ready in a shed of reasonable dimensions. To tier to the height required to husband

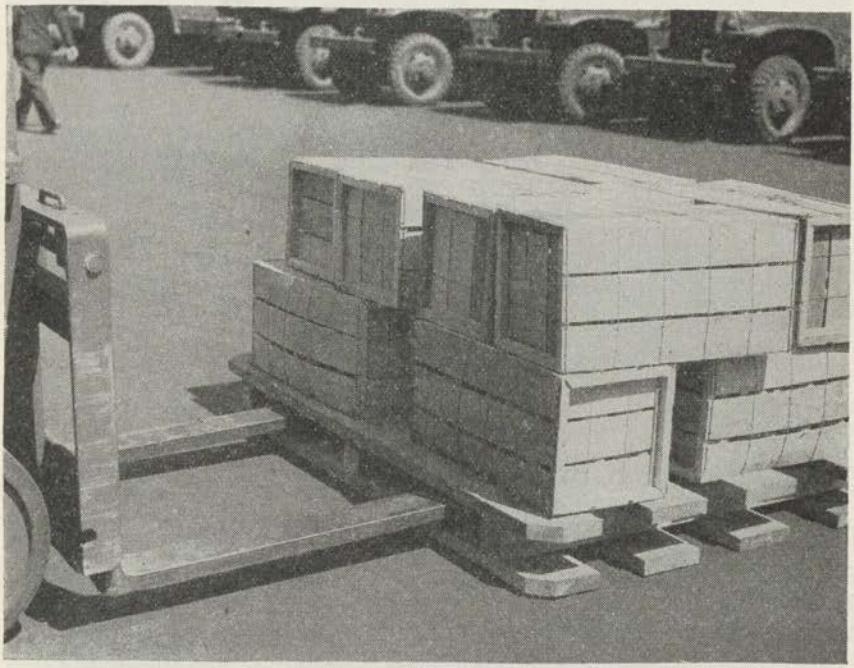

FIGURE 38.—Fork lift picking up load on "cooty" pallet ready for tiering.

space requires a large force of men. Tiering is done in a pyramidal plan with ledges or steps about a yard high. Each ledge requires a workman to hand the bag of coffee to the next higher ledge. Therefore, every additional yard in the height of the tier means an additional man and as many handlings as the stack is high. A tiering elevator is the solution and has been successful wherever built by reliable firms. A saving of as much as 80 percent in some cases has been credited to these machines. Here again the fork tractor and the "cooty" pallet play an important part in the quick tiering of cargo.

FIGURE 39.—Truck being hoisted after having been made ready for shipment.

SECTION VI

SPECIAL INFORMATION

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Boxing, crating, baling, and marking	67
Preparation of motor vehicles for shipment	68
Duties of first officer in connection with cargo	69

66. Fumigating.—Very often ships put into port with a serious disease on board. More often the cargo is laden with disease germs. These ships are fumigated immediately upon docking. All live cargo is discharged and men warn stowaways that the ship is about to be fumigated. This is shouted in every room and hold on the ship in ten or twelve different languages. Sometimes tear gas is permeated throughout the vessel as a warning to stowaways. If no answering call is heard the disinfecting crew close all hatches, ports and ventilators, and disinfect the vessel with cyanide gas. After a number of hours, the disinfecting crew returns to the ship equipped with masks, and open all ventilators, ports, and hatches. Tests are then made and when all traces of the cyanide have vanished, the stevedores are allowed to come aboard and start unloading. It is important to remember that any carelessness on board a freshly fumigated vessel may lead to very serious consequences. *Always* make certain that the ship is clear of gas before boarding it.

67. Boxing, crating, baling, and marking.—Boxing, crating, and baling will be in accordance with standard War Department specifications for oversea shipments. Students should be familiar with these specifications in order to be able to know at a glance the contents of boxes, crates and bales, their weights and cubic measurements.

68. Preparation of motor vehicles for shipment.—All automobiles, trucks, motorcycles, etc., must be thoroughly drained of water and gasoline, and batteries must be disconnected before being loaded on any ship. They must also, when carried as deck loads, be covered and securely lashed.

69. Duties of first officer in connection with cargo.—The first officer, under the master, is always in attendance during both loading and discharging of cargo and has at least one ship's officer or petty officer in each hold to see that the cargo is properly handled and to prevent theft. He will also see that all hatches are properly closed after loading. The master of the ship is consulted during the loading whenever any question of stowage or arrangment of cargo makes an unusual decision necessary. When the cargo is discharged, the first officer has every compartment of the ship thoroughly examined to see that nothing is left on board. Bags, cases, or crates, etc., if broken, are not taken from a ship in that condition; whenever such are found, the officer in charge of the hold has the container placed in a serviceable condition immediately. While loading or unloading a ship, there should be a commissioned officer in charge of the stevedore group or groups. He will make periodic inspections of the group or groups working the holds and will confer with the first officer of the ship

or his substitute, or the master of the ship when the occasion arises. There should be the closest cooperation between the authorities of the ship and the stevedoring officers.

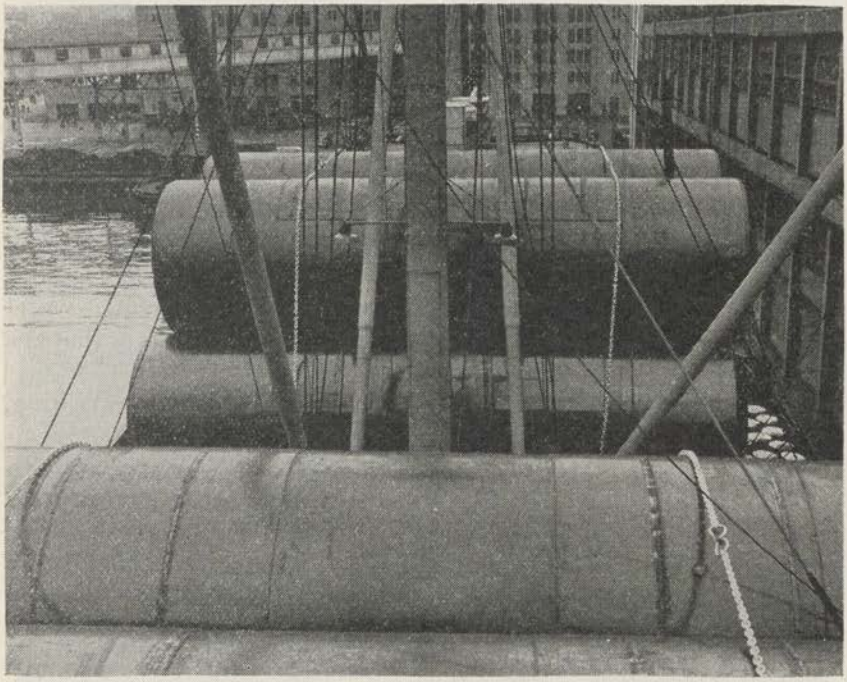

FIGURE 40.—Gasoline tanks chained to the deck of a transport for shipment.

SECTION VII

LEGAL POINTS COVERING A STEVEDORE'S PROPOSAL, EASTERN SHORES, U. S. A.

	Paragraph
Services furnished	70
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70. Services furnished.—Stevedores will furnish services from ship to dock and (or) dock to ship, handling ship's lines, gangway, mooring, and unmooring. They will assist in coaling of vessels. Extra services consist of the following: dock and car labor, ship stores, baggage, mails, clearing holds, lashing cargo, breasting off or in, handling lines, manning ships, salvaging cargo, rerigging for

heavy lifts, rigging and unrigging ship, furnishing equipment for loading or unloading, including rigging for heavy lifts and removing such rigging and equipment. They will take off and put on all hatches, and load and lay all dunnage. They furnish winchmen, also take cargo from ship length.

71. Taking delivery.—The stevedores take delivery of cargo, whether by land or water, at the point where delivery is made according to the custom of the various ports. If cargo is on deck

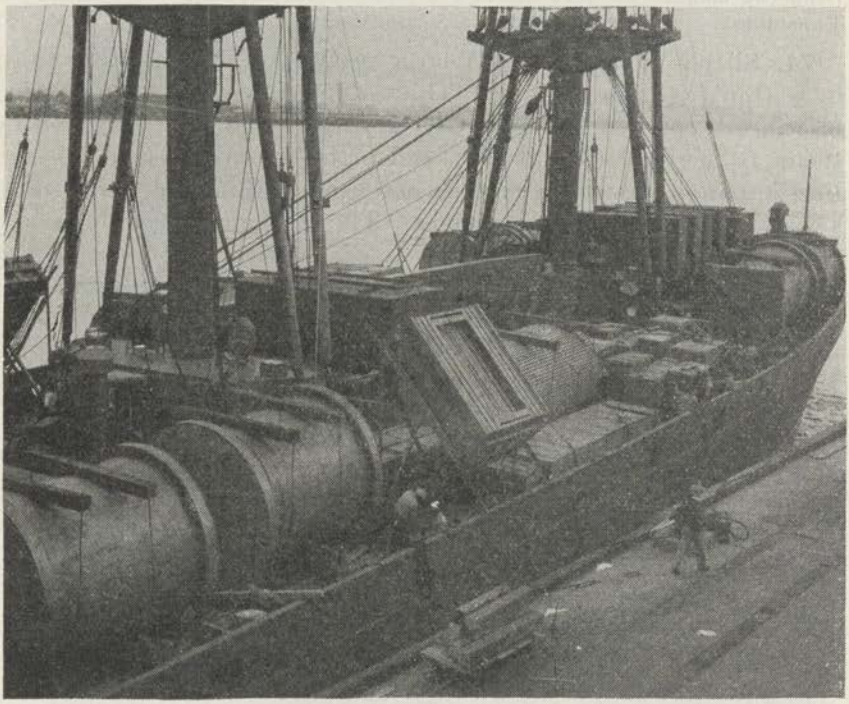

FIGURE 41.—Deck stowage by ship's gear.

delivery, it will be taken within ship's length. They shall transport cargo to and load it aboard steamer with all dispatch and safety, and properly stow same according to destination.

72. Discharging.—The stevedore will at his own expense break out and discharge cargo, either on dock and (or) craft alongside, transport same to any point on dock within ship's length, and pile it not more than breast high.

73. Gear.—The stevedore shall supply all necessary tackle and appliances to work the cargo when vessels are not adequately equipped with booms and winches.

SECTION VIII

OPERATIONS

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Kinds of winches 79
Drum-end man 80
Unloading 81

74. Ship's equipment.—A large proportion of cargo is handled by a ship's equipment alone. This equipment is simple, consisting of winches operated by electricity or small steam engines driven by steam from the donkey boilers, and of booms to which blocks and lines are fitted. A winch contains one or more drums, on which winds a wire rope that hoists the freight. The simplest conceivable apparatus would be one consisting of a winch with one drum around which is wound a wire. The wire is led through a block fixed at the end of a boom and then down into the hold; a weight fastened to it may be lifted by revolving the drum in such a way as to wind up the wire. Additions to this simple form are necessary to obtain horizontal movement, secure speed, and gain greater lifting power. Speed is secured by the elimination of lost time. There would be lost time if the rope itself had to be tied to each weight; therefore, the rope ends are in a hook which can be quickly attached to or detached from a receptacle in which the weight is put. Greater lifting power may be gained by running the wire rope through more than one block.

NOTE.—Rope may be wire or manila hemp.

75. Clearing the hatches.—*a.* In the loading of a vessel with general cargo, the first step is to get up steam, then clear the hatches, and next rig up the necessary tackle. Clearing the hatches is not difficult. A hatch consists of an opening boarded over at each deck that it passes through. These boards rest upon steel stringers and "strong backs" that may run either athwartship or fore and aft and are fitted to a coaming (raised portion of the deck around the opening) by grooves, in such a way that the boards can be lifted out.

b. Clearing a hatch, then, consists of rolling back the tarpaulins (usually four) that cover the boards, removing the boards by hand and setting them to one side, and lifting out and laying to one side by ship's tackle the beams and "strong backs." If the hatch is very large and the packages to be loaded are small, only part of the hatch needs to be cleared. The coaming, which should be at least 3

feet high, is primarily a safety device that helps to prevent the men from falling into the opening thus made.

76. Rigging.—The kind of rigging adopted will vary with locality, commodity, and equipment available. The simplest type consists of one rope attached to the center drum of a winch and passes through a block on the boom, which is fixed in position over the hatch, or through a block suspended from a span running from mast

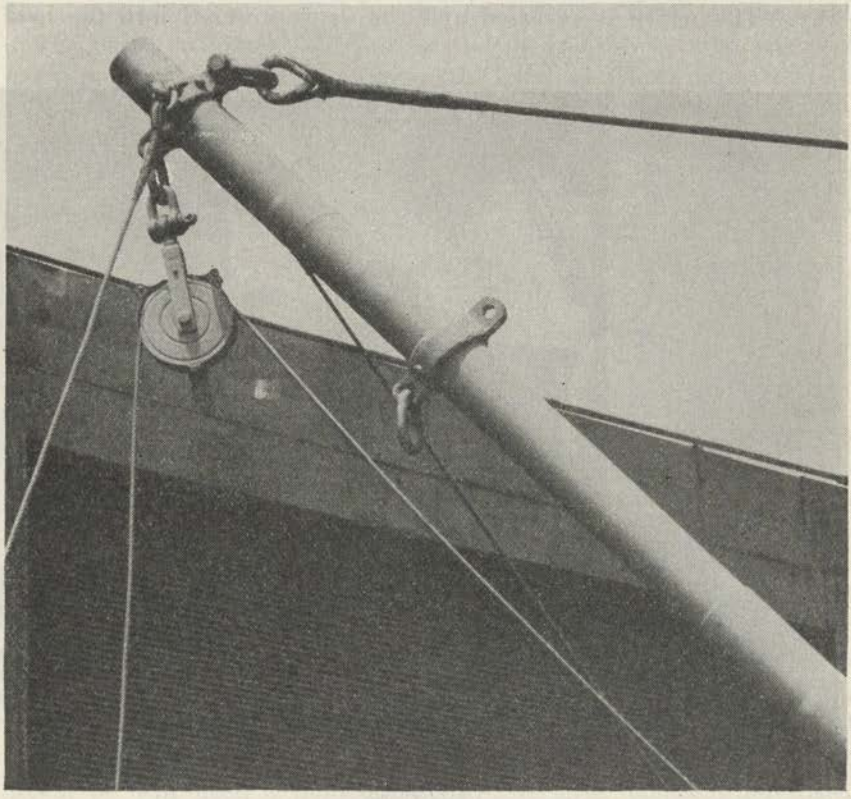

FIGURE 42.—Fittings at end of typical cargo boom.

to mast. This rope is called a "fall" or "whip." At present, in loading most cargo, two falls are used, the up-and-down fall, to lift and lower the draft or load, and the burton to obtain horizontal movement. If only one fall is used, the draft is dragged up to the hatch coamings. In order that it can be dragged, there must be a skid, or inclined plankway, from the pier to the deck and another from the side of the ship to the hatch coaming. These two skids, with the winch, the boom, and the fall, make up the transfer equipment.

77. Sling operation.—The packages are laid on the sling. The two ends of the sling are then brought up over the packages, and one end is passed through the other. The end that is passed through is the long rove and the other end is the short rove or bight. A hook on the end of the fall is then attached to the long rove. The gangway man gives the signal to the winchman, and the fall is wound up around the center drum. The sling tightens around the draft, which is dragged along the skids and swung out over the open hatchway. The winch is reversed and the draft lowered into the hold.

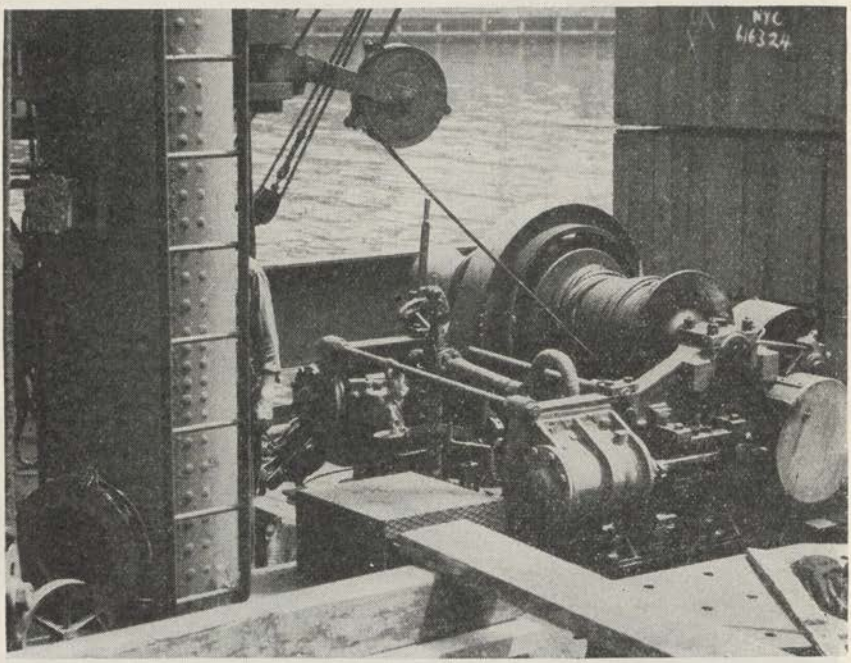

FIGURE 43.—Winch, block and cargo mast. Note simple winch, one winding drum and one niggerhead.

The stop is made in time to hold the draft clear of the deck or floor on which it is to be placed. Then several holdmen grasp the load and swing it as far as possible in the direction which it is to be stowed. It may take several swings. When it is over the proper place, the winchman lowers it rapidly to the deck. The hook is released and the fall is swung so that it can be caught by the whip runner as the winchman raises it. Finally the whip runner carries it down the skid and it is attached to another draft.

The disadvantages of this method, its slowness and the damage done to the draft by dragging it over the skids, are so serious that other methods have been adopted.

78. Other methods.—In some cases one fall drags the draft to the hatch coamings and is then released and returned to the pier, while another fall is attached to the draft and lowers it into the hold. This method speeds up the work considerably. In other cases one boom is swung over the ship's side and another over the hatch. The fall attached to the boom over the side lifts the draft to the level of the hatch coamings; the burton and up-and-down falls, attached to the boom over the hatch, swing to the hatch and down into the hold.

79. Kinds of winches.—There is not always a separate winch for each fall, although most vessels have two winches (many have more) at each hatch. There are three types of winches: one has only a central drum, another has only end drums, and the third has both central and end drums. The third type is most common. The burton is wound around and attached to the central drum; the up-and-down falls are wound on the drum ends but are not attached, and it is the duty of the drum-end man to cause a shortening or lengthening of the fall as necessary.

80. Drum-end man.—The work of a drum-end man may be difficult to understand unless seen. A fall runs from a block on the boom to the drum end, around which a few loose turns are taken, and a length of it is coiled up back of the drum-end man. Assume that a fall is used for lowering a draft into the hold. When the gangway man gives the signal to lower away, the drum-end man tightens the turns of the rope around the drum end, thus causing the drum end to "bite" the rope and begin uncoiling it. The drum-end man then feeds the rope to the drum end, being careful not to feed too fast or too slow. The entire weight of the draft is now placed on his fall, and he handles it simply by the purchase granted by the turns around the drum. If the weight is great, or if he is new to the work, he will need a number of turns to give sufficient purchase. When the draft is lowered in the hold the winch is stopped, but as soon as the hook is removed it is started again in a reverse direction, and the drum-end man takes up the slack and coils it behind him. He protects his hands from chafing and heat by wearing leather gloves.

81. Unloading.—In the discharge of a vessel, about one-half of the gang are on the pier and one-third in the hold with the remainder on the deck. The sling is laid under the "square of the hatch", and two men usually make up the draft. A common rigging consists of

an up-and-down fall from a drum end to a boom over the hatch and a burton from the central drum to a boom over the ship's side. The draft is lifted to a point near the level of the coaming by the up-and-

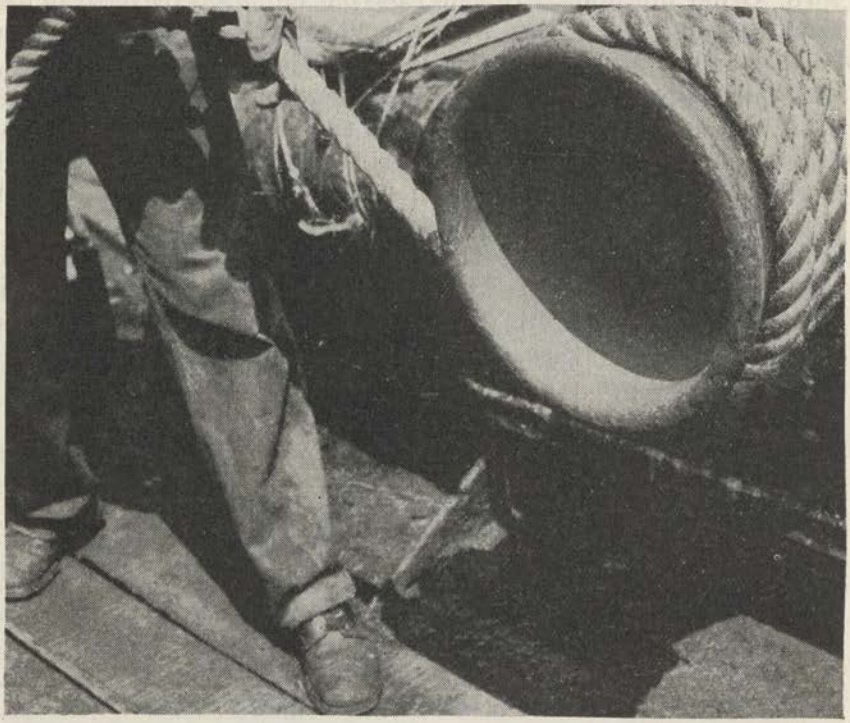

FIGURE 44.—Drum-end man using four turns around niggerhead.

down fall, and it is held while a deck man, called the "hooker-on" throws the hook on the burton and engages the up-and-down fall. Then both burton and up-and-down fall is payed out as the burton carries it to the side and lowers it to the pier.

SECTION IX

GEAR

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Use of floating cranes or derricks ---- 98
Miscellaneous cargo-handling equipment ---- 99
List of equipment normally in stock to load or discharge a five-hatch ship, with five groups, for general and bulk cargoes ---- 100

82. Claws.—For some classes of goods, hooks permanently fixed to the fall bite into the package. More often there are a pair of claws fastened to the fall, especially in lifting barrels or heavy cases.

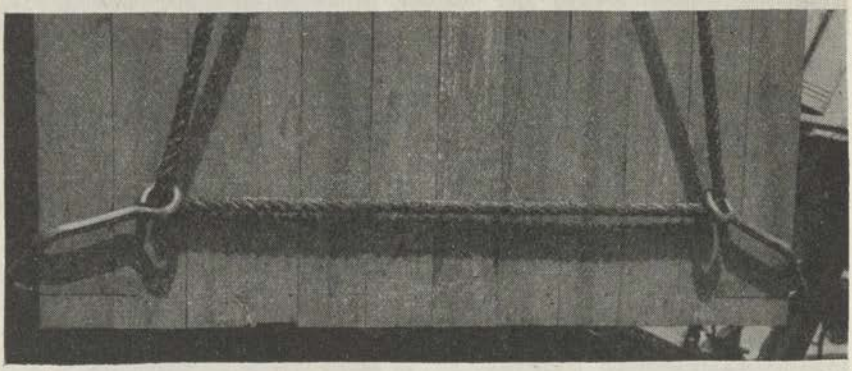


FIGURE 45.—Crate and box hooks used to elevate burden a few inches so that wind sling can be placed underneath.

The two claws are set in the wood or against projections on opposite sides of cases or barrels so that when the pull comes they grasp the package firmly. In handling small articles a net (either of rope or wire) or a box (a fruit box) is used. Buckets of various kinds replace the sling when ore, coal, etc., is hoisted. Sheet iron, small boxes, and other articles are in some instances carried on platforms or airplanes, which are rectangular in shape, with ropes or wires leading from each corner to the hook of the fall. Chains or wire may replace the rope sling for lifting heavy commodities; a web sling is sometimes used on packages that may be cut by rope or wire.

83. Block and tackle.—Block and tackle arrangement depends primarily on the weight of the draft. The winches on most ships will hoist about 5 tons by direct lift. For heavier weights shore machinery must be used or the power of the winch must be multiplied

by use of special tackle. The following paragraphs list the kind of tackle and show the power gained.

84. Single whip.—A rope through a single block fixed in any position. No power gained.

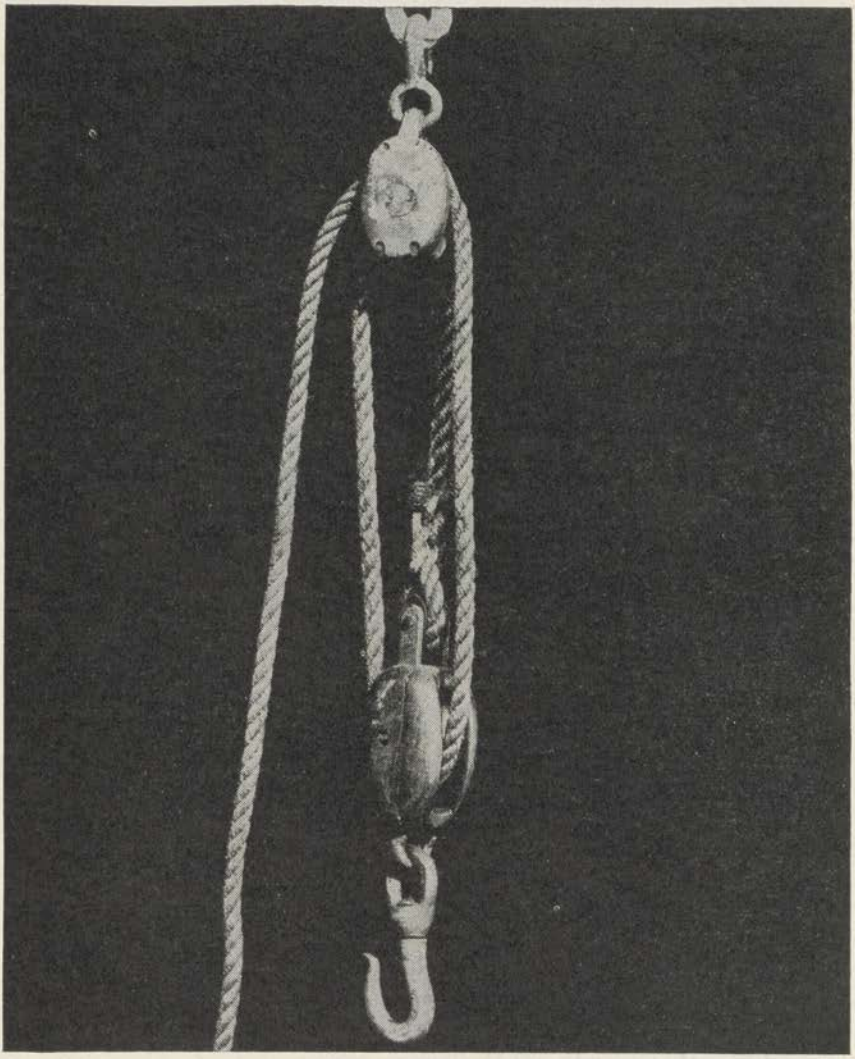


FIGURE 46.—The tackle. Blocks and ropes make a tackle.

85. Double whip.—A rope rove through two single blocks; upper block a tail block, lower block a movable hook block, the standing part of the fall secured close to the tail block. Doubles the power.

86. Runner.—A rope rove through the single block with standing eye on one end and pointed at the other. Doubles the power.

87. Single Spanish burton.—Two single blocks and a hook. Lift three or four times as much as a single block.

88. Luff tackle.—Two hook blocks, one double and one single. The standing part of the fall of the tackle is spliced into a strap

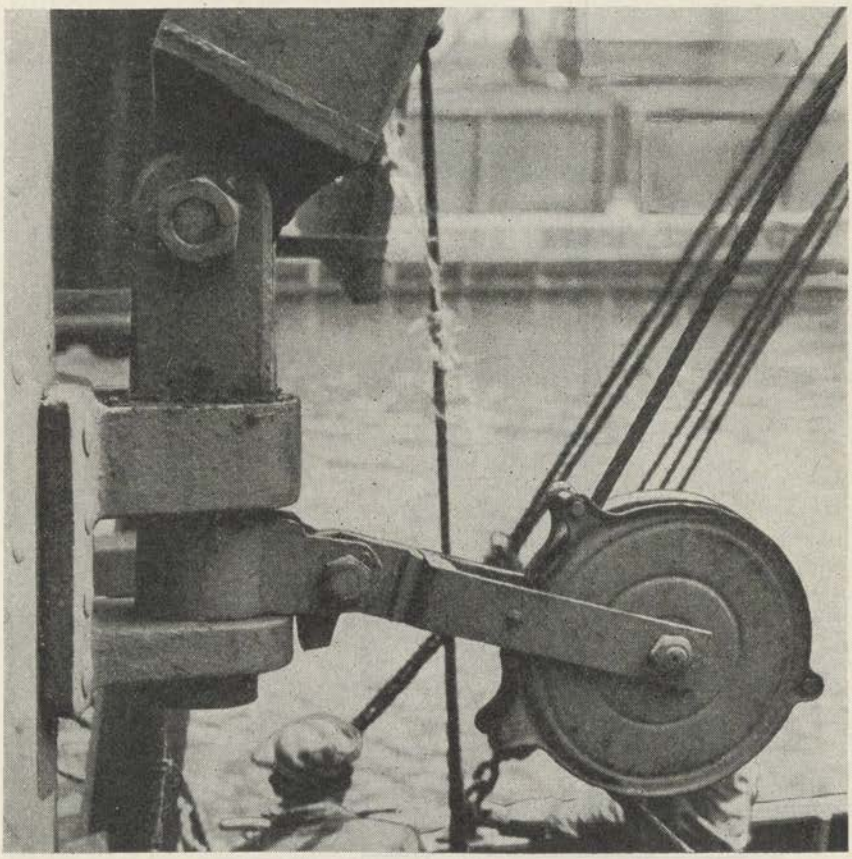


FIGURE 47.—Mast end of a typical cargo boom. Note swivels and simple block.

at the arse of a single block. It is sometimes rove through a becket in the arse of the single block and secured by being spliced around the strap at the neck of it. Lift three or four times as much as a single block, according to which is the movable block.

89. Jigger.—A double block with a tail, called a tail jigger, and a single block with a hook. Lift three or four times as much as a single block, according to which is the movable block.

90. Up-and-down.—A double and single block, the double block fitted with a thimble, the single block a hook block fitted with a long strap. Standing part of the fall is spliced in the strap of the single block. Lift three or four times as much as a single block.

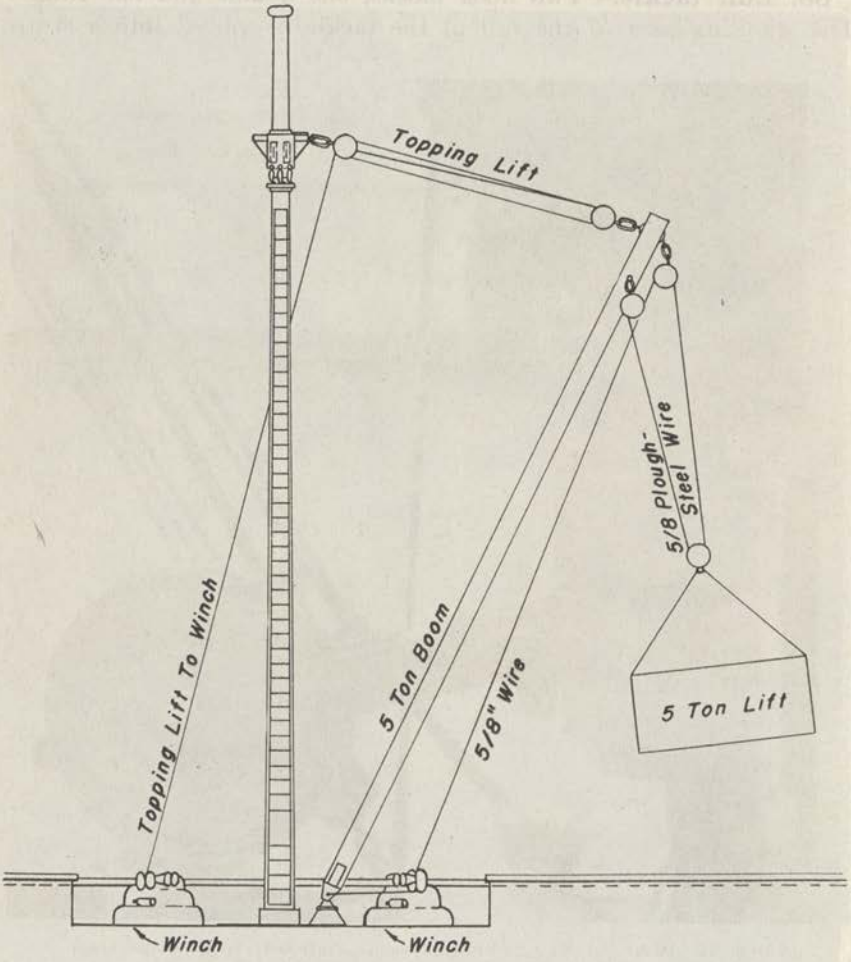


FIGURE 48.—Lifting 5 tons with winch of only 3- to 4-ton capacity.

91. Burton.—A double hook block and a single hook block, fitted with a long strap, the standing part spliced around the strap and hook of the single block. Lift three times as much as a single block.

92. Runner and tackle.—Three blocks, one double and two single. One of the single blocks is fitted with a thimble, as a lashing or shackling block through which the runner is rove. The double block of the tackle is spliced in the seat of the single block, which is fitted

with a long strap and hook. Lift eight times as much as a single block.

93. Threefold purchase.—Two threefold blocks. Lift six times as much as a single block.

94. Fourfold purchase.—Fourfold purchase has two fourfold blocks. Lift eight times as much as a single block.

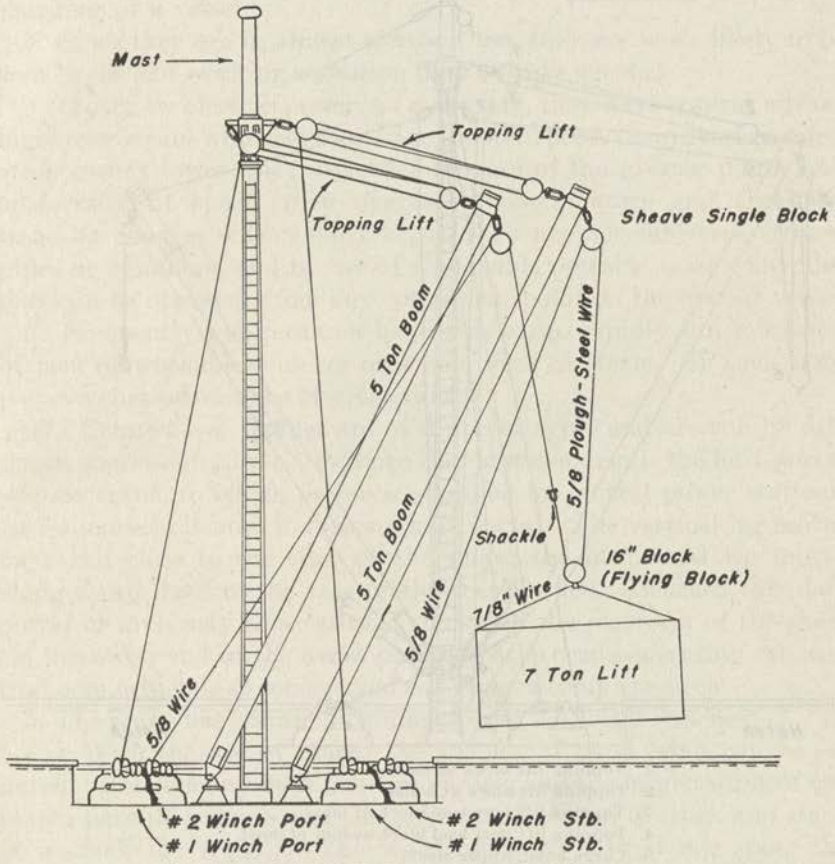
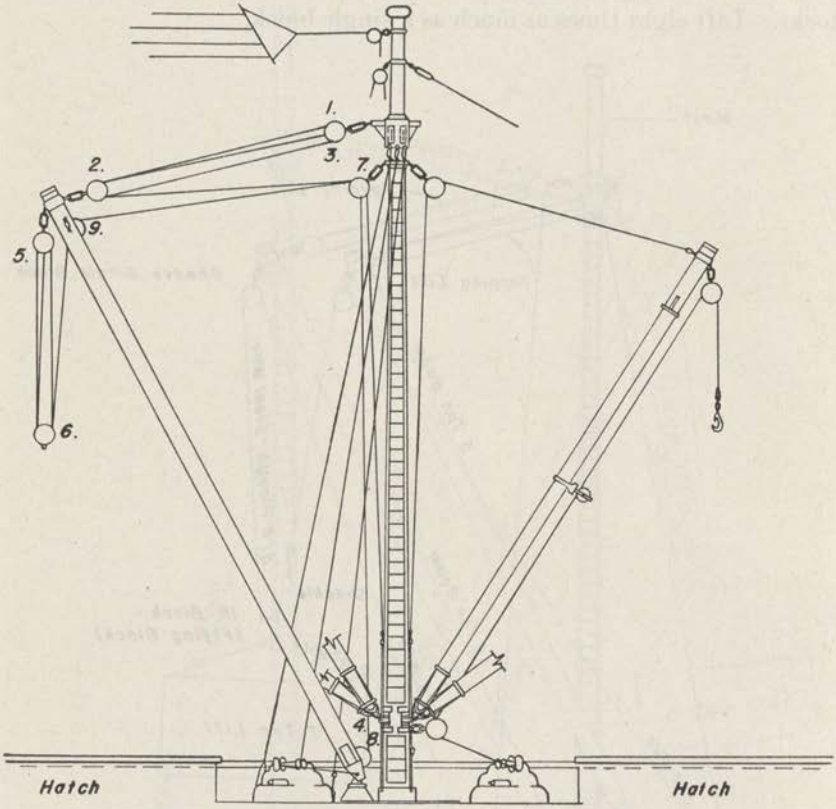


FIGURE 49.—Lifting 7 tons on two 5-ton booms.

95. Cargo masts.—Most of the modern piers are provided with a cargo mast of which there are several types. The oldest type consists of strong wooden masts stepped near the edge of the pier and connected with another near the edge of the pier and also near their summits by a stay. To the stay are fixed stirrups to which blocks may be attached. A second type was developed by connecting the projections of the pier columns by a stay. The most modern type replaces the stay by a steel beam that overhangs the pier columns

and is hinged in order to revolve according to the direction in which the load is applied.

96. Pier winch.—The height of the cargo mast above the pier varies from about 60 feet to 80 feet. These masts render unnecessary



1. Topping lift block at mast.
2. Topping lift block at boom.
3. Topping lift port lead block at mast.
4. Topping lift port lead block at foot of mast.
5. Cargo hoist, upper block.
6. Cargo hoist, lower block.
7. Cargo hoist starboard lead block at mast.
8. Cargo hoist starboard lead block at foot of mast.
9. Cargo hoist sheave or single block on boom.

FIGURE 50.—Derrick block arrangement, 5- to 50-ton boom.

the swinging of one or more of a ship's booms over the side of a vessel and release these booms for other service. Moreover, they allow for the operation of a pier winch. In almost all cases where a pier is so equipped, the burton is run through a block attached to cargo mast; in many cases this burton is operated by a pier winch

instead of a ship winch. Winches on the pier would seem, at first thought, to be an unnecessary expense, since in most cases they merely replace a ship winch, but they have proved advantageous for the following reasons:

a. They can be used for handling the lighter cargoes or in moving freight on the pier. Therefore, they accelerate the loading or discharging of a vessel.

b. Since they are in almost constant use, they are more likely to be kept in efficient working condition than a ship's winches.

c. If run by electric power, as many are, they have several advantages over steam winches: they have greater speed, their average operating cost is lower, they are safer because of the greater power and uniformity of speed, they operate at short notice and eliminate stand-by charges when delays occur, they are not subject to frozen pipes or cylinders, and by use of the double portable mast controller they can be operated from any convenient point on the pier or vessel.

d. Frequently a ship cannot handle its cargo rapidly either because of lack of workable winches or a poor feed of steam. In such cases pier winches prove to be of great value.

97. Cranes.—*a.* Cranes are of different types and are run by different sources of power. Perhaps the most common is the half-portal electric crane, to which power is supplied by central power stations. As its name indicates, it forms a half portal. The vertical leg moves on a rail close to the edge of the quay; the horizontal leg moves along a rail fixed to the face of the transit shed. Beneath this half portal or arch may be a railroad track and the platform of the shed. On the water end of the horizontal leg is the crane-operating cab and the boom, which is so constructed as to turn a complete circle.

b. The crane has certain advantages over the ship's winches:

(1) With the use of cranes the amount of hand labor can be reduced. Not so many deck men are needed, and the large radius of the cranes permits reduction of the force on piers used to truck and stack or unstack the freight. The winch deposits only at one spot; the crane deposits over a fairly wide area.

(2) The average electric crane is more powerful than the average ship winch, therefore extra rigging is not so often necessary.

(3) The crane can be used to handle lighter and barge cargoes and to transfer freight on the wharf, with a resulting acceleration in the movement of goods and dispatch of vessels.

(4) The crane is likely to be in better working condition than the ship's winch.

(5) Electric power has all the advantages over steam power already given in the discussion of pier winches.

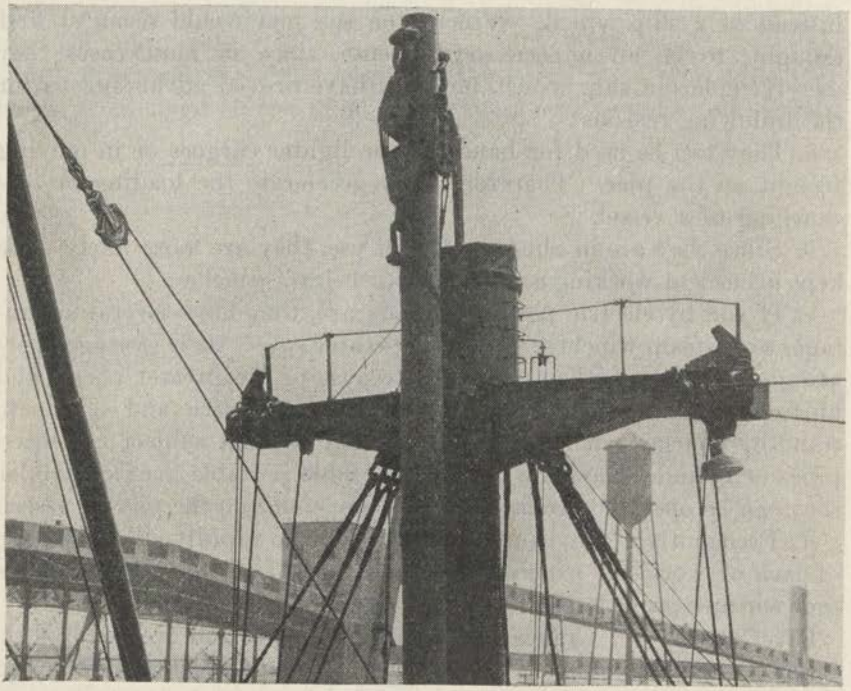


FIGURE 51.—Fourfold purchase. The 40-ton boom and rig.

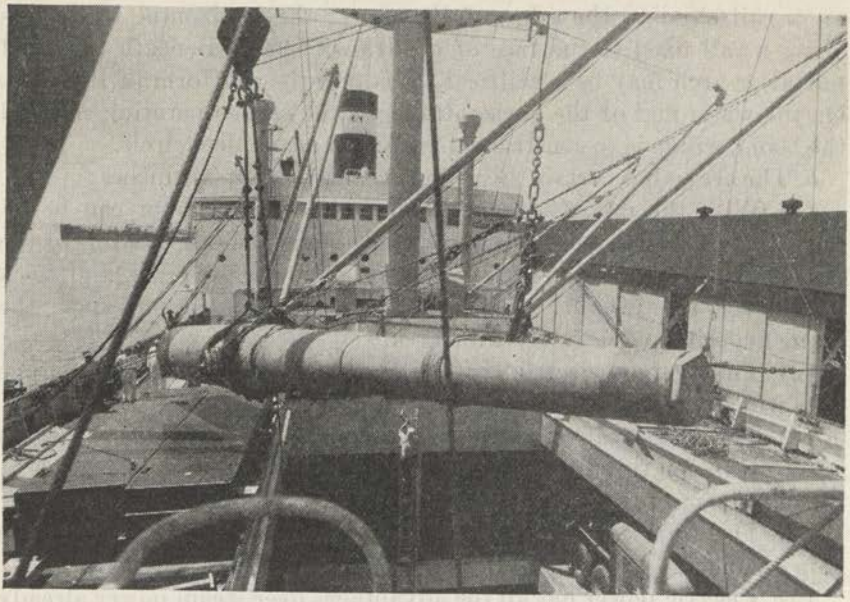


FIGURE 52.—Heavy cargo boom lift.

c. The crane has also disadvantages over ship's winches:

(1) Cranes are expensive to install and they replace existing equipment; consequently, their total overhead cost is large. They can only be advantageously used where their work is largely continuous due to a great volume of freight.

(2) Cranes occupy a large amount of space and cannot be placed on narrow piers common to American ports.

(3) Even when two cranes are used to a hatch there are only two falls. This difficulty has been met in some places by attaching a "bridle" to the fall so that three or four drafts may be handled at one time.

FIGURE 53.—Floating crane.

(4) The revolving crane may be wasteful of time and may be limited in action by the ship's shrouds.

98. Use of floating cranes or derricks.—To handle very heavy articles floating cranes are used. Ordinarily it would not pay to install a large, expensive crane at a wharf over which general merchandise passes, for its service would be limited, but a crane that can move from ship to ship as needed, is of great service. Such cranes are built with capacities up to 150 tons and are of various types. There are floating steam hoisters, lifting towers, derrick lighters, etc. These floating cranes are used in loading uncrated airplanes. Movement generally is from an open barge at one side of the crane to the ship's deck at the other side.

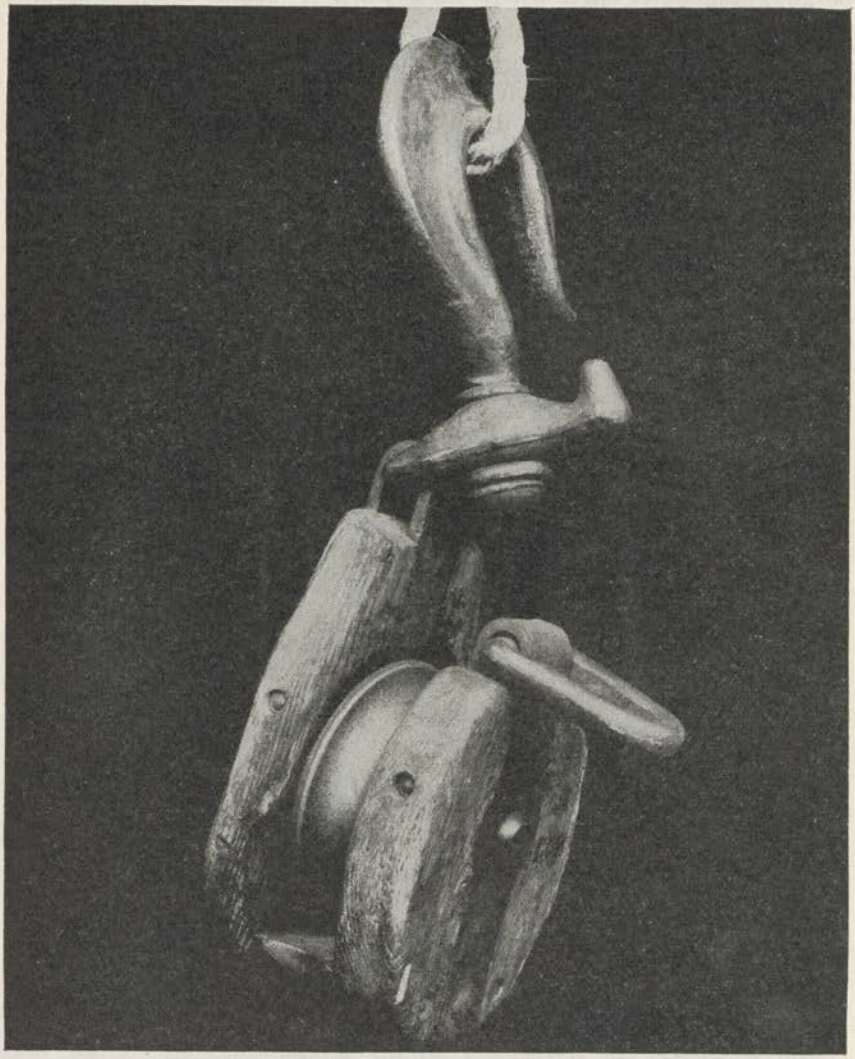


FIGURE 54.—Snatch block. This block can be rigged without passing an end of rope through the eye.

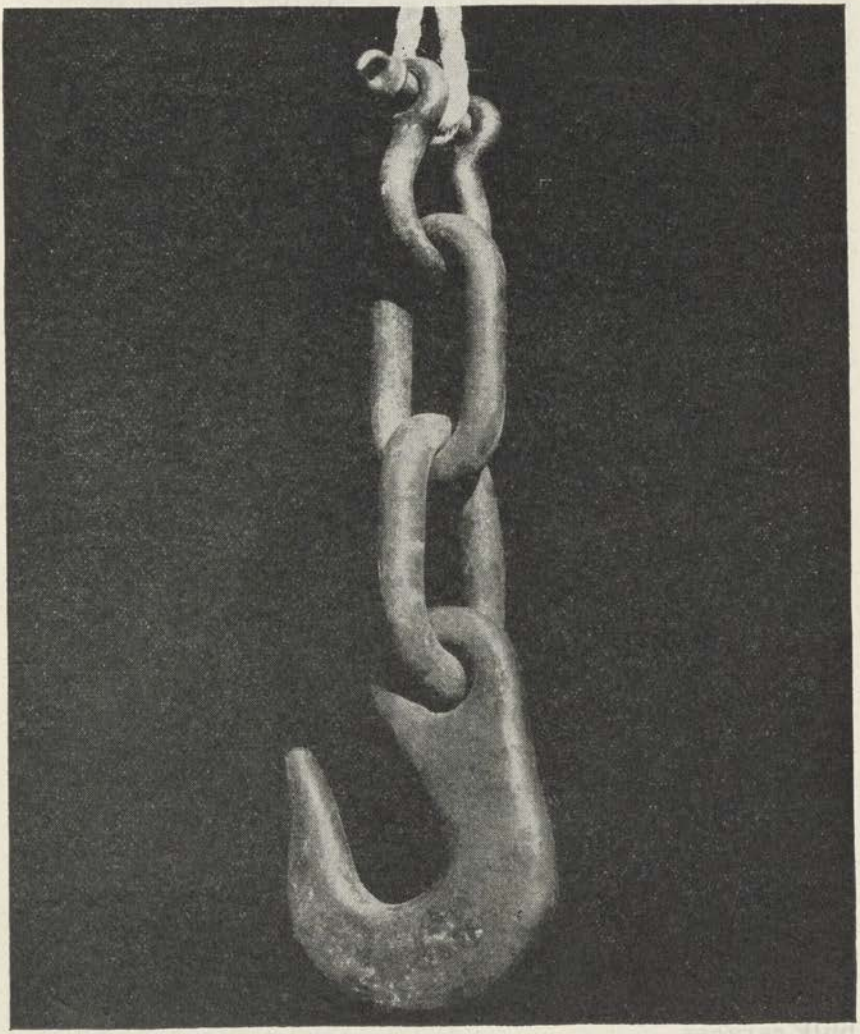


FIGURE 55.—Small, heavy-duty cargo hook.

99. Miscellaneous cargo-handling equipment.

Ammunition boxes
Barge cranes
Barrel skids
Beam clamps
Cargo hooks
Crawler cranes
Crowbars
Differential chain hoists
Fids
Flexible wire
Fork lift trucks
Gangways
Gravity conveyors
Hand trucks
Hatch tents
Jacks
- Hydraulic
- Mechanical
- Roller

Lighters
Manila rope
Marlin spikes
Nets
- Rope cargo
- Rope save all
- Wire cargo

Overhead traveling crane
Pallets
Pinch bars
Power conveyors
Power shovels
Rigger's splicing vise
Shackles
Anchor screw
Cargo
Screw pin
Steel sheets
Side-cutting pliers
Slings
- Automobile
- Bridle chain
- Canvas balloon
- Rope
- Single chain
- Truck
- Wire

Sling boards
Snatch blocks
Straps, rope
Tackle blocks (double and triple)
Tarpaulins
Tractors
Trailers
Wheelmount cranes
Winches
Wire chokers
Wire rope clips
Wire rope thimbles
Wood rollers
Wood spreaders

100. List of equipment normally in stock to load or discharge a five-hatch ship, with five groups, for general and bulk cargoes.

No. for each hatch	*Item*	*Total*
10	Rope slings, 3- to 3½-inch rope, 30 feet long	50
10	Sugar or canvas slings, 3- to 3½-inch rope, 30 feet long, each sling with 8 feet of canvas	50

No. for each hatch	*Item*	*Total*
4	Net slings, 3-inch rope, 3½-inch outside rope and 4-inch grab rope for slinging, 14 by 14 feet	20
5	Double pallets, 4 by 4 and 4 by 8 feet	25
5	Single dishes or board slings, 4 by 6 feet	25
5	Rope slings (single rope sling) 3½-inch rope, about 10 feet long, eye in each end	25
5	Lumber bridles, 4-inch rope, 18 feet long, sliding hook, eye in each end, and iron ring	25
1	Auto sling, four wires, size of wire ⅝-inch with 6 by 6-inch oak spreaders. Each of the four wires 15 feet long, with a hook on end of each	5
4	Single wire slings, ⅝-inch wire, 12 feet long, with eye and sliding hook	20
4	Wire bridles, ⅝-inch wire, 18 feet long, each wire with ¾-inch iron ring and sliding hooks, eye in each wire	20
5	20-, 30-, 40-, and 50-foot lengths, 1-inch plow-steel wire for heavy lifts, at least four tucks in splices, with eye in each end, five of each	25
1	Seawall, 2-inch rope about 20 by 25 feet with about 5 foot lashings on long side	5
10	Airplane or board slings with bridles	50
10	Ammunition boxes, with bridles attached	50
3	Chain slings, ¾-inch chain, 12 feet long, with 2 rings, 1 ring larger so chain can be run through	15
	Car plates ⅜-inch by 6 feet by 4 feet with hole drilled to handle, each ship	10
5	Rail keys	25
2	Sliding pans 18-inch by 18⅜-inch sheet	10
1	Snatch block	5
1	Cargo hook	5
	Shakles, each ship	10
7	Hand trucks	35
7	Four-wheeled trailers	35
6	Crowbars	30
	Pulling or towing tractors, each ship	5
3	Rollers	15
1	Barrel hook, with spreaders, 6 by 6 by 4 feet, six chains with six hooks to sling three barrels at a time	5
4	Buckets	20

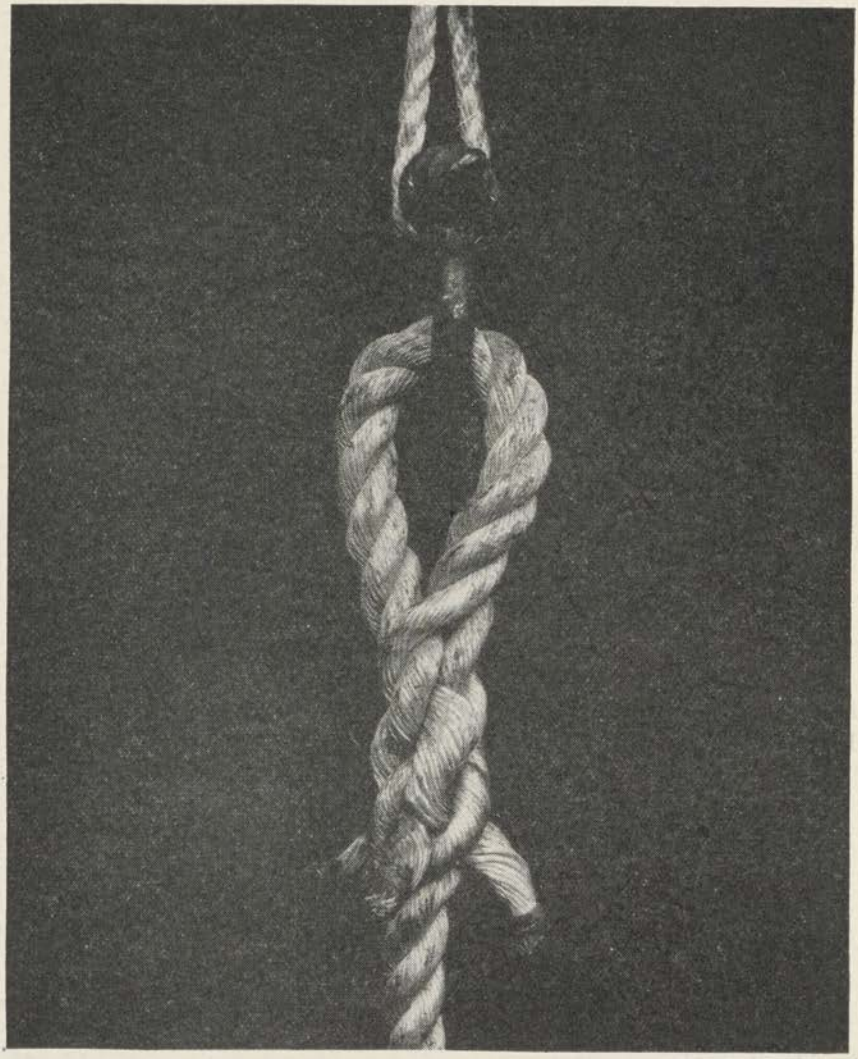


FIGURE 56.—The eye. Note the short splice.

SECTION X

SPECIFICATIONS

	Paragraph
Nets	101
Tents	102
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Slings	105
Shackles	106

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Conveyors 112
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Pliers 115
Jacks 116
Thimbles 117
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Blocks 119

101. Nets.—*a.* Cargo, save-all type, size 20 by 40 feet as per the following specifications: Frame to be constructed of four-strand manila rope, 3¾-inch circumference; eye splices at each corner of the net to be made with three tucks into which four rope lanyards of three-strand manila rope, 3½-inch circumference, 12 feet in length when finished, shall be spliced with three tucks each. Netting to be constructed with three-strand manila rope, 3-inch circumference, and to be made with a six-inch square mesh, measured inside mesh. In making the meshes one strand of the vertical rope is to be put through one strand of the horizontal rope. The ends of each row of meshes are to be spliced into the frame with eye splices with two tucks, best commercial grade. Rope to conform to Federal Specifications TT–R–601a.

b. Cargo, manila rope, size 12 by 12 feet as per the following specifications: Frame to be constructed of four-strand manila rope, 3¾-inch circumference; eye splices at each corner of the net to be made with three tucks into which two rope lanyards of three-strand manila rope, 3½-inch circumference, 12 feet finished, shall be spliced with three tucks each. Netting to be constructed with three-strand manila rope, 3-inch circumference, and to be made with a 6-inch square mesh, measured inside mesh. In the making of meshes one strand of the vertical rope is to be put through one strand of the horizontal rope. The ends of each row of meshes are to be spliced into the frame with eye splices with two tucks, best commercial grade.

c. Wire, cargo, each net to measure 10 by 10 feet, frame to be constructed of ½-inch diameter, 6 by 19 lay plow-steel wire rope, with eye splices made with four tucks at each corner of net, into which two wire lanyards of ⅝-inch diameter, 6 by 19 lay wire rope, 10 feet long shall be spliced with four tucks. The netting of nets is to be constructed with ⅜-inch diameter, 6 by 19 lay plow-steel wire rope and is to be fabricated with a mesh 8 inches square. In the construction

of the meshes the vertical wire ropes are to be put through three strands of the horizontal wire ropes. The ends of each row of meshes are to be spliced into the frame with eye splices with three tucks. All wire used in nets is to be galvanized.

102. Tents.—Hatch, size 25 feet base by 26 feet wide by 28 feet hoist, to be made of the special flexible waterproofed and mildew-

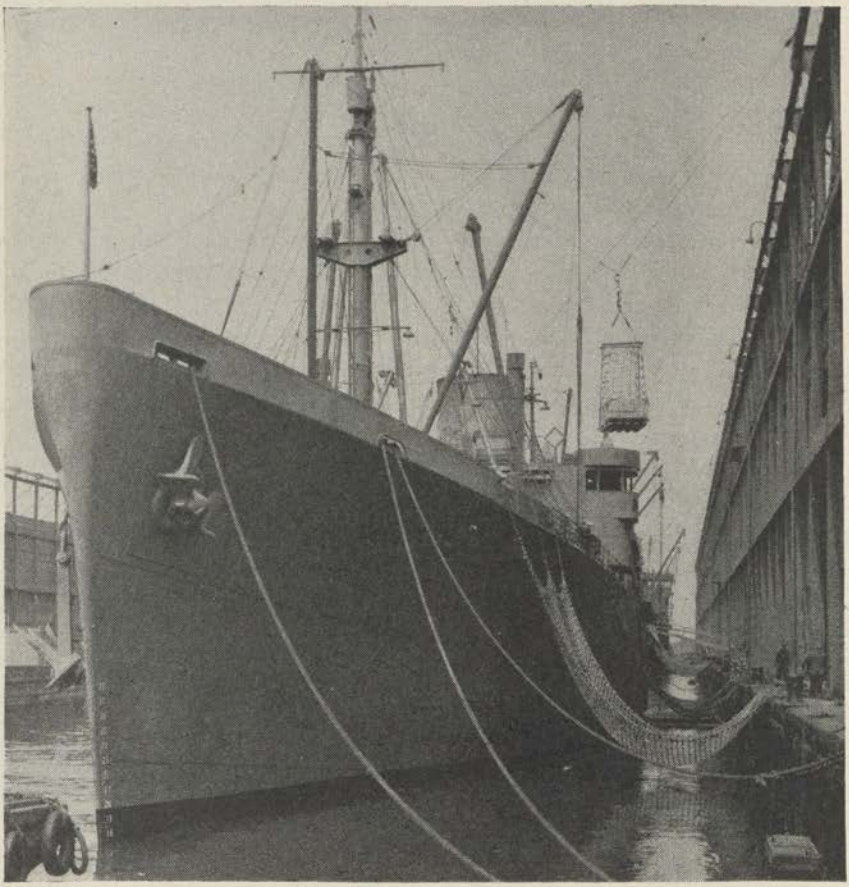

FIGURE 57.—Draft of cargo on "cooty" pallet being taken aboard by airplane sling. The picture also shows method of securing catchall.

proofed No. 6 Mount Vernon duck or its equivalent, and will be fully hand roped and fitted with flexible cable ridge.

103. Trucks.—Hand, dock, wood, lower crossbar to extend out over wheels, forming a shield; upper crossbar doubled to form a heavy brace for handles; heavy center strap riveted to crossbars, length of handles, 5 feet by 2½ inches, cast semisteel wheels, with

rubber tires molded on; width at upper bar 20½ inches; width at nose 6½ inches, with Hyatt roller bearing.

104. Crowbars.—Steel. These bars, for heavy duty use in the holds of vessels, measure 5 feet long and have 5½-inch heel on the lifting end; steel leading to the heel square for 12 inches and measures 1⅝ inches. Remainder of length of crowbar to be made of round steel tapering off to 1⅛ inches diameter at other end of crowbar.

105. Slings.—*a.* Wire, plow-steel uncoated, 6 by 9 lay made of ¾-inch diameter wire. Each end to have an 18-inch eye spliced with four tucks, ends of splices to be served with marline in the best commercial manner. Wire rope to be in accordance with Federal Specifications RR–R–571.

b. Wire, plow-steel, uncoated, 6 by 19 lay made of ¾-inch diameter stock. Each end to have an 18-inch eye spliced with four tucks, ends of splices to be served with marline in the best commercial manner. Wire rope to be in accordance with Federal Specifications RR–R–571.

c. Wire rope, plow-steel, uncoated, 1-inch diameter 6 by 19 lay, with a 2-foot eye spliced in the end of each sling with five tucks finished and full and the splices served with marline according to the best commercial practice. Wire rope to be in accordance with Federal Specifications RR–R–571.

d. Wire, marline-covered wire rope, plow-steel, uncoated, 1-inch diameter after serving with marline, ⅝-inch diameter before serving. Each end of sling to have an 18-inch eye spliced with four tucks and the ends of the splices served with marline according to best commercial practice. Wire rope to conform to Federal Specifications RR–R–571.

e. Chains, single, 12 feet long finished length, with hook on one end and ring on other end of each sling, to be made of ⅝-inch diameter chain, uncoated, with coupling links, ¾-inch diameter rings to be made of 1⅛-inch round steel, medium, with an inside width of 5 inches, sling hook on other end of chain to be fabricated of 1⅝-inch diameter round steel, medium, with a 2½-inch throat opening, extreme length of hook to measure 9 inches, best commercial grade.

f. Chains, double branch, 12 feet long finished length, with hook on one end and one ring coupling two single chains, to be made of ⅝-inch plain iron chain, uncoated, with coupling links ¾-inch diameter. Ring to be made of 1⅛-inch round steel, medium, with an inside width of 5 inches. Sling hooks on other end of chain to be fabricated of 1⅝-inch diameter round steel, medium, with a 2½-inch throat opening, extreme length hooks to measure 9 inches.

106. Shackles.—Anchor, screw, pin, drop-forged steel, galvanized, Federal Specifications RR–C–271.

107. Rope.—*a.* Manila, three-strand, plain, plaited, Federal Specifications TT–R–601a.

b. Wire, plow-steel uncoated, fibre core, 6 by 19 lay, 5/8-inch diameter, Federal Specifications RR–R–571, type XX. To be placed on 36 reels 2,000 feet each.

FIGURE 58.—Crane hoist lifting a 3-ton ingot with wire sling.

108. Clips.—Wire rope, galvanized, heavy steel μ-volt with standard hexagon nuts, U. S. Army Specifications 29–70A.

109. Hooks.—*a.* Cargo, drop-forged steel, Liverpool pattern, 13-inch hook, 1-inch swivel, 1 5/8-inch throat opening.

b. Cargo, lip.

c. Hoist, reversed eye.

110. Hoists.—*a.* Chain, differential, 3-ton capacity, standard lift 10 feet, reach 11 feet 11½ inches, minimum distance between hooks

23⅓ inches, chain pull to lift full load 103 pounds. Weight each 261 pounds.

b. Chain, differential, 5-ton capacity, standard lift 12 feet, reach 15 feet 2½ inches, minimum distance between hooks 38½ inches, chain pull to lift full load 102 pounds. Weight each 399 pounds.

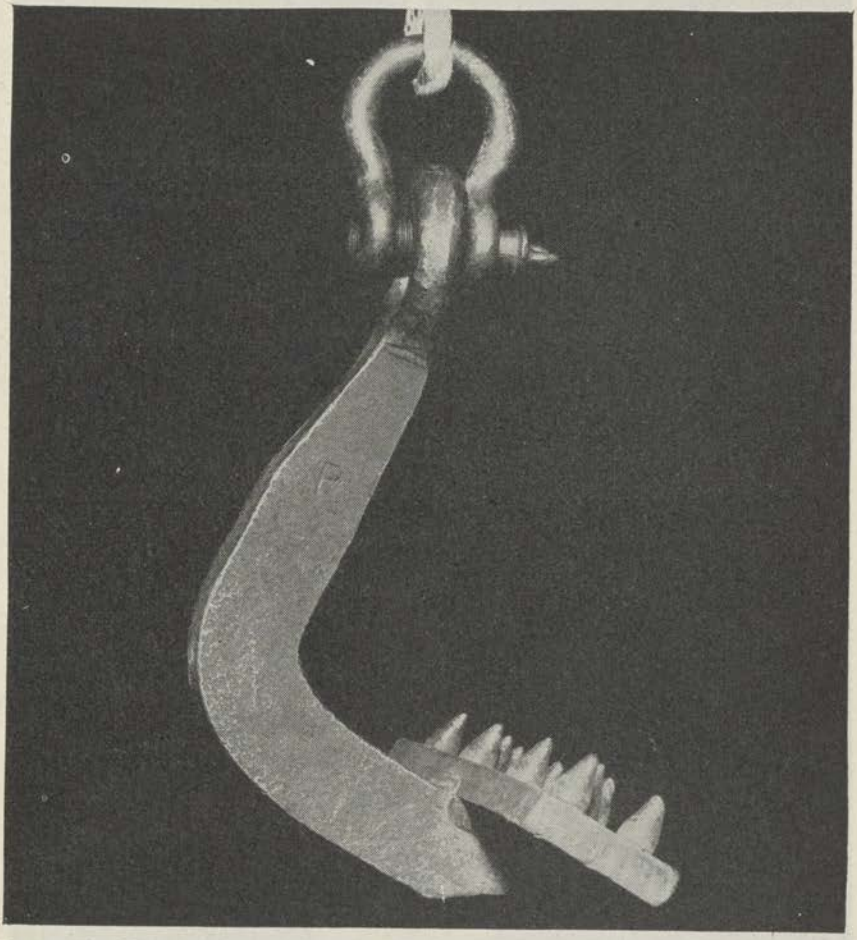

FIGURE 59.—Box hook designed by the Army to hoist large packing boxes. Used in pairs.

111. Clamps.—Beam, hand-forged, assorted.

112. Conveyors.—Roller type, as per the following specifications: Conveyors are to be made up in 3½-inch, #10 gage channels, in 10-foot sections, 12 inches wide between channels. Three 1½-inch by 1½-inch by 3/16-inch angles are welded between channels as spreaders. The angles are welded in the center of the channel to make an equal stiff-

ness. A locking plate is provided for each section so that the sections may be joined together to make a continuous run. This lock is held together with pins, constructed so as not to slip apart during operation. Rollers are mounted on 7/16-inch hexagonal shafts, held securely in

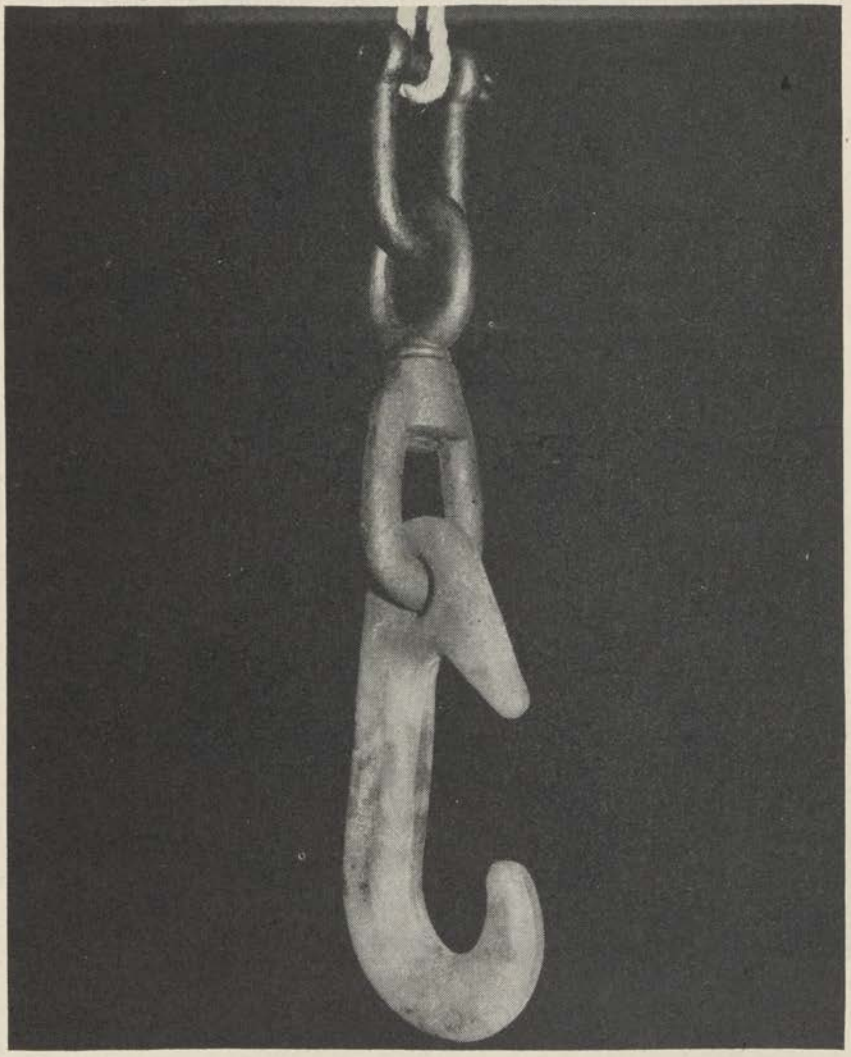

FIGURE 60.—Heavy cargo hook, hand forged, capable of hoisting 80 tons.

place in the rails by one locking bar on each side. The locking bars are bolted to the side rails to prevent rollers from slipping out under rough handling. Rollers are made of #16 gage steel tubing, and are fitted with self-contained removable ball bearings, made of twenty

5/16-inch diameter carbon steel balls with hardened inner and outer races. Top of roller is 3/16 inch above rail flange. Housings of the bearings are pressed into the steel tube, forming the end of each tube over to make the housing secure. The distance between the end of the tube and the rail is 5/32 inch. Rollers are spaced 6 inch centers, insuring proper travel for boxes of any length down to a minimum of 14 inches long. The weight of each 10-foot section to be 135 to 140 pounds to permit easy handling on the dock. Equipment to be equivalent to Samuel Olson roller conveyor for dock handling.

113. Tarpaulins.—Canvas, heavy duck, khaki, water-proofed, #4, hard, 17 by 30 feet without grommets or ropes, hemmed, 42-inch widths, best commercial grade.

114. Vises.—Riggers', splicing, 6-inch, to be the same as one now in use in marine superintendent's office. Federal Specifications GGG–V–436.

115. Pliers.—Side cutting, 8½-inch, lap joint, forged steel, plain blued finish handles, tip of nose and face polished, best commercial grade.

116. Jacks.—*a.* Hydraulic automobile, 4-ton, Big Boy, Roll-a-Car, power raise 20-inch capacity size; 7-inch diameter, front wheel size 4½-inch diameter, weight 180 pounds.

b. Hydraulic, utility, automobile, 2-ton, Short, Roll-a-Car, power raise 16½ inches, capacity size 7-inch diameter, wheel size 3¾-inch diameter, weight, 116½ pounds.

c. Hydraulic, Roll-a-Car, power raise 16 inches, capacity size 5¾ inches, front wheel size 6-inch diameter, weight 338 pounds.

d. Mechanical, plain automobile and motor truck, ratchet lever, quickly adjustable sliding-type foot lift.

e. Mechanical, plain, ratchet lever, automatic lowering, base and frame of malleable iron, rack bar of steel, properly hardened and equipped with forged claw or ground lift.

f. 25-ton, mechanical standard speed, bevel geared screw, ball bearing, pinion, suitable shaft between pinion and ratchet, sleeve, standard and screw with suitable threads in standard lining cap, ratchet and lever, complete with handles.

117. Thimbles.—Wire rope, steel, galvanized for ⅝-inch diameter rope, approximately 3⅝ inches, extreme length, oval, best commercial grade.

118. Trucks.—Hand, four-wheel, heavy, Pull–E–Z with Hyatt roller bearing Hi-steel iron wheels, L–P–3 size.

119. Blocks.—*a.* Double, regular inside iron strapped, wood wheels, with loose single hook, iron sheaves, 8-inch shell with sheave

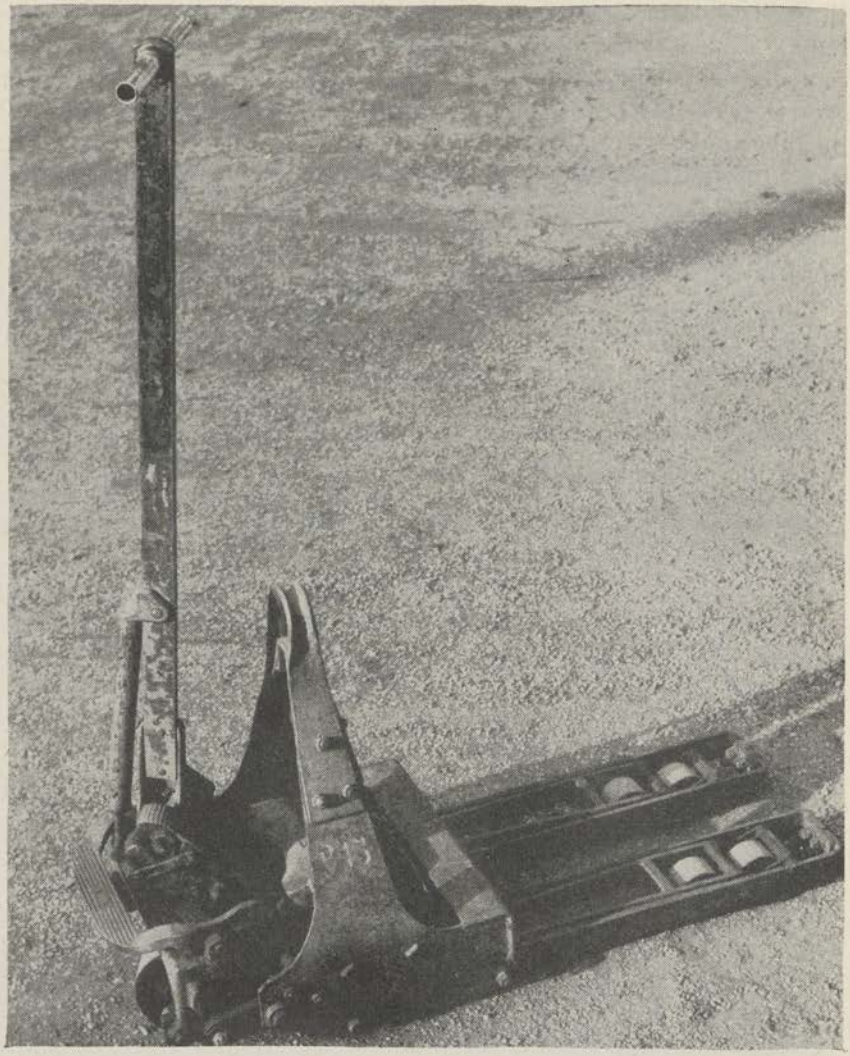

FIGURE 61.—Heavy duty, low-lift, hydraulic jack.

for 1-inch manila rope. Sheave to be 4¾ by 1⅛ inches, bronze self-lubricating bushings.

b. Triple, regular inside iron strapped, wood shell, with loose single hook, iron sheaves. Blocks to have an 8-inch shell with sheaves for 1-inch diameter manila rope. Sheave is 4¾ by 1⅛ inches, bronze self-lubricating bushings.

c. Metal, heavy galvanized for manila rope 1½-inch diameter, double sheave, loose hook. Sheave is 8 by 1⅝ by ¾ inches, length of shell 12 inches.

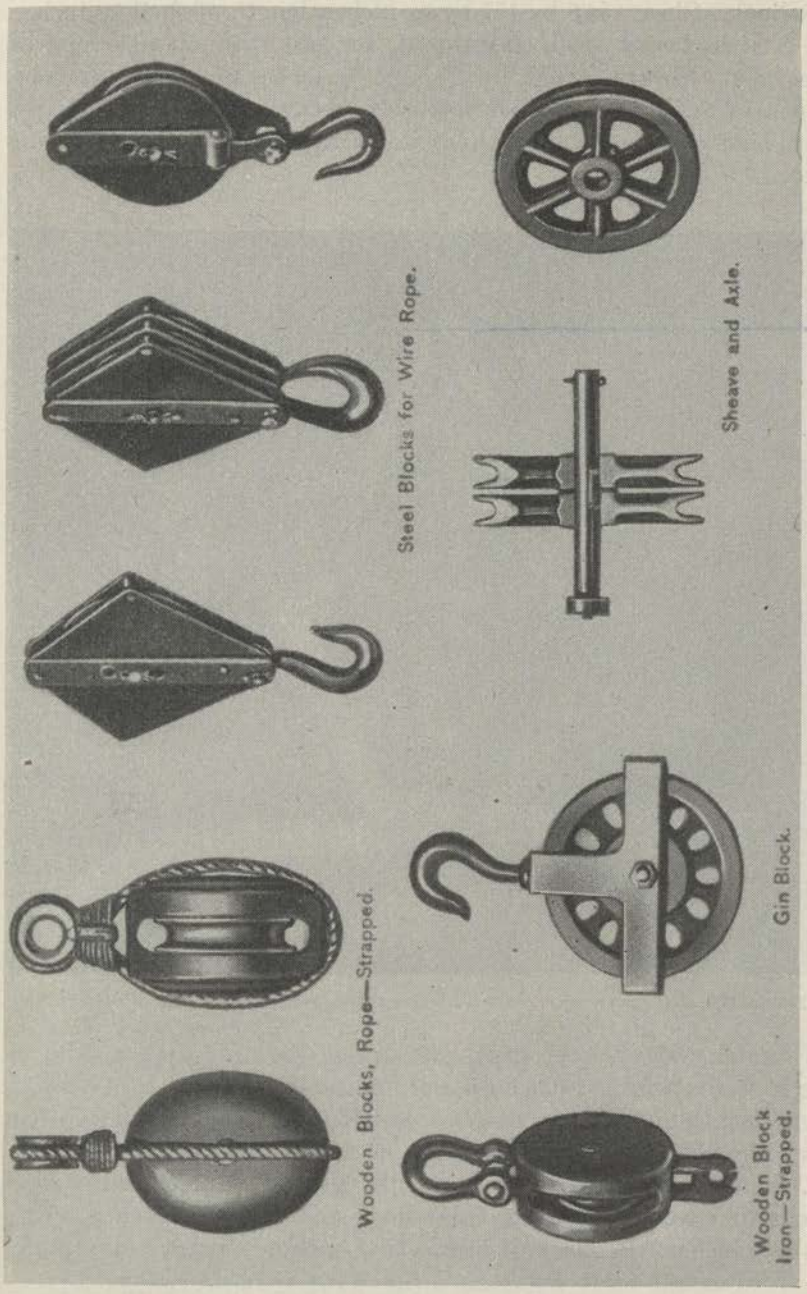

FIGURE 62.—Blocks.

d. Metal, heavy galvanized, for 1½-inch manila rope, triple sheave, loose hook. Sheave is 8 by 1⅝ by ¾ inches, length of shell 12 inches.

e. Snatch, heavy steel, galvanized, for use with manila rope or wire rope. Sheave is 6¾ by 2⅛ by ¾ inches for 1½-inch rope. Length of shell 12 inches, bronze self-lubricating bushings, flatted swivel hook and link drop-forged, extra heavy pin with safety locking device.

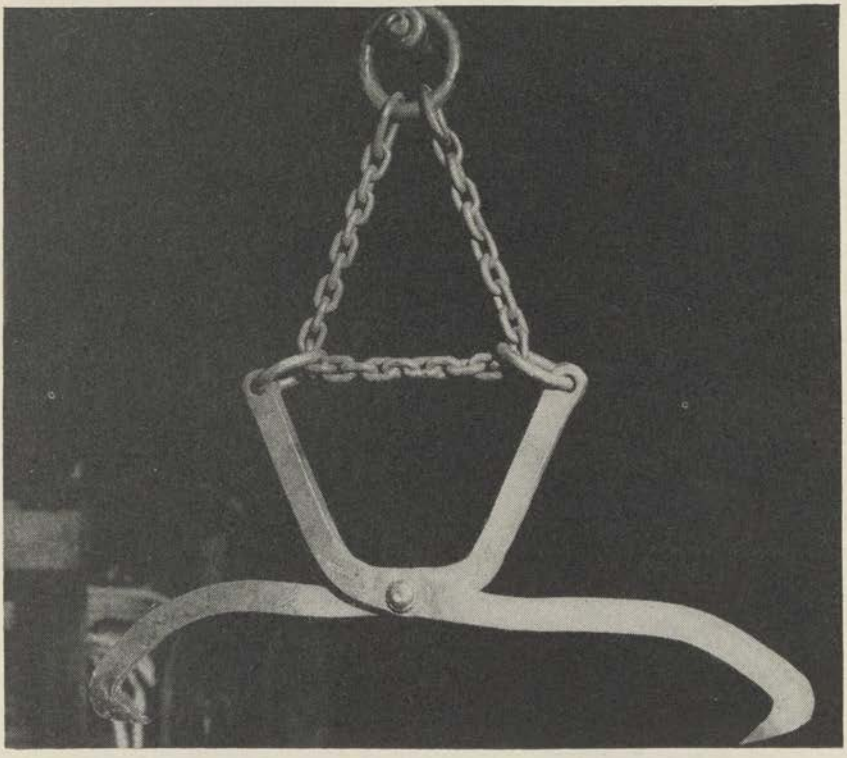

FIGURE 63.—Bale hooks used to extricate jammed bales and drag them to the well.

f. Snatch, heavy steel shell, galvanized, for use with manila or wire rope, drop-forged flat hook and link. Sheave is 4½ by 1⅜ by ⅝ inches, length of shell 8 inches, bronze self-lubricating bushings, extra heavy pin. Is to be fitted with safety locking device.

g. Snatch, steel plate, for use with ⅝-inch diameter wire rope. Blocks to have a drop-forged flat hook and link. Sheave is 10 by 1¼ by 1 inches. Bronze self-lubricating bushings, extra heavy pin.

CHAPTER 2

LOADING THE CARGO

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SECTION I

SIGNALS FOR SIGNALMAN

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120. General.—A signalman must be constantly on the alert when loading a ship. He is not to smoke while on duty. He must be the type of individual who does not become excited, but remains calm under all conditions. There should be an assistant with similar characteristics, trained to relieve the signalman as occasion arises. The signalman takes a position where he can be clearly seen by the winchmen at all times during operations.

121. Hoist.—The right arm extended forward with the forearm raised at right angles to the body; first finger pointing upward, other fingers closed; in this position he waves his hand in a circular motion from the wrist. (See fig. 64.)

122. Lower.—The right arm is extended outward from the elbow, straight from the body, with fingers and wrist pointing downward. (See fig. 65.)

123. Stop.—The right arm is extended forward from the body with the palm of the hand outward, fingers extended slightly upward, and hand remaining stationary. (See fig. 66.)

124. Rack.—The right forearm is extended forward and upward from the body, hand clinched, forefinger extended inwardly. (See fig. 67.)

125. Travel.—The right arm is extended outward, hand clinched, forefinger extended outward. (See fig. 68.)

126. Emergency.—Both arms extended from body, palms out, fingers extended. He assumes this position quickly and holds it. (See fig. 69.)

FIGURE 64.—Going up.

FIGURE 65.—Lower away.

FIGURE 66.—Stop.

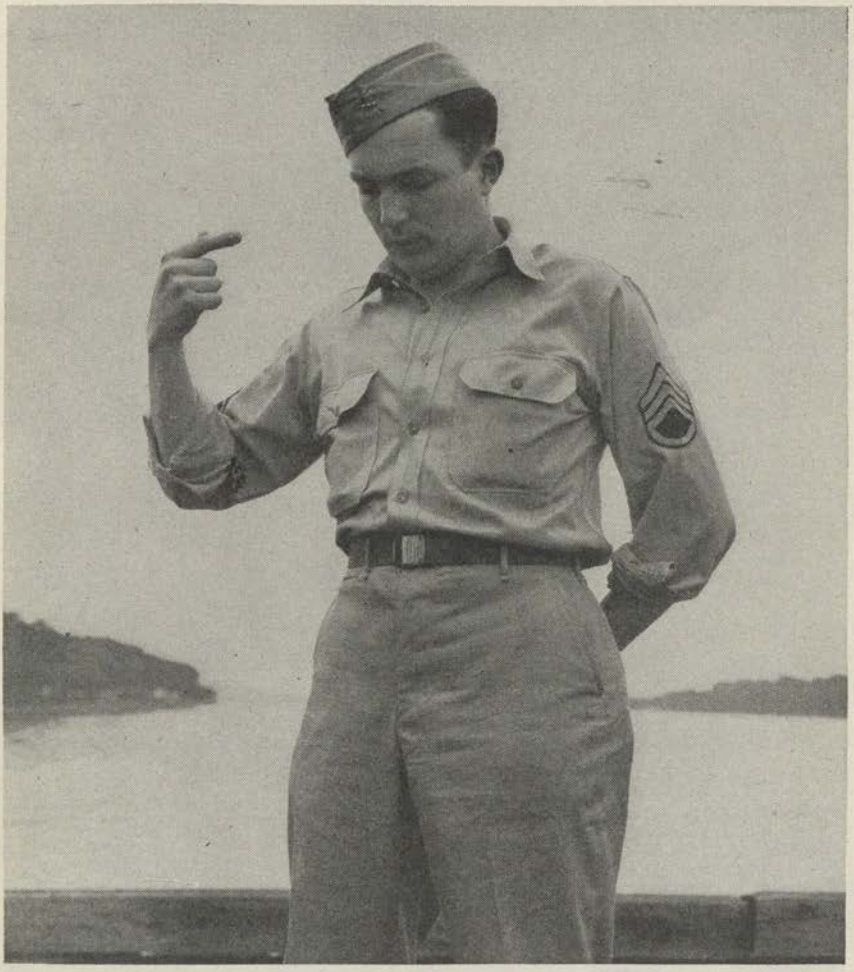

FIGURE 67.—Rack.

FIGURE 68.—Travel.

FIGURE 69.—Emergency stop.

SECTION II

LOADING

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Ship's capacity 127
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127. Ship's capacity.—Tons of cargo can be calculated, when the cargo capacity of a vessel in cubic feet and the storage weight per cubic foot of the cargo to be carried is known. But in making this

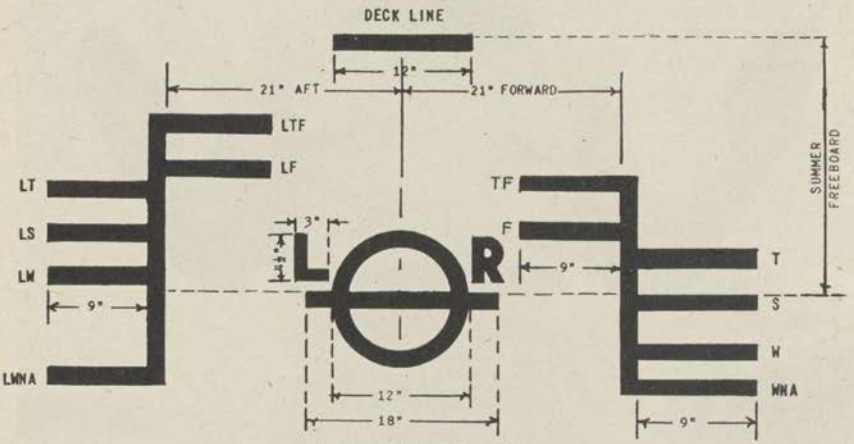

FIGURE 70.—Plimsoll.

Plimsoll (nautical) is the load-line mark conspicuously painted on the sides of all merchant vessels, to indicate the limit of submergence allowed by law; so called from Samuel Plimsoll, by whose efforts the act of Parliament to prevent overloading was procured. A similar mark has been required since 1930 on all ships registered in the United States.

Plimsoll mark illustrated is for starboard side of vessel (on the port side the markings are reversed). The center of the disk is placed at the middle of the load line. The lines are 1 inch thick. The letters signify: LR—Lloyd's Register of Shipping; TF—tropical fresh-water mark; F—fresh-water mark; T—tropical load line; S—summer load line; W—winter load line; WNA—winter load line, North Atlantic; LTF—lumber, tropical, fresh; LF—lumber, fresh; LT—lumber, tropical; LS—lumber, summer; LW—lumber, winter; LWNA—lumber, winter, North Atlantic.

calculation, no account is taken of the draft or freeboard, although it is evident that a vessel with a cargo of iron ore will settle much deeper than one with a cargo of cotton, as the weight per cubic foot of the former is more than that of the latter. On the sides of all vessels are markings which indicate the minimum freeboard a vessel can have at certain times of the year. These markings are called Plimsoll lines. (See fig. 70.)

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128. Loading.—Even with a freeboard assigned to a vessel, the cargo she carries and the way it is loaded have a most important effect on her stability. When loading a general cargo, it is difficult to stow everything from a stability standpoint. Yet care and judgment must be exercised. The curves of stability, if supplied by the

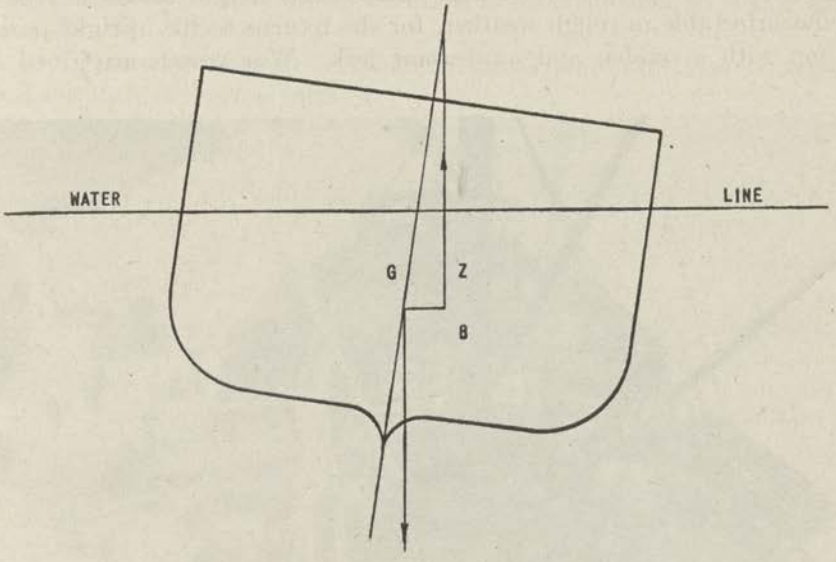

FIGURE 71.—Center of gravity.

When an object floats in water the force of gravity which tends to cause it to sink is exactly balanced in amount by the force of buoyancy of the water which the object displaces.

In this sketch of the cross section of a ship, slightly heeled over from wind or wave action, the force of gravity acts vertically downward through the center of gravity, represented by point G. The force of buoyancy acts vertically upward through the center of buoyancy, represented by point B. Since these two forces are equal and acting in opposite directions but not in the same straight line, they will cause rotation. From the positions in the sketch the rotation will be counterclockwise, and the vessel accordingly will right itself. The rapidity with which it will right itself is determined by the length of the line GZ, the perpendicular distance between the lines of action of the two forces. This distance is called the righting arm.

It is apparent that if, in loading, the center of gravity, G, is brought lower than is shown in the sketch, the righting arm will be longer and the recovery of the ship much more violent. On the other hand if, in loading, the center of gravity, G, is raised above the position shown, the righting arm will be shortened and recovery will be much slower. The ideal position for the center of gravity is such that the vessel will right itself, but not so violently as to carry it beyond the upright position.

shipbuilder, should be consulted, particularly if the captain is not familiar with his ship; and if exceptionally heavy weights are to be carried, approximate calculations should be made as to the trim.

129. Metacenter.—*a.* If a vessel is narrow and deep, heavy articles should be placed low and light articles above, thus insuring a comparatively low center of gravity, as a narrow and deep steamer has

a low metacentric height. If, however, a ship is broad and shallow, and has a comparatively high metacentric height, the heavy weights should be placed higher than in a narrow and deep vessel, and thus tend to raise the center of gravity. Furthermore, weights should be winged out both longitudinally and transversely, and not all concentrated in one place. A high metacentric height makes a vessel uncomfortable in rough weather, for she returns to the upright position with a sudden and unpleasant jerk. War vessels are given a

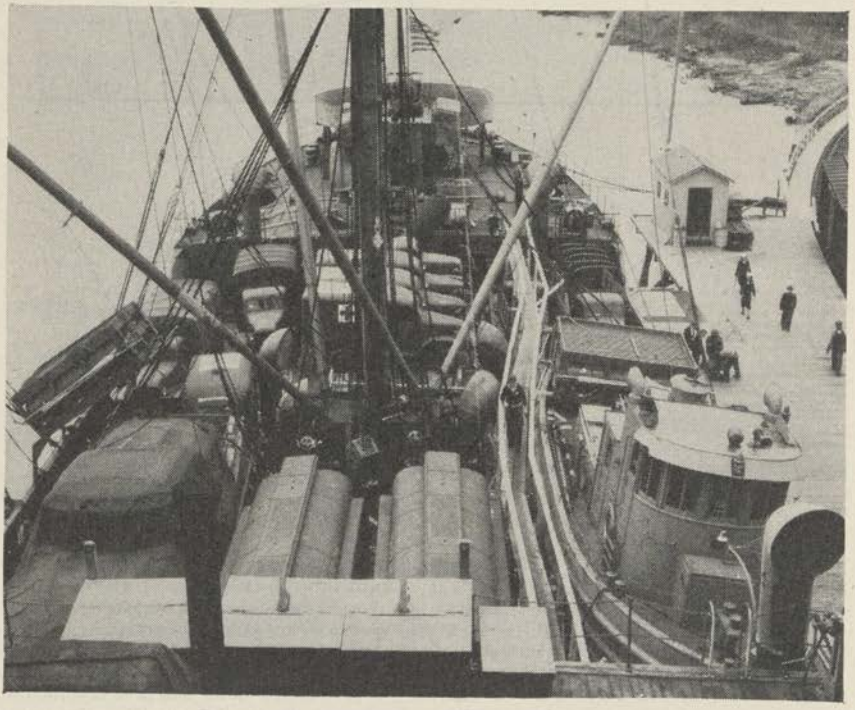

FIGURE 72.—Fully loaded.

metacentric height designed to create a steady platform from which to fire their guns.

b. While the above applies in a general way to cargoes of all kinds, grain, coal, and timber require special stowage. Additional study should be made for the stowage of these items when a vessel is at her load line. With a load all of one material, an unfavorable position of the center of gravity cannot be changed by moving the cargo, such as by winging out the heavy weights. The only recourse is to discharge, or leave behind, part of the cargo.

c. Refined oil is shipped in barrels, drums, or in small cans and cases. Loading is the same as for any cargo of one material and can be treated as a solid, rather than as a cargo with a free open surface such as oil in bulk. When oil is shipped in barrels and cases, no special structural features such as expansion trunks or cofferdams are required to be built in the vessel, as is the case when oil is carried in bulk.

130. Tonnage terms.—*a.* Tonnage terms used in relation to cargo and ships are defined as follows:

(1) *Cargo.*—(*a*) *Ship ton* is a unit of volume, and is equal to 40 cubic feet.

(*b*) *Long ton* is a unit of weight, and is equal to 2,240 pounds, avoirdupois.

(*c*) *Short ton* is a unit of weight, and is equal to 2,000 pounds, avoirdupois.

(*d*) *Measurement freight* is a term commonly used to designate cargo whose volume exceeds 40 cubic feet per long ton of weight.

(*e*) *Dead weight freight* is a term commonly used to designate cargo whose volume is less than 40 cubic feet per long ton of weight.

(*f*) *Stowage factor* is a term applied to cargo, and indicates the volume in cubic feet per long ton. The stowage factor of measurement freight will, therefore, exceed 40, while the stowage factor of dead weight freight will be less than 40.

(2) *Ships.*—(*a*) *Gross tonnage* of a ship is the total volume of its enclosed spaces, and is expressed in units of 100 cubic feet.

(*b*) *Net tonnage* of a ship is the volume of the enclosed spaces which are available for pay load (cargo or passengers), and is expressed in units of 100 cubic feet. The difference between gross tonnage of a ship and net tonnage represents the space taken up by engine and boiler rooms, fuel bunkers, crews quarters, etc., which are essential to the operation of the ship but are not available for pay load.

(*c*) *Dead weight tonnage* of a ship is its weight-carrying capacity of pay load, fuel, ship's stores, etc., and is expressed in long tons.

(*d*) *Displacement tonnage* is the weight in long tons of the vessel and its contents.

(*e*) *Displacement light* is the weight of the vessel without stores, bunker fuel, or cargo.

(*f*) *Displacement loaded* is the weight of the vessel plus fuel, ship's stores and cargo.

b. It is to be noted that net tonnage of a ship does not include space provided for bunker fuel and ship's stores, but that dead weight tonnage includes the weight of bunker fuel and ship's stores.

c. Symbols.

M—Measurement cargo in long tons.
W—Ship's cargo capacity in long tons.
V—Ship's cargo space in cubic feet.
f—Stowage factor, deadweight freight.
F—Stowage factor, measurement freight.
D—Deadweight freight in long tons.

(1) $M \div D = W$
(2) $MF \div DF = V$
(3) $MF \div Df = Wf$ ---------- multiplying (a) by F
(4) $MF - Mf = V - Wf$ ---------- subtracting (c) from (b)

$$M = \frac{V - Wf}{F - f}$$ ---------- dividing (d) by (F–f)

131. Tank loading.—The loading of various types and sizes of armored tanks must be given specific planning, for no definite or standard method can be given to meet all situations. A plan of the situation should be devised to conform to conditions of the ship to be loaded. Accurate measurements of the space to be loaded must be taken; movement and placement of the tanks must conform to the ship's capacity. It is essential, when tanks are hoisted or lowered, that slings be equalized to distribute the weight.

NOTE.—A type of sling used at the New York Port of Embarkation for armored tank loading is as follows: Two slings of 1½-inch plow steel wire with an eye in the ends of each sling, two eyes shackled together with an 8-inch shackle and a 6- by 6-inch wooden spreader between the slings. The spreader is held in place by a lanyard leading from the top eye of the wire sling to the top of the spreader.

132. Animals.—*a. Loading.*—Three methods by which animals may be loaded, depending upon condition, type of vessel, and pier and wharf facilities, are—

(1) *Ramp.*—The ramp is a specially constructed, portable bridge equipped with railings and floor cleats. Animals are led aboard in single file by an attendant. When in use, flooring of the ramp should be covered with a heavy coating of sawdust, cinders, sand, or other suitable litter. This method cannot be employed when decks of transports are too high or too low compared with the level of the pier or wharf.

(2) *Flying stall.*—This is a large substantial crate in which individual animals are placed and hoisted aboard by the ship's tackle. This method is slow but can always be employed regardless of tide conditions.

(3) *Sling.*—The sling is a heavy canvas girth placed around the animal's belly, to which the ship's tackle is attached. The animal is hoisted aboard like other cargo.

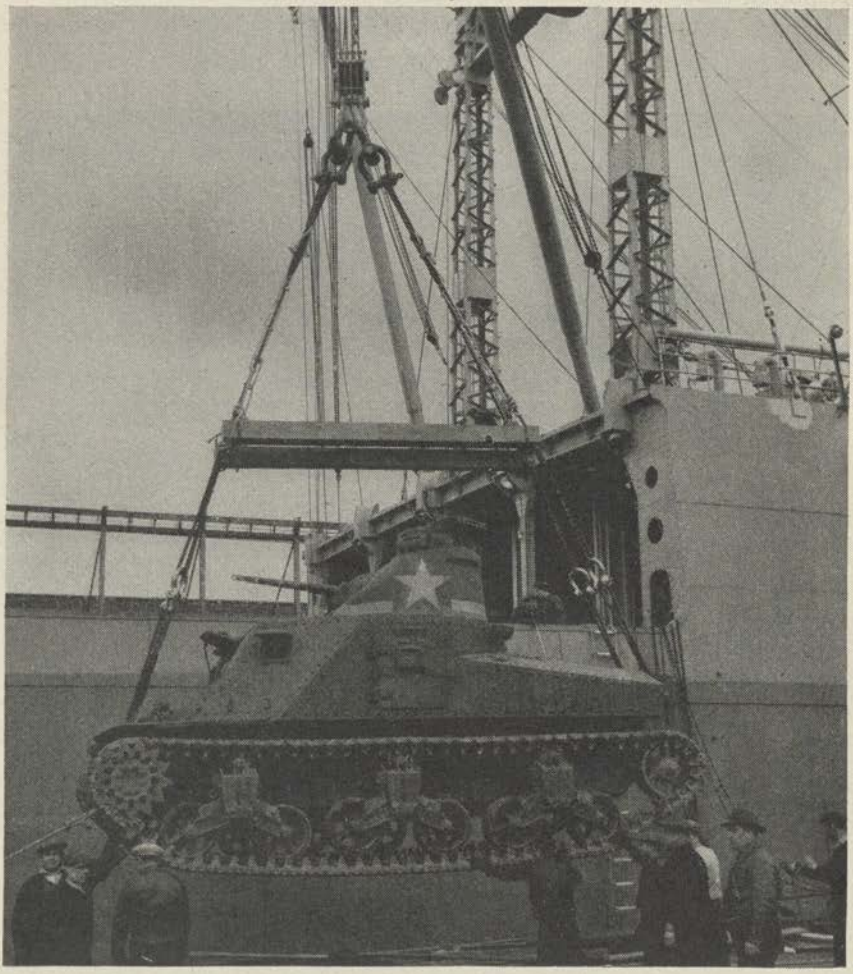

FIGURE 73.—Tank being loaded—slings attached, lifted from pier, guide ropes at corners to aid in direction. Note spreader immediately above tank, tackle block, etc.

b. Debarkation.—All of these methods may be employed in debarkation. In addition, when conditions are favorable, animals may be landed by swimming. Swimming, when feasible, is safer and quicker. This method involves construction of a gangplank 16 feet long, with crosspieces nailed on the under side, which is poised on the edge of a port. The animal is led to the port, a light rope, tossed up

from a boat below, is passed through the halter ring, and the animal, after being led onto the gangplank, is forced into the water by lifting up the interior end of the plank. When he begins to swim, he is pulled close to the boat, care being taken not to hold his head too high for swimming. At the beach the rope is given to a man who wades out from shore and takes charge of the animal.

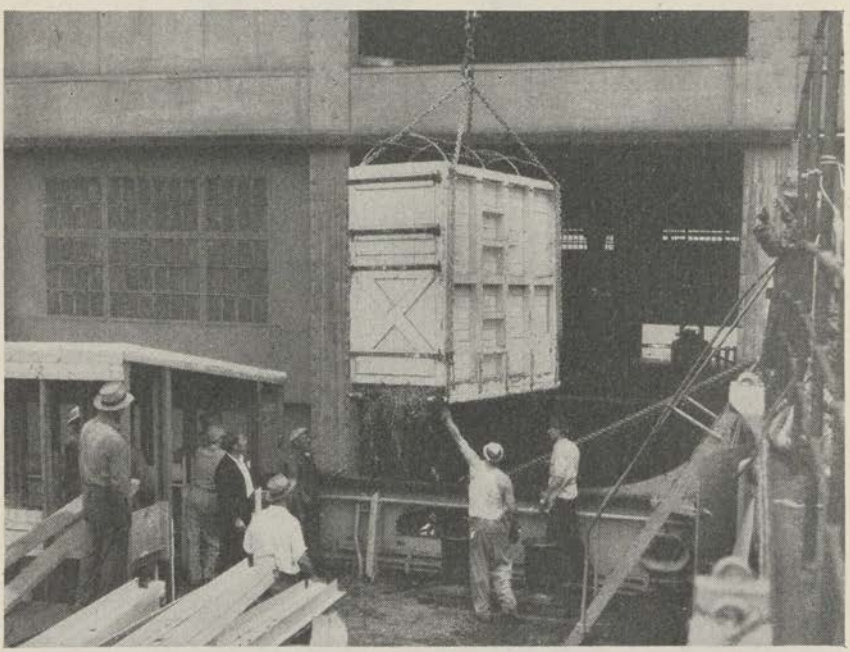

FIGURE 74.—Horses being hoisted on ship in special loading crate.

133. Check items.—The most important items to check before loading or unloading are—

a. Condition of masts or king posts.
b. Condition of stays.
c. Condition of booms.
d. Condition of fair lead whip.
e. Condition of blocks and tackles.
f. Proper lubrication of all blocks.
g. Condition of cargo nets, rope slings, hooks, and other items of cargo gear.
h. Condition of winches.

If any one of these essential items fail, a life may be lost, or even a whole regiment may be trapped and lost because the ship was delayed.

CHAPTER 3

STOWING THE CARGO

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SECTION I

GENERAL

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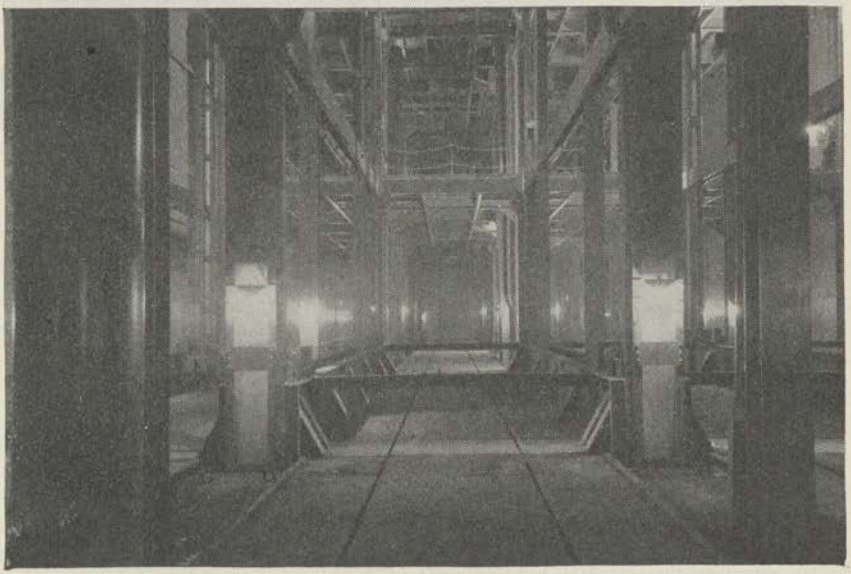

FIGURE 75.—The hold, looking aft, starboard side. Note other deck.

134. Objective.—The first objective of a stevedore is to have a ship in seaworthy trim and balance at sailing. The second is to load the greatest possible amount of cargo in the shortest possible time.

135. Distribution.—*a.* To be seaworthy, a ship must have a comparatively low center of gravity, for if heavy cargo is stowed too high a ship will be topheavy, cranky, and unsteady. Most of the

weight cargo, such as pig metal, should go into the bottom of a ship, and be as evenly distributed as possible since unequal distribution of weight has a tendency to strain a ship. On the other hand, it is dangerous to put all the weight in the bottom, for a very low center of gravity causes a ship to have a tendency to roll, which might easily

FIGURE 76.—Stowing deck cargo.

prove disastrous. In a ship with one cargo deck, the rule is to stow two-thirds of the weight in the lower hold. In a ship with no cargo deck a stevedore must use his judgment as to the best method for securing proper balance.

b. The ship must be in good trim, that is, on approximately an even keel. Most captains like to sail with a "drag" of a few inches,

that is, with the ship drawing more aft than forward. To insure proper trim, a stevedore usually holds about 200 tons of heavy cargo until the last day or two, which he puts forward or aft, as required. The greater the distance from the "tipping center" of the ship, the greater is the effect; hence the hatches used for trimming are those at the extremes of the ship. A ship with her engines aft needs a drag of about 2 feet, as she usually carries her fuel aft, and, as it is used, she has a natural tendency to go by the head.

136. Example.—The simplest and clearest way to describe the stowing of a steamer is to take a hypothetical ship of average size and describe the loading of a typical cargo.

a. Assume the ship to be an oil-burner that has a total deadweight capacity of 7,300 tons, from which must be deducted 1,000 tons for fuel (round trip), 200 tons for water, and 100 tons for stores, leaving a cargo capacity of 6,000 tons weight, and 330,000 cubic feet bale measurement. Ten percent must be deducted from the measurement for loss in stowage, leaving a net space of 297,000 feet.

b. Suppose the cargo engaged to be as follows:

Commodities	*Weight (Tons)*	*Measurement (cu. ft.)*
Steel billets	1,000	12,000
Machinery	800	56,000
Oil	500	30,000
Salt meat	1,500	75,000
Bale leather	200	24,000
Turpentine	200	12,000
Oil cake	800	28,000
Sugar	500	25,000
Automobiles	100	15,000
Condensed milk	100	5,000
General	300	15,000

c. The stevedore begins with the steel. He first dunnages his holds and then begins loading. Of the thousand tons, he will probably put 700 tons in the lower holds, 150 tons in the 'tween-decks of No. 2 and No. 4, and hold out 150 tons for trimming.

d. (1) His problem now begins. He cannot put any foodstuffs into the same hold as the turpentine, because the fumes of the latter would render them unfit for use. He cannot stow oil, turpentine, or salt meat in No. 3 hold, because it is next to the ship's engine room and is therefore too hot; and he prefers not to stow machinery in No. 4 and No. 5, if the cases are large and heavy, because the shaft forms an obstruction and makes quick and economical stowage difficult until it is covered.

(2) He will decide to do something like the following: He will put the barrel oil in No. 1, together with the turpentine; and if the hold is not filled, he can top off with small cases of general cargo or condensed milk, the milk being immune from the turpentine because it is in metal containers. In the lower hold of No. 2 he will

FIGURE 77.—Barrels being lowered into hold. Note planking dunnage on stowed barrels.

put most of the machinery, and top it off with sugar or small cases; and in the 'tween-deck the rest of the machinery, most of the automobiles, and some of the sugar. No. 3 will take the greater part of the oil cake and the sugar, and No. 4 can be used for salt meat and condensed milk exclusively. The rest of the oil cake, sugar, and general cargo will be put in No. 5 and 'tween-deck, and the remainder

of the automobiles in the 'tween-deck. The leather, being light and not affected by heat, is ideal for the bridge deck, which it would come pretty close to filling; any space remaining could be utilized by the remainder of the general cargo.

e. (1) It will be noticed that the cargo stowed aft is a little heavier than that stowed forward. This is for two reasons: first, the space forward is almost invariably greater than that aft; and second, most oil-burners have a tendency to go by the head as the fuel is used.

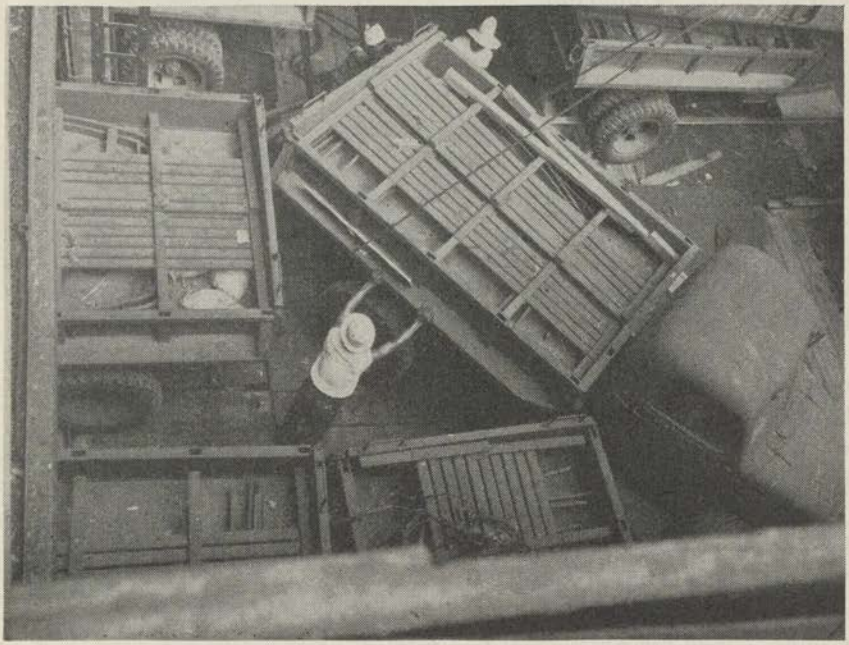

FIGURE 78.—Vehicles in hold.

(2) Suppose that the ship had been booked for provisions, oil, and turpentine only, what could be done in No. 3? Absolutely nothing. The entire ship would have to be held up until suitable cargo arrived, for the master of the ship would not allow four of the five holds to be loaded while the fifth remained empty, for fear of straining the ship from an unequal distribution of weight. Or suppose that the stevedore had been saving the bridge deck for the leather, and at the last moment 200 tons of automobiles, which have about the same measurement per ton, had been substituted, and No. 3 hatch was too small to admit large cases? Again the ship would have to be held up, or sailed with the bridge deck empty. Or suppose that when ready to start loading, it was found that 1,500 tons of light cargo were

on hand, but none of the steel was alongside—what could be done except wait for the steel?

(3) In one instance, a ship that was half loaded and had 1,200 tons alongside had to stop work for several days and wait for the arrival of some heavy machinery, because the cargo on hand consisted entirely of crates of window glass. It is hardly necessary to discuss the inadvisability of stowing heavy cases on top of window glass. Window glass is one of the various cargoes that requires special stowage, since it is necessary to stow the cases on edge, athwartships, or aburton.

137. Chocking.—*a.* Any commodity in barrels must be stowed with special care, as the breaking of one barrel causes adjacent barrels to roll, and may result in the loss of twenty or thirty additional. Therefore, a short oblong piece of wood is placed under each end of the bottom tier of barrels to distribute the weight; otherwise the entire weight of all the cargo will come on the center of the bilge where the barrel is thickest. Furthermore, to prevent rolling, pieces of cord wood or loose barrel staves are inserted, wherever there is room, between the barrels and the skin of the ship, and around the stanchions and ventilators.

b. The practice of wedging is employed to a lesser degree with all classes of cargo, since it is imperative that everything below decks be absolutely secure. If the cargo starts to shift, not only will much valuable freight be ruined, but the ship may be given a dangerous list. This wedging is called "chocking."

138. Dunnage.—It is obvious that thinly protected cases cannot be stowed in the bottom of a ship, or the enormous weight of 20 feet or more of tightly packed merchandise will crush them. Even heavy cases so stowed are protected as much as possible by placing dunnage (rough 1-inch boards) every few feet of depth to take up or equalize the strain. Ordinarily these boards are spaced at intervals of a few feet, but where "wet" cargo, such as oil or salty meat, or sifting cargo, such as flour, is to be stowed above material liable to damage, the under cargo must be floored off with a double layer of dunnage boards.

SECTION II

STOWING IN THE HOLD

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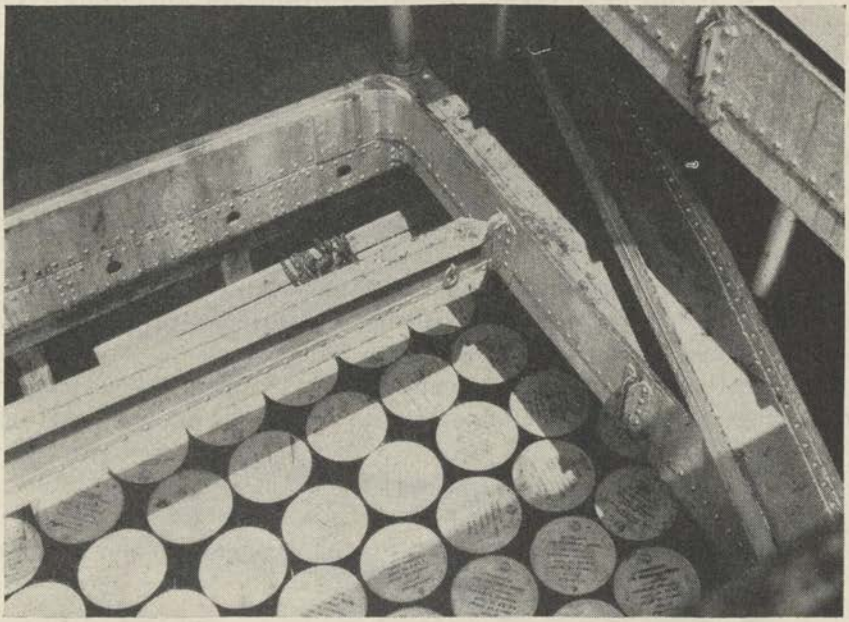

FIGURE 79.—Oil barrels—looking down into partially filled hold. Note one strongback in position, and another lying flat on the 'tween-deck.

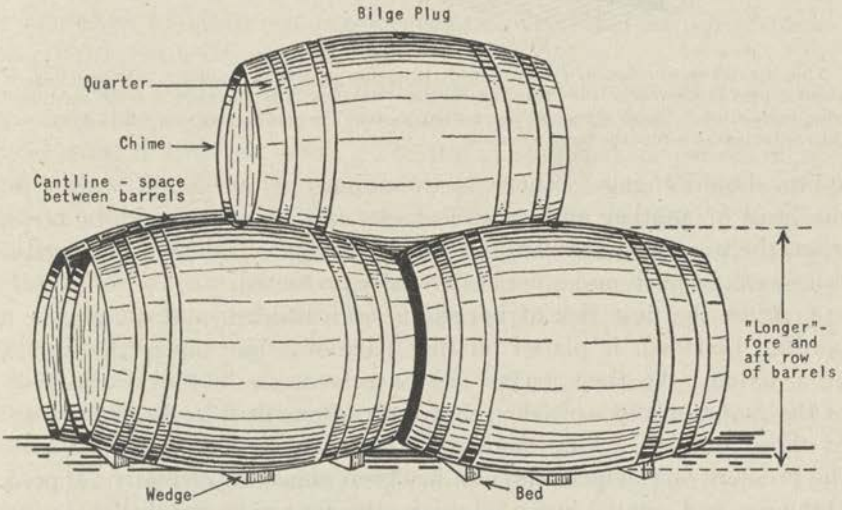

FIGURE 80.—Barrel stowage.

139. Stowing commodities in hold.—After goods have been lowered to the hold of a vessel great art must be displayed by the stevedore in placing them to the best advantage.

140. Stowing of barrels.—*a.* Barrels ordinarily are swung into the hold three at a time ("married") by three pairs of hooks on the whip or fall, although slings are often used. When the barrels hit the hold, the hooks are released, and the barrels are rolled to a midship section, where they are placed against each other with their lengths fore and aft. This position is desirable because there is less danger of shifting, as there is not so much waste space in the wing; also it then becomes easier to roll the barrels of the upper tiers to their proper places. Most holds have greater length than breadth, therefore the greatest amount of rolling must be done in a fore-and-aft direction, and a barrel is rolled most easily over the "quarters" and "cantline" of the barrels underneath.

b. Each barrel is turned so that its bung is up, to lessen danger of leakage. The chimes of two barrels and of all other barrels in

FIGURE 81.—Stowing pipe.

This illustrates stowage of cast iron pipe 12 inches or less in diameter. Twelve-inch or smaller pipe is stowed by the "bell and cantline" method, and the tiers are not separated from each other. These pipes are not nested because they are heavy enough to lower the ship to its marks before the holds are filled.

a line should engage; otherwise the chimes of one might work into the head of another and cause leakage, and the chimes might break when the barrels are broken out for discharge. The head of a barrel is its weakest part, and must be carefully protected.

c. After the first tier of barrels is laid, bedded, and dunnaged, a landing platform is placed on that part of a tier under the square of a hatch. As they arrive the barrels are rolled over cantlines of the first tier and stowed so that their bilges fit into the "cantlines" of those beneath. This method of stowing economizes space, puts the pressure on the quarters, and has been almost universally adopted. Dunnage and quoins are used as in the first tier, but beds are not necessary unless the barrels are weak or are to be tiered high.

d. Tier after tier is laid in this way until the hold has been filled or until the height becomes so great that there is danger of crushing the lower tier. Determination of the height of tiering rests pri-

marily on the stevedore's judgment of the strength of the barrels. Hillcoat gives the following allowable heights, which are substantiated by American stevedores, though exceptions were made in the war period:

Three tiers of pipes.
Four tiers of puncheons.
Six tiers of hogsheads.
Six tiers of tierces of beef and pork.
Eight tiers of flour barrels.

If it is necessary to stow barrels to a greater height than consideration of safety would justify, a tier can be "floored off" and new tiering started.

e. If barrels containing different commodities are stowed together or if barrels are stowed in a hold with other goods, care must be exercised to avoid damage by leakage. Since most barrels contain liquids, it is the customary practice to place them at the bottom of the hold or on some heavy commodity that will not be damaged by their contents. They should never be placed on top of fine goods. Oil barrels should not be stowed over barrels of molasses, nor should barrels containing liquids be stowed over barrels containing dry goods.

f. Piles of commodities should be cross-tied. When necessary to stow bags or sacks on top of other freight, the bags or sacks must be protected by clean dunnage boards or paper laid on top of packages to prevent tearing or cutting.

141. Case and container handling.—Hooks must not be used in handling fiber containers. Cases and containers should be trucked and loaded in between decks. The use of rope, net, or canvas slings and slides for cases and containers must be avoided. Wooden cases should not be piled on sides or ends. Fiber containers should be piled with sealed cover in horizontal position. Heavy freight must not be piled on top of cases or containers. Whenever necessary to pile cases or containers on top of other freight, sufficient dunnage boards should be used to give an even surface.

142. Stowing airplanes on deck.—For stowing uncrated and large airplanes on the weather decks, in addition to the stevedoring platoons there should be a special stowing group consisting of a welder and assistant, carpenters and assistants, and gearmen. The purpose of this group is to construct framing or cradles for each airplane, perform necessary welding to ship's decks, and lash to the ship's structure such wire cables as are necessary to insure a firm hold. Padeyes are to be arc-welded to the deck in such a position that ⅜-inch galvanized wire and turnbuckles can be used.

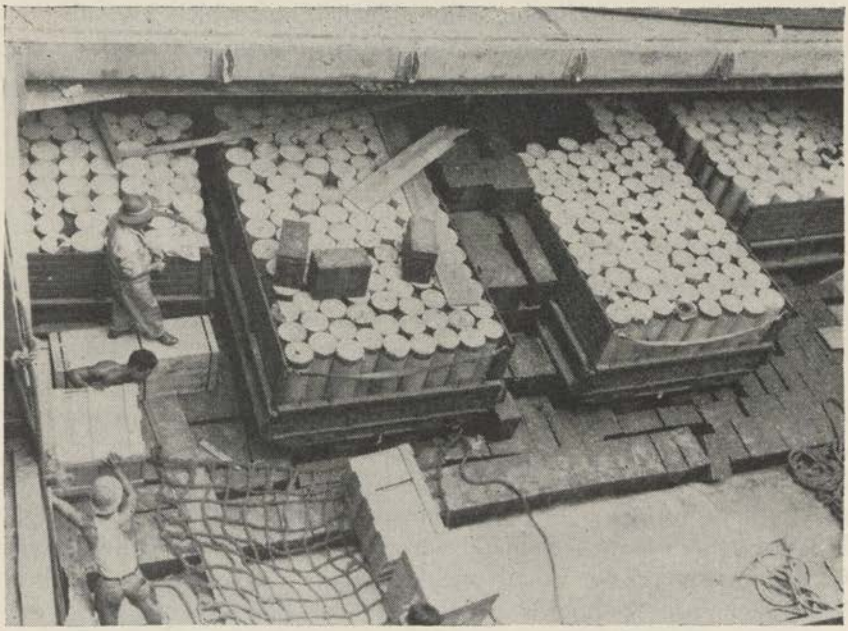

FIGURE 82.—Stowage being worked by cargo net.

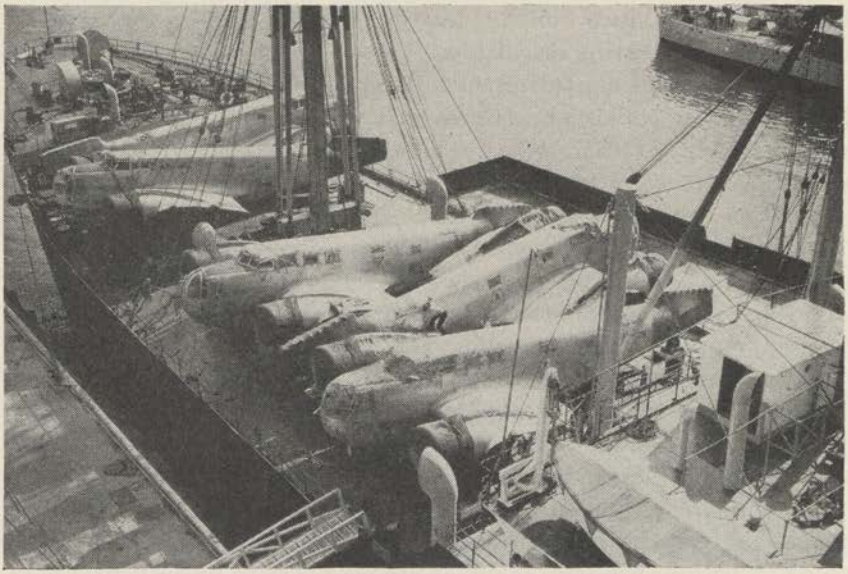

FIGURE 83.—Deck load ready for unloading.

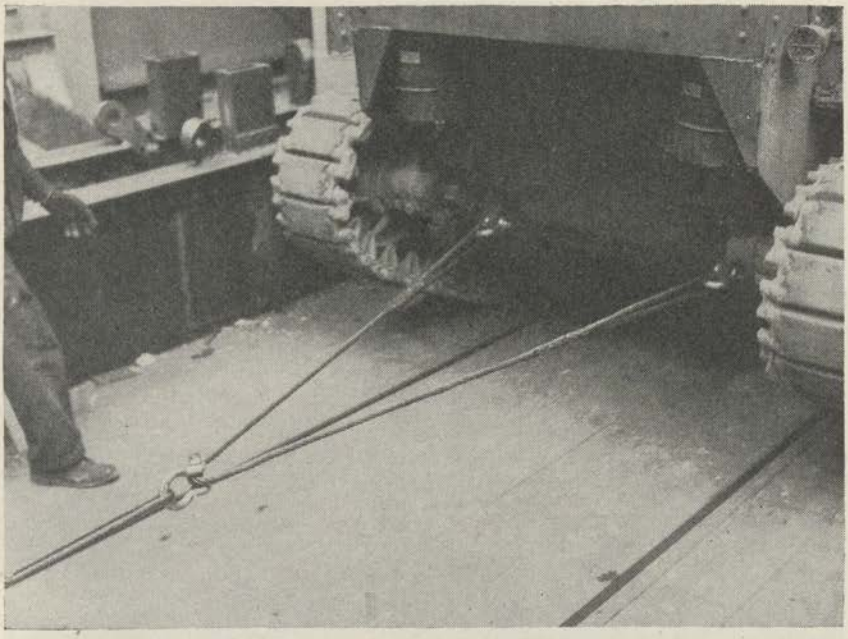

FIGURE 84.—Live tank, now a tractor, with cables attached.

143. Stowing of armored tanks.—Stowing armored tanks in the hold of a ship, if such tanks are entirely sealed, is very difficult because the steering apparatus cannot be operated. To move this heavy load requires planning with the greatest amount of ingenuity. The use of a "dolly" may solve the problem in some ships. In other ships it may require the use of a live tank that can be operated by its own power, or a tractor of sufficient capacity to move the sealed tank. The live tank or tractor is first placed in the opposite section of the hold to that in which the sealed tank is to be stowed. After it has reached the floor of the hold, tackles are arranged to be attached to the sealed tank. Meanwhile the sealed tank is hoisted and then lowered into the hold. When it reaches the floor, two 6-foot angle irons, with a shackle in each end, are used to connect the sealed tank to the live tank for traction purposes.

144. Loading.—During the entire loading operation extreme care is necessary and attentive observation to all signals given by the signalman. Close attention must be shown by the winchman, both for immediate response to any signal given by the signalman, and also to the state and action of the winch. The same condition must be observed by all guide-rope men on the pier or on the decks. Neglect or carelessness of any one connected with such loading may mean loss of life or the destruction of a ship. Too much emphasis

FIGURE 85.—Loading crates of instruments.

cannot be given to the seriousness of loading armored tanks. Careful planning and attention to duty is essential.

145. Check questions.—*a.* Is cargo being stowed to prevent injury to crew, stevedores, and ship?

b. Is cargo being stowed to secure maximum volume and weight?

c. Is cargo being stowed to secure the maximum speed and yet to be easy to unload?

d. Are all spaces being properly filled?

e. If empty space is located, is adjacent cargo being properly braced or secured so that the cargo will not shift?

f. Is the cargo likely to settle? Has provision been made to secure it after settling?

g. Have all articles subject to crushing been carefully stowed?

h. Is deck load properly wedged or shored to prevent shifting?

i. Are precautions being taken to prevent damage to cargo from moisture, heat, vermin, and rodents?

j. Have dangerous articles, such as explosives, been properly stowed and protected?

SECTION III

STOWAGE GUIDE

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146. Apples.—Barrels of American apples are generally stowed in the 'tween-deck, bilge-and-cantline, other light goods being used to chock them off. Care should be taken to give plenty of ventilation, and that beds are put under the lower tiers. Barrels of green apples average from 145 pounds to 155 pounds, measure 6 feet, 6 inches; each barrel of dried apples weighs 138 pounds to 170 pounds, and measures 6 feet, 10 inches each; boxes of evaporated apples

FIGURE 86.—Barrel hooks—ready for hoisting.

weigh 50 pounds, measure 7 feet, 6 inches each. One ton of 20 hundredweight stows in about 90 cubic feet.

147. Bacon and hams.—These should be stowed in a cool part of a vessel, separated from heavy goods. Sides of bacon are sometimes shipped packed in coarse sacking only; then extra care is required to prevent damage from outside pressure. *Such articles should not be used for blocking off rough cargo.*

148. Baggage.—Under this heading are included packages not manifested as cargo or stores on board a vessel. The work of re-

ceiving and delivering it devolves upon the junior officer or upon some other person duly appointed for the purpose, who should, when receiving, have all the heavy articles struck below at once, those "not wanted on the voyage" first, over which can be stowed those "wanted." The light packages should on no account be put under the heavy ones.

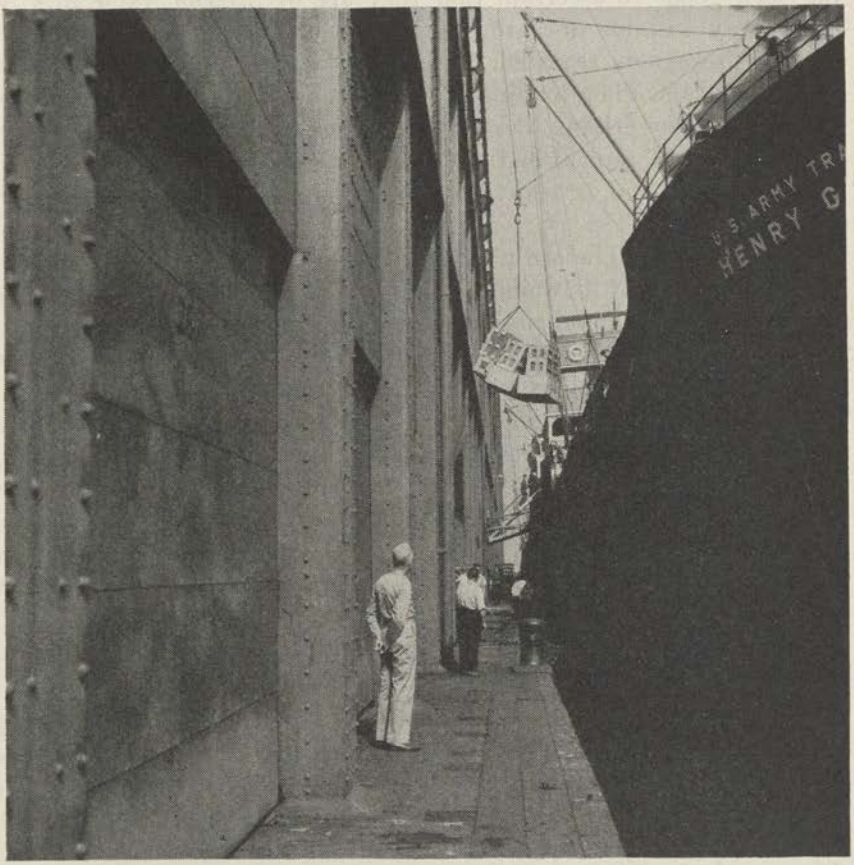


FIGURE 87.—Broken stowage going aboard. Note narrow pier.

149. Bales of canvas.—20 hundredweight should stow in 42 to 45 cubic feet.

150. Bales of ducking.—20 hundredweight should stow in 47 cubic feet.

151. Beef and pork.—Stow as moist cargo, apart from dry goods.

152. Bread or biscuits.—Care should be taken not to stow bread on or near cordage as it readily becomes impregnated with the fumes

of turpentine or tar. Also the scent from camphor will make bread unfit for use. If stowed in a clean lime-washed iron tank, and the lid made airtight, it will keep for years.

153. Broken stowage, beam fittings, etc.—When loading complete cargo, it is the duty of the officers and stevedores to select certain articles for broken stowage. Care should be taken in choosing such goods to ascertain that they are of inferior value and in every way suitable for stowing in out-of-the-way corners where broken stowage is required. Sometimes vessels are provided with broken stowage when loading. When such is the case, it is customary to begin by getting 5 or 10 tons on board in a convenient place, to be used and replenished as required. Vessels will stow 5 or 6 percent more cargo, in many instances, if well provided with suitable broken stowage.

154. Bricks.—The ordinary brick is said to be capable of absorbing one-fifteenth of its weight of moisture; consequently, small, heavily laden vessels should provide adequate protection to make certain that bricks do not get wet. In bad weather any water leaking in below might cause serious trouble.

155. Butter.—Packages containing butter are generally sufficiently strong to carry the contents with safety, but when roughly handled, or if heavy articles are stowed upon them, they are likely to give way and cause trouble. The coolest part of the ship should always be preferred for goods of a greasy nature. It is hardly necessary to point out the advisability of keeping such articles by themselves and away from anything likely to damage by contact.

156. Camphor.—Camphor is shipped in casks, cases, or drums. Sometimes the covering is very light, and the cases are badly lined. A small parcel of camphor stowed in the hold will damage a whole cargo of tea, sugar, flour, or any food stuffs. Camphor wood boxes, or planks, have been known to damage shipments of tea, coffee, etc., even in a short passage. Care should be taken to stow camphor in a part of the vessel where it will be perfectly dry and not likely to damage other goods.

157. Candles.—Boxes of candles, being light and easily worked, should be stowed over heavier goods in a cool part of the vessel. Stevedores, if not watched, will sometimes use fragile articles of this nature to block off heavy cases. This practice is considered bad stowage, and likely to result in loss to the ship should she encounter heavy weather.

158. Canned or preserved meats, jams, fruit, etc.—Cases of condensed milk average 56 to 60 pounds, and measure 1 foot 2 inches each.

Cases of preserved beef, 32 pounds, measure 7 inches each.
Cases of preserved beef, 60 pounds, measure 1 foot 1 inch each.
Cases of preserved beef, 97 pounds, measure 2 feet 1 inch each.
Cases of preserved beef, 113 pounds, measure 2 feet 4 inches each.

159. Canvas.—Sails, awnings, sail cloth, etc., should not be stowed where they can become damp or get stained by iron rust, as they would if stowed against stanchions, etc., in the holds. Loose newspapers or pieces of brown packing paper should be spread about when rats are around, otherwse they will destroy the canvas by eating holes in it.

160. Carpets.—Carpets are generally shipped in rolls.

161. Casks, barrels, kegs, puncheons, etc.—It is usually allowable to stow three heights of pipes, four heights of puncheons,

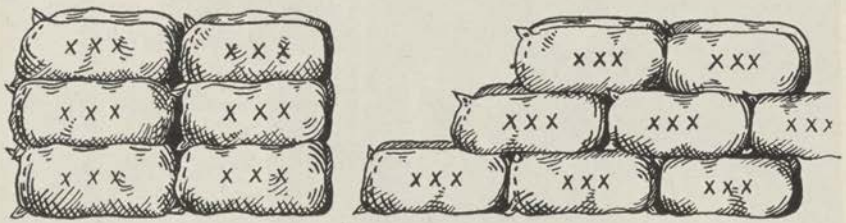


FIGURE 88.—Stowage of bags.

Figure 88 illustrates the correct method (left) and the wrong method for stowage of bagged material. Bags should be stowed on top of each other in order to facilitate handling and economize space, but many stevedores still place them alternately. Skilled longshoremen gain much space by throwing the bags forcefully into place. Some men can throw a sack of sugar from the hip or shoulder a distance of 6 feet, landing it exactly in place with such force that it fits snugly against adjacent sacks.

six heights of hogsheads, six heights of tierces of beef or pork, and eight heights of flour or bread barrels. Authorities differ concerning the best means of stowing large quantities. Casks properly stowed either bilge-and-bilge, or bilge-and-cantline, will under ordinary circumstances ship well.

162. Cattle.—Refer to specifications by U. S. Department of Agriculture.

163. Cement.—There are many kinds of cement of various compositions but all may be summed up under three heads: hydraulic and stony, asphaltic or bituminous, resinous and oily. The first named is that commonly known to commerce. When cement is being stowed all articles about the place should be covered up or removed if liable to damage by the dust, which is unavoidable. Steamers loading cement as ballast do not usually place dunnage below, but

vessels carrying general cargo should not neglect this precaution, otherwise damage may take place.

164. Chalk.—Chalk is generally shipped in barrels.

165. Cheese.—There should be no rough handling allowed in stowing cheese. If possible, moving it about after it has once been stowed should be avoided. Loose cheeses should never be used for blocking off other goods of a heavy nature. If large quantities are stowed together, cheese boards should be used to keep undue pressure from those in the wings and on the bottom. When the ship rolls heavily, the under cheeses, if not in cases, are often found to be much damaged.

FIGURE 89.—Canned goods on "cooty" pallet.

This can generally be avoided by care in stowing, and by supporting each height with boards. Cheese will damage if carried near tar, tarpaulins, turpentine, etc.

166. Chinaware.—Chinaware is packed in crates, barrels, and cases, with no fixed weight. It is often shipped in rolls (packed in straw), about 2 feet per roll. Careful special stowage is required to avoid extensive breakage when it is shipped in this way.

167. Cigars.—Cases of manufactured tobacco, such as cigars, need to be stowed carefully in a dry part of the ship. On long voyages they should not be placed near such articles as tea, sugar, etc.

168. Clocks.—Packages containing fragile articles such as clocks, watches, etc., should be very carefully handled, and stowed as choice, valuable, and dry cargo.

169. Cloth goods.—Articles of a manufactured nature such as blouses, trousers, overcoats, flannel, serge, stockings, blankets, shirts, sheets, towels, etc., should be kept dry and away from damp or oily articles. The heavier articles stow 20 hundredweight in 85 to 90 feet (uncertain).

170. Coal.—Steam coal is said to absorb about twice its own volume of oxygen in 10 days. The admission of small quantities through an air shaft has been found sufficient to aid spontaneous ignition, but not to ventilate the cargo. A system of surface ventilation should be carried out which will be effective in all weather, and afford continuous egress of gas to the open air (independent of the hatchways). Gas is especially dangerous during the first part of the voyage. Coal dust will damage most kinds of cargos. It is advisable, therefore, to wash out and dry all holds after discharging coal, before taking in other goods.

171. Coffee.—Coffee is shipped in bags, casks, or tierces; sometimes in cases. It will damage easily, especially on long voyages, if stowed near damp or objectionable articles, such as tar, turpentine, guano, bones, etc.

172. Coffins.—These are generally packed one inside the other, an arrangement called a "nest", with two nests in one case. Cases of coffins shipped for use in Great Britain weigh from 200 to 290 pounds, and measure from 22 feet 6 inches to 27 feet 3 inches each. Coffins are sometimes shipped in the form of rough planed boards, of suitable sizes for the purpose.

173. Coke.—Coke, or "coked" coal, contains about 10 to 12 percent of ash; the remainder is nearly pure carbon. It can be made only from that class of coal known as "coking coal," and is about one-half to two-thirds as heavy as coal. It is said to absorb about 20 percent of moisture. Cargos of coke require plenty of surface ventilation. There is very little dust from good coke.

174. Condensed milk.—This is contained in tins, packed in cases. Several shipments of this article were found on delivery to be much damaged by rust. Surveyors in their report considered the tins to have been packed damp and labeled with injurious materials, which caused the damage during the voyage.

175. Copper.—Vessels in the copper ore trade are generally fitted with platforms and trunkways, not only to equalize weight in the bottom, but to ease the vessel in heavy seas. Copper dross, often

FIGURE 90.—Unloading ammunition in ship's hold.

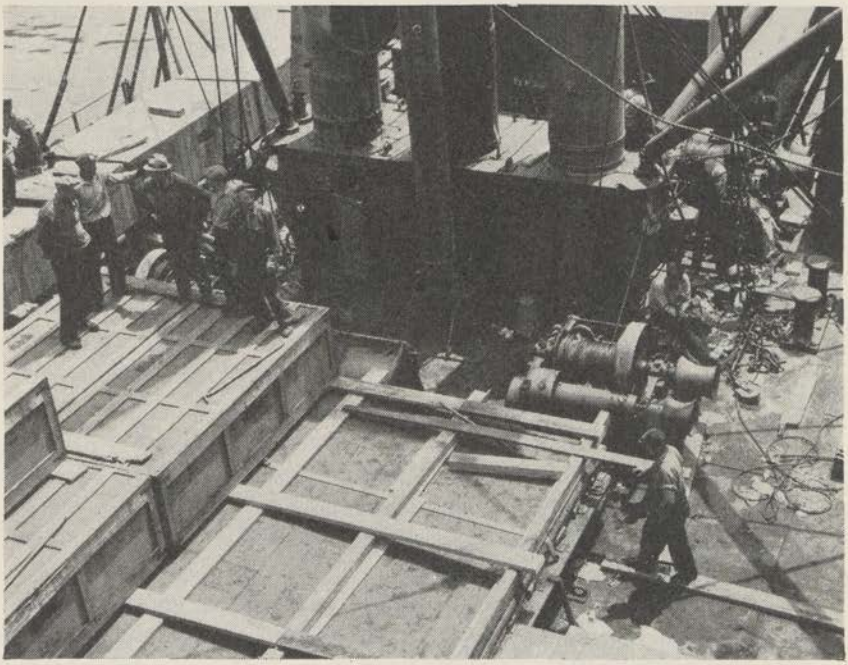


FIGURE 91.—Cargo on deck. Stowing "jeeps" in crates on top of battened hatches. Note framing and dunnage.

shipped as ballast, has a tendency to destroy ironwork exposed to its action.

176. Confectionery.—Confectionery is packed in cases and should be treated as choice cargo, to be stowed in a part of the 'tween-decks away from rough or objectionable articles.

177. Cranberries.—These berries are packed generally in barrels 2 feet, 4 inches by 1 foot, 8 inches, and measure 6 feet, 6 inches, weight 130 to 135 pounds, each.

178. Creosote.—A colorless transparent fluid obtained from tar by distillation, creosote in its crude form is used for impregnating timber. Creosoted wooden sleepers are sometimes shipped in large quantities. When discharging such cargoes, the stevedores find it impossible to remain in the holds for any length of time without coming on deck to breathe, as the fumes are strong and pungent. Much care should be taken, after having creosote aboard in any form, that the smell and effects are entirely eliminated.

179. Cutlery.—Cutlery and hardware goods, packed in casks (generally cases lined with soldered tin or zinc), should be kept apart from liquids, and articles such as sugar, salt, nitre, etc.

180. Dunnage.—Before cargo is received on board ship, the holds should be carefully provided with an adequate amount of dunnage, which should be laid under direct supervision of an officer of the vessel and not left to irresponsible persons. In selection of dunnage, care should be taken to use good, sound, clean wood only. Any boards previously used for stowing oil, grease, or other objectionable articles should never be used for stowing dry goods. All wood used as dunnage should be perfectly dry. Moisture present in partially dried wood evaporates, when the hold becomes heated, and may injure certain types of cargo. For this reason, sawdust should never be allowed to remain in the hold.

181. Dynamite.—It should be noted that extremes of temperature render dynamite extremely sensitive and likely to explode. Detonators are generally packed in sawdust, in tins containing about 100 caps. They should never be stowed with the dynamite, but should be kept by themselves. Great care should be used in handling cases of dynamite. Relative to shipping explosives or other dangerous articles, reference should be made to Regulations Prescribed by Secretary of Commerce, Bureau of Marine Inspection and Navigation, April 9, 1941.

182. Eggs.—Eggs are generally shipped in cases, crates, or jars. Every care should be taken in handling cargo of this nature, and it should never be used for blocking of other goods.

183. Firearms.—Packages containing articles of this character should be stowed in a part of the hold set aside for such purpose, away from any goods of a damp or heating nature. Loaded firearms should be allowed on board ship only under most exceptional circumstances, and then only in the hands of responsible persons.

184. Flour.—Cargo of this type will not stand rough handling nor should it be stowed among any but dry goods. Barrels run eight heights, after which nothing of a weighty nature should be placed on them. Lower tiers must have good beds and be bilge free; upper tiers bilge-and-cantline. A barrel in the lower part subjected to any undue pressure, especially against the head, will give way, break up, and start the whole lot adrift. This is not an unusual occurrence in badly stowed cargoes during heavy weather.

185. Frozen meat.—Cold is one of the simplest and least objectionable preservatives for food, but must not be confused with freezing, which tends to deteriorate to a certain extent the flavor of meat and game. It is sufficient to maintain just the amount of chill that will suspend the vitality of putrefactive organisms. Meat brought from New Zealand and Australia is frozen, on account of the distance it must come, but meat brought from America is simply chilled. Great cold-storage depots are now established at the docks for reception of frozen and chilled meats, pending arrangements with dealers. In the summer season and in torrid zones, beef should be handled and loaded on ships during the cool of the night. Beef being removed from freight cars to ships should be handled with the greatest dispatch.

186. Fruit.—Oranges and lemons are generally packed in boxes. Since the latter are heavier, they are generally placed below orange boxes, which are stowed on their sides. Ventilation of fruit is a most important point to consider when loading for long passages. Once on board, it will heat rapidly and become rotten and valueless if not well ventilated. In a full cargo a space must be left under each ventilator, and air shafts must be built with the boxes fore-and-aft of the holds. A continuous current of fresh air passing down to the bottom of each hold should be insured, as it is the only means of getting rid of foul, damp, and heated gasses generated by the fruit.

187. Furniture.—Furniture should be handled carefully, and when stowed loose, should not be subject to any undue pressure.

188. Fuel (patent).—This is a compound of small coal, tar, resin, sawdust, etc., compressed into blocks like bricks. It is used more for locomotives and mills than for marine work. It is dry, and easy to handle, has a very strong odor, and consequently should never be

FIGURE 92.—Packed meat being stowed.

stowed near any article likely to be damaged by contact. It stows well in the holds, but should not be roughly handled.

189. Garlic and onions.—These have a strong odor, considered by many to be highly objectionable, but not injurious. Articles coming under this heading should be stowed as perishables, and should have plenty of ventilation.

190. General cargo.—*a.* Weighty articles, such as machinery, should be stowed first, so that the various pieces may be made secure, placed in beds, and attended to properly. Coal should be stowed in the bottom, leveled off, and covered with boards, to prevent goods stowed on the top from being soiled or rotted by contact. No dry goods should be stowed until all the coal is taken on board, as coal

dust settling on them destroys their appearance and value. Coal shipped damp is likely to damage dry goods. Greater efficiency in discharge is achieved by stowing all heavy lifts in one hatch.

b. Soda crystals, washing soda, bleaching powder, caustic soda, blue vitriol, and all chemicals should be stowed by themselves, and never on top of or contiguous to other goods. Caustic soda and chloride of lime, especially, should be kept at a distance from bales, which are sometimes rotted by these chemicals.

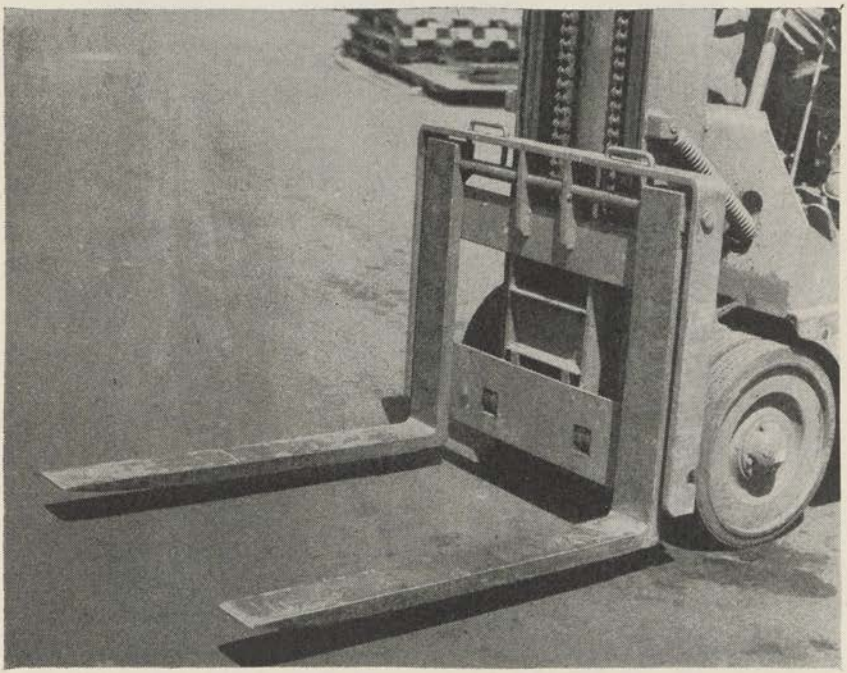


FIGURE 93.—Fork lift for general cargo.

191. Iron.—Whether in bars or in bundles, iron should be dunnaged in the bottom.

192. Sheet and plate iron.—This should be stowed in piles, not spread, to avoid damage which arises from sweat running from one plate to another. If spread out, with cargo placed on top, plates and sheets are buckled or twisted, and their value destroyed. When stowing iron, keep the various marks separate by means of rope or wood, as the paint marks may become obliterated on a long passage.

193. Bales.—Bales should not be stowed on top of bar iron, or allowed to come in contact with beams or stanchions. The spring of the ship causes bales to chafe wherever they touch.

194. Manufactured goods.—These should have sufficient dunnage at the side to leave a free water course for sweat to drain off. On no account use lightly made packages for blocking off heavier cargo, but stow separately or over other cargo. It is readily observable that the fumes of many kinds of cargo injure others, but with proper care the damage is avoided. Articles of value should be stowed 'tween decks where practicable. Weight should, as far as possible, be kept amidships, light cargo being reserved for the fore and aft holds. Mats can be used at the sides for tea, etc. Such

FIGURE 94.—Tiering—manufactured goods being tiered.

articles as guano, superphosphate, turpentine, bone dust, etc., ought not to be shipped with a general cargo, especially if a vessel has only one continuous hold. Endeavor to keep all liquids as much in one part of the ship as possible; have good cross beds at the quarters, well chocked with wood, and stow.

195. Glass plate.—Glass plate, packed in cases, should always be stowed on edge, with care to have the proper end up as marked. Much care is required in slinging and handling such fragile articles. Never permit such cargo to bang against the side of ship or pier.

196. Glass, cases of.—These should always be stowed athwartships, and on edge. No dunnage should be used except for blocking

in the wings. Dunnage is often used to level off a place that a case will not fill. As a consequence it works down and causes damage.

197. Grain.—A vessel carrying heavy cargoes should have one-third of the weight in the 'tween decks, or above the beams. When

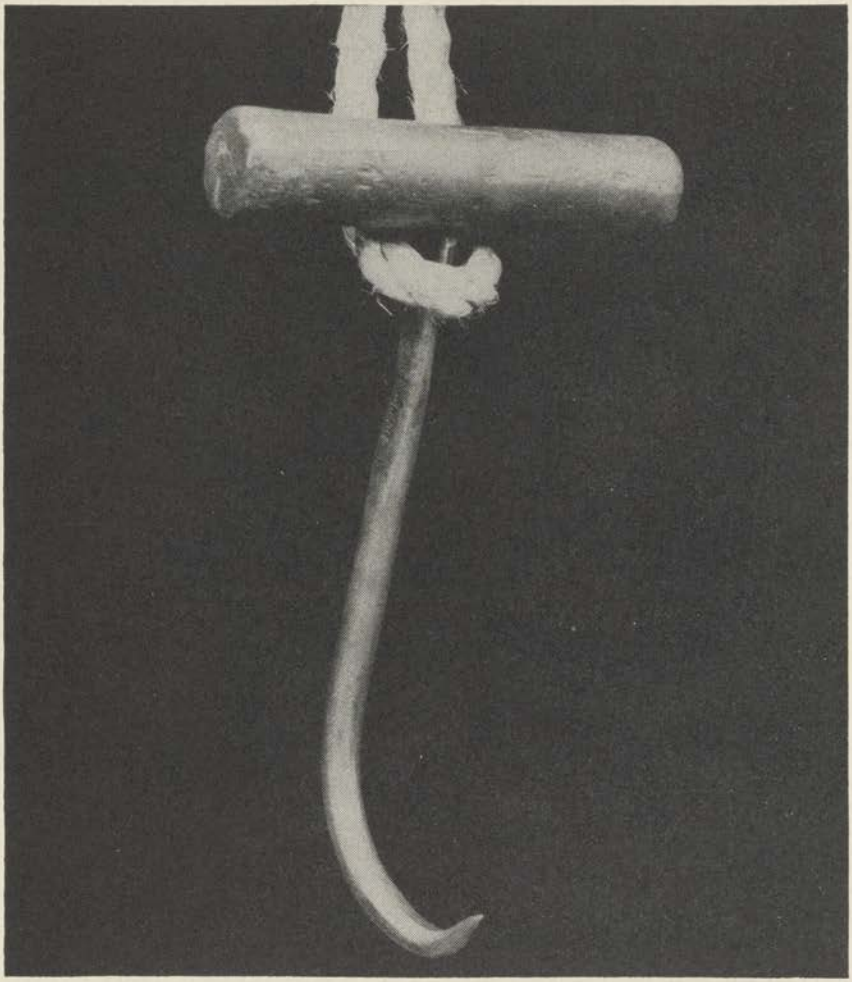


FIGURE 95.—Hand hook—the most destructive and dangerous tool on a ship or dock.

bulk grain fills the lower holds, shifting boards and properly constructed feeders are not necessary. Vessels carrying more than one-third of their net register tonnage in grain are considered as ships laden with grain cargo. Reference should be made to special instructions regarding shipments of bulk grains.

198. Grease.—In stowing such oleaginous cargo, care should be taken to keep it away from any goods likely to be damaged. Avoid stowing it in the center of the vessel, as it will damage by heat.

199. Hay.—Damp bales are liable to spontaneous combustion, therefore, hay should not be shipped unless dry and sweet. When in small quantities among general cargo, it should be stowed convenient to a hatchway, where the bales will get plenty of ventilation and be easily accessible. Full cargoes of hay or straw should be stowed on the same principle as green fruit, allowing free ventilation to pass throughout the entire cargo.

200. Heavy lifts.—Such lifts as 30-ton boilers, guns, bedplates, etc., should be taken on board and discharged under properly constructed shears, fitted and tested for the work. When this cannot be done, the risk must be run of working them in or out by the ship's tackle. A large derrick and suitable gear is then absolutely necessary. Every care should be taken to have the mast well stayed, and when stepped in the 'tween deck it should have stanchions and shores to support it below. The same care should be given to the deck under the heel of the derrick.

201. Railway iron.—Ships loading cargoes of iron should have at least one-third of the weight in the 'tween decks. Railway iron should not be stowed fore-and-aft until level with the keelson. Then it should be stowed diagonally, that is, grating fashion, keeping the rails well apart so that the weight will be raised to make the ship easy in a seaway. Protect the ship's side with bars laid fore-and-aft on top of each other, where the stowing is diagonal. Use rough-sawn battens between the tiers when necessary. Finish by stowing fore-and-aft, locking the top two tiers by inverting the upper rail. Then lay 3-inch planks across the cargo under the beams, and tomb them well down, placing the tombs about 5 feet apart. Wedge the upper tiers at sides by driving large wedges down on planks put up-and-down before stowing. The end tiers must be lashed with chains to keep them from fetching away if the ship is pitching heavily. A space is left about a third of the distance from the midship stanchions between them and the side, for this purpose. Bars are laid across the top, and the lashing is passed around them and the 'tween deck beam. When laid 'tween deck, rails must be laid across the first tier on the deck for lashing down. Those lashings are wedged up tight and will require attention at sea.

202. Lard.—Avoid stowing lard near the center of a ship. It is essentially a delicate article, unless in casks or tierces. When so packed, it may be stowed with casks of beef and pork, etc. It is always desirable to keep such cargo away from dry or choice goods.

203. Lumber.—Cargoes of lumber, especially long lumber on deck, should never be allowed to bear any unequal strain on the ends. Weights should be equally borne along the entire length. This cargo should be carefully wedged off and well secured to prevent the possibility of shifting in bad weather.

204. Meat.—Extra care should be taken to consider weather conditions in handling meat. Beef, packed, runs about 95 cubic feet to

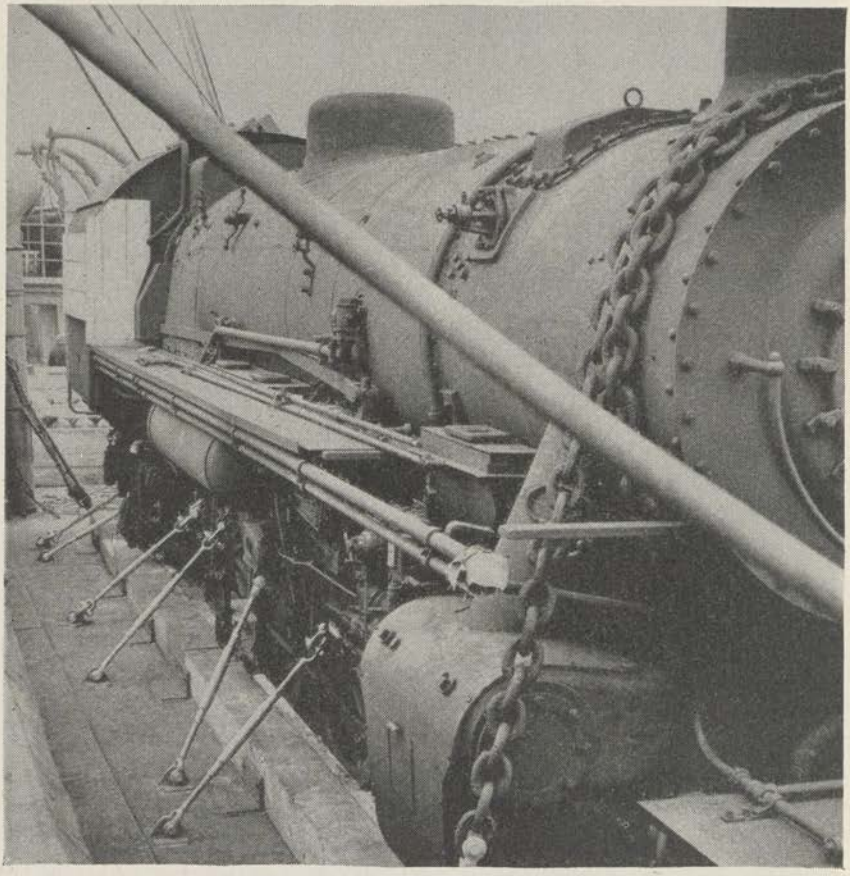


FIGURE 96.—Locomotive—deck cargo.

the ton. Quarters and pieces run about 130 cubic feet per ton of 20 hundredweight.

205. Molasses.—Molasses in casks, puncheons, and hogsheads, require no dunnage.

206. Musical instruments.—These should be packed in tin-lined cases to prevent damage from sweat, rust, etc. Stow in a part of the hold away from moist or heavy articles, and keep the marked

side uppermost. Handle the packages gently to prevent jar or injury to internal parts, which are fragile and easily displaced by rough usage.

207. Naphtha.—This caution applies to inflammable articles generally. There are many volatile liquids, such as brandies, rum, gin, whisky, ether, spirits of wine, other alcoholic liquors, etc., which are well known to be highly inflammable, but it is not so well known that these give off an invisible gas which is as inflammable, and much more dangerous because it cannot be seen. The greatest care should be

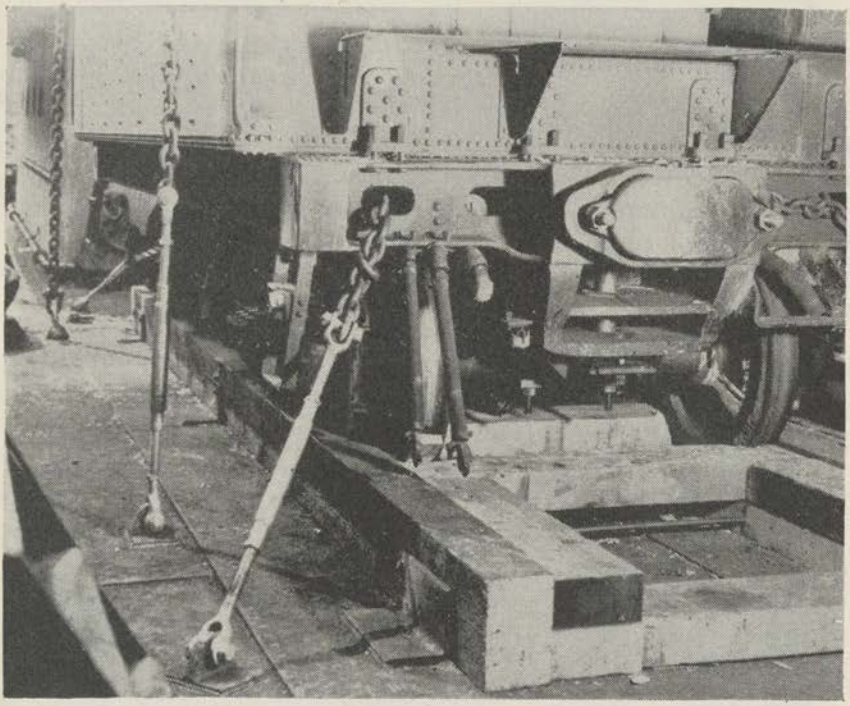


FIGURE 97.—Turnbuckle stays for deck cargo.

taken to give free ventilation where such a cargo is stowed, and on no account should anyone be allowed to enter such places with a naked light. Remember to keep goods of this class separate from all cargo of an edible nature.

208. Oats.—Oats in bags are much lighter than most grains. Care should be taken to give them plenty of ventilation; otherwise, they will heat and become damaged.

209. Oil.—Essential oils are packed in bottles, cans, or drums which are large and very strongly protected by wood on the outside. Care should be taken not to stow them in a hold with tea, flour, or

other articles liable to damage. One pint bottle placed in the hold can spoil an entire cargo of tea. Vegetable oils are said to promote spontaneous cimbustion if stowed with coir, rags, hemp, cotton, etc. For long voyages, pieces of leather should be nailed across the bung-holes of oil casks. Some recommend a piece of iron hoop instead of leather. Oil should never be put in the 'tween decks with general cargo below, as it is at all times a dangerous and uncertain commodity where other goods are concerned.

210. Soap.—Manufactured soap, packed in cases, etc., is generally free from objectionable qualities and may be stowed in any safe place. Soft soap, however, should be kept apart from dry or perishable articles, as in hot weather it will often run and damage other goods.

211. Soda.—Casks of soda should not be stowed with dry goods, for in the hold soda, like salt, will cause a dampness all around it. When soda is carried in large quantities with general cargo, a part of the ship should be allotted to such commodities.

212. Spontaneous combustion.—Certain kinds of coal, cotton or oily waste, inodorous felt, oiled cloth, rape seed, old rags, hay and some other commodities are likely to heat and ignite if not well ventilated.

213. Starch.—Starch made from flour, potatoes, rice, or other vegetables, packed in boxes and barrels, should be stowed as dry goods, apart from articles such as soda, potash, saltpeter, etc., and from all ammoniacal substances.

214. Sugar.—Sugar may be packed in hogsheads, casks, boxes, and bags. Sugars packed in casks are usually drained of their syrups; notwithstanding, sometimes as much as 10 percent is lost in weight during transit. Clayed sugars lose less in weight, because they are more thoroughly drained before packing. Some sugars are simply packed in bags and mats. Due to drainage, soft sugars must be stowed with free space for the syrups to run off.

215. Tar.—Full cargoes of tar require much care in stowing as the casks are likely to leak and choke the pumps. Some shipmasters sprinkle sawdust over the bottom to cause the tar to clog and thereby prevent it from finding its way below. Casks of tar carried among general goods should be stowed underneath everything else, and apart from such articles as tea, sugar, coffee, etc. Tar is an inflammable article.

216. Turpentine.—Turpentine requires great care in stowing, as it will damage other articles by its odor.

217. Paints.—Tin or kegs containing paints should receive much care and attention in stowing. When any considerable quantity is to be carried, a space should be set apart in the 'tween decks, and each

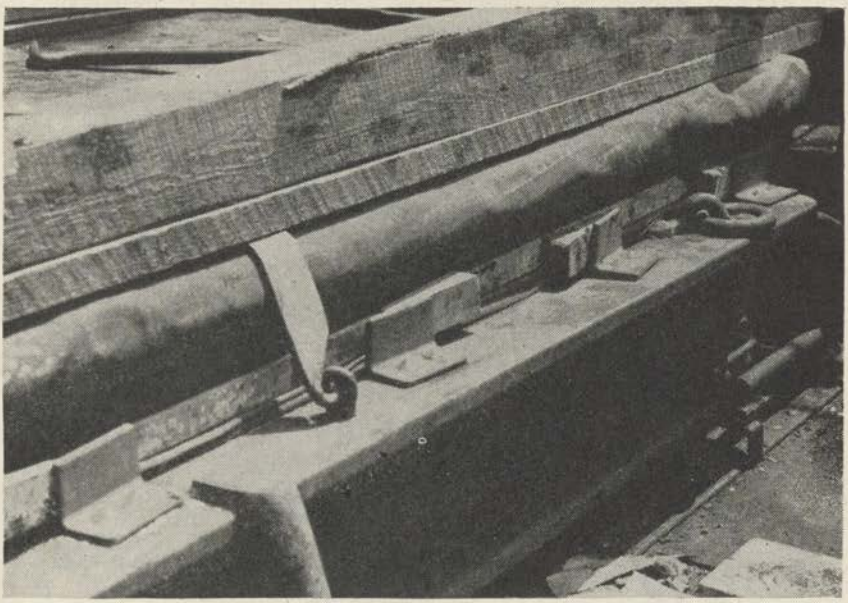


FIGURE 98.—A battened hatch. Note canvas, battens, and wedges in place.

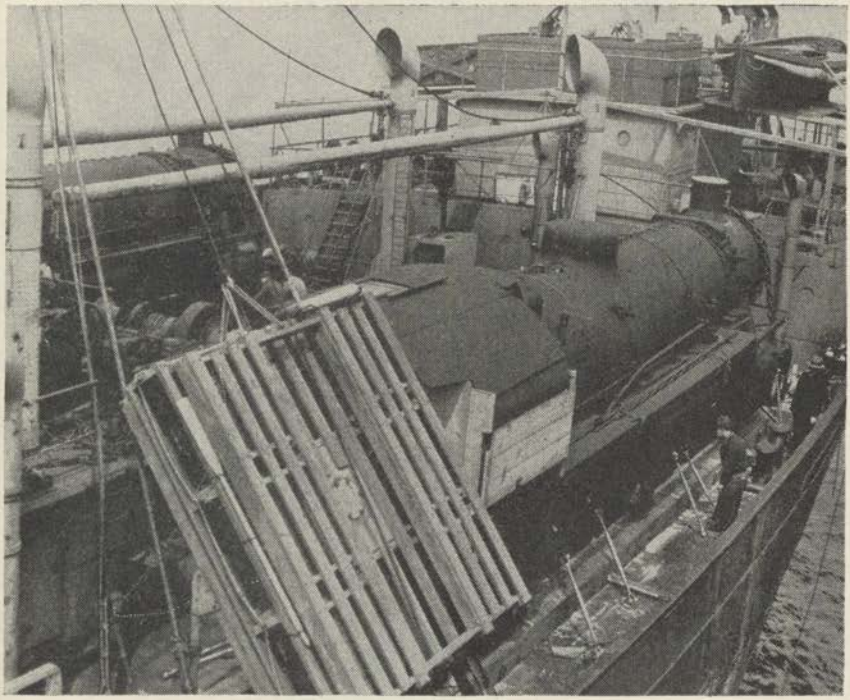


FIGURE 99.—Locomotive.

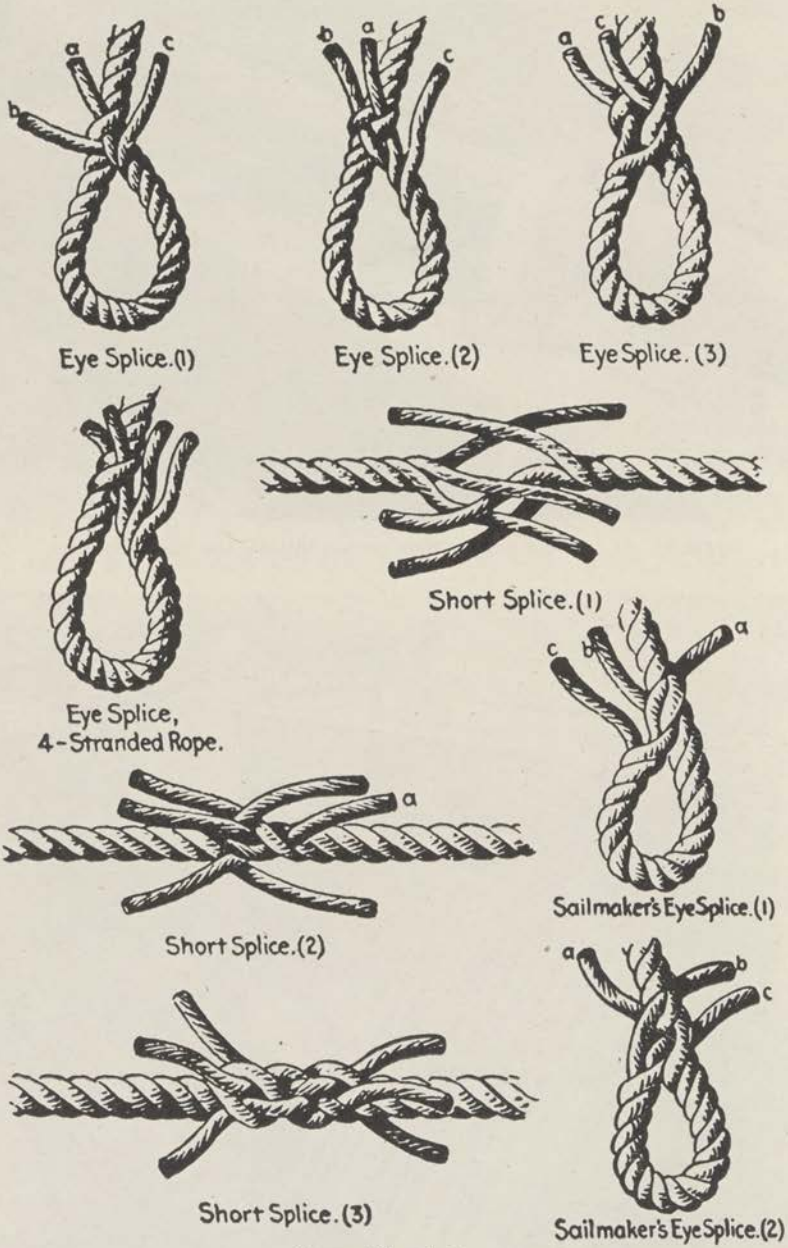
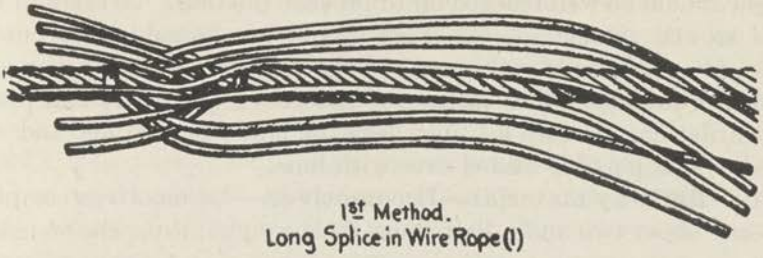
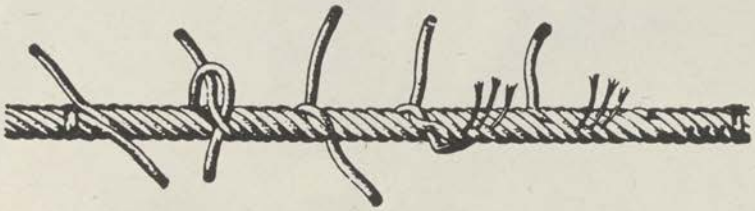


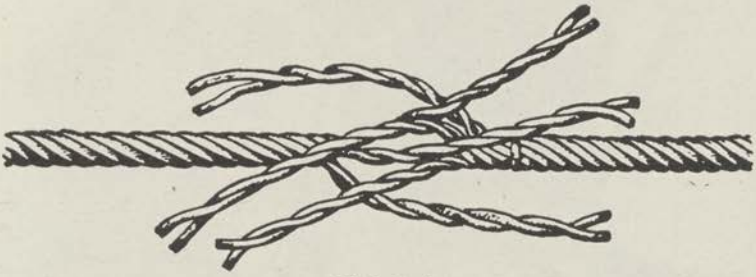
FIGURE 100.—Splices.



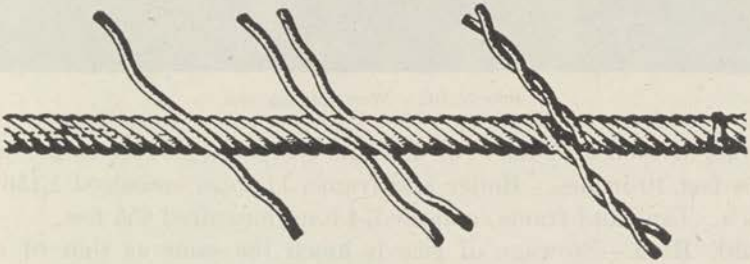
1st Method.
Long Splice in Wire Rope (1)



1st Method.
Long Splice in Wire Rope. (2)



2d Method.
Long Splice in Wire.



2d Method.
Long Splice in Wire.

FIGURE 101.—Long splice in wire.

height should be well blocked off to prevent shifting. Articles of this kind stowed among general cargo should not be subject to outside pressure or the heads will burst and the contents be lost or damaged.

218. Potatoes.—Full cargoes of potatoes require care and plenty of ventilation. Before loading, have the holds cleaned out and well dried, and if possible dusted over with lime.

219. Railway material—Locomotives.—Locomotives, complete, measure about two and a half times their weight; thus, one weighing

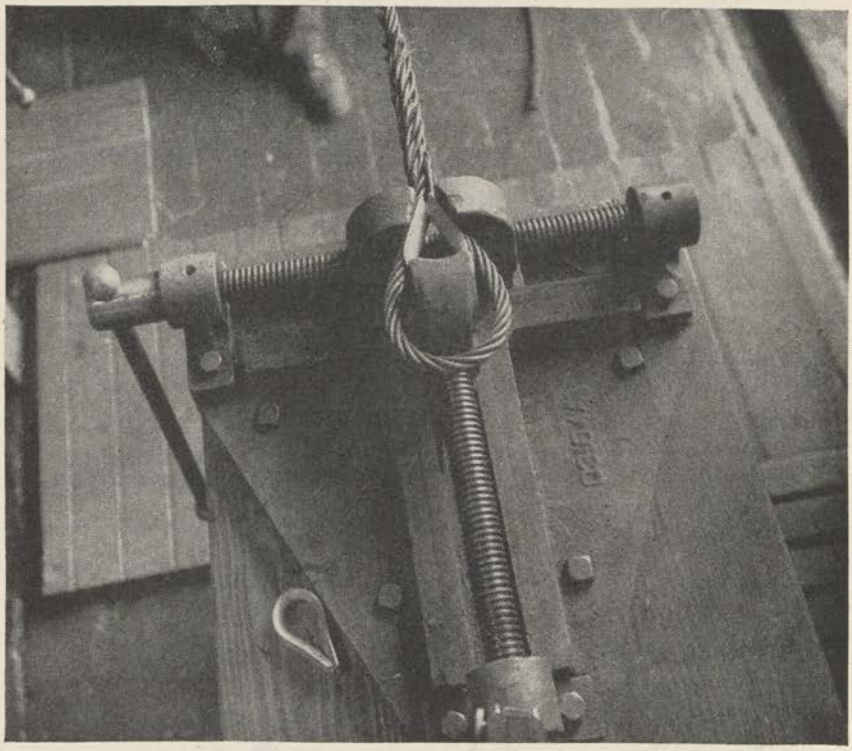


FIGURE 102.—Wire splicing vice.

28 tons measured 71 tons (of 40 cubic feet) and 18 feet 10 inches, or 2,878 feet 10 inches. Boiler and frame, 11 tons, measured 1,156 feet 1 inch. Tank and frame connected, 4 tons, measured 653 feet.

220. Rice.—Stowage of rice is much the same as that of other cereals, but more attention is required in ventilating the holds. Bags should be well protected from the sides and iron work of the vessel; otherwise they may rot and damage.

221. Rope, etc. (ships stores).—A ship may carry a complete set of spars and all necessary ropes, etc., as stores. Manila, wire, and

hemp rope are generally shipped in coils, covered with tarred cloth. They should be stowed in a dry part away from damp articles. The smell of rope will often damage tea, macaroni, flour, sugar, etc., if it is stowed near them. White manila is about 20 percent, and coir about 50 percent lighter than tarred hemp rope, size for size.

222. Sleepers.—Wood, steel, or iron pot sleepers are generally carried in a part of the hold among machinery or heavy goods. When made of wood, they are often painted or impregnated with tar or creosote (see par. 178) and consequently emit a strong odor. It is not unknown to have whole cargoes of foodstuffs ruined by being stowed in a hold which has recently contained creosoted goods; consequently, the utmost care must be taken to have holds thoroughly cleansed after such goods are discharged.

APPENDIX I

TERMINOLOGY

A-Frame.—Derrick, a type in which the mast is formed by two timbers crossed by a ground timber at the foot. The foot of the boom is stepped in the ground timber. Two additional ground timbers also form an "A" and serve as a foundation.

After guard.—Men detailed to tend gear at the after part of a vessel. Also, the officers who have their quarters aft.

Alongside.—By the side of the pier or a vessel.

Amidships.—Usually in the line of the keel, but sometimes midway between bow and stern; commonly corrupted to "'midships."

Angle iron or frame.—A bar of iron bent longitudinally so that it shows an angle in cross section.

Angle of repose.—The greatest angle at which a bulk cargo will rest without shifting.

Arch construction.—A system in which the deck beams are of unusual size and strength, relieving the necessity for lower beams, and allowing a clear interior for bulk cargoes.

Ash whip.—Fall and single block used with ash hoist.

Astern.—Backwards; behind the vessel.

Athwart.—At right angles to the fore-and-aft line of a vessel. Also athwartship. "Athwart the tide" applies to a vessel lying across the current.

Athwart hawse.—Across the vessel's bow or anchor chain.

Auxiliaries.—Small engines for winches, pumps, dynamos, etc.

Backlash.—Shocks caused by play in steering gear or other mechanical devices.

Ballast.—A quantity of iron, stone, gravel, sand, water, or other weighty substance placed in the lower hold of a vessel to increase stability by lowering the center of gravity. A vessel sails in ballast when she carries no cargo.

Ballast tanks.—Tanks in the lower holds of vessels for carrying water ballast, also called double bottoms. They can be pumped out and flooded at will.

Barge.—General name given to flat-bottom craft, but more particularly to vessels built for towage purposes. Formerly the term was applied to elegantly fitted boats or vessels of state, and we still have the "admiral's barge," which is a fine fast motorboat for this officer's use.

Bass rope.—Coir rope.

Bar lattice boom.—Constructed of latticework steel and serves as a cargo or derrick boom.

Bat rivet.—One with a cone head.

Battens.—Strips of iron that fit over staples in the hatch coamings and secure the tarpaulins. When securely wedged the hatches are then said to be battened down. Battens are placed about the rigging to save the gear from chafing. Cargo battens are long planks in the holds and 'tween decks along the ship's sides to protect the cargo from sweat and rust.

Baulk.—Heavy squared piece of timber.

Beam.—The greatest breadth of a vessel. An athwartship timber or member of a vessel upon which the decks are laid. The depth of a beam is called the molding; its breadth, the siding. A vessel may be referred to as a five-beam vessel, meaning that her length is five times her beam. A clipper ship was from five to six times her beam in length.

Beam ends.—A vessel is on her beam ends when listed to an angle where her beams are almost perpendicular, and her righting power gone so that she does not return to her normal upright condition. This occurs usually through shifting of the cargo or ballast.

Beam filling.—Cargo in small packages convenient for filling the space between the beams.

Beam line.—The line of the tops of beams, indicating the intersection with the frames.

Beam knee.—The enlarged end of a beam (or separate right-angled piece) by which it is attached to a frame.

Becket bend (sheet bend).—An efficient bend used for the purpose of uniting two ends of a rope's end to an eye. It jams with the strain, will not slip, and is easily cast loose.

Bed.—The general term given to the foundation of an engine, boiler, or any other object of weight.

Belay.—To make fast; to cease.

Belaying pin.—A device of brass, iron or wood which is set in the pin rails for securing the running rigging.

Between decks ('tween decks).—The space between any two decks, but especially that in a cargo vessel below the main deck.

Bilge.—The turn of the hull below the waterline; that part of the inside hull about the keelson where bilge water collects is called the bilge. The part of a cask having the greatest diameter is the bilge.

Bilge and cantline.—A method of stowing casks where the lower tier is arranged chime and chime and the next tier lies in between the lower rows.

Blackwall hitch.—A turn of a line around the hook of a block in such a way that the line binds itself. A double turn makes a double blackwall hitch.

Block.—A contrivance consisting of a frame or shell which supports a sheave or roller over which ropes are run. There is a great variety of blocks, in shape, size, and design, such as single, double, treble, secret, gin, leading, clump, sister, cheek, jeer, dasher, and snatch. Blocks with a rope through them form a tackle.

Block and block.—The condition that exists when two blocks of a tackle come together; the tackle must be then overhauled before another pull.

Blown up.—A stevedore's term used when a cargo has been so stowed as to raise the center of gravity above that of ordinary stowage.

Boatswain's chest.—A chest given over to boatswain's stores, such as marlin-spikes, rigging screws, marline, ropegear, sail needles, palms, etc.

Booby hatch.—A small opening in the deck forward or aft of the main hatches. It is used to facilitate communication below or upon deck.

Boom.—Cargo booms, which are attached on swivel joints to the foot of the masts, are raised and lowered by topping lifts and swing from side to side by guys according to where the pieces of cargo suspended from them are to be placed.

Boom cradle.—A holder or contrivance so shaped as to receive and hold secure the cargo booms when lowered into a horizontal position when not in use at sea.

Boom horse.—A circular device of iron made into the boom band of the sheet block to travel on.

Boom irons.—Bands or withes at the end of a yardarm through which a stunsail boom is rigged out.

Bosom piece.—A butt strap for angle bars.

Bowline.—One of the most useful knots; it is tied in such a way as to make an eye in the end of a rope.

Bracket.—A small plate used to connect two or more parts, such as deck beam to frame, or a frame to margin plate.

Breech of a block.—The part opposite the swallow; the opposite end from that through which the rope passes.

Bridge crane.—An arched structure having overreaching cantilever extensions at each end. The cargo pendant is suspended from a carriage which travels under the bridge; the whole moves on rails.

Bridle.—A piece of rope or chain each end of which is fast to a spar or rope. The purchase to be applied is hooked to the bight.

Broaching cargo.—The act of breaking into the ship's cargo and appropriating food, drink, or other articles for individual use.

Broadside on.—Sideways, opposite to end on.

Broken stowage.—Stowage of cargo where it is interferred with by parts of the ship that extend into the hold. Also odds and ends of freight that are used to fill the spaces.

Brow.—A gangway to a vessel.

Brow landing.—A platform attached to the side of a ship at deck level to support the brow.

Buckling.—The dangerous bending of a spar under a heavy stress. The warping under stress of any member of a vessel's structure.

Bulk cargo.—A cargo comprised of one type of goods, for example, cotton, wheat, etc.

Bulkhead.—A verticle partition extending athwartship or fore and aft of a vessel. The main bulkheads are mostly watertight, and are known as such. They are equipped with watertight doors which are so fitted with a rubber gasket and dogs as to make a tight contact through which no water will pass. If the bulkheads extend only to a certain deck this is called the bulkhead deck. The bulkheads are reinforced by angle irons called stiffeners and often a web plate is provided at the center of the bulkhead. The collision bulkhead is most important, being as its name implies, near the bow of the ship to restrict sea water from the larger compartments in case of damage forward. A bulkhead is said to be stepped when it is carried forward or aft for the accommodation of machinery and is not all in the same vertical plane.

Bull's eye.—A round piece of lignum vitae, doughnut-shaped and scored around the edge to receive the eye of a rope. A heavy piece of glass set in the deck to let light below.

Bulwark plating.—The strake or strakes above the sheer-strake which form the bulwarks.

Bung up and bilge free.—A phrase used in the stowage of casks. It means that the bungs should be up and that the cask should rest on skids so as to raise the bilge or middle of the cask clear of the deck.

Bunkering.—The act of or the charge for putting coal or oil fuel aboard.

Bunkers.—Compartments of a vessel for the stowage of coal. There are side bunkers, reserve, wing, cross or athwartship bunkers. The term also applies to fuel, both coal and oil.

Bushing.—The replaceable lining of a heaving or other moving part.

Butt.—The end of a plank or plate; the placing of two planks or plates end to end. A barrellike container of 126 gallons. If steel plates are butted, a small plate is riveted over the joint called a butt strap. To start a butt is to have the end of a plank loosen.

Butterfly nut.—A nut with two wings to turn by hand. Also called wing nut.

Buttock.—The rounding part of a vessel's stern.

By the head.—A vessel nosing deeper than her normal draft forward.

By the stern.—A vessel riding deeper than her normal draft at the stern; out of trim by an excess of weight aft.

Cable.—A heavy wire rope, usually used for towing.

Can (cant) hooks.—Used in hoisting casks by hooking into the chimes.

Cant body.—That part of a vessel near the bow or stern where the frames depart from the perpendicular.

Cant frame.—One not square to the keel line. Such frames occur at the bow and stern.

Cantilever tanks.—Located in the gunwales and are also known as gunwale tanks.

Cargo—There are bulk, general, package, and homogenous cargo.

Cargo battens.—Planks spiked or bolted across the frames to keep the cargo from contact with the ship's side.

Cargo boom or derrick.—A heavy boom resting at the foot of a mast. It is elevated by a topping-lift tackle and controlled by guys. It is arranged to work cargo through deck hatches.

Cargo clusters.—Groups of electric lights fitted under a reflector to give light for working cargo.

Cargo jack.—A screw or hydraulic jack for moving and stowing cargo, especially where it is to be forced into small spaces. Cotton is always jacked into a hold.

Cargo net.—A square or rectangular net of heavy rope. It is used to sling case goods or small package freight. When old, it is stretched between the ship and the pier abreast a working hatch to catch and save pieces of cargo that break adrift from the slings.

Cargo plan.—A plan showing the proposed stowage of cargo. It is usually prepared in the office of the pier superintendent with the indorsement of the master. The cargo is stowed according to this plan. A copy of the plan goes with the ship for the aid of the stevedore at port of discharge.

Cargo port.—A large opening in the side of a vessel for loading and removing cargo.

Cargo ton.—Occupies 100 cubic feet of space.

Cargo worthy.—A term applied to a vessel adapted to carry the particular cargo being considered.

Carrick bend.—Used principally for bending two pieces of hemp rope together. There are the single, double, and open carrick bends.

Cat's-paw.—A peculiar twist in the bight of a rope, by which two eyes are formed. The hook of a tackle is passed through them for hoisting purposes.

Ceiling.—The inside planking of a ship. A ceiling of planks is laid over the tank tops to serve as a floor and protect the tanks.

Center of buoyancy.—The center of displacement. It is the center of upward or buoyant action.

Center of gravity.—The center or balancing point of downward pressure. The whole weight of a ship and cargo is assumed to act downward through this point.

Center-line bulkhead.—One running fore and aft amidships.

Chafing batten.—A strip of wood along the side of a yard to take the chafe of the gear.

Chafing gear.—A winding of canvas, rope, or other material around the rigging, spars and rodes, to take the wear.

Chain hoists.—A combination of gin blocks and chain falls. They possess great power and are an important part of a steamer's equipment. *See* Differential, Screw, and Planetary hoists.

Chain slings.—Short pieces of chain provided with hooks for handling rails and similar cargo.

Chain splice.—A method of securing a rope to a chain.

Cheek block.—One whose sheave is set against the side of a spar with only one cheek to support the pin.

Cheeks.—Substantial pieces of timber bolted a short distance below the top of a mast to support the trestle trees.

Chock.—An iron casting which serves as a lead for lines to a wharf or other vessel. There are several types—open, closed, and roller chocks. A roller chock reduces friction and wear on a line when working a vessel around the docks. A convenient block of wood for shoring up boars, weights, etc.

Chock-a-block (two blocks).—The situation when two blocks of a tackle come together. When a hold or cask is full to the top.

Clamps.—The heavy planks or timbers forming the ceiling upon which the deck beams rest. The clamp of the forecastle is the strake under the forecastle deck beams. Likewise, the poop or raised quarterdeck clamps.

Clamshell bucket.—A device for moving coal, ore, or mud. It consists of two scoops like a clam's shell hinged at one point so they can be opened as the whip lowers it to the pile of coal or the bottom, but so arranged as to close when the raising tension is applied.

Clapper (sometimes called the tumbler, or tongue).—A movable fitting between the jaws of a gaff to prevent jamming.

Clear.—To observe the formalities in connection with ship's papers at the customhouse when a vessel is about to sail. To empty a hold.

Clear for running.—The gear is coiled down on its ends so when cast off the pins it will run out quickly without becoming tangled.

Cleat.—A piece of wood or metal with two horns around which ropes are made fast.

Clew jigger.—A handy tackle made fast aloft for various uses about the decks.

Clinker or clincher built.—A method of planking in which the lower edge of a plank overlaps the upper edge of the one below it. This is also called lapstrake. This is also done with steel plates by placing a tapering liner underneath and on the frames.

Clip match hooks.—Two hooks similar in shape and so beveled as to lie together and form an eye.

Close ceiling.—The edges of the ceiling planks very closely fitted.

Clove hitch.—A most useful and efficient method of making a line fast to spar or other rope.

Coal bunker.—A storage place for coal, aboard ship.

Coaling port.—An opening in the side of a vessel for the handling of bunker coal. Also a port or harbor that offers facilities for coaling.

Coaming.—The name applied to the structure raised about a hatchway to prevent water getting below, and to serve as a framework to receive the strongbacks and hatchcovers and for the securing of the tarpaulins.

Coil.—To lay a rope down in circular turns; if the rope is laid up right-handed it is coiled from left to right or clockwise; if left-handed from right to left. Hemp rope is always coiled from left to right. Rope is sold by the coil which contains 200 fathoms standard length and 100 fathoms in so-called half coils.

Coir hawser.—A rope made of coconut husks and sufficiently light to float; it has about one-fourth the strength of manila rope.

Collars.—The eyes of standing rigging that go over the masthead.

Collision bulkhead.—A partition in the forward part of the ship, built of sufficiently heavy material to stand great strain should the bow became damaged through collision.

Companionway.—A series of steps or stairs leading below from the spar deck. With some authorities, companionways are skylights, which cover the hatches, allowing light and air below; but with others it applies only to the covering leading to a stairway, called a companion ladder. The latter appears to be the best usage.

Compartments.—Spaces below decks between bulkheads.

Cork paint.—Used to prevent sweating on the inside of a steel vessel. Granulated cork is mixed in the paint.

Covering boards.—Planks that cover the top of the frames; plank shears.

Crab.—A small capstan or winch.

Crane.—An apparatus for hoisting purposes, appearing in many forms adaptable to many demands. Some cranes are designed for heavy and others for light weights, even to a single davit used for a minor purpose. *See* types of derricks and cranes: A-frame, stiff-leg derrick, guy derrick, tower crane, hammerhead crane, bridge crane, gantry crane, and straight-line crane.

Crank.—A term given to a vessel which is unstable and handles poorly. It is due to faulty construction or badly stowed cargo.

Cross bunkers.—Those running athwartships.

Crutch.—A stanchion formed at its upper end to receive and support a boom or other spar.

Deckload.—A cargo carried on deck.

Deep stowage.—Cargo stowed in a deep hold where there are no decks to break the depth.

Dock.—The loading and discharging place of a vessel.

Donkey engine.—A steam engine which furnishes power, turns cargo winches, and operates fire pumps and radio.

Draft marks.—Figures painted on the stem and sternpost, the lower edge of which indicate the draft of the vessel.

Drag.—The amount that the after end of the keel is below the forward end when the ship is loaded. Vessels are designed and loaded to have a small amount of drag.

Drumhead man.—The winchman; the man who operates a winch in the loading and discharging of cargo.

Dunnage.—All kinds of wooden blocking or planking used in the holds of a vessel to raise the cargo above the floors and sides, preserving it from sweat and leakage, and to serve as chocks to prevent it from getting adrift. It is a general custom to use approximately 19 inches over floors, 14 inches at the bilge, from 2 to 6 inches at the sides and 3 inches on the 'tween decks. No hard and fast rules can be laid down beyond a sufficient amount of dunnage to bring the cargo to port in good condition.

D. W. T.—Dead weight tonnage.

End for end.—To reverse the position.

End on—Head on.

Even keel.—The trim of a vessel when its keel is parallel with the water surface, or more properly, when it takes its designed position for normal trim.

Eye bolt.—One with a looped opening in its head to receive a shackle or a rope.

Eyes.—The collars of the rigging that goes over the mastheads. The holes in bolts, needles, and loops in the ends of rope. A worked eye has smoothed edges while a shackle eye is a straight drilled hole.

Fag end.—The end of a rope that is untwisted.

Fall.—The rope which with the blocks comprise a tackle. The fall has a hauling part and a standing part, the latter being the end fast to the tail of the block. With some simply the hauling part is the fall.

Fast.—To make fast is to secure.

Fay.—To join a timber so closely to another that they serve the purpose and have the appearance of a single timber.

Fore and aft.—Inline of the keel.

Fore and afters.—Fore and aft pieces which fit in a hatchway from coaming to coaming, and are crossed by cross beams known as strongbacks. They all support the hatch covers.

Forward.—Toward the bow.

Freeboard.—The distance (in the center of a vessel's length) from the top of the freeboard deck to the water.

Freeboard tables.—A tabulation of freeboards for standard vessels to which allowances are made according to the time of year, the trade, the deck houses, the strength of hull sheer, etc.

Gangway.—A passageway aboard or ladder up a ship's side.

Gangway door.—A hinged section of the bulwark which swings down or to the side and allows a gangway.

Gangway ladder.—Steps leading down the ship's side to the water.

Gantry crane.—A spanning carriage which moves on tracks and from which a hoisting tackle depends for use in moving heavy weights. All wharf gantry cranes have revolving arms and are divided into two classes: the full arch which travels on two tracks on the ground, and the half arch in which the inner side travels on a rail fast along the face of the warehouse, thus having only one leg on the ground.

Gear.—A general term for a hoisting equipment, that is, jacks, crowbars, spars, ropes, canvas, etc.

Give.—The stretching of new rope, or bending of a spar.

Guy.—A rope or whip that supports or steadies a spar usually in a horizontal or inclined position, such as a bowsprit or a cargo boom, while a stay supports in a vertical position.

Guy derrick.—A mast and boom, the mast stayed in several directions by guys.

Gyn tackle.—A purchase consisting of a double and a three sheave block, the standing part of the fall being fast to the double block.

Half hitch.—A turn made around a rope or spar with the end coming through the bight.

Hatch.—This term, in common usage among seamen, applies to the opening on a ship's deck and to the covers that close it.

Hatch battens.—Strips of steel or wood wedged to the side of the hatch coamings to make fast the tarpaulins.

Hatch boom.—A cargo boom guyed over a hatch and used with a yard boom. The whip used with a hatch boom is called a hatch whip or tackle.

Hatch cleats.—Cleats which secure the battens to the hatch coamings.

Heave taut.—To put a strain on a line or chain.

Hitch.—A combination of terms for making a rope fast to a spar or stay, etc.

Hoist.—To elevate a sail, spar, or piece of cargo.

Hold.—A large lower compartment of a vessel for the stowage of cargo.

Homogeneous cargo.—One composed of merchandise of the same nature, as all grain or all cotton.

Hook.—A general term, but referring usually to a cargo hook on the block of a cargo whip, over which the cargo slings are hooked.

Jack.—A device for moving heavy pieces of cargo and for forcibly stowing bales, etc., in a small space.

Lattice boom.—A cargo boom built of structural steel for lifting heavy weights.

Light load line.—The waterline of a vessel with no cargo aboard.

Lighter.—A small vessel usually rectangular and flat bottom used for discharging or loading vessels.

Linchpin.—A forelock pin; any pin which passes through a shaft to secure a pulley in position.

Long splice.—Joining the ends of two ropes in such a manner that the splice does not enlarge the rope and it will pass freely through a block.

Longshoremen.—Handlers of cargoes.

Marlinespike.—A pointed steel tool for making splices, etc.

Measurement ton.—Usually 40 cubic feet (or 2,240 pounds) on the Atlantic and 42 cubic feet (or 2,000 pounds) on the Pacific coast.

Metacenter.—The point of intersection between a vertical line and an upright extension passing through the center of gravity of a vessel upright and a vertical line passing through the center of gravity of the displaced water of a vessel, listed or heeled. If the metacenter is above the center of gravity the vessel has stability, if separated by an insufficient distance she is cranky, and if below, she is unstable. The metacentric height (G. M.) is the distance from the center of gravity to the metacenter.

Naval stores.—Such stores as pitch, turpentine, oils, etc.

Overhauling weight.—Usually a globular iron weight sufficient to separate the blocks of a cargo tackle. Sometimes a whip is used and is known as an overhauling whip.

Pair masts.—A cargo-working unit of two masts abreast with their usual booms. Their heads are connected by a heavy spanner stay.

Part.—To break, as a rope. A section of the rope of a tackle is a part. There is the hauling part and the standing part.

Patent block.—One in which the sheave turns on rollers like ball bearings.

Pay out.—To let out rope or ease off on a rope.

Platform sling.—A small platform capable of suspension from a tackle by bridles reaching the four corners. It is used for cargo which does not safely lend itself to ordinary slinging.

Port.—The left side of a vessel (formerly called the larboard side). A harbor for embarkation and discharge of cargo, etc. An opening in the side of a vessel, which takes its name from its location or from the purpose it serves, such as a gun port, light or air port, lumber or cargo port, coal, bulwark, bow ballast gangway, hawser port, etc.

Quay.—A loading and discharging place for vessels. It is usually filled in behind solid masonry. This type of pier is very common in Europe.

Riders.—The upper tier of casks or barrels stowed in a hold.

Rigger.—An artisan skilled in the rigging of ships, the hoisting of heavy weights and the care and use of cordage, wire, and hemp.

Rigging.—The ropes of a ship. The wire rope supporting the spars is called standing rigging.

Right-handed rope.—That which is laid up from right to left, and should be coiled down with the hands of a watch. In a right-handed rope held up before you the direction of the stands is diagonally upward to the right.

Ring bolt.—A bolt with a ring in its eye.

Rope, working rules for ropes and tackles.

1. To find safe working load of Manila rope: Square the circumference in inches and divide by 7 for the load in tons.

2. To find the size of Manila rope for a given working load: Multiply the load in tons by 7, and take the square root of the product for the circumference in inches.

3. To find the size of rope when rove as a tackle to lift a given weight: Add to the weight $\frac{1}{10}$ of its value for every sheave to be used in hoisting, this gives the total resistance including friction; divide this by the number of parts in the movable blocks for the maximum tension on the fall, reeve the fall of a size to stand this tension as a safe load. *Example:* Propose to lift 10 tons with 3-fold purchase which means 6 sheaves, and 1 for fairlead. To 10 tons add $\frac{1}{10}$ for each sheave, 17 tons, divide this by the number of parts, which is $17 \div 6 = 2.8$ tons each part of the fall equals $4\frac{1}{2}$-inch fall.

4. To find the weight which a given purchase will lift with safety: Find the safe working load for the rope to be used (Rule 1). Multiply this by the movable block, this gives a total including friction. Multiply the total resistance by 10, and divide by 10 the number of sheaves used: the result is the weight that may be lifted in tons.

Round up.—To heave away on a tackle, taking up the slack preparatory to completing the hoist.

Runner and tackle.—A single block in the end of a piece of wire rope that is to be hauled on. This is a pendant. A line made fast at one end, perhaps to an eye bolt in the decks, leads through this block making a whip and a tackle is clapped on the hauling part.

Sagged.—When a vessel has settled structurally amidships.

Scow.—A box-shaped vessel of light draft used in the local transportation of wood, coal, etc.

Screw hoist.—A chain hoist in whose upper block is an endless screw turning on a worm which gives the power.

Shakes.—The parts of casks or barrels knocked down.

Shifting beam.—A portable support for hatch covers; strongbacks.

Shifting boards.—Temporary partitions extending fore and aft and down about 6 feet or more into a cargo that is likely to shift.

Single lock.—One with a single sheave.

Sister, clip or clove hooks.—Those comprising twin hooks flattened on one side so that they lie together and form an eye when moused with a piece of marlin.

Slippery hitch.—One made fast to spar or ring in such a way that by a pull on the rope it is released.

Spars.—A term applied to all masts, yards, gaffs, booms, etc.

Special cargo.—That which has unusual value for its measurement, for example, specie; or that which requires special attention.

Splice.—To join two ropes by tucking the strands in different ways according to the purpose. There are short, long, chain, or sailmaker's splices. (See figs. 100, 101, and 102.)

Spontaneous combustion.—Fire started in coal or in paint, rags, etc., by the generation of heat within.

Stanchions.—Upright pillars either of wood or steel. They are usually used to support the various decks.

Starboard.—The right side of vessel, looking forward.

Stay tackle.—That made fast to a stay for use in hoisting weight to a midship position and lowering to the hold.

Steam lighter (same as lighter).—A bulky craft used in transferring cargo about harbors and having power of its own.

Stern.—The after part of a vessel.

Stevedoring.—The loading and discharging of cargo.

Straight-line crane.—One which travels usually on the roof of a shed. A boom is supported from the traveling structure at a point between the ends which allows it to be topped satisfactorily over a hatch, while its inner end extends inside the shed. The carriage from which the cargo pendant is suspended travels in and out on the under side of the boom, which does not revolve.

Strain.—A distortion due to an excessive stress.

Strip.—To remove all rigging.

Strongback.—A steel or wood beam placed across a hatch to support the sections of the hatch covers. See fore and afters, a spar lashed to and running between the old style davits to steady them and to aid in controlling and securing the boat.

Swallow (of a block).—The space between the sides of the shell where the rope passes.

Tackle.—A purchase composed of blocks and ropes, gun, watch tackle and jeers. The theoretical power of a tackle is equal to the number of parts of rope entering the moving block or blocks. In order to obtain the working power of the tackle, a deduction ranging from 10 percent to 50 percent is necessary for friction, depending on the type of tackle and of the sheaves. The rope used in reeving off a tackle is called the fall; the free end is the hauling part.

Tarpaulin.—A painted or treated canvas covering for the hatches. There should be three tarpaulins over the hatches of a sea-going vessel. They are secured to the sides of the hatch coaming by means of battens driven tight with wedges.

Ton.—A long ton is 2240 pounds; a short ton, 2000 pounds. A ton of fuel oil equals about 6.7 barrels. A measurement ton is 40 cubic feet and a cargo ton 100 cubic feet.

Tons per inch immersion or tons per inch.—The amount of weight a vessel will take aboard to increase her mean draft 1 inch. By dividing the square feet in the waterplane at a certain draft by 420 the tons per inch at that draft will be approximately at hand.

Treble block.—One with three sheaves.

Web sling.—A flat woven strap for handling bag cargo likely to be ruptured by a rope sling.

Wharf.—A projecting structure extending off to a depth of water sufficient to accommodate vessels alongside, where they are discharged, loaded, and repaired.

Wharfinger.—A man in charge of a wharf. On larger wharves now called the pier superintendent.

Winch.—A piece of machinery which operates a horizontal shaft, upon its ends being fitted the drums by which lines and tackle or whip falls are hove in. Winches are driven by either steam or electricity and are used for the loading and discharging of cargo and the handling of spars and sails.

Winch platform.—A raised structure, usually around a mast, upon which cargo winches are installed.

Yard rope.—That used for hoisting or lowering a yard.

Yardarm.—A yard is divided for easy designation into two parts, port and starboard; the outer quarter of each of these parts is the yardarm.

APPENDIX II

LIST OF GENERAL CARGO

1. Supplies list.

Airplanes and parts, boxed.
Airplanes and parts, unboxed.
Airplane engines.
Arms; ammunition, small caliber; bombs and shells, all types except explosives.
Automobiles, boxed, trucks, busses, ambulances, passenger cars, chassis, gun carriers, tanks, tractors, bulldozers, and similar items.
Automobiles, unboxed, as above.
Ballast (by special arrangement).
Boats, landing and crash.
Boats, all small craft, N. O. S.
Barrels and metal drums containing asphalt, solid or liquid, oil, gasoline, turpentine, resin, ethyl fluid, toluol, etc.
Cement in paper and paper-lined bags.
Cement in cotton bags.
Copper, lead and zinc in bars, slabs, ingots, and cathodes.
Explosives (by special arrangement).
Forage, hay, straw in bales.
General cargo.
Guns, boxed or unboxed, mounted or unmounted.
Houses, knocked down. Knocked down wooden buildings, all kinds.
Iron and steel products.
Ingots, blooms, bars, slabs, billets.
Packaged products:
    Tin plate, sheets, nails, spikes, bolts, washers, fittings, nuts, tools.
Fabricated.[1]
Pipe over 6-inch diameter.
Landing mats.
Machinery, boxed or unboxed.
Medical and surgical supplies and equipment.

[1] Fabricated steel structurals referred to are beams, angles, channels, etc., to which plates or other metal fixtures have been attached by bolts or otherwise, preliminary to their use in building operations, or which have undergone some manufacturing process which renders their handling and stowage more difficult.

Subsistence supplies.[2]
Subsistence supplies, refrigerated—Beef, etc.
Organizational equipment:[3]
To include clothing and other troop supplies and equipment, N. O. S.
Wallboard:
Building board, celotex, gypsum, board, plastic board, lining paper, and similar products.
Wheeled vehicles (not motorized):
Including trailers, carts, caissons, rolling kitchens, gun carriages, without guns, etc.
Lumber and timber, plain.
Lumber and timber, creosoted.
Ties, piles, poles, creosoted.

2. Cubic feet per short ton of various type supplies.

Class	*Cubic feet per short ton*
Mail	160
Motor transport	143
Medical	124
Air Corps	86
Chemical Warfare	81
Welfare	78
Forage	71
Quartermaster (except forage)	66
Signal Corps	64
Railroad equipment	61
Ordnance	50
Engineer	32
Average for military supplies	57

In view of the above figures, a load of military cargo may be taken as 1⅔ of net registered tonnage, or 1 short ton of military cargo will require 1 gross registered ton of shipping.

3. Troop and supply shipments.—*a.* Eight gross registered tons or five net tons per man are required for an oversea movement when troops are accompanied by their organizational equipment and organic transport.

[2] Subsistence supplies to include all items for human consumption and toiletries, not otherwise specified.
[3] Organizational equipment to include clothing, hardware, paint, camping equipment, etc., not otherwise specified.

b. Four gross tons or two net registered tons per man are required when men are accompanied by their personal baggage only.

c. For animals, 11 gross registered tons or 7 net registered tons are required. Allowing for cargo that can be carried in addition to the animals, the net requirements is 3.4 net registered tons per animal.

d. The weight (in pounds per man) of unit equipment and loads of vehicles for the units listed are as follows, data computed prior to organization of triangular divisions:

Unit	Unit equipment	Loads of vehicles	Total per man
Infantry division	311. 3	422. 5	733. 8
Corps troops	1, 289. 5	849. 3	2, 138. 8
Army Corps (3 divisions)		536. 0	1, 107. 3
Cavalry division		1, 051. 1	1, 565. 0

From the figures may be computed a rough approximation of tonnage which must be handled by lighters, piers, etc., in a landing on hostile shores. The changes in the numeral strength of organizations and their allowances make it necessary that the above figures be tentative, and are used simply as a basis for a further study of the estimate of a situation.

NOTE.—The student should become familiar with the type of case, bale, crate and bag in which the aforementioned supplies are inclosed for shipment. He should know the size, dimensions and proportions of each. Also it is possible for him to know the weight of each bulk item. Further he should become thoroughly acquainted with the nomenclature of the supplies of the various services other than Quartermaster Corps; for instance, Medical Corps, Signal Corps, Corps of Engineers, Army Air Forces, Ordnance Department, Coast Artillery Corps, and Red Cross. Also, the equipment in bulk of the soldier and of the organization of which he is a member.

APPENDIX III

FREIGHT MANIFEST

War Department
QMC Form 146

WAR DEPARTMENT

RECAPITULATION OF FREIGHT MANIFEST

U. S. A. T._____ Voyage No._____ From_____
Sailed_____ Destination _____

[Unit of measure, 40 cubic feet per ton; unit of weight, 2,000 pounds per ton]

	Tons	
	Weight	Measure
Medical Corps:		
(a) Medical supplies	22. 97	54. 62
(b) Wheel transportation:		
(1) Ambulances, motor		
(2) Ambulances, A. B		
(3) Carts		
(4) Other		
	22. 97	54. 62
Signal Corps:		
(a) Telegraph supplies		
(b) General supplies	45. 75	104. 01
(c) Wheel transportation:		
(1) Carts		
(2) Wagons		
(3) Trucks		
(4) Other		
	45. 75	104. 01
Engineer Corps:		
(a) Rails and fittings		
(b) Locomotives		
(c) Cross ties		
(d) Lumber		
(e) General supplies	116. 76	305. 00
(f) Wheel transportation:		
(1) Carts		
(2) Wagons		
(3) Trucks		
(g) Heavy lifts (describe on reverse side)		
	116. 76	305. 00

War Department recapitulation of freight manifest—Continued

	Tons	
	Weight	Measure
Air Corps:		
(a) Airplanes:		
(1)		
(2)		
(3)		
(b) General supplies	300. 00	954. 12
(c) Wheel transportation:		
(1) Carts		
(2) Wagons		
(3) Trucks		
(4) Other		
	300. 00	954. 12
Ordnance Department:		
(a) Heavy guns:		
(1)		
(2)		
(3)		
(b) Small arms		
(c) Large caliber ammunition		
(d) Medium caliber ammunition		
(e) Small caliber ammunition	1. 07	. 62
(f) General supplies	156. 07	481. 98
(g) Wheel transportation:		
(1) Carts		
(2) Wagons		
(3) Trucks		
(4) Other, tractor, bxd	5. 23	6. 45
	162. 37	489. 05
Chemical Warfare Service:		
General supplies	. 68	2. 64
Quartermaster Corps:		
(a) Subsistence (not refrigerated)	1, 165. 59	1, 268. 68
(b) Subsistence (refrigerated)		
(c) Clothing	19. 02	56. 63
(d) Gasoline		
(e) Construction materials:		
(1) Timber		
(2) Dimension lumber	50. 30	85. 55
(3) Other lumber		
(4) Cement		
(5) Hardware		
(6) Miscellaneous		

War Department recapitulation of freight manifest—Continued

	Tons	
	Weight	Measure
Quartermaster Corps—Continued.		
(f) Troop property	3. 15	6. 30
(g) Forage:		
(1) Baled	182. 99	367. 40
(2) Sacked	10. 33	28. 80
(h) General supplies	510. 16	1, 353. 05
(i) Motor transportation:		
(1) Passenger cars		
(2) Light trucks	362. 09	2, 274. 90
(3) Medium trucks	7. 68	52. 73
(4) Heavy trucks		
(5) Wagons		
(6) Carts		
	2, 311. 31	5, 494. 04
Personal property:		
(a) Household goods	12. 00	68. 68
(b) Automobiles	6. 56	59. 75
	18. 56	128. 43
Coast Artillery Corps:		
(a) General supplies	3. 05	5. 25
(b) Mine equipment		
(c) Reels, cable		
	3. 05	5. 25
Miscellaneous:		
(a) U. S. Army	28. 76	66. 69
(b) U. S. Navy and Marine Corps	5. 62	8. 47
(c) Insular government		
(d) Commercial		
(e) Post exchange		
(f) Welfare organizations	3. 84	12. 13
(g) Miscellaneous (describe on reverse side)	. 30	. 82
Total cargo	3, 019. 97	7, 625. 27
Pounds of mail:		
(a) Letters		
(b) Prints		
Number of remains:		
(a) Army		
(b) Navy		

War Department recapitulation of freight manifest—Continued

	Tons	
	Weight	Measure
Number of animals:		
(a) Horses		
(b) Mules		
(c) Dogs		
Number of automobiles:		
(a) Public*	162	
(b) Private	4	

*Including 1 tractor, boxed, for Ordnance Department.

(Signature)

APPENDIX IV

SPECIFICATIONS FOR HASTY REFITTING OF A CHARTERED STEAMSHIP FOR TRANSPORTATION OF ANIMALS

1. Preparation.—All compartments selected for the accommodation of animals should be thoroughly cleaned out and washed as

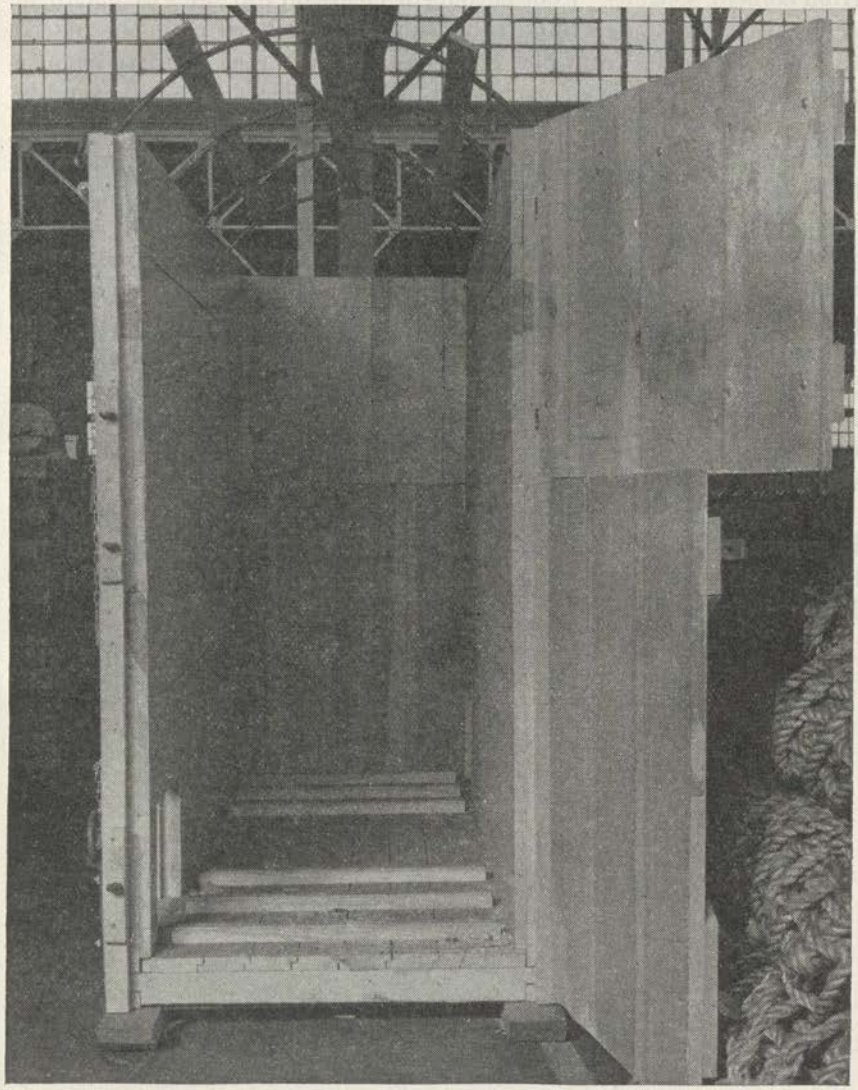


FIGURE 103.—Horse cradle for loading and unloading. Open view.

necessary, and placed in proper condition for the erection of stalls or pens.

2. Deck covering.—Decks to be properly cleaned and coated with suitable material, then sheathed, except at waterways, with 1½-inch planks (spruce or yellow pine). That portion of sheathing in stalls or pens will be made up in portable sections with planks laid athwartship the full length of each stall strongly cleated with two 1- by 4-inch cleats fastened with clinched nails on under side of the plank 4 inches from ends of sections. Foot battens or cleats on top sides of platform or sheathing sections will be 4- by 2-inch oak or hard pine, one placed 12 inches from the front one 12 inches from the rear and two equally spaced in the middle of each stall, all four cleats to be thoroughly secured in platform with ⅜- by 2½-inch iron screws with heads well countersunk 1 inch deep and plugged. The sheathing in passageways to be laid fore and aft lengthwise of the passage on the 2- by 4-inch stringers laid athwartship at all stanchions.

3. Stalls or pens.—*a.* All stalls for animals will be arranged with animals standing athwartship, wherever possible, facing fore and aft passages. Stalls will be of such size as to accommodate only one animal, allowing 32 inches in width for each. Length in clear 7 feet 6 inches to 8 feet where possible. Passages between stalls and the ship's side to be not less than 3 inches in width to be used for the removal of manure, and to be kept as free as possible from obstructions and ship's web frames.

b. In case of short voyages under 6 days where conditions of sea is generally smooth or moderate, pens to accommodate two to four horses each may be substituted for individual stalls, allowing 30 inches in width for each horse.

Appendix V

BIBLIOGRAPHY

Robert Edwards Annin: Ocean Shipping. Copyright, permission of D. Appleton-Century Co., Inc.
Charles H. Hillcoat: Stowage of Ships.
Gershom Bradford: A Glossary of Sea Terms.
Thomas Rothwell Taylor: Stowage of Ship Cargoes. U. S. Department of Commerce.
MacElwee: Ports and Terminals Facilities (lecture reports of the Quartermaster School).
TM10–380, Water Transportation.
Barr Shipping Company, New York.
Army Air Forces, photographs.
Signal Corps, photographs.
New York Port of Embarkation, photographs.
Eugene H. Lederer, Lt. Colonel, Q. M. C., photographs.
Olivier E. Ragonnet, 1st Lt. Q. M. C., photographs, subject matter.

APPENDIX VI

CARGO AND DECK STOWAGE PLANS

1. **Cargo stowage plan (one destination).**—See figure 104 in back of manual.

2. **Cargo stowage plan (several destinations).**—See figure 105 in back of manual.

3. **Deck stowage plan (airplane forward).**—See figure 106 in back of manual.

4. **Deck stowage plan (airplane aft).**—See figure 107 in back of manual.

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[A. G. 062.11 (6–7–42).]

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FUEL 1682 L.T. 11,100 BBLS.

WATER 478 L.T.

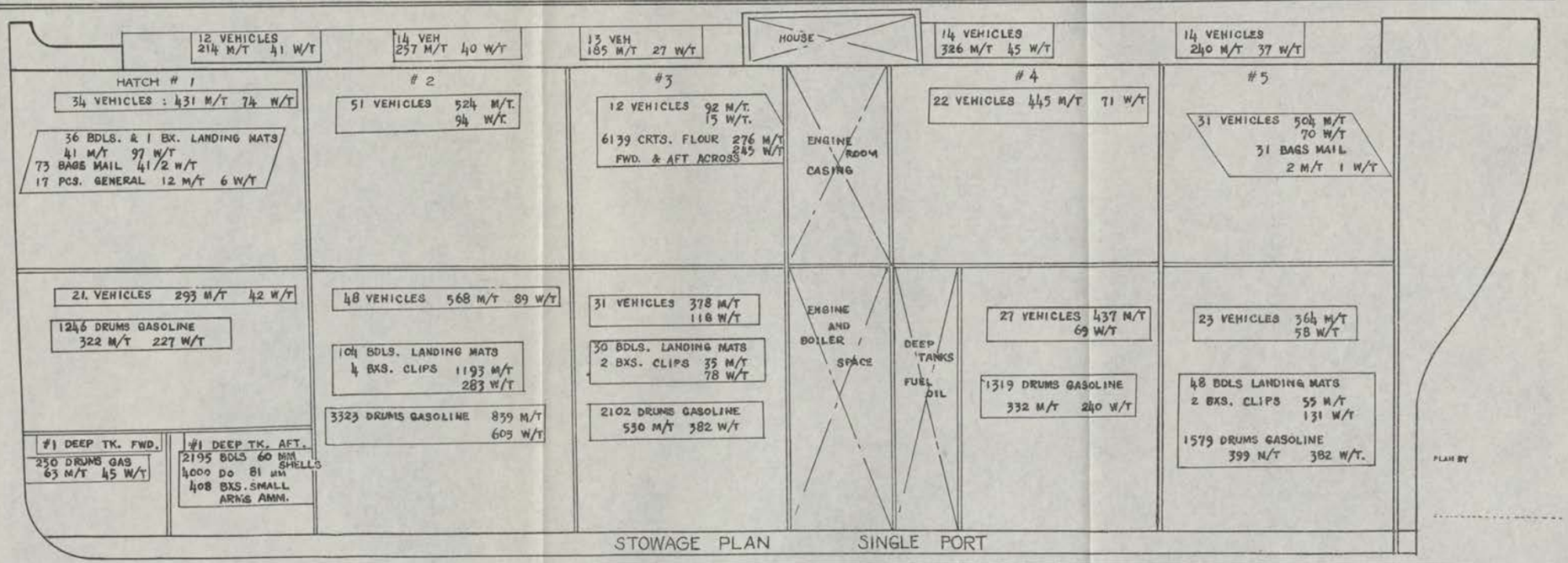
	WEIGHT TONS	CUBIC FEET		WEIGHT TONS	CUBIC FEET		WEIGHT TONS	CUBIC FEET
HATCH 1			HATCH 4			HATCH 7		
HATCH 2			HATCH 5			HATCH 8		
HATCH 3			HATCH 6			HATCH 9		

STEVEDORE

EXPLANATION

Colors shows below denote port of destination

PLAN BY

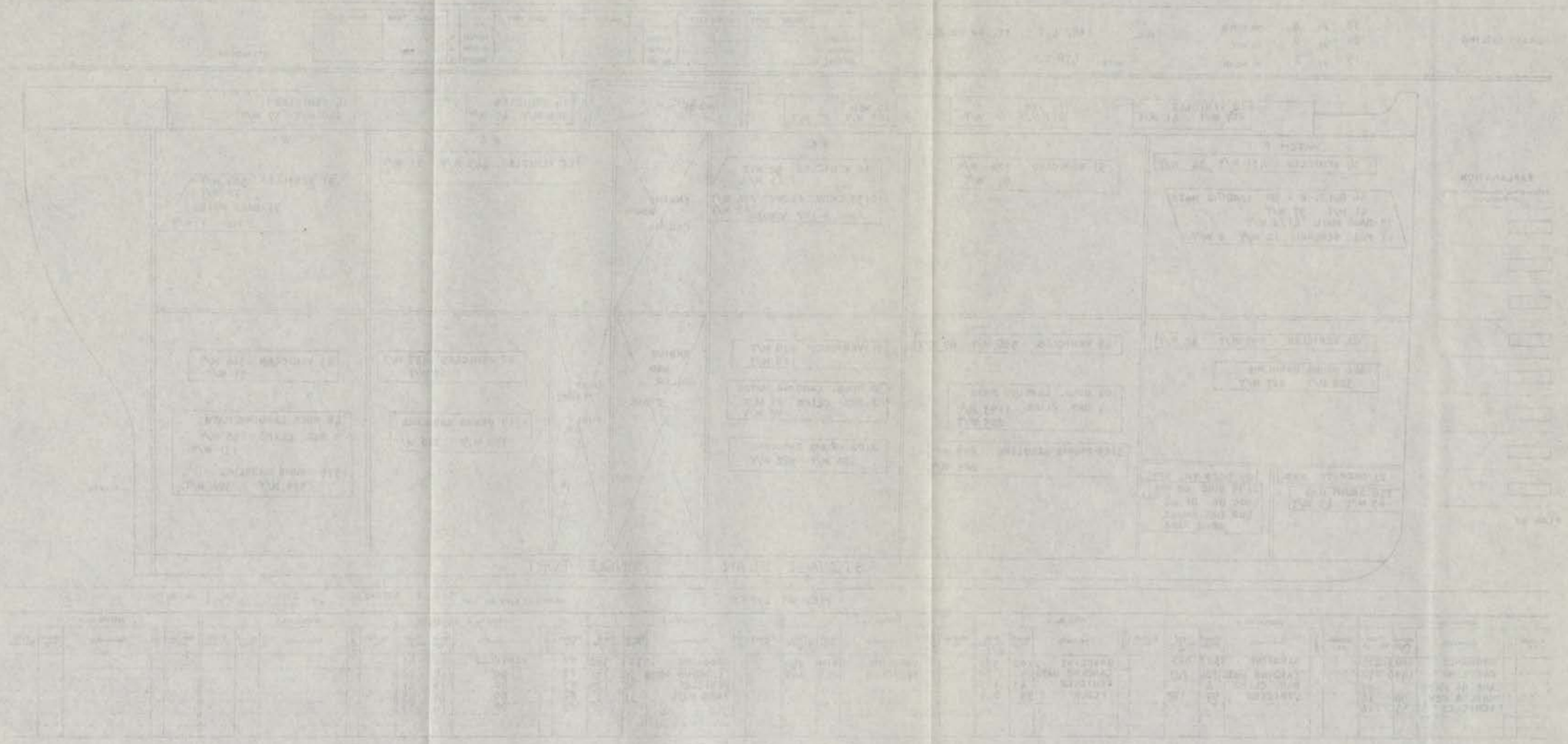


HEAVY LIFTS

HEAVIEST LIFT IN SHIP DIA T. WRECKER WT. 23000 LBS. No. 1 on deck

HATCH No. 1				HATCH No. 2				HATCH No. 3				HATCH No. 4				HATCH No. 5				HATCH No. 6 ON DECK				HATCH No. 7				HATCH No. 8			
Receipt No.	Commodity	Amount Pkgs.	Total Wt. Lbs.	Receipt No.	Commodity	Amount Pkgs.	Total wt. Lbs. W/T	Receipt No.	Commodity	Amount Pkgs.	Total wt. Lbs. W/T	Receipt No.	Commodity	Amount Pkgs.	Total wt. Lbs. W/T	Receipt No.	Commodity	Amount Pkgs.	Total wt. Lbs. W/T	Receipt No.	Commodity	Amount Pkgs.	Total wt. Lbs.	Receipt No.	Commodity	Amount Pkgs.	Total wt. Lbs.	Receipt No.	Commodity	Amount Pkgs.	Total wt. Lbs.
	ORDNANCE	6603	2254		GASOLINE	3323	605		GASOLINE	2102	382		GASOLINE	1319	240		GASOLINE	1579	382	#1	VEHICLES	12	41								
	GASOLINE	1436	272		LANDING MATS	104	283		LANDING MATS	32	78		VEHICLES	49	140		LANDING MATS	30	131	#2	DO	14	40								
	LANDING MATS		97		BXS. CLIPS	4			VEHICLES	43	133						VEHICLES	54	129	#3	DO	13	27								
	MAIL & GEN.	90	10		VEHICLES	99	183		FLOUR	6139	245						BAGS MAIL	31	1	#4	DO	14	45								
	VEHICLES	55	116																	#5	DO	14	37								

FIGURE 104.—Cargo stowage plan (one destination).



U. S. A. T. _____ MASTER _____ SAILED FROM PORT OF _____ DATE _____, 1942 VOYAGE NUMBER _____ B. NUMBER _____

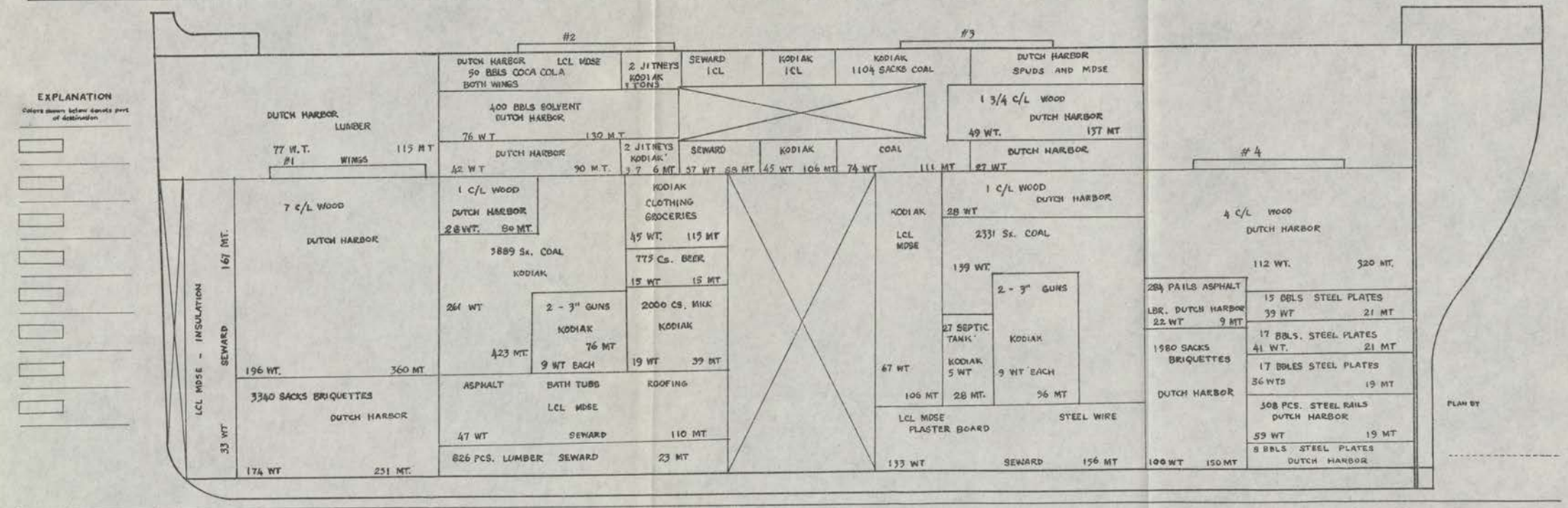
DRAFT SAILING
16 FT. 3 IN FOR'D
19 FT. 6 IN AFT.
17 FT. 9½ IN MEAN

FUEL _____

WATER _____

	WEIGHT-TONS	CUBIC FEET		WEIGHT-TONS	CUBIC FEET			
HATCH 1			HATCH 4			HATCH 7		
HATCH 2			HATCH 5			HATCH 8		
HATCH 3			HATCH 6			HATCH 9		

CARGO SUPERVISOR
STEVEDORE _____



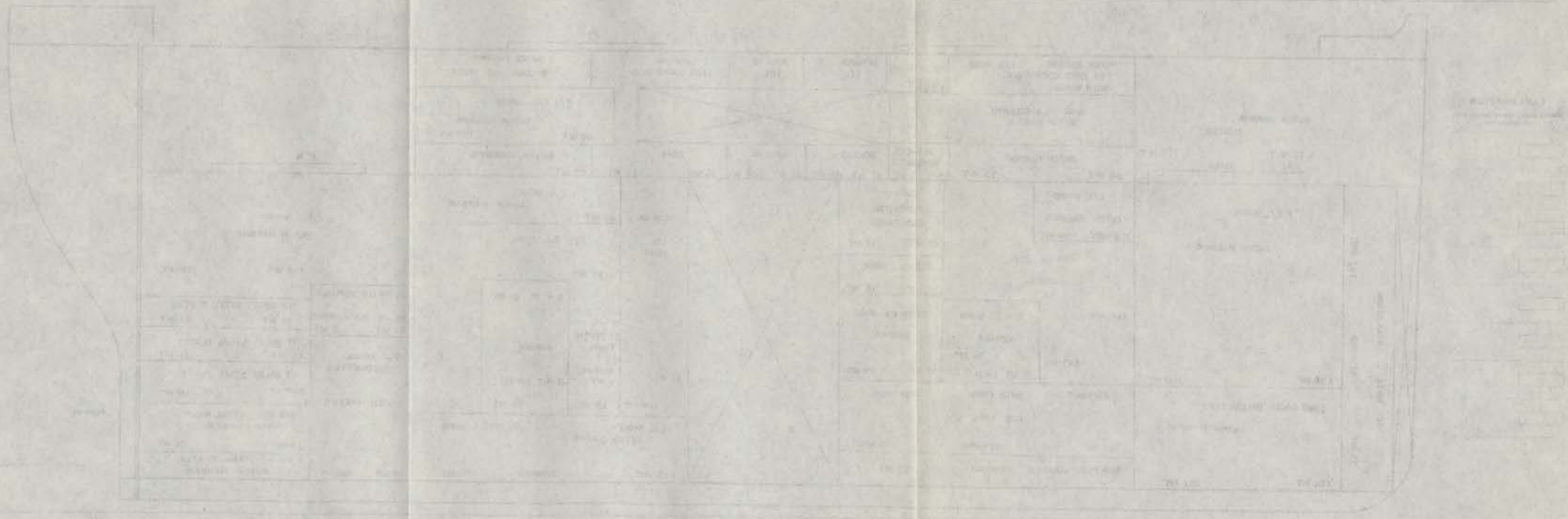
HEAVY LIFTS

HEAVIEST LIFT IN SHIP _____ WT. _____ LBS.

HATCH No. 1					HATCH No. 2					HATCH No. 3					HATCH No. 4					HATCH No. 5					HATCH No. 6					HATCH No. 7					HATCH No. 8				
Receipt No.	Discharge	Commodity	Amount Pkgs.	Total Wt. Lbs.	Receipt No.	Discharge	Commodity	Amount Pkgs.	Total Wt. Lbs.	Receipt No.	Discharge	Commodity	Amount Pkgs.	Total Wt. Lbs.	Receipt No.	Discharge	Commodity	Amount Pkgs.	Total Wt. Lbs.	Receipt No.	Discharge	Commodity	Amount Pkgs.	Total Wt. Lbs.	Receipt No.	Discharge	Commodity	Amount Pkgs.	Total Wt. Lbs.	Receipt No.	Discharge	Commodity	Amount Pkgs.	Total Wt. Lbs.	Receipt No.	Discharge	Commodity	Amount Pkgs.	Total Wt. Lbs.
							GUNS	2	36,000			GUNS	2	36,000																								

FIGURE 105.—Cargo stowage plan (several destinations).

467524°—42



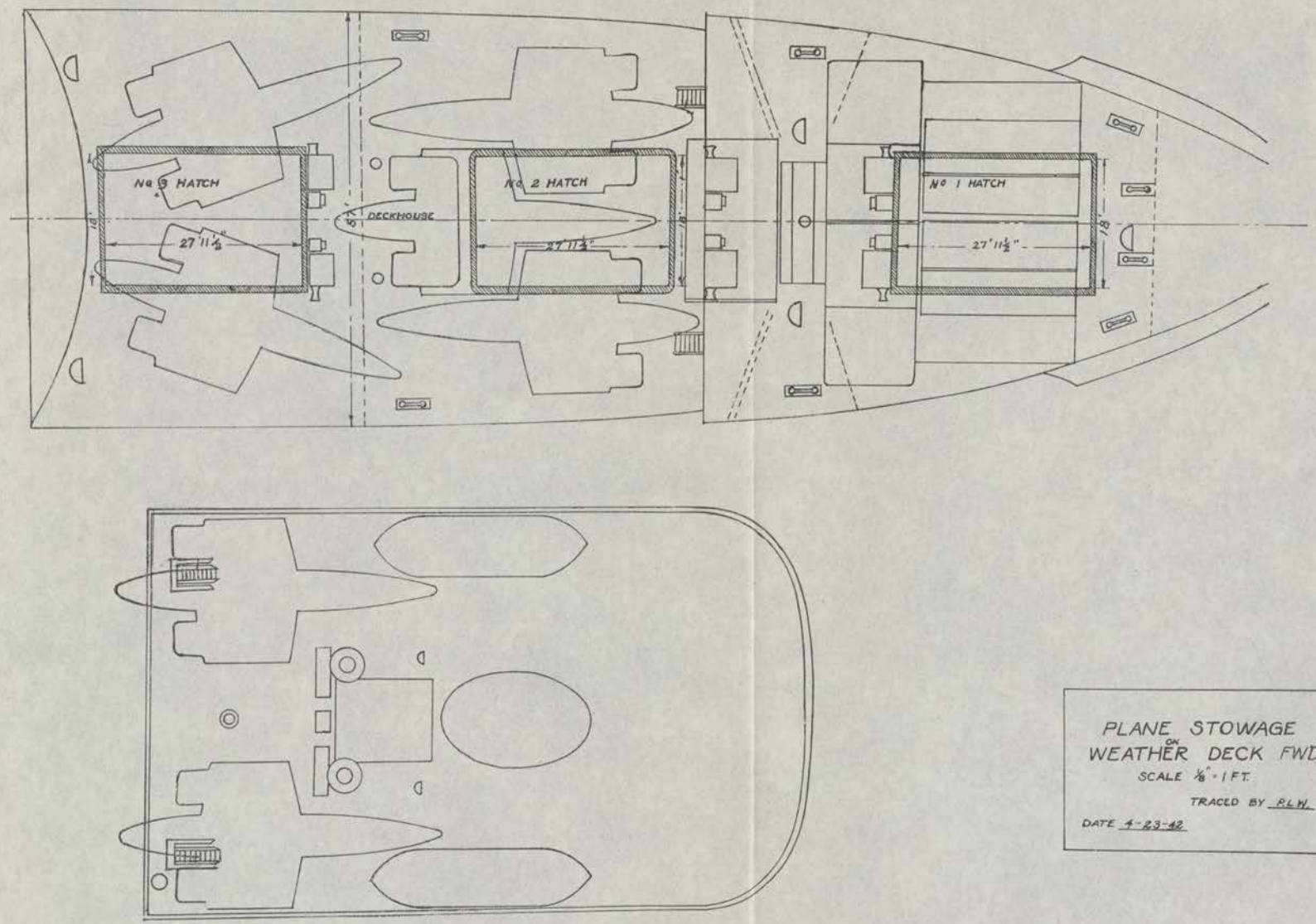
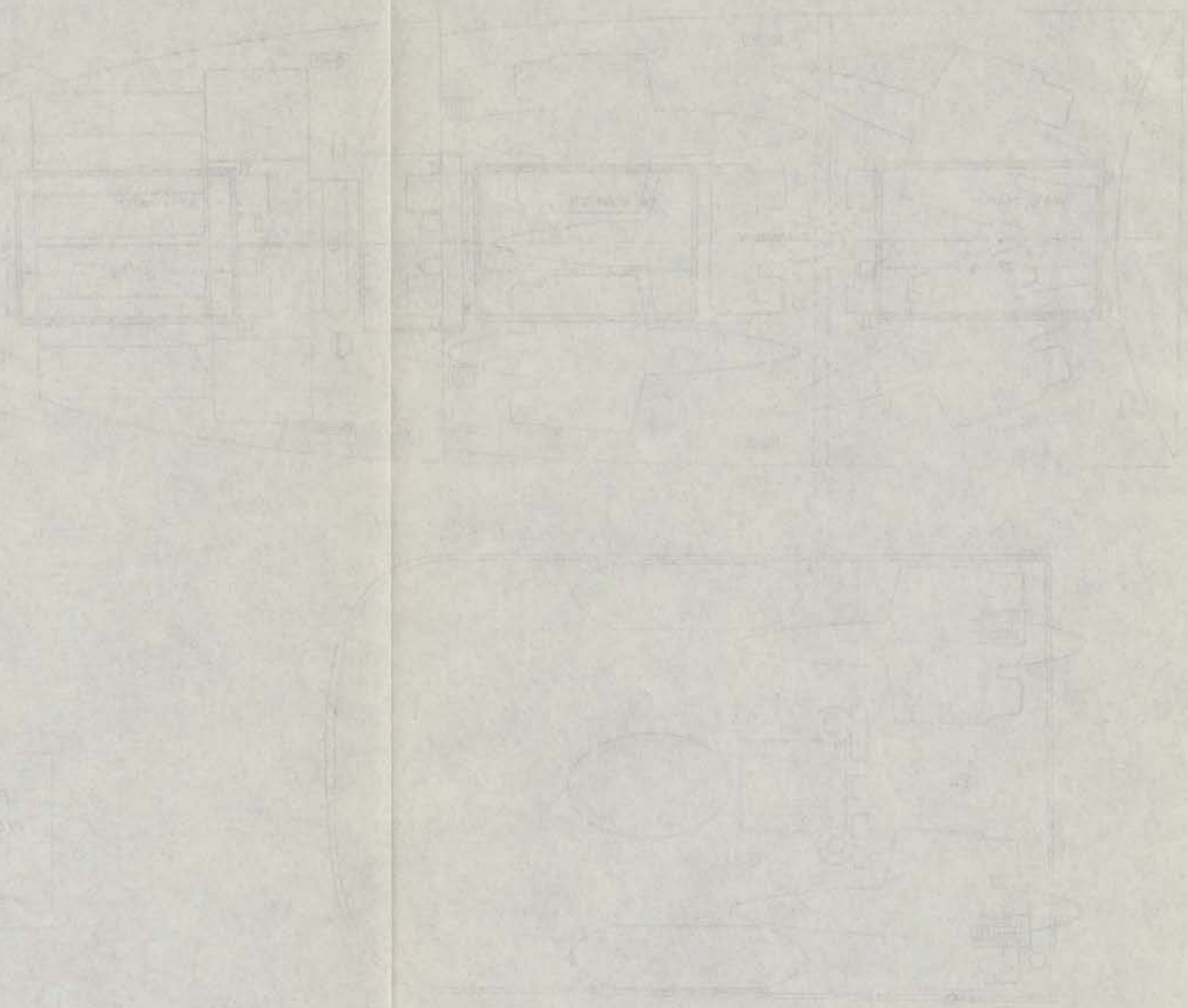


FIGURE 106.—Deck stowage plan (airplane forward).



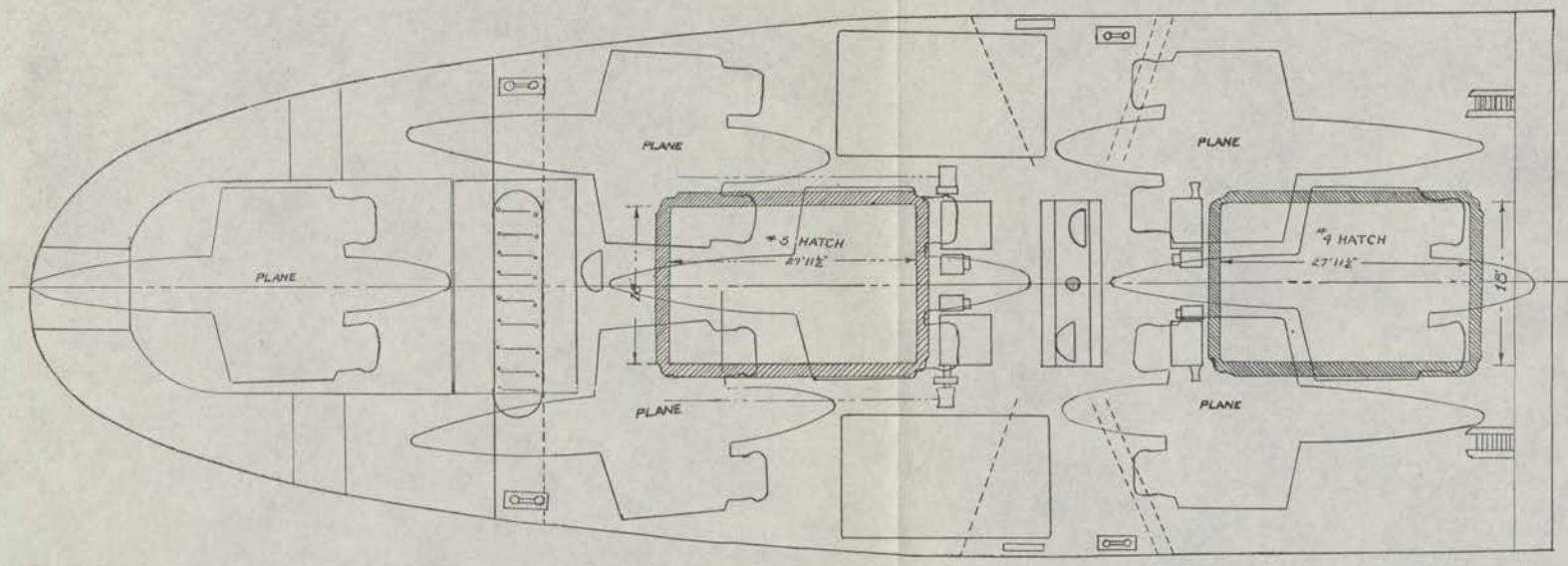


FIGURE 107.—Deck stowage plans (airplane aft).

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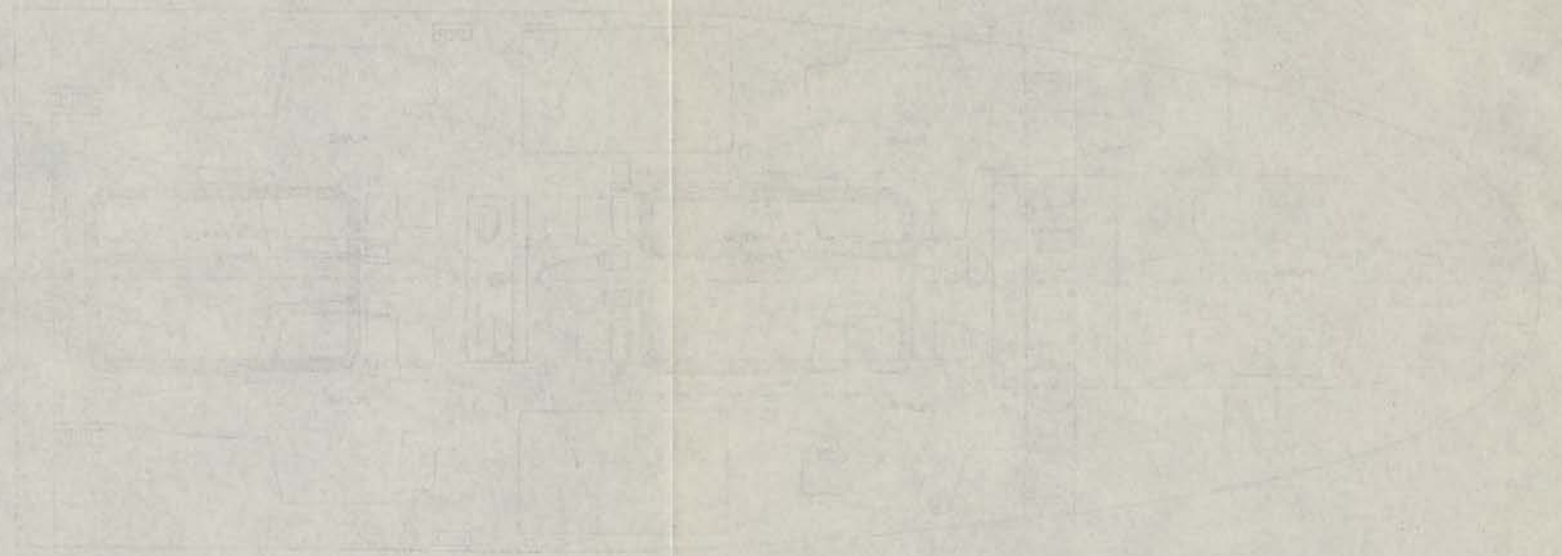

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