CHAPTER 12

CARGO HANDLING FACILITIES

12-1. Cargo transfer between dock and vessel.

a. Use of lighters.

(1) *Application.* In loading operations, cargoes are transferred from the dock to lighters and then into vessels. In unloading the process is reversed. This system is generally used where vessels are berthed offshore or where cargoes are brought to a berth by water rather than land transport.

(2) *Equipment required*. Transfer from lighter to vessel usually employs ship's rigging or, where heavy lifts are required, a floating crane. For transfer between lighter and dock, a dock crane, truck or railroad cranes, or forklift trucks and ramps are used.

b. Direct transfer between dock and vessel.

(1) *Application.* Where vessels are berthed at piers or wharves and where cargoes are delivered by truck or rail, direct transfer of cargo between dock and vessel may be made by using one of the systems set forth below.

(2) *Using ship's equipment*. This system employs ship-mounted equipment, either alone or with dockmounted equipment.

(a) *Conventional burtoning gear*. This system consists of a pair of ship's booms, each stepped at the foot of a kingpost, so that one boom is fixed fast over the ship's hatch and the other over the dock (fig. 12-1). Cargo falls, used to lift cargo, run from either hydraulic, electric, or steam-operated winches and pass through the boom head by means of fairleads (heel blocks, lizards, and head blocks), then married together at a common point above the cargo hook. Modifications and jury rigging of this gear is possible. The advantages include relatively simple design, economical first costs and maintenance, and elimination of highly skilled operators. The disadvantages are: maximum load limitation, lack of flexibility (fixed booms are deficient in spotting ability); time loss in reporting or doubling-up to maximum capacity, rigging dangers involved; and limited over-the-side reach.

(b) *Farrel rig*. This system is similar to conventional burtoning gears except that working guys are made fast to vang posts that are erected on deck, midship guy is nonexistent, and topping lift lead block assumes a position at or near the vessel's center line. Efficiency is improved by providing winches for the topping lifts. The advantages are: topping or lowering accomplished without lengthening or shortening the guys; greater spotting ability, reduction of port time, and greater safety than conventional burtoning system; and push-button control over topping lifts. The disadvantages include greater initial and maintenance costs of vang posts and topping lift winches. These disadvantages are minor.

(c) Ebel rig. This rig is similar to the Farrel rig but employs winches for both guying and topping. Vang posts are not used. The advantages of the Ebel rig are: loads up to maximum boom capacities can be handled if doubling-up blocks are properly employed; guying and topping are done completely with pushbutton control (if winches are provided with "joy stock" operated master switches, both motions can be controlled by one hand); greater spotting ability; increased safety; reduction of port time; and improvement in deck housekeeping.

(d) Jumbo boom. Practically all American cargo ships have one or more jumbo (heavy-lift) booms located at strategic hatches on the vessel. These booms are stepped in a pedestal mounted along the center line of the vessel. When not in use, they are kept collared aloft. The advantages are greater over-the-side reach than conventional burtoning gear and high capacity (when backstays are used, capacities up to 60 tons are common). The disadvantages are: greater number of personnel required to operate the system; slow in operation; boom must be slewed (used as swinging boom); limited maximum capacity; dangerous operation (particularly when lowering heavy weights); time required to ready gear from secured position, and additional space required to stow auxiliary gear when not in use.

(e) Shipboard crane. The shipboard crane is another means of handling cargo with ship's gear. It has been found, at least in certain trades, to be faster than the boommast/kingpost rigs. The advantages are: increase in spotting ability; increase in over-the-side reach when athwartship tracks are used; increase in safety about decks; and easier housekeeping. Deck watch officers at sea also find that a "forest" of masts, kingposts, and booms is eliminated when shipboard cranes are used The disadvantage is that a highly skilled operator is required.

(f) House fall. Certain piers (particularly those having narrow aprons or two-deck levels) are equipped with cargo masts that may be used in combination with the vessel's regular cargo handling gear. The

usual method is to rig the ship's off-shore boom and winch to manipulate the up-and-down fall, and the cargo mast and dock winch to manipulate the burtoning fall, the latter being referred to as the house fall (fig. 12-1). This system has these advantages: increased over-the-side reach, sometimes being able to spot laterally the entire width of the pier apron; increased height that cargo can be worked by regular burtoning gear (being able to work second-deck levels); and since the onshore boom is not employed, the danger of this boom coming in contact with the pier terminal is eliminated.

(g) *Self-loading/unloading vessels*. Some bulk carriers are fitted with self-unloading conveyors, either of the endless-belt or scraper type. A few of the latest all-container vessels are fitted with self-loading/unloading shipboard transporter-type cranes. Such carriers have the advantage of flexibility of operation.

(3) *Using floating equipment*. The advantages of the floating cranes are high capacity and elimination of breaking-out the ship's jumbo boom. A disadvantage is the high cost of chartering the equipment, which may not be readily available. The use of floating cranes is usually limited to the offshore side of a ship during calm-to-moderate sea conditions.

(4) *Using shore-based equipment*.

(*a) Gantry cranes*. Gantry cranes are usually large frame-supported mobile cranes, which may be either rubber-tired (fig. 12-2) or railmounted (fig. 12-3). Cargo handling, especially containerized cargo, by gantry cranes directly to railway cars or tractor-trailers are effective methods of handling materials. Gantry cranes are also used as general purpose yard cranes, stacking containers two or three high, in conjunction with other materials handling equipment. Due to the trend toward containerization, most gantry cranes are now being manufactured with minimum lifting capacities and outward reaches of 40 tons and 130 feet, respectively.

(*b) Fixed derricks*. Fixed derricks on the wharf provide heavy lift (up to 100 tons in some commercial ports) for cargo handling (fig. 12-4). Fixed derricks are not considered to be as efficient as mobile gantry cranes.

(*c) Mobile cranes*. Truck or crawler-mounted cranes may be used to load and unload cargo ships (fig. 12-5). Table 12-1 and figure 12-6 present the manufacturer's rated capacities for a number of larger commercially available cranes. Figure 12-6 shows that the large mobile cranes are not capable of lifting 40-foot containers weighing 67,000 pounds beyond a 30-foot radius.

(*d*) *Conveyors.* Conveyors are used for handling bulk or relatively small packaged goods, but their limited maximum lifting capacity restricts their use to relatively light cargoes. For example, the endless-belt cuoveyor is especially useful for side port discharge, the pneumatic or air conveyor, for handling large quantities of dry bulk commodities; the endless pocket conveyor, for handling small package units of cargo; the gravity roller conveyor, for side port handling when the endless-belt powered conveyor not available or prohibited; and the screw-type conveyor, for over-the-side or for side port handling of bagged goods. Also, the spiral conveyor utilizes gravity to propel cargo being worked.

(5) Roll-on/roll-off system. There are several ways in which containers can be handled in this type of operation. In most cases, the method of handling containers and design of the berth and layout of the port area is inextricably tied up with the design of the ship. A large number of new ships and new berths for this type of operation have been built or are under construction, which shows the importance of this type of operation. It will undoubtedly increase throughout the world, especially as feeder services on short sea routes from main container transshipment ports. Basically, there are three methods of handling containers on a roll-on/roll-off service:

(*a*) Trailer and tractor unit drives on, remains on the ship during its voyage, and drives off at the other end. This method can only be economical on very short sea journeys because the tractor unit is idle and burdens the ship's capacity during the sea journey. No special facilities or equipment are required in the port area except sufficient land for parking the trailer while waiting to drive on.

(*b*) The trailer unit only remains on ship during the sea journey. The tractor unit simply tows the container on its trailer from the storage area onto the ship and drives off leaving the container on its trailer. A further set of tractor units is required at the destination to tow the containers off the ship and to reload the ship for its return journey. The trailers may be normal road trailers suitable for driving on public roads or special small trailers suitable only for use in the port areas. The former is heavier and takes up more room on the ship but would be used where the container is driven some distance to the port and will be driven inland some distance to its destination. The latter would generally be used where the inland depot is m the port area so that the container is only handled in the port area, or where the container is delivered by rail and transferred to the trailer in the port area This type of trailer is generally much lighter and cheaper than the normal road trailer and takes up less ship capacity. For the method where the road trailer is driven on and off the ship, no special equipment is required. Where the small trailer is used, equipment may be required for transferring the container from rail or road trailer to

Table 12-1. Characteristics of Various Commercially Available Cranes.

Characteristics of Various Commercially Available Cranes

Manufacturer	Model	Type of Lover Works	Length of Boom, ft	Hoist Speed with 50k Rig fpm	Approximate Gross Weight kips	Maximum Capacity at Minimum Radius, kips	Minimum Radius ft
PUH	6250 TC 80 tons	Truck	150 Container tip	140	384.0	160.0	35
American	9520	Truck	150 92" tubular	80	301.0	218.0	27
Lima	7700	Truck	150	150	398.0	279.6	35
Manitowoc	4600	Crawler	150	112	494.6	227.7	29
American	11250	Crawler	150	163	494.0	271.0	29
LeTourneau	GC500	Gantry Rubber tires	120	170	708.5	150.0	29
Butters	50 tons	Stiffleg	150	38		112.0	36
American	S-40	Stiffleg	180	90 (380 hoist) 180 (550 hoist)		179.0	40
American	S-50	Stiffleg	200	90 (380 hoist) 180 (550 hoist)		368.o	50
Floating Crane	261 B	Pedestal (barge)	123.5	56		200.0	55

by U.S. Amy Engineer
Waterways Experiment Station

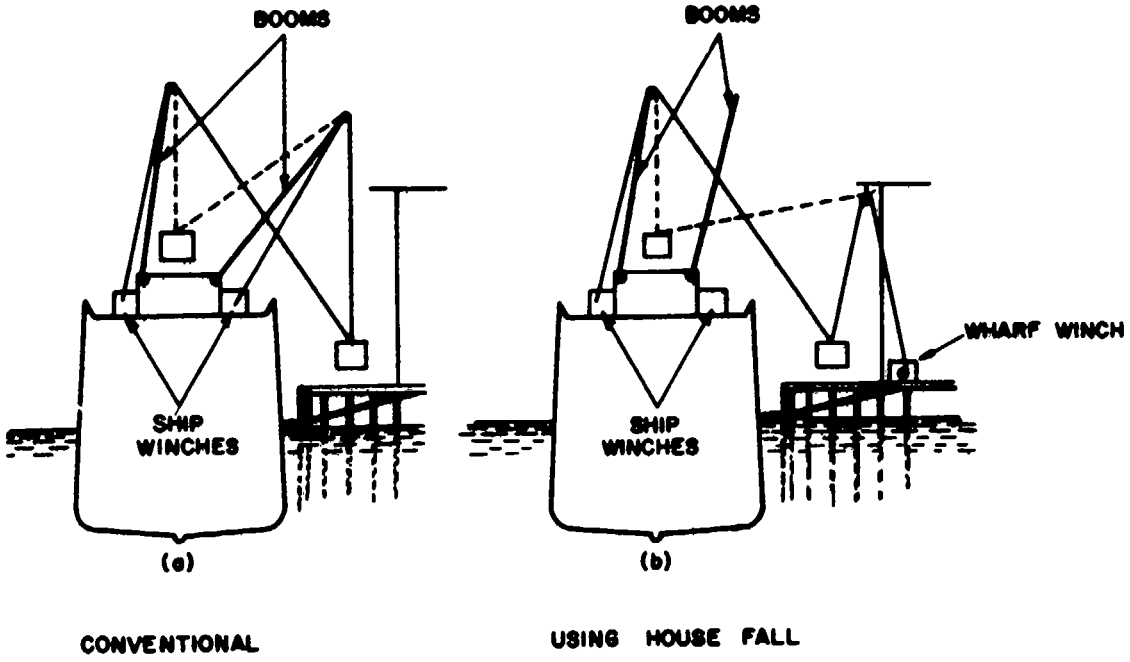


Figure 12-1. Burton system.

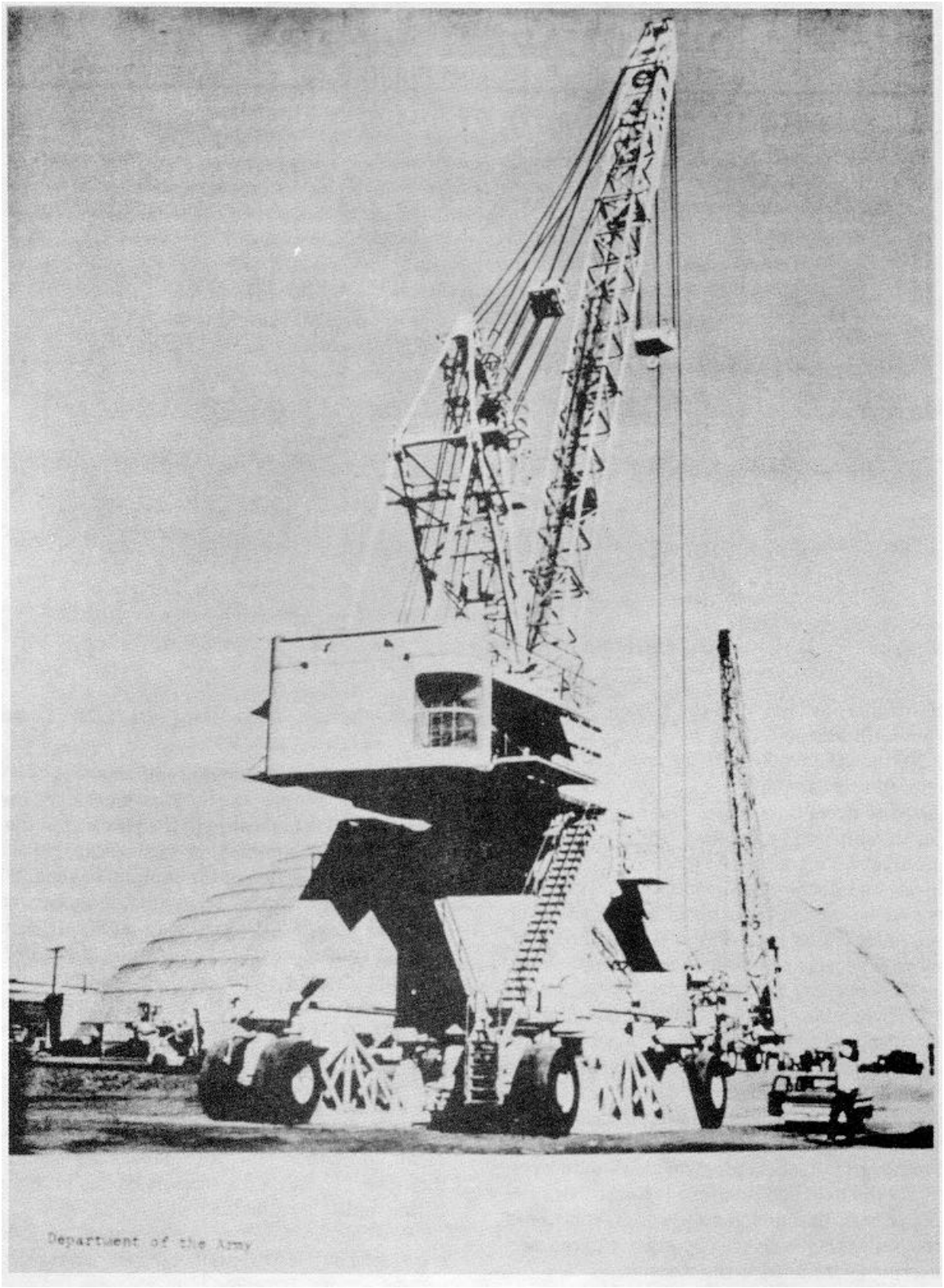


Figure 12-2. Typical heavy duty, rubber-tired gantry crane.

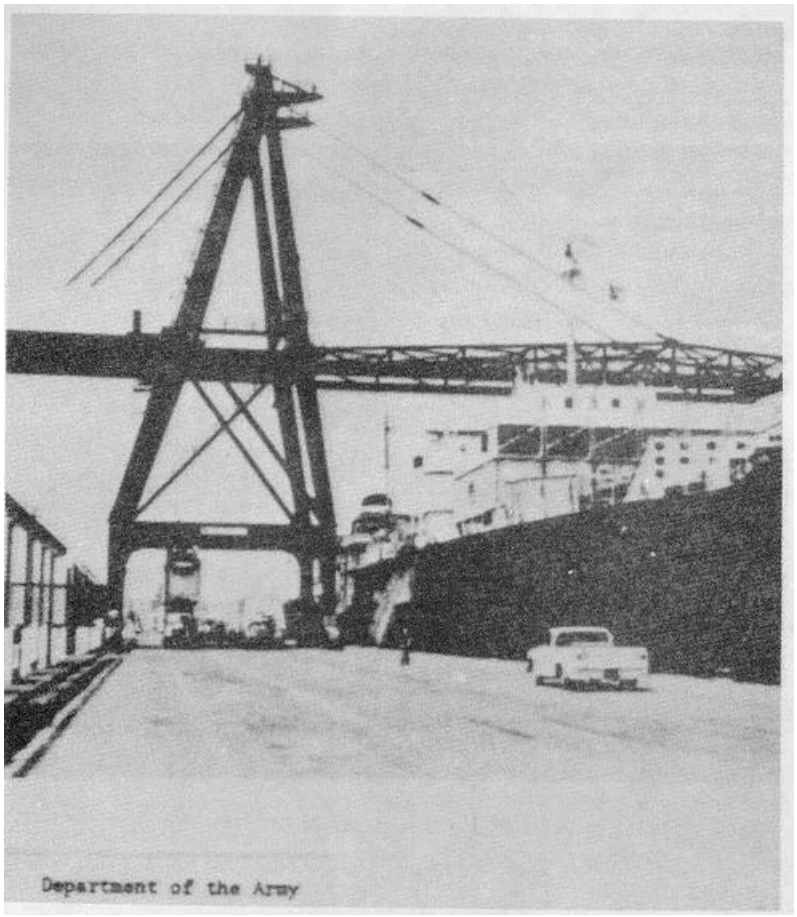


Figure 12-3. Typical rail-mounted gantry crane.

the special trailer; or load onto the trailer if the container is normally stacked on the ground.

(c) Neither the trailer nor tractor unit remains on the ship. In this case, either a straddle-type carrier must be used to drive the container onto the ship and stack it, or the ship itself must have lifting equipment, which can lift it off a trailer and stack it. This type of operation is generally more efficient because it enables containers to be carried two high, and there is no wanted space by trailer or tractors. It does, however, require more expensive container handling equipment.

(6) *Specialized port facilities*.

(a) *Coal handling facilities*. These facilities include the tilting system, unloading bridges, and unloading towers. The tilting system accomplishes the loading by tilting a cars load into a hopper and discharging it by gravity into the vessel The unloading bridges span the storage pile and cantilever over the vessel. Trolley grab bucket are provided for recovering coal from the hold and dumping it in the stockpile or into hoppers in the unloading towers. From these towers, the coal is then conveyed by gravity to railroad cars or to a conveyor linked to the stockpile.

(b) *Oil terminals*. Equipment requirements are limited to storage tanks, hoses, and hose-handling facilities.

12-2. Cargo handling in the shed and storage area.

a. General cargo handling equipment.

(1) *Forklift trucks*. Forklift trucks are useful for handling palletized cargo in the pier and in the transit shed. They are available in various capacities and are generally most efficient for hauls up to about 200 feet.

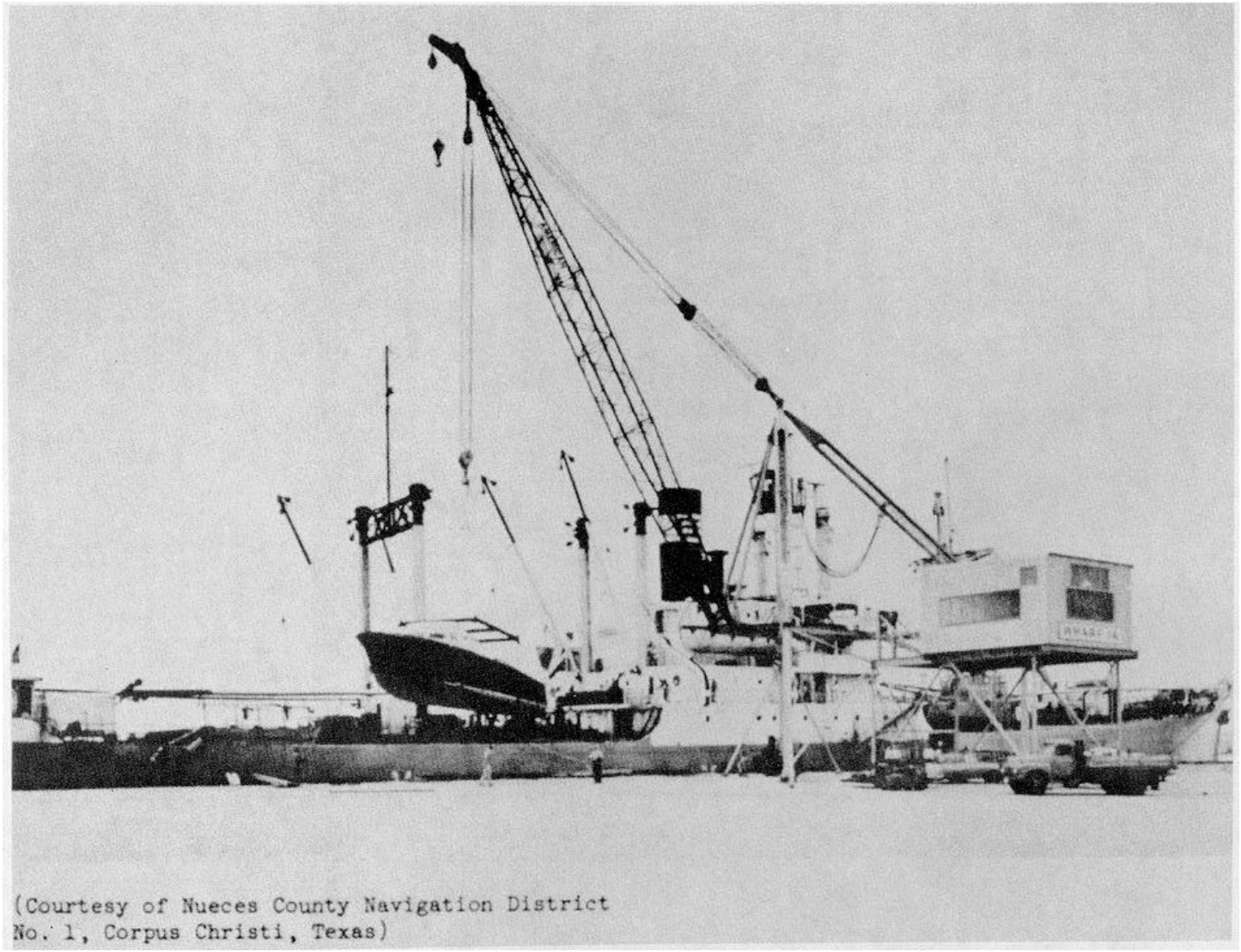
(2) *Tractor trains*. Where distances between shipside and storage areas are too great for efficient use of forklift trucks, tractor-drawn trains of low-bed, small-wheeled trucks may be used. The trucks are loaded or unloaded at shipside by the shiploading gear and in the storage area by forklift trucks. There trains are also useful for transporting material that cannot be palletized, or is otherwise unsuitable for forklift operation.

(3) *Conveyors*. See paragraph 12-1b(4d).

(4) *Straddle trucks*. Straddle trucks are used for handling lumber, pipe, rails, steel shapes, and similar materials. The straddle truck may also be adapted for lifting multiple pallet load.

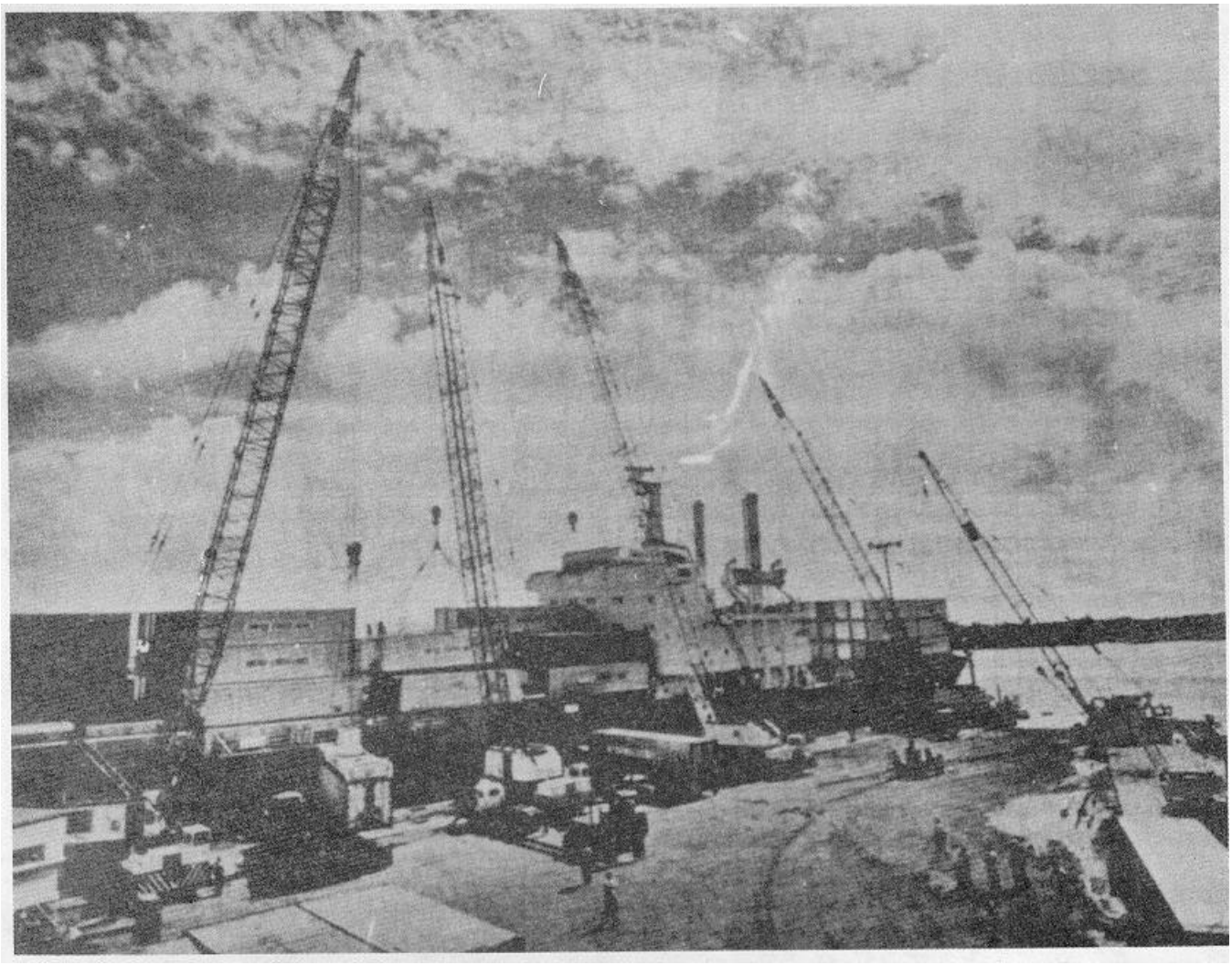
(5) *Overhead cranes*. An overhead, underhung jib crane may be used to handle cargo in the transit shed.

b. Container handling equipment. The typical con tainer handling equipment used in the storage and marshaling areas is contained in Appendix B.



(Courtesy of Nueces County Navigation District
No. 1, Corpus Christi, Texas)

Figure 12-4. Fixed derrick.



(Courtesy of Manitowoc Engineering Corporation, Manitowoc, Wisconsin)

Figure 12-5. Container off-loading through the use of crawler-mounted craw

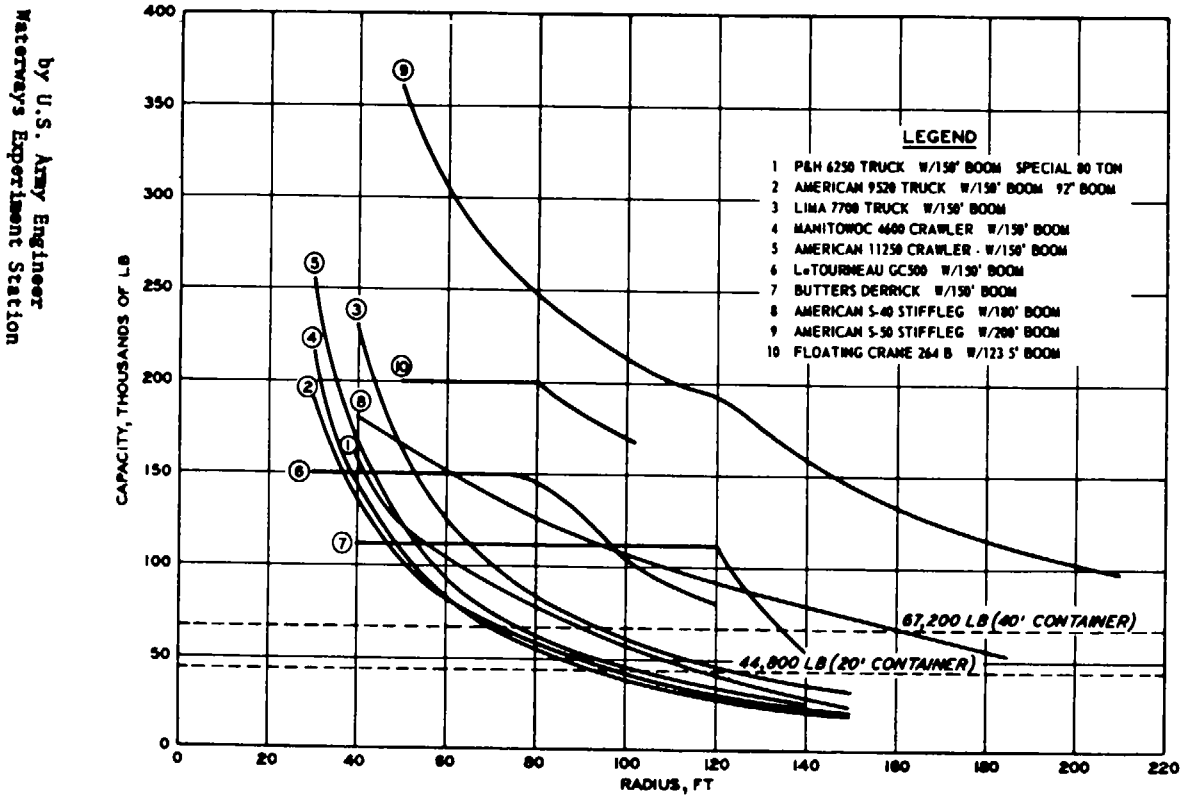


Figure 12-6. Crane capacity.