TM 5-273

WAR DEPARTMENT

TECHNICAL MANUAL

25 TON PONTON BRIDGE MODEL 1940, M16 ...

Ponton Bridge Model 1938

July 1, 1942

TECHNICAL MANUAL

25-TON PONTON BRIDGE, MODEL 1940, AND 10-TON PONTON BRIDGE, MODEL 1938

CHANGES No. 1

WAR DEPARTMENT,
WASHINGTON, May 26, 1943.

TM 5–273, July 1, 1942, is changed as follows:

Change title of manual to read: 25-TON PONTON BRIDGE, MODEL 1940, AND 10-TON PONTON BRIDGE, MODEL 1938.

1. Purpose.—The normal use * * * light ponton bridge. Although the normal capacity of the bridge is 25 tons it may be reinforced to accommodate tank loads up to 45 tons.

[A. G. 062.11 (4–10–43).] (C 1, May 26, 1943.)

3. (Superseded.) **Bridge unit.**—*a.* The principal components of one unit of bridge are four trestles with trestle bracing, twelve pontons, twelve 12-ton pneumatic floats, and the necessary balk and chess for the floor system. The pneumatic floats are supplied for reinforcing the bridge.

b. One unit of bridge provides for 210 feet of unreinforced bridge, or of bridge reinforced with pneumatic floats, if four trestles are used. Each additional unit provides an added 180 feet of floating span.

c. One unit of equipage is sufficient for 157 feet of bridge reinforced by extra pontons, provided four trestles are included; each additional unit gives an added 90 feet of floating span.

[A. G. 062.11 (4–10–43).] (C 1, May 26, 1943.)

6. (Superseded.) **Truck and trailer loadings.**—*a. Trailer loading.*

Transportation and loading—Medium (25-ton) ponton bridge—Semitrailers

Item	Total required	Ponton load		Abutment load	Trestle load
		1 to 8 inclusive	9 to 12 inclusive	13 and 14	15 and 16
Anchor, Danforth, 30-lb	2	------	------	------	1
Anchor, Kedge, 150-lb	32	2	2	2	2
Balk, ponton	168	12	12	12	------
Balk, transverse	16	1	1	1	1
Balk, trestle	96	------	------	24	24
Boat, assault, M2 with 9 paddles in carrying case	2	------	------	1	------
Chess	302	16	16	23	32
Chess, half	16	------	------	8	------
Clamp, siderail, complete	96	6	6	6	6
Hanger, hinge sill	26	------	------	7	6
Hanger, transverse balk	32	2	2	2	2
Hook, boat, ballpoint, 10-ft	32	2	2	2	2
Oar, ponton, 14-ft	84	7	7	------	------
Oarlock, ponton	96	8	8	------	------
Ponton	12	1	1	------	------
Pump, bail, ponton	16	1	1	1	1
Rope, manila, ½-in., 600-ft. coil	[1] 4, 800	------	1	1	1
Sill	4	------	------	1	1
Stirrup, detachable, for balk	96	12	------	------	------
Strut, bracing	16	------	------	------	8
Trestle, complete, without hoist	4	------	------	------	2

[1] Feet.

b. Truck loading.

Transportation and loading—Medium (25-ton) ponton bridge—Truck tractor

Item	Total required	Ponton load					Abutment load		Trestle load
		1	2	3	4	5 to 12 inclusive	13	14	15 and 16
Bracing, trestle, set, less strut, bracing	1	---	---	---	---	---	---	---	1/2
Bracket, reflector, ponton gunwale type	78	24	18	18	18	---	---	---	---
Bracket, stern attachment, 22-hp motor	4	1	1	1	1	---	---	---	---
Buoy, life, ring	2	---	---	---	---	---	1	1	---
Carrier, balk	75	6	6	6	6	6	3	---	---
Chain, sling, ½-in. x 16-ft. with hook and eye	4	---	---	---	---	---	1	1	1
Chest, spare parts and accessories	12	1	1	1	1	1	---	---	---
Clip, wire rope, ½-in	48	---	---	---	---	---	24	24	---
Flare, electric, emergency	70	6	6	6	4	4	4	4	4
Float, pneumatic 12-ton, with emergency kit, carrying case and 9 paddles in case	12	1	1	1	1	1	---	---	---
Kit, repair, ponton, with chest	1	1	---	---	---	---	---	---	---
Lamp, electric, flasher	5	2	1	1	1	---	---	---	---
Lamp, electric, debris-patrol	2	1	1	---	---	---	---	---	---
Lantern, electric, dry cell, 6-volt	3	1	1	1	---	---	---	---	---
Manifold, inflation-deflation	1	1	---	---	---	---	---	---	---
Marker, safety, reflector, red	78	24	18	18	18	---	---	---	---
Motor, outboard, 22-hp., complete with chest and accessories	4	1	1	1	1	---	---	---	---
Picket, steel	76	---	---	---	---	---	19	19	19
Pole, range, 6-ft., 2-section	2	---	---	---	---	---	2	---	---
Pump, water, portable, complete with 2 hose and spanner C wrench	1	1	---	---	---	---	---	---	---
Rigging, set, complete with chest	1	1	---	---	---	---	---	---	---
Rope, manila, 1-in., 600-ft. coil	20	1	1	1	1	2	---	---	---
Rope, wire, ½-inch., 500-ft. reel	1	---	---	---	---	---	1	---	---
Set, 2 hoists, with chest	4	---	---	---	---	---	---	---	2
Tape, metallic, 50-ft	2	---	---	---	---	---	1	1	---

7. (Superseded.) **Summary of loading.**—*a. Ponton load.*—One ponton bay with accessories. (See fig. 1.1.)

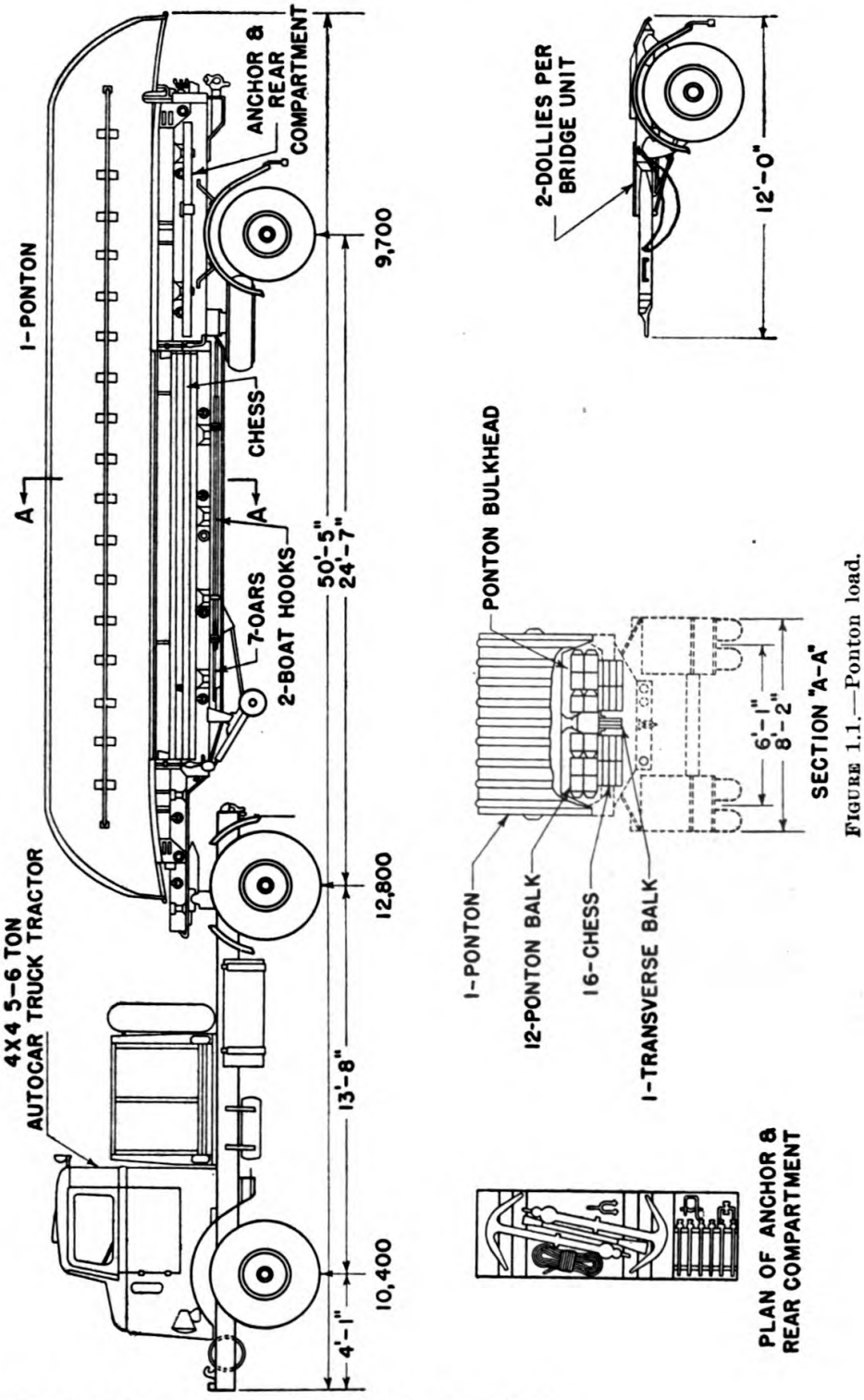

FIGURE 1.1.—Ponton load.

[A. G. 062.11 (4-10-43).] (C 1, May 26, 1943.)

b. Abutment load.—One abutment span, one hinge span, an extra bay of ponton balk, and one assault boat. (See fig. 2.1.)

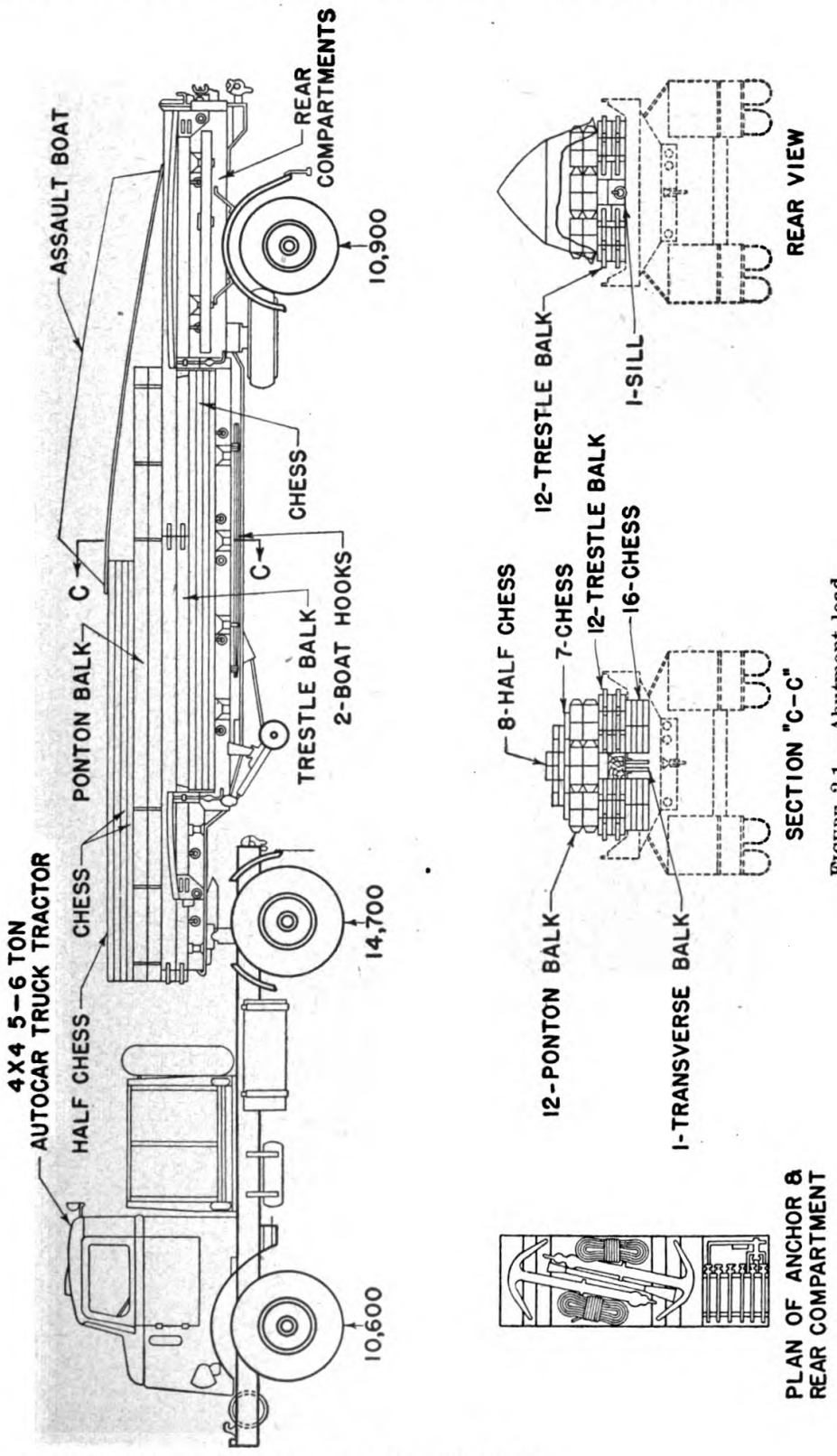

FIGURE 2.1.—Abutment load.

[A. G. 062.11 (4–10–43).] (C 1, May 26, 1943.)

c. Trestle load.—Two trestle bays with all accessories. (See fig. 3.1.)

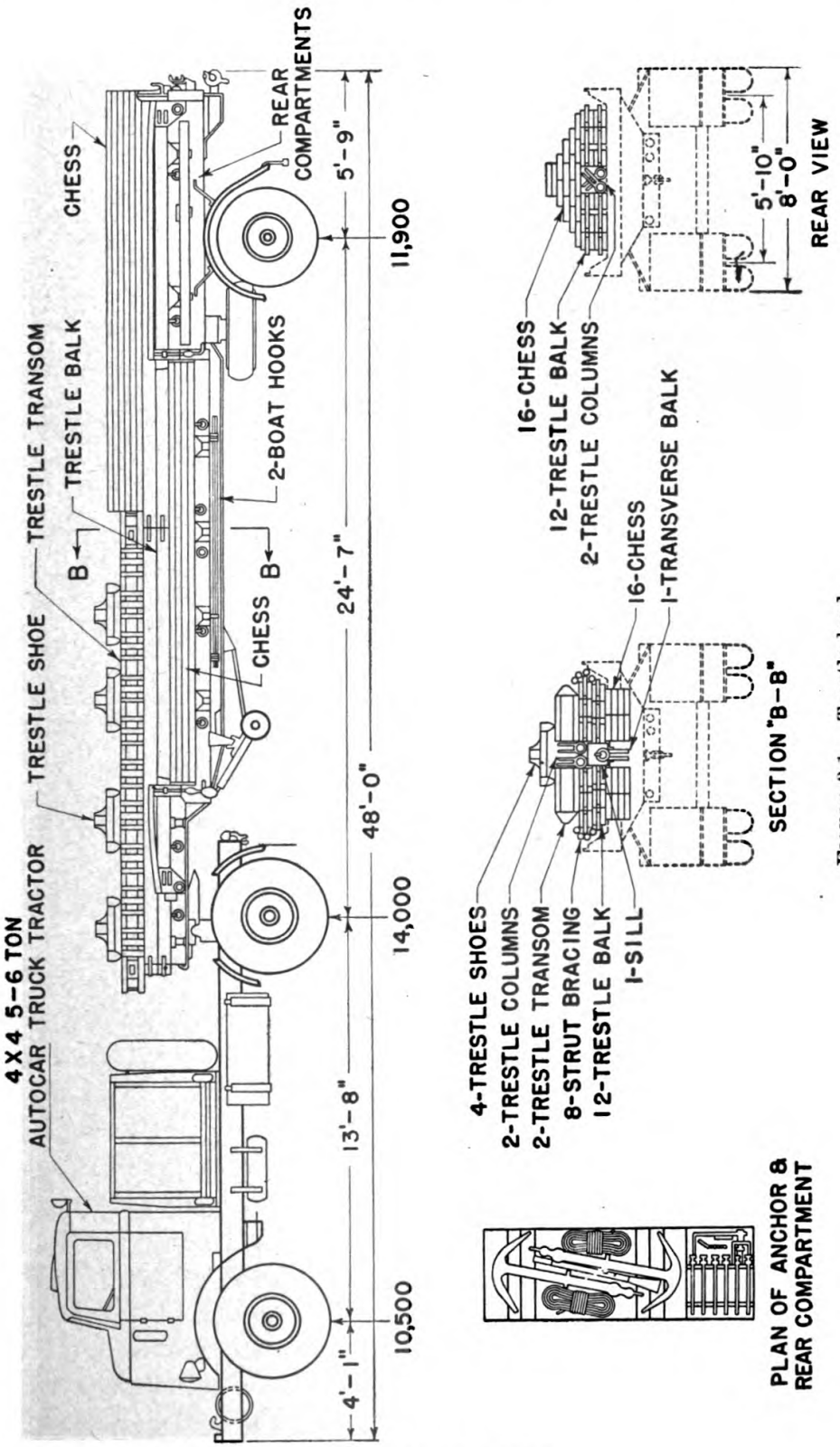

FIGURE 3.1.—Trestle load.

[A. G. 062.11 (4–10–43).] (C 1, May 26, 1943.)

18.1 (Added.) **Use of trestle bracing.**—*a. General.*—Trestle bracing is used to increase the stability of trestle spans subjected to heavy traffic. When properly installed it increases the capacity of a trestle span in addition to improving its stability. The manner in which trestle bracing is used is governed mainly by the stability of the soil at the site.

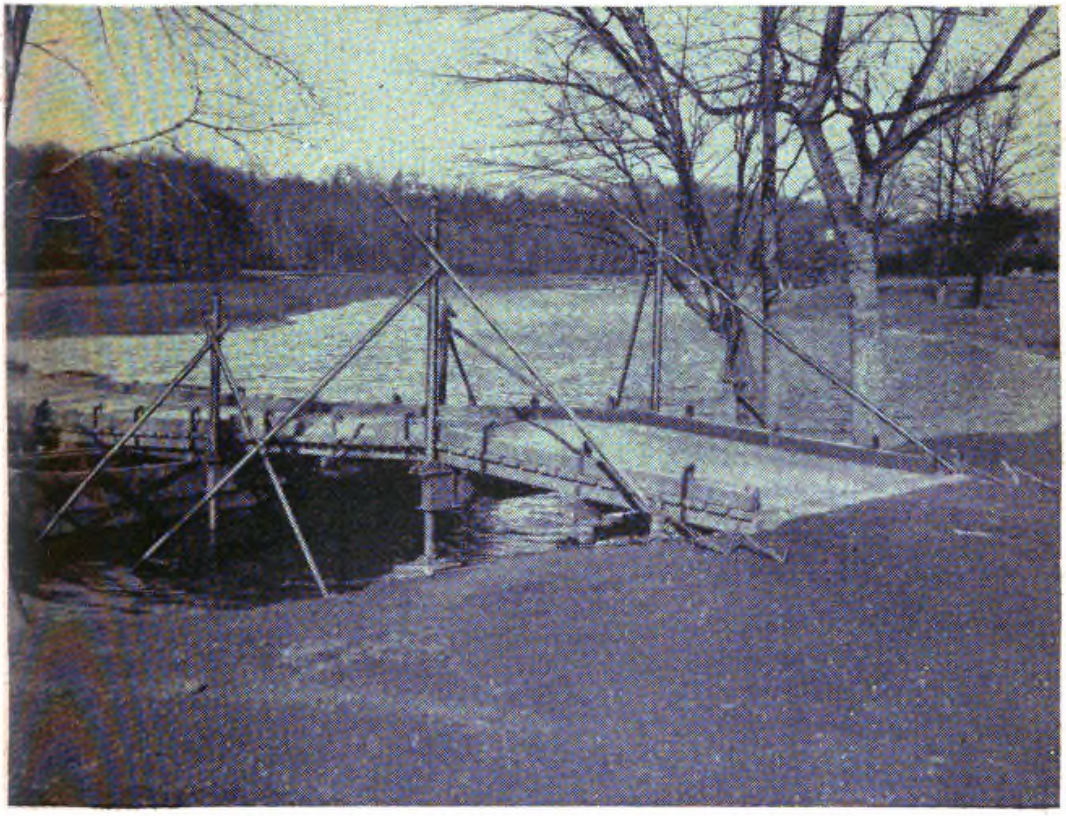

FIGURE 7.1.—Use of trestle bracing—unstable foundation.

[A. G. 062.11 (4–10–43).] (C 1, May 26, 1943.)

(1) On unstable foundations where large settlements of individual trestles are probable, it is desirable to make an integral unit of each trestle and its bracing. (See fig. 7.1.) This is called tripod bracing. It requires two diagonal bracing struts from the top of each trestle column to the ground at the sides.

(2) On semistable foundations where little settlement is probable, it is advantageous to connect adjacent trestles with single diagonal bracing. (See fig. 7.2.)

(3) On stable foundations it is desirable to connect adjacent trestles with double diagonal bracing. (See fig. 7.3.) Where 4 or more trestles are used, it is necessary to brace alternate spans only with this cross bracing, thus forming piers of each pair of trestles.

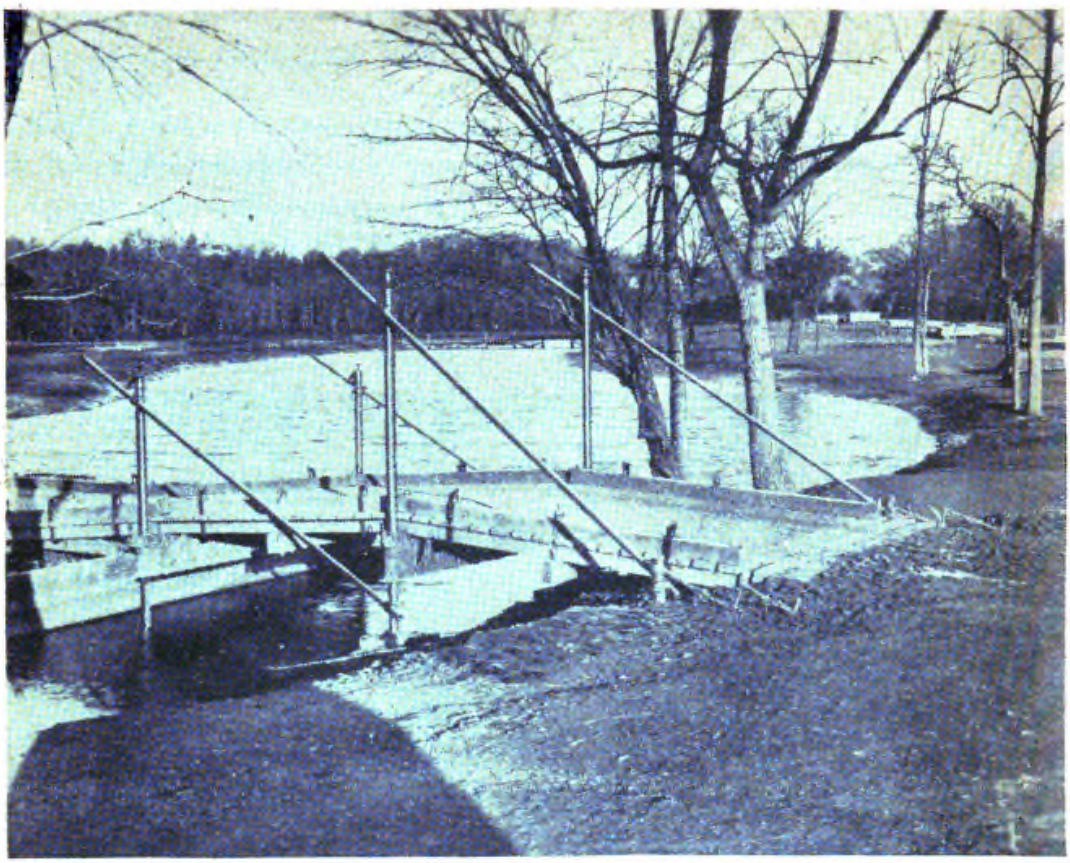

FIGURE 7.2.—Use of trestle bracing—semistable foundation.

[A. G. 062.11 (4–10–43).] (C 1, May 26, 1943.)

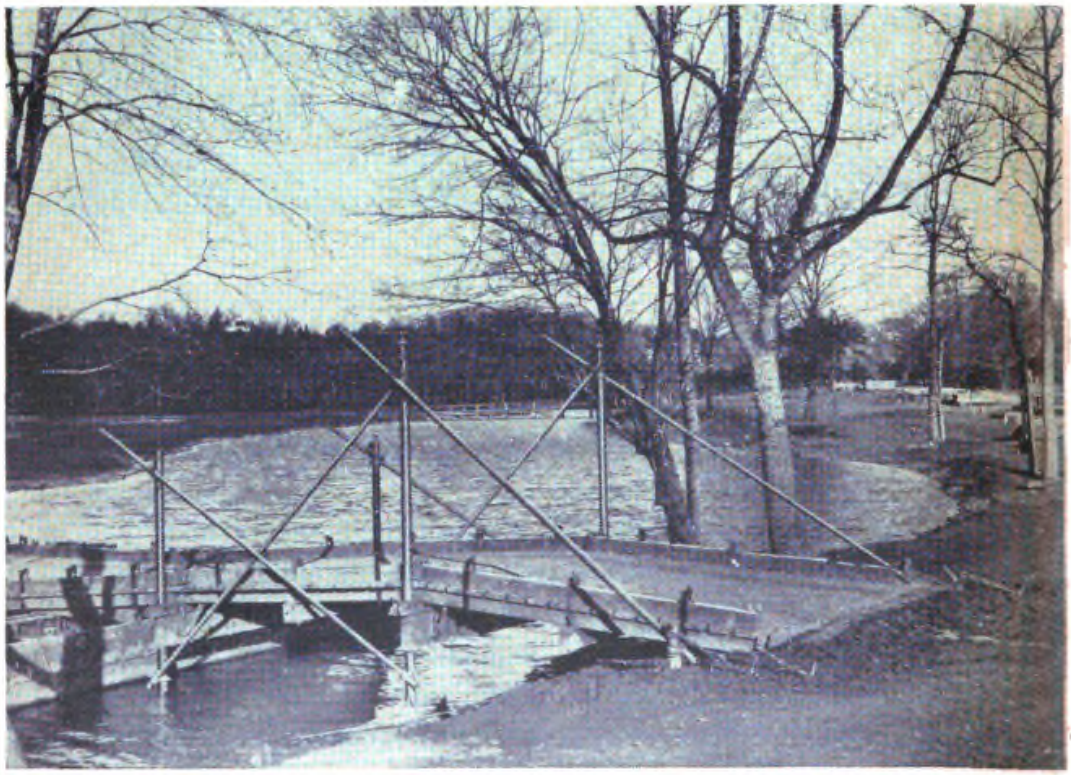

FIGURE 7.3.—Use of trestle bracing—stable foundation.

[A. G. 062.11 (4–10–43).] (C 1, May 26, 1943.)

(4) When the trestle transom is near the top of the trestle columns, transverse bracing must be used in order to provide lateral stability. In soft ground, this may consist of struts from the top of the trestle columns directly out to the sides; in hard ground it may consist of two diagonal struts (X-bracing) or a single diagonal strut between the two columns beneath the trestle transom.

b. Erection.—(1) *Bracing the end trestle.*—The end trestle on any type of foundation is braced from the shore. Each anchor post is set in a hole dug with an earth auger. A bracing strut is fastened to the anchor post near the bottom, and to the trestle column near the top; the strut is secured by means of trestle-bracing clamps. (See fig. 7.2.) The anchor post should be anchored securely to other posts driven into the ground as shown in figure 7.4 or to natural or prefabricated holdfasts.

On unstable foundations the end trestle is further braced in a tripod manner by running a second bracing strut from the top of each column to the ground alongside the bridge. (See fig. 7.1.)

(2) *Bracing intermediate trestles.*—(*a*) *Unstable foundation.*—When foundation conditions are unstable, each trestle and its bracing should be made to act as a unit. (See fig. 7.1.) When this type of bracing is used, the bracing struts form an angle of about 30° with the center line of the bridge. The first step is the assembly of the bracing strut and strut shoe. The strut shoe shank is inserted into the end of the bracing strut and the strut shoe pin inserted and fastened. The strut shoe at the end of the bracing strut is then placed at the point where it will enter the soil, and the upper end of the bracing strut is held against the trestle column to determine where the trestle clamp is to be fastened to the column. A trestle-bracing clamp is clamped firmly to the column, and the strut portion of the clamp is fastened loosely about the bracing strut. This permits the clamp to serve as guide for the strut while the strut is turned by means of a steel picket inserted into the hole at the end. The strut shoe assembly is screwed into the ground until it reaches a firm footing. (See fig. 7.5.) The column and strut clamps are alternately loosened and tightened to obtain a firm bearing between column and strut, and, finally, the trestle-bracing clamps are tightened around the bracing strut. Under no circumstances is X-bracing used between adjacent trestles to obtain longitudinal stability when there is a possibility of either trestle settling more than a foot.

(*b*) *Semistable foundation.*—The necessary bracing is provided by using one diagonal in each span. (See fig. 7.2.)

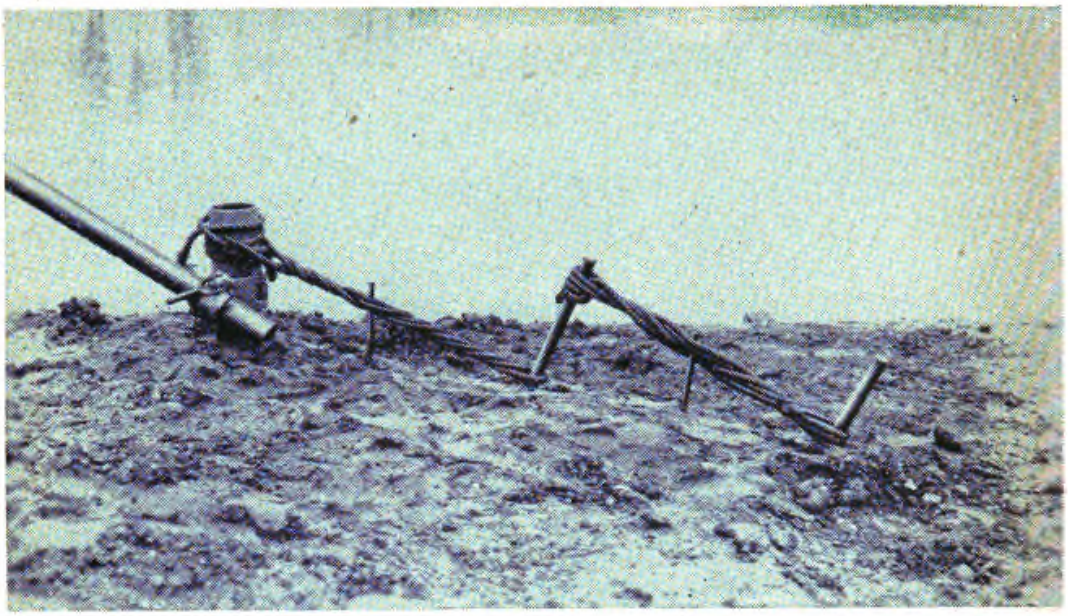

FIGURE 7.4.—Anchor post in use.

[A. G. 062.11 (4–10–43).] (C 1, May 26, 1943.)

FIGURE 7.5.—Screwing strut shoe and strut into ground.

[A. G. 062.11 (4–10–43).] (C 1, May 26, 1943.)

(*c*) *Stable foundation.*—When using longitudinal X-bracing with a floor system of 25-ton balk and chess, it is necessary to clamp both ends of the first diagonal strut on the outside of the columns (side away from roadway) and the opposite ends of the second strut on

FIGURE 7.6.—Trestle bracing clamp in use.

[A. G. 062.11 (4–10–43).] (C 1, May 26, 1943.)

the inside and outside of the column respectively. Position of the floor system with respect to the height of the columns determines which end of the second strut will be clamped to the outside of the column and which end will be clamped to the inside. (See fig. 7.3.)

NOTE.—For 10-ton trestles both ends of one diagonal brace may be clamped on the outside and both ends of the second diagonal brace on the inside of the columns.

c. Trestle-shoe anchor lines.—The shoes of the end trestle are prevented from slipping by fastening each shoe of each shoreward trestle

by means of wire rope to the anchor posts or to natural or prefabricated holdfasts. If site conditions warrant, all trestle shoes should be so anchored. Wire rope rather than manila rope should be used, as it stretches less and may be tightened more readily by means of a ratchet chain hoist and cable grips.

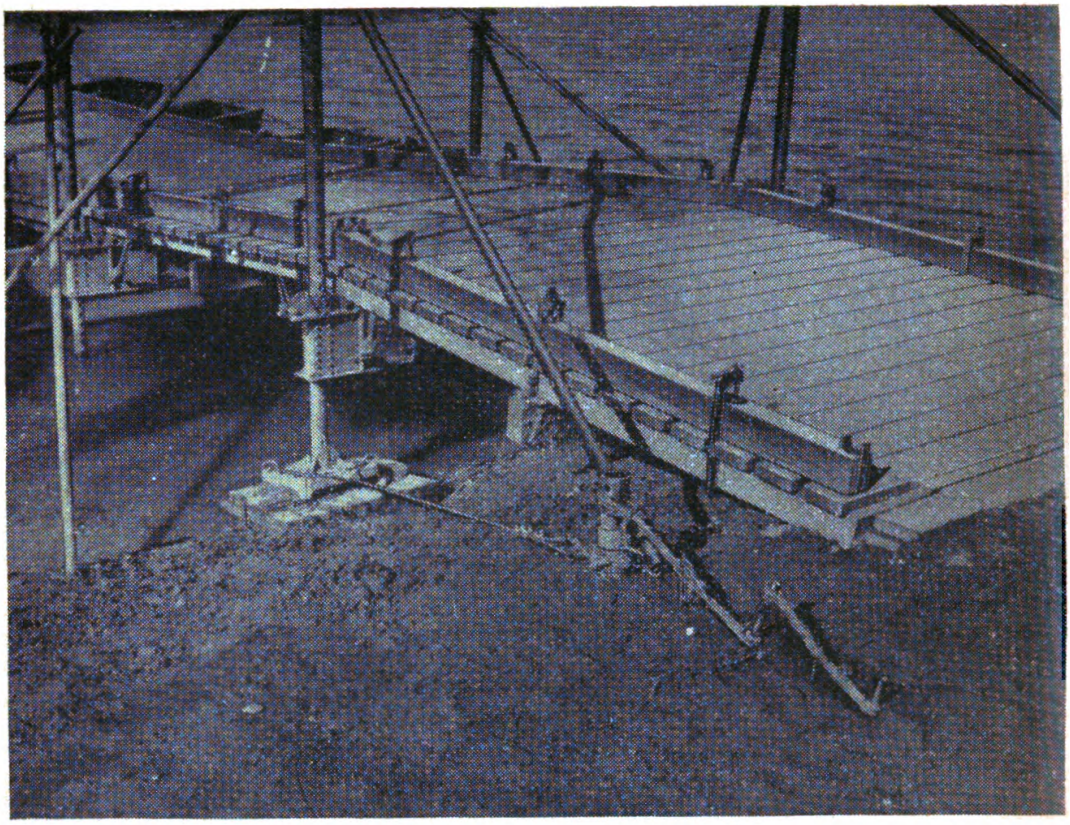

FIGURE 7.7.—Use of trestle shoe anchor lines.

[A. G. 062.11 (4–10–43).] (C 1, May 26, 1943.)

To attach the anchor cable, pass one end of the cable through the four rings of the trestle shoe and fasten the free end to the standing part of the cable using three cable clips, spaced about 3 inches apart. The grips of the cable clips should bear against the standing part of the cable; they are tightened with a special open-end wrench. Pass the other end of the anchor cable around the holdfast, place one cable grip on the free end and one on the standing part of the cable, and connect the two grips with the ratchet chain hoist. Fasten loosely three cable clips in their approximate position. Tighten cable with ratchet chain hoist. Tighten cable clips. Remove ratchet chain hoist and cable grips. (See figs. 7.7 and 7.8.)

[A. G. 062.11 (4–10–43).] (C 1, May 26, 1943.)

21.1: (Added.) **Construction at night.**—*a. Limitations of equipment.*—The equipment is not well adapted for a bridge to be thrown across a stream quickly, without knowledge of the enemy, and before a bridgehead has been established. Because of the nature of the transportation and equipment, assembly at the bridge site creates considerable unavoidable noise.

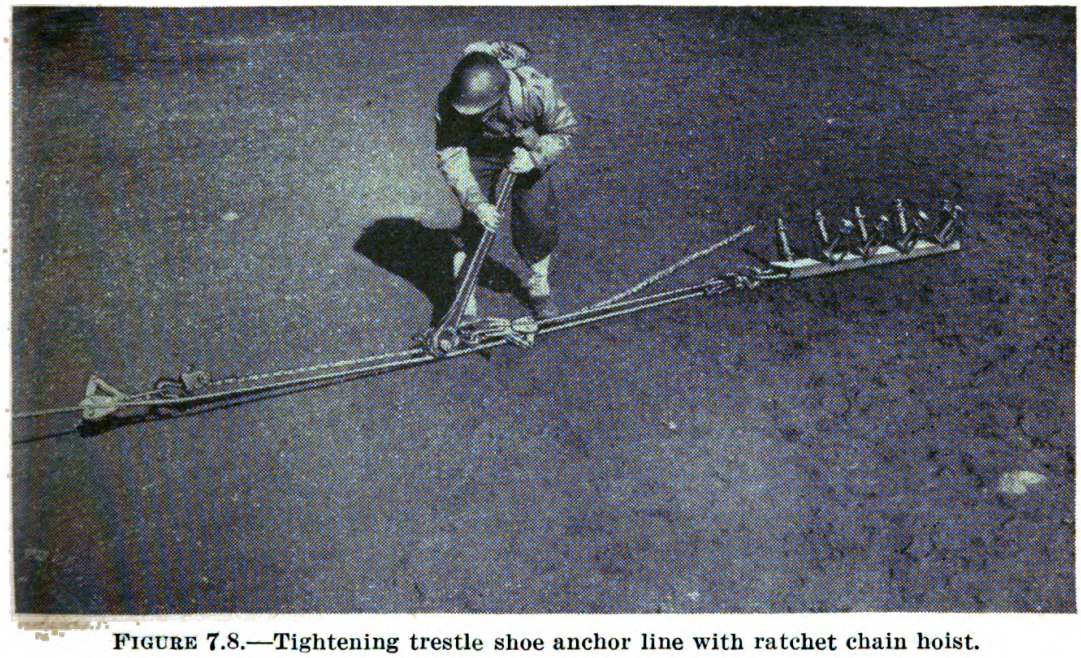

FIGURE 7.8.—Tightening trestle shoe anchor line with ratchet chain hoist.
[A. G. 062.11 (4–10–43).] (C 1, May 26, 1943.)

b. Difficulties imposed by darkness.—Construction of the bridge under cover of darkness is generally the same as construction in daylight. It is not particularly difficult to incorporate individual pontons or parts into the bridge during darkness, although the process is somewhat slower. The chief difficulty arises in getting the equipment to the unloading points, in placing and handling cables and lines, and in alining the bridge and directing it to the far shore. These difficulties vary greatly with width of stream, force of current, and degree of darkness. Successful and rapid construction at night depends on careful planning, good organization, close control, and adequate training, practice, and rehearsal.

c. Prior rehearsal.—Before an important river crossing, construction of the bridge should be thoroughly rehearsed. Rehearsal should take place at night and on a stream as similar to the stream to be crossed as possible. The troops participating in the rehearsal must be the troops who are to construct the bridge for the actual crossing.

Also, during the rehearsal, the bridge must be constructed in a manner similar to that to be used in the actual crossing. The rehearsal should be as similar to the real construction as possible.

d. Reconnaissance.—A detailed reconnaissance of the bridge site must be made during the hours of daylight by the officers and key noncommissioned officers who are to supervise the construction at night. The exact location of the bridge site, each parts site, unloading areas, and line of upstream and downstream anchors are selected. A definite decision concerning the route of approach and traffic circulation plan must be made. If secrecy permits these points should be marked with tracing tape or signal cloth. If the bridge or parts site must be cleared and graded, a small advance crew should be sent to prepare the site during daylight hours. If this is not possible due to secrecy, definite arrangements must be made for preparing the bridge site shortly before construction starts. Members of the reconnaissance party must memorize the appearance and characteristics of the bridge site as it looks in daylight and take all possible measures to avoid confusion during the night construction.

e. Signal communication.—During construction at night telephone communication between the near shore, far shore, construction end of the bridge, and each parts site is essential. A single flashlight, providing a shielded weak white light, can be used on the far bank to assist in securing proper direction and alinement of the bridge. Similar lights may be used to show the positions of upstream and downstream lines of anchors. Unshielded flashlights to aid in the assembly should never be used. If available, luminous markers or paints, white tracing tape, or pieces of cloth are useful in outlining essential points such as routes of approach to the unloading points, vehicular parking areas, and the heads of pickets and connecting pins.

f. Maintenance of secrecy.—Although actual construction will usually be started only after the need for secrecy has passed, lights and sound at the bridge site should be held to a minimum.

[A. G. 062.11 (4–10–43).] (C 1, May 26, 1943.)

34. Abutment section.

* * * * * * *

e.

* * * * * * *

(4) Transverse balk are **not normally** placed at the middle of **floating spans.**

* * * * * * *

[A. G. 062.11 (4–10–43).] (C 1, May 26, 1943.)

39. Maneuver line section.

* * * * * * *

c. Subsequent duties as siderail section.

* * * * * * *

(4) (Added.) All siderail clamps should be placed handle side up.

[A. G. 062.11 (4–10–43).] (C 1, May 26, 1943.)

45. General.

* * * * * * *

b. (Superseded.) *Preparation of site.*—The preparation of a site to permit building by parts depends upon the location. Every effort should be made to locate sites, above or below the bridge site, at which parts may be constructed without prior preparation. From two to four sites should be selected. Where no suitable natural sites exist, parts sites may be cleared. Figure 23 is considered typical of the general arrangements required. It is necessary to provide a cleared area for the abutment site and each parts building site, proper approach roads, a turn-around, and road connections to each cleared area.

* * * * * * *

d. (Superseded.) *Size of working party required.*—The working party that starts the bridge from the abutment should include all sections necessary for expeditious construction by the method of successive pontons. Each working party constructing a part should be of sufficient size to perform all operations necessary to construct the part, from unloading of equipment to the dispatch of the completed part to the bridge. For the usual four-boat three-bay part, an engineer combat platoon is an ideal work group.

e. (Rescinded.)

[A. G. 062.11 (4–10–43).] (C 1, May 26, 1943.)

46. Assembly of parts and incorporation into the bridge.—*a.* (Superseded.) (1) *Construction of a part.*—In general, the construction of a part is accomplished in the same manner as that of a floating portion of the bridge where the method of successive pontons is used. The necessary balk, chess, siderails, and siderail clamps with which to make the connection to the bridge are loaded on the part

before it is moved from the parts site. Material carried on the part should be used for connecting the next part. The completed part is moved to the bridge site by an anchor section. The working party then proceeds to the construction of an additional part.

(2) *Incorporation of part into bridge.*—As parts are completed, they are taken over by an anchor section and moved to the maneuver cable with shore lines, power pontons, or power boats. Upstream anchors are cast and the part is placed in extension of the bridge by means of the anchor ropes. Necessary downstream anchors are cast with the aid of power boats. The part is then connected to the bridge by the working party on the bridge. The location of parts sites downstream from the bridge facilitates the safe handling of parts. The rate of construction of the long bridge may be greatly increased by building concurrently, from both banks and making the junction near the center by fastening balk with detachable stirrups. In fact, this procedure should be the rule in constructing any bridge appreciably longer than 300 feet.

* * * * * * *

47. Reinforced bridges.

* * * * * * *

b. (Superseded.) (1) *General.*—The bridge reinforced by inserting an extra ponton in each floating span, four extra trestle balk in each fixed span, and two extra ponton balk in each floating span, as in *a* above, will carry tank loads in the neighborhood of 45 tons. In its construction, there will generally be a problem in closing the gap left after the last complete reinforced floating span has been put in. The gap will often be too small to permit insertion of a reinforcing ponton and yet be of such extent that the unsupported length of ponton balk across the gap is comparatively great.

NOTE.—In the reinforced bridge, the unsupported length of balk between adjacent pontons is approximately one foot measured between outside edges of gunwales of adjacent pontons.

If the unsupported length across the gap is appreciably greater than one foot, 14 balk should be utilized in closing the gap.

(2) *Reinforcing bridge with pneumatic floats.*—(*a*) *General.*—Another way the bridge may be reinforced is by inserting a 12-ton pneumatic float under each floating span, and increasing the number of balk in the fixed and floating spans to 14 and 12 respectively as in *b* above. This reinforced bridge will carry tank loads of approximately 40 tons.

(*b*) *Inflation of floats* (see fig. 28.1).—The pneumatic float can be inflated in about 6 minutes by use of the inflation-deflation manifold

(provided with each unit of bridge), attached to an air compressor. The working pressure should not be greater than 1½ pounds per square inch, at which point the float firmly resists pressure applied with the heel of the hand. Additional pressure adds nothing to the efficiency of the float and may blow out bulkheads or cause leaks. The effects of changes of temperature should be anticipated; floats inflated to the proper pressure become overinflated if the temperature rises. Valves should be securely closed when the desired pressure is reached.

FIGURE 28.1.—Inflating pneumatic float.

[A. G. 062.11 (4–10–43).] (C 1, May 26, 1943.)

(*c*) *Assembly of float superstructure.*—Superstructure is placed upon the inflated floats to prevent wearing of the float fabric and to maintain float buoyancy under load. Superstructure for each float consists of seven float transoms (timber planks 3 by 12 inches by 7 feet) and two float sills (ponton balk) which are placed upon the inflated float as shown in figure 28.2. Float sills are strapped into position with the float straps.

(*d*) *Launching floats.*—At least 16 men are required to pick up a float and carry it into the water. It should be carried by the D-rings and *not* by the life line. It should be held well off the ground, as dragging damages the rubberized fabric.

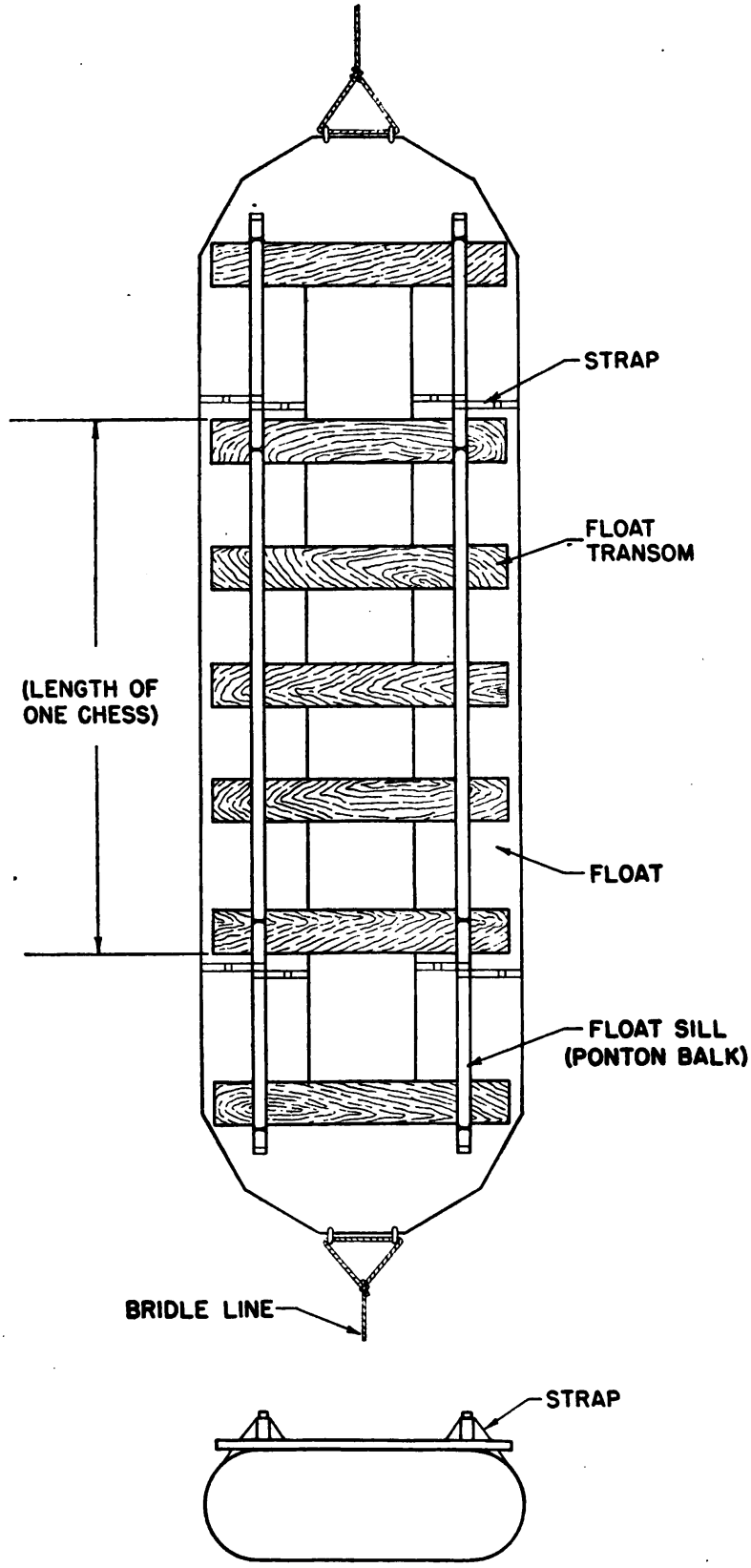

FIGURE 28.2.—Float assembly.

[A. G. 062.11 (4–10–43).] (C 1, May 26, 1943.)

(*e*) *Assembling floats in bridge.*

1. General.—A pneumatic float should be placed under each floating span, centered, and secured to the bridge deck with siderail clamps, four per float, as shown in figure 28.3. The float should be further secured with rope lashings between the end D-rings of the float and the handrails or cleats of adjacent pontons. (See fig. 28.4.) A float should not be used in place of the center ponton of a hinge span

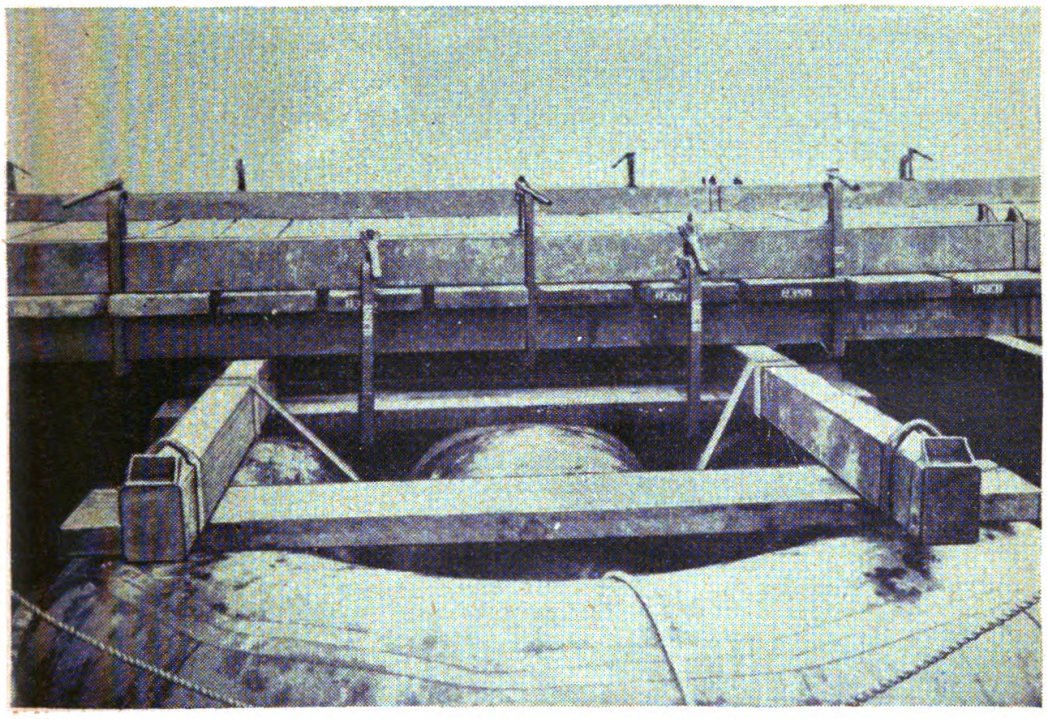

FIGURE 28.3.—Float clamped to bridge deck.

[A. G. 062.11 (4–10–43).] (C 1, May 26, 1943.)

raft. If the span that closes the gap is too small to permit insertion of a reinforcing float, one or two center tubes from pneumatic floats may be used under that span. (See fig. 28.5.)

2. Construction of bridge reinforced.—In construction of the reinforced bridge the floats, fully inflated, are inserted under the bridge deck balk before the balk are lowered into place by the balk carriers.

3. Reinforcing existing bridges.—In the reinforcement of existing bridges, float assemblies are prepared as described above except that float sills are placed on their sides. Upon arrival at the bridge site, floats are partly deflated so that

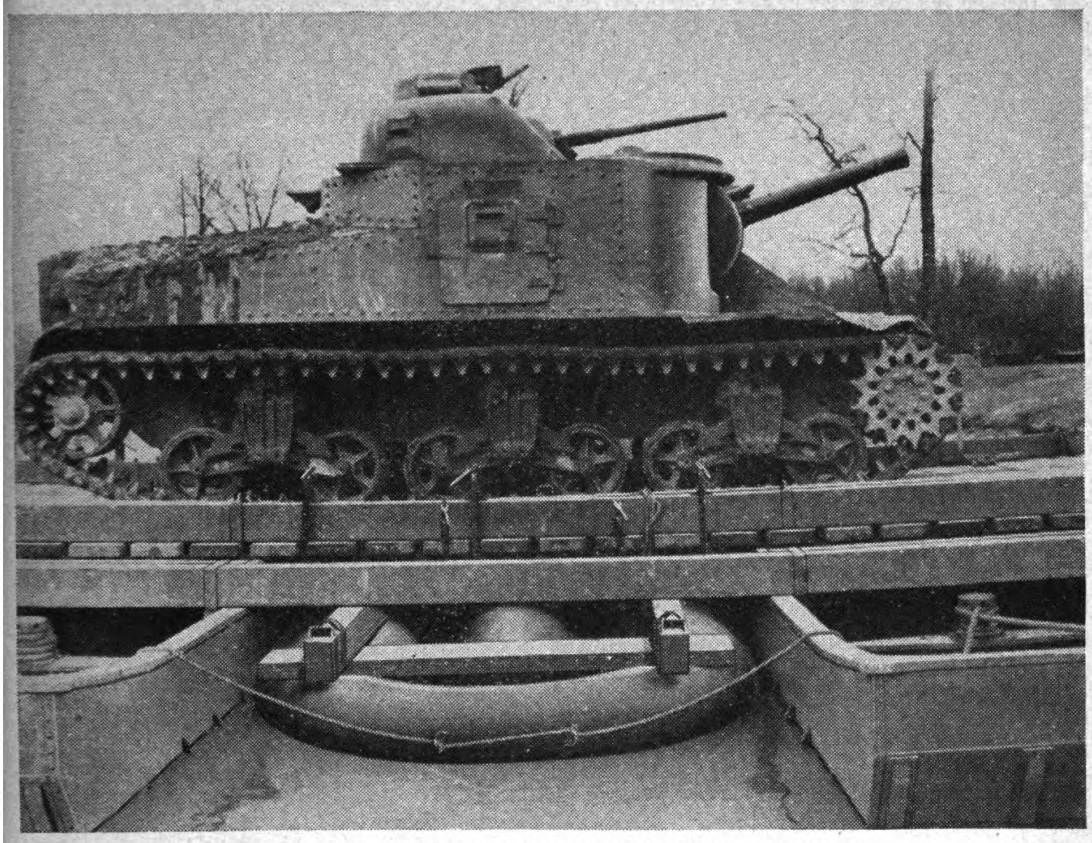

FIGURE 28.4.—Bridge reinforced with pneumatic floats.
[A. G. 062.11 (4–10–43).] (C 1, May 26, 1943.)

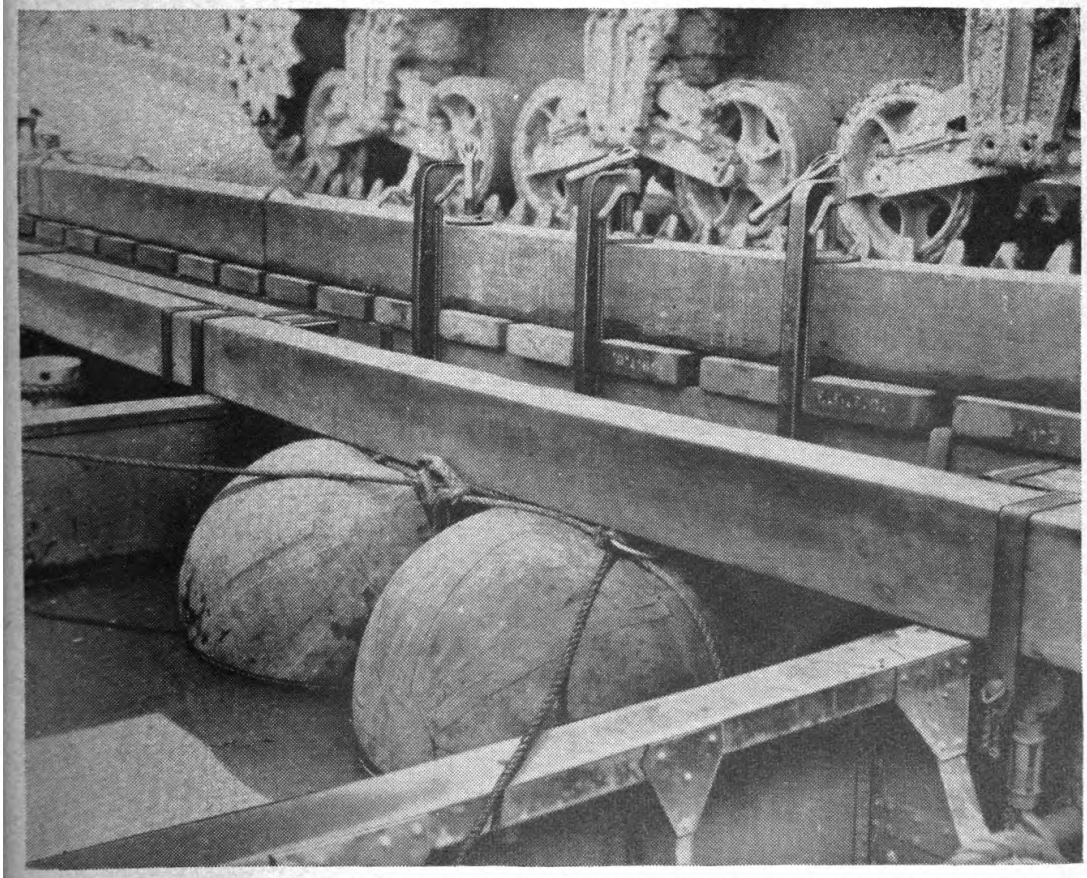

FIGURE 28.5.—Center tubes from pneumatic floats used under span which closes the gap.
[A. G. 062.11 (4–10–43).] (C 1, May 26, 1943.)

they can be placed under the span. After the floats are centered under the span, sills are turned up and the floats are reinflated to the proper pressure with an air compressor.

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[A. G. 062.11 (4–10–43).] (C 1, May 26, 1943.)

53. Useful suggestions.

* * * * * * *

f. (Added.) After the initial settlement of the trestles, and periodically when the bridge is in use, trestle-bracing clamps should be loosened and retightened to release any stresses introduced in the bracing struts by movements of the trestles.

g. (Added.) If the bridge is reinforced with pneumatic floats, the floats may have to be removed from under the spans when necessary to allow floating debris to pass under the bridge. Pressure in floats should be checked regularly. If necessary the air compressor can be run out over the bridge to add air to the floats without removing them.

[A. G. 062.11 (4–10–43).] (C 1, May 26, 1943.)

63.1 (Added.) **Single float.**—In an emergency single pneumatic floats may be used as an expedient for ferrying personnel. The central tube should be removed and chess laid on the floor of the float. About 40 men (including paddlers) can be carried on one float, 20 men straddling each outer tube of the float. Machine guns and mortars can be placed on the chess.

[A. G. 062.11 (4–10–43).] (C 1, May 26, 1943.)

64. Raft ferries.—*a. General.*

* * * * * * *

(4) (Added.) Pneumatic floats may be used to reinforce ponton rafts, or as flotation for expedient rafts.

* * * * * * *

[A. G. 062.11 (4–10–43).] (C 1, May 26, 1943.)

69. Outboard motors.—*a.* Included in the organizational equipment of each **ponton company are four 22 hp outboard motors for each unit of ponton equipage. Four attachment brackets are included in each unit of ponton equipage.**

* * * * * * *

[A. G. 062.11 (4–10–43).] (C 1, May 26, 1943.)

72. Repairs.

* * * * * * *

h. (Superseded.) *Painting.*—(1) *General.*—Pontons, trestles, trestle bracing parts, balk, chess, sills, and metal fittings must be kept well painted to prevent corrosion, rusting, or rotting. This is particularly

necessary when equipment is stored in the open or used in salty or brackish water.

(2) *Materials required.*—(*a*) Paint, olive-drab, lusterless, marked: "Paint A"—Finish coat for repainting marine engineer equipment. (This is a high water-resistant paint, containing critical materials, and should be used only for refinishing water-immersible equipment.)

(*b*) Primer, rust inhibiting, marked: "Paint F–I"—Priming coat for repainting steel and aluminum marine engineer equipment. (This primer contains critical materials and should be used only for repainting steel and aluminum water-immersible equipment.)

(*c*) Primer, phenolic, marked: "Paint F–II"—Priming coat for repainting wooden marine engineer equipment.

(*d*) Mineral spirits, marked "Paint cleaner and thinner"—Mineral spirits cleaning agent for repainting engineer equipment and thinner for engineer paints. Furnished in 50-gallon drums.

(*e*) Phosphoric acid solvent, marked "Paint etcher"—H_3PO_4—Etching agent for repainting aluminum alloy engineer equipment. Furnished in 1-gallon containers.

NOTE.—The "paint etcher" as furnished is 50 percent phosphoric acid and 50 percent butyl alcohol. Four parts of water are mixed with one part of "paint etcher" before application.

(*f*) Wire brush to be used in removing old paint.

(3) *Repainting aluminum and steel pontons and trestles.*—Loose and cracked paint and other foreign substances should be removed from all surfaces with a wire brush. Cleaning by sand blasting is the most satisfactory method if sand blasting equipment is available. When sand blasting equipment is used, sand remaining on the surfaces must be removed before the application of the paint. In addition to cleaning with the wire brush or sand blasting, surfaces should be washed with mineral spirits (paint cleaner and thinner mentioned in (2) (*d*) above) and should then receive a final rinsing in clean, unused, mineral spirits.

Aluminum surfaces to be painted should next be etched. This etching should be done with phosphoric acid etching solvent (paint etcher). This solution should remain in contact with the aluminum surfaces for 15 minutes and the surfaces should then be washed thoroughly in warm water.

The pontons or trestles (steel or aluminum) should be given two coats of primer (paint F–I). After priming, the surfaces should receive one finish coat of paint (paint A).

(4) *Repainting balk, chess, and other wooden items.*—All surfaces to be painted should be thoroughly cleaned of all loose or cracked

paint and other foreign substances with a wire brush. Wooden surfaces should be given two coats of primer (paint F–II). After priming, the surfaces should receive one finish coat of paint (paint A).

(5) *Nonferrous metal surfaces.*—Brass, bronze, and other nonferrous metal surfaces (except aluminum) need not be painted but should be given a dull finish to reduce reflection of light to a minimum.

(6) *General remarks.*—The first coat of paint should be applied within 5 hours after completion of cleaning. All paint when applied should provide a satisfactory film and smooth even surface, suitable for the proper application and adhesion of subsequent coats. Paint may be applied by brush or spray, but if applied by spray, each gallon of paint should be diluted by an additional quart of mineral spirits (paint cleaner and thinner). No paint should be applied to surfaces upon which there is frost or moisture condensation, nor during rainy weather unless the part being painted is amply protected against the effects of the weather. While any painting is being done, the temperature of the atmosphere in contact with the paint surface should be maintained at or above 50° F. Also, all paint, when applied, should be at approximately the same temperature as the surface on which it is applied. When painting has been commenced on any portion of the work, the complete painting operation, including priming coats and finish coat on that portion of the work, should be completed as soon as practicable; however, at least 24 hours should be allowed to elapse between the priming and finish coats.

73. (Superseded.)

Unit No. 1038,

bridge, ponton, 25-ton

Items	Quantity
Anchor, Danforth, 30-lb	2
Anchor, Kedge, 150-lb	32
Bag, paddle, 9-paddle capacity	14
Balk, ponton, 25-ton	168
Balk, transverse, 25-ton	16
Balk, trestle, 25-ton	96
Battery, dry cell, 6-volt electric lantern	3
Boat, assault, M2	2
Bracing trestle, set containing:	
Auger, post hole, 6″	2
Block, steel, for ⅞-in. manila rope, 7-inch, snatch	4
Clamp, column bracing, 25-ton	32
Clip, wire rope, ½″ nut	40
Grip, cable, for ½″ wire rope	4

Items	Quantity
Bracing trestle, set containing—Continued.	
Pin, assembly, strut shoe	19
Post, anchor, 25–ton	4
Rope, wire, ½″, 6 x 19 plow steel, 250′	2
Shoe, bracing strut	16
Strut, bracing	16
Wrench, adjustable, open end, single head, 10″ (Crescent)	4
Bracket, reflector, ponton gunwale type	78
Bracket, stern attachment, 22 hp. motor, ponton 25-ton	4
Buoy, life, ring, 24-inch	2
Carrier, balk, 25-ton	75
Chain, sling ½″ x 16′, w/hook and eye	4
Chess, ponton, 25-ton	302
Chess, ponton, half, 25-ton	16
Chest, spare parts and accessories	12
Clamp, side rail, 25-ton	96
Clip, wire rope, ½″, w/3/4″ nut	48
Flare, electric emergency	70
Float, pneumatic, 12-ton, complete with emergency repair kit, and carrying case	12
Hanger, hinge sill, 25-ton	26
Hanger, transverse balk, 25-ton	32
Hoist, chain ratchet, 1½ to 3-ton, 2 hoists in chest—set	4
Hook, boat, ballpoint, 10-ft	32
Kit, repair, ponton, with chest	1
Lamp, electric, flasher	5
Lamp, electric debris, patrol	2
Lantern, electric, dry-cell, 6-volt	3
Manifold, inflation-deflation, four hose complete	1
Marker, safety reflector, red	78
Oar, ponton, 14′ long	84
Oarlock, ponton	96
Paddle, boat, single blade, 5-ft	126
Picket, steel	76
Pole, ranging, 6-ft, two-section	2
Ponton, 25-ton	12
Pump, water, bail, ponton	16
Pump, centrifugal, 2-inch, 55 G. P. M., complete w/25′ 1½″ discharge hose, 10′ 1½″ suction hose and spanner wrench	1
Rigging, equipment	1
Rope, manila, ½″[1]—feet	4, 800
Rope, manila, 1″[1]—do	12, 000
Rope, wire, ½″ diam. 6 x 19 plow steel—do	500
Sill, abutment, 25-ton	4
Stirrup, detachable, for wooden balk, 25-ton	96
Tape, metallic, 50′, in feet and inches	2
Trestle, complete (w/o hoist)	4

[1] Expendable items.

74. Ponton.

* * * * * * *

c. (Added.) *Steel pontons.*—Steel pontons are being manufactured in lieu of aluminum pontons. These steel pontons have the same general characteristics and dimensions as the aluminum ones but weigh 4,200 pounds, 1,500 pounds more than aluminum pontons. Their net displacement is therefore 1,500 pounds less; this does not materially affect their load carrying capacity.

74.1. (Added.) **Pneumatic float.**—*a. Description of float* (see fig. 38.1).—The 12-ton pneumatic float is 25 feet long, 7½ feet wide, and 30 inches deep. It is made of rubberized fabric and consists of an outer tube, a floor, and a removable central tube. Each tube is

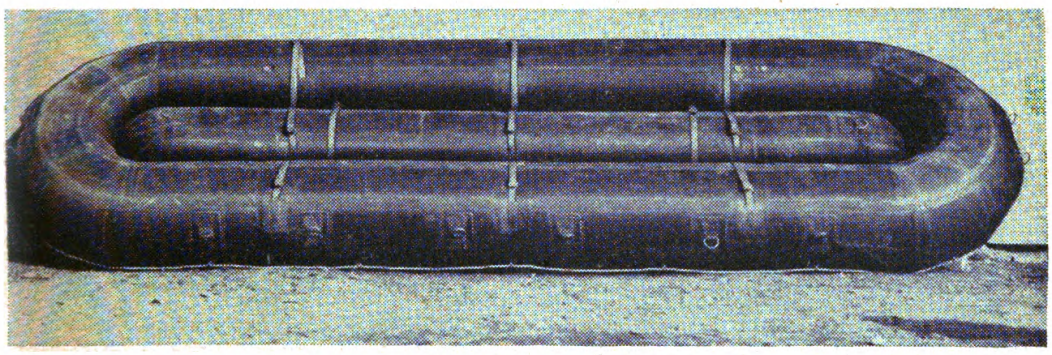


FIGURE 38.1.—12-ton pneumatic float.

[A. G. 062.11 (4–10–43).] (C 1, May 26, 1943.)

30 inches in diameter and is divided by bulkheads into separately inflated air chambers. Attachments consist of straps for holding float sills to the float, straps to hold the central tube in place, D-rings for carrying the float and for attaching bridle lines, and a life line. The float weighs approximately 525 pounds. It has a buoyancy of approximately 17,000 pounds with a 9-inch freeboard, or of approximately 24,000 pounds when floating with no freeboard. When the float is submerged and water fills the space between the central and outer tubes, buoyancy is reduced to approximately 21,000 pounds. The float is carried in a canvas carrying case with dimensions approximately 4 by 3½ by 2½ feet. An emergency repair kit is included in each carrying case.

b. Manifold, inflation-deflation.—The float is inflated by use of an inflation-deflation manifold attached to an air compressor. The manifold has a connection to receive the hose from the air compressor, a regulating valve, and 4 outlet hoses, each about 6 feet long and each equipped with an individual valve. To inflate the float, attach the air compressor hose to the manifold, open air compressor valve to allow

air to flow to the manifold, turn manifold regulating valve to "inflate," open valves of four-float compartments by turning them counterclockwise, and press the end of each manifold hose to one of these valves. Four compartments of the pneumatic float can be inflated simultaneously. The float is just rounded out at a pressure of about 1 pound per square inch. The working pressure should be 1½ pounds per square inch, at which point the float ceases to be soft but continues to yield slightly under hand pressure. The float can be inflated in about 6 minutes using one manifold. Floats may be deflated by removing the valve caps of the floats and allowing the air to escape. However, for best results, all air should be drawn out with the inflation-deflation manifold. This makes the floats easier to pack in a small space. The procedure for deflation is the same as for inflation except that the regulating valve of the manifold is turned to "deflate."

[A. G. 062.11 (4–10–43).] (C 1, May 26, 1943.)

75.1. (Added.) **25-ton trestle M2.**—*a. General.*—The 25-ton trestle M2 is an all-steel trestle similar in general design and dimensions to the aluminum trestle M1 described in paragraph 75. The weight of the assembled trestle is approximately the same as the weight of the trestle M1 (1,450 lb.). Following is a description of the parts of the steel trestle in so far as it differs from the aluminum trestle. (See fig. 39.1.)

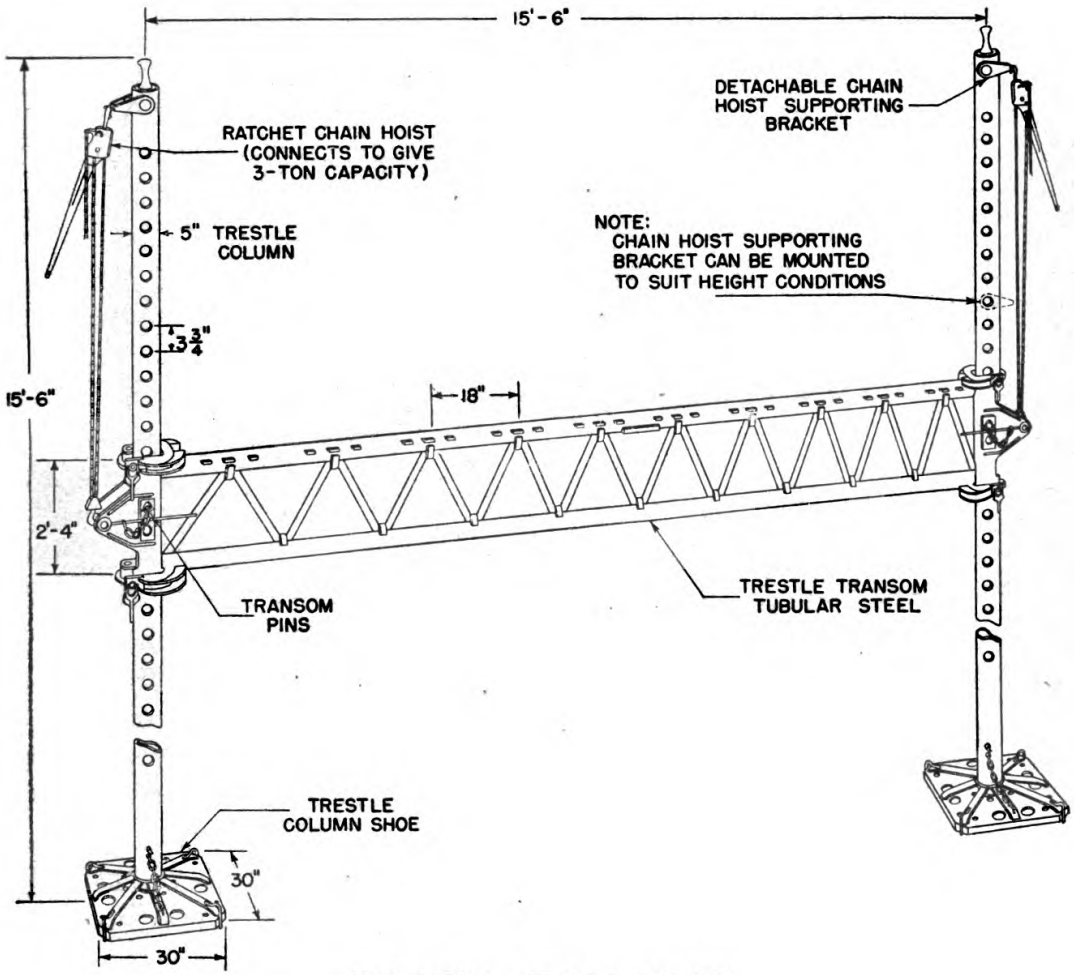


FIGURE 39.1.—25-ton trestle M2.

[A. G. 062.11 (4–10–43).] (C 1, May 26, 1943.)

b. Trestle column M2.—The vertical row of holes in the column extends to the top of the column. The swiveled hangers on top of the column for attachment of chain hoists is eliminated. In its place is substituted a detachable chain-hoist supporting bracket which can be mounted in any of the holes of the trestle column according to height desired. This bracket is described in *f* below.

c. Trestle transom M2.—This transom consists of a tubular steel truss section. There is no column well at each end; instead each end

is open so that the trestle column can be inserted from the side. Two metal clamps keep the jaws of this opening together (they do not serve to hold up the column). Two pins are attached to each end of the transom with chains. There are three sets of pin holes at each end of the transom. To one pin, inserted in the outermost set of pin holes, is attached the lower end of the ratchet chain hoist. The second pin is inserted thru one or the other of the two remaining sets of holes and thru one of the holes in the trestle column, thus securing the transom to the column. The latter two sets of holes are 5⅝ inches apart and since the holes on the trestle column are spaced 3¾ inches apart, a 1⅞ inch adjustment can be made as with the trestle M1.

d. Trestle column shoe M2.—These shoes are made of steel and are 30 inches square.

e. Ratchet chain hoists.—Two 1½- to 3-ton ratchet chain hoists are provided with each trestle for adjusting the height of the transom. This type of hoist supplants the 1½-ton differential chain hoist, and is used with both types of trestles.

The ratchet chain hoist is a commercial type hoist with a 12-foot chain. (See fig. 39.2.) This chain can be attached so that only a single strand of chain takes the load (capacity 1½ tons) or so that two strands of chain take the load (capacity 3 tons). The hoist can be adjusted to raise or to lower. For use with 25-ton trestles, the chain should be doubled (3 tons) thus giving an effective chain-hoist length of only 6 feet.

One hook of the ratchet chain hoist is attached to the chain-hoist supporting bracket described in *f* below and the other hook to the stirrup at the end of the transom M1 (or to the pin at the end of the transom M2). To adjust the height of the transom, sling two hoists one on each column, remove transom pins, adjust height of transom to desired level (actuating both hoists at the same time), reinsert the pins, and remove the hoists. The hoists were not designed to take the heavy loads of the bridge; it is essential therefore that they be removed or at least disengaged (with the transom pins in place) before any load goes on the bridge. Each ratchet chain hoist weighs about 38 pounds.

f. Chain-hoist supporting bracket.—A chain-hoist supporting bracket is used with each ratchet chain hoist to support the upper end of the hoist when the hoist is used to adjust the height of the trestle transom. (See figs. 39.1 and 39.2.) This bracket may be attached to the trestle columns at any convenient height above the transom. The bracket is held in place on the trestle column by an inserted pin that is attached to the bracket with a chain, through

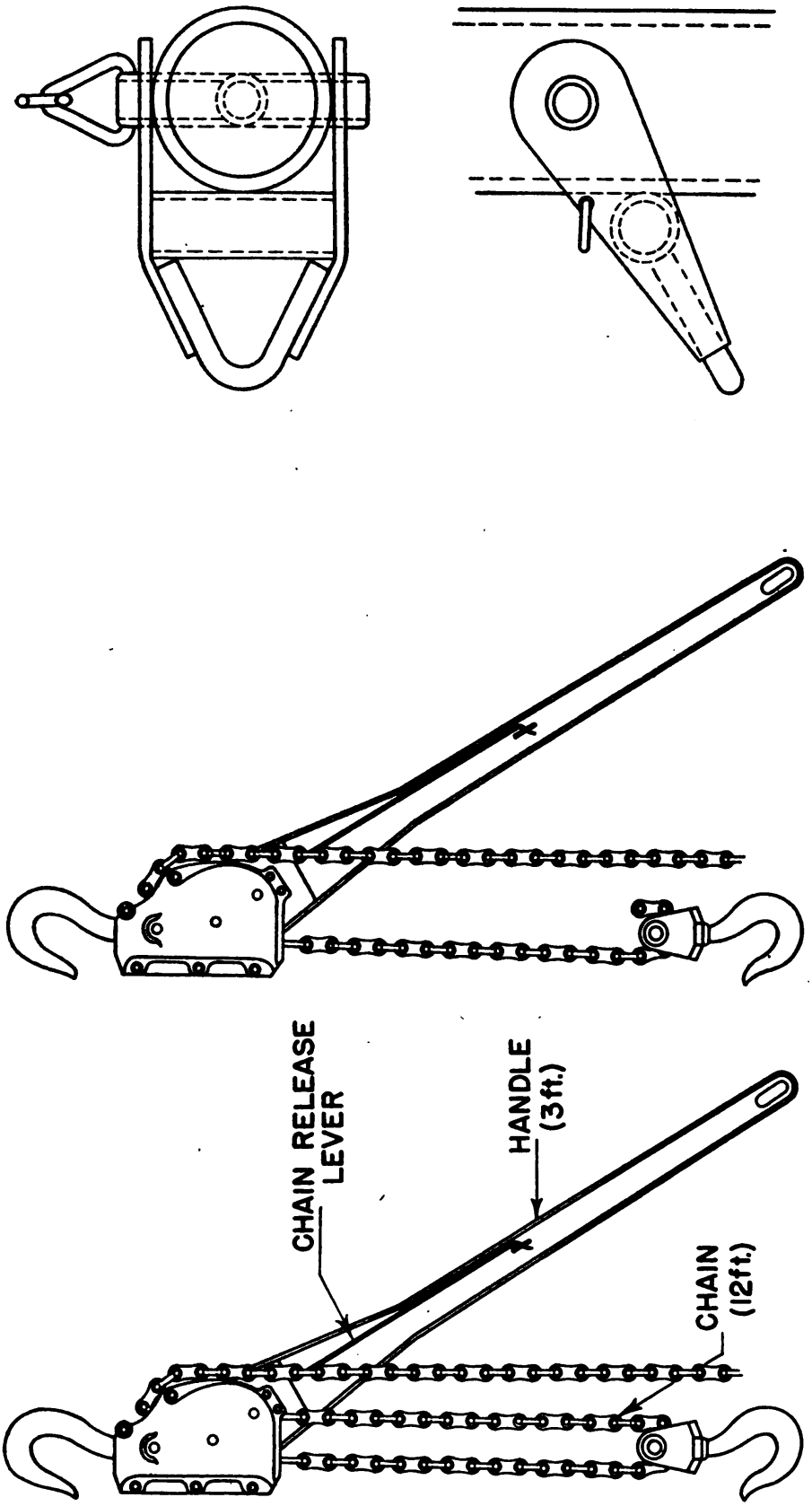


FIGURE 39.2.—Ratchet chain hoist and chain hoist supporting bracket.

[A. G. 062.11 (4-10-43).] (C 1, May 26, 1943.)

one of the holes in the trestle column. A boat snap attached to the end of the pin after it is inserted in the column prevents the pin from slipping out of the column.

When ratchet chain hoists are used with the trestle M1, chain-hoist supporting brackets must be used since the effective length of the hoist (doubled to give 3-ton capacity) is only 6 feet which is not long enough to reach the swiveled hanger at the top of the column.

75.2. (Added.) **Trestle-bracing equipment.**—Following is a description of the components of the trestle-bracing set:

a. Bracing strut (see fig. 39.3).—The strut is a 22-foot section of a 2½-inch standard pipe with a $^{13}/_{16}$-inch hole and a $^{15}/_{16}$-inch hole drilled at each end. The smaller hole permits fastening of the strut shoe. The larger hole allows the use of an ordinary picket as a handle when the assembled strut and strut shoe is to be screwed into or out of the ground as is an auger.

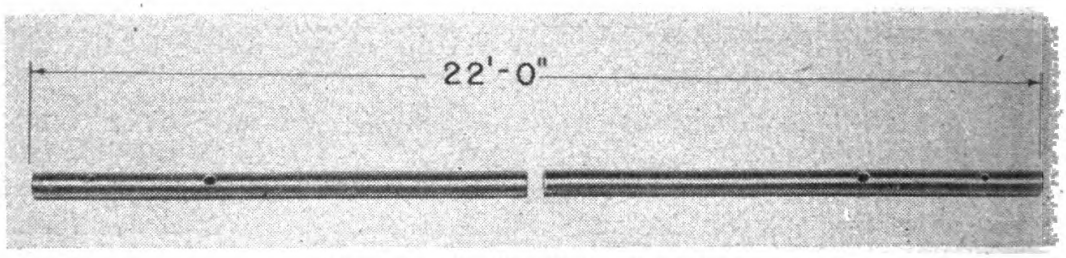


FIGURE 39.3.—Trestle-bracing strut.

[A. G. 062.11 (4–10–43).] (C 1, May 26, 1943.)

NOTE.—The strut is sufficiently strong for use as bracing. Abuse, excessively rough handling, or use of the strut for purposes other than the one for which it is intended can easily damage it. If not handled properly, the strut can be bent without much difficulty. Each bracing strut weighs about 125 pounds.

b. Strut shoe.—The shoe is a steel casting which is fastened to the bracing strut with the strut shoe pin when it is necessary to screw the strut into the earth. The shoe is so shaped that it may be screwed into soft earth. Each strut shoe weighs about 15 pounds. (See fig. 39.4.)

c. Strut shoe pin.—The strut shoe pin is used to fasten the bracing strut to the strut shoe. It is provided with a latch and is fitted with a boat snap to prevent the latch from working out of the pin. When the strut shoe is removed from the strut, the strut shoe pin should be replaced in the strut shoe with the latch and boat snap inserted in their proper positions to prevent loss of the strut shoe pin.

d. Trestle-bracing clamp.—The clamp consists of two cast steel clamps connected by a swivel joint. The larger of the two clamps is fastened to the trestle column or anchor post, and the smaller one to

the bracing strut. The clamp weighs about 18 pounds. (See figs. 39.5 and 7.1.)

e. Anchor post (see fig. 39.6).—The anchor post is a 5-foot section of 4½-inch standard pipe which has a spiral flange fastened to one end. The other end has a 15/16-inch hole to permit the use of a steel picket as a handle for screwing the post into a hole made with the post

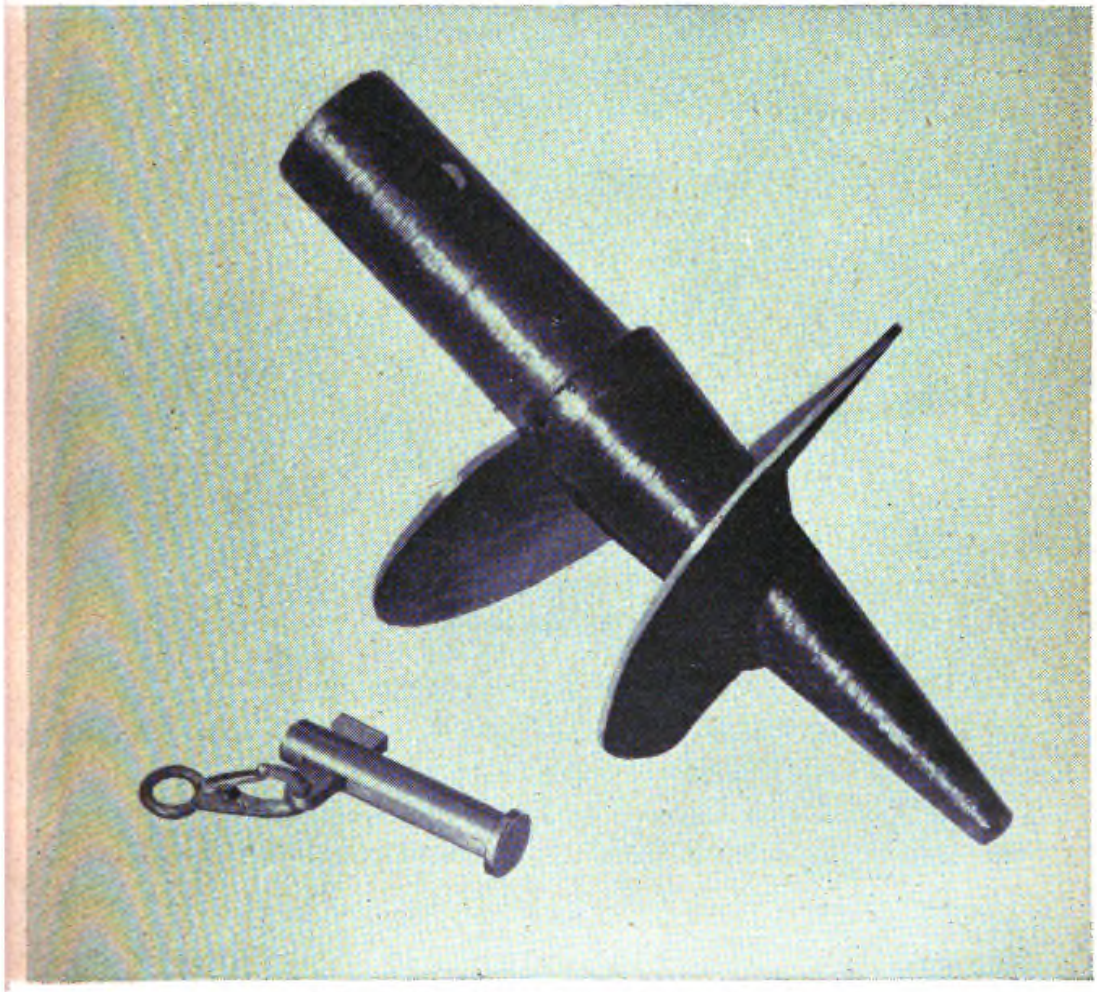


FIGURE 39.4.—Strut shoe and strut shoe pin.

[A. G. 062.11 (4–10–43).] (C 1, May 26, 1943.)

hole auger. The diameter of the anchor post is such that a bracing strut can be attached to it with a trestle-bracing clamp. The anchor post is provided only to permit use of trestle-bracing clamps, and should be anchored securely to other posts driven into the ground as shown in figure 7.4. Anchor posts are used to anchor the end trestle, where the ground is usually too hard to permit use of strut shoes. A holdfast consisting of a series of stakes may be substituted for the anchor post. Each anchor post weighs about 100 pounds.

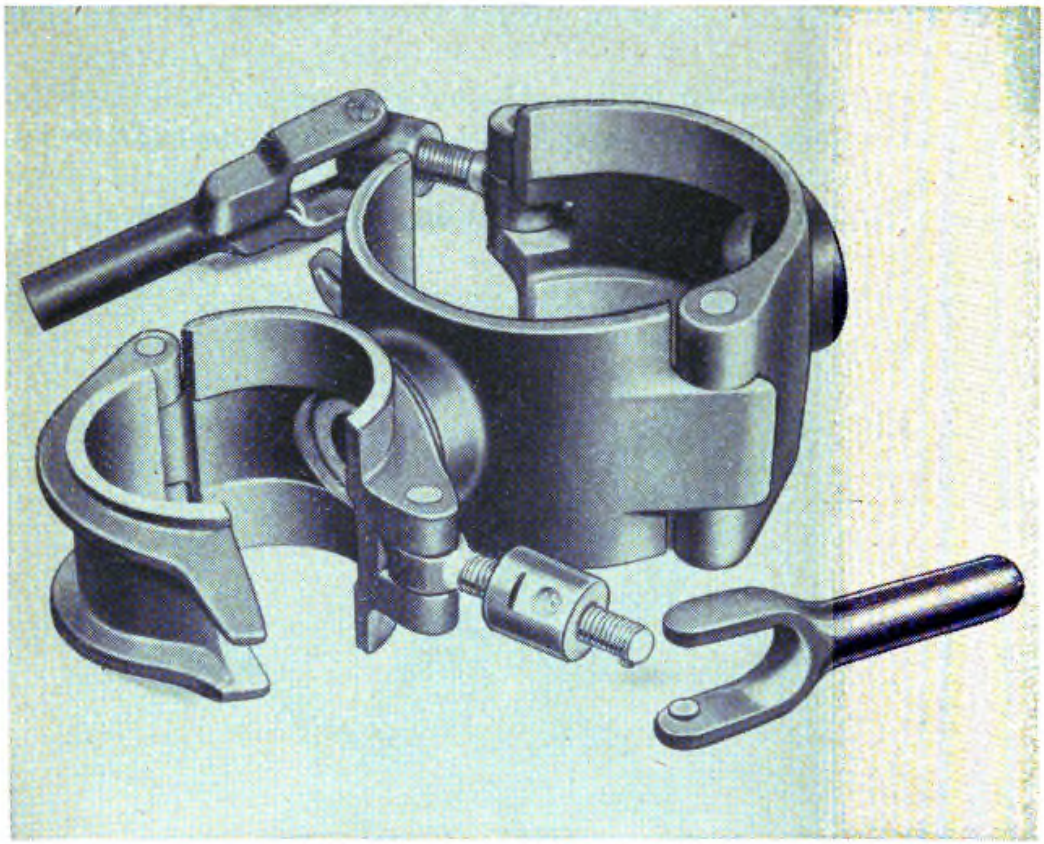


FIGURE 39.5.—Trestle-bracing clamp.

[A. G. 062.11 (4-10-43).] (C 1, May 26, 1943.)

f. Post hole auger.—This is a hand-operated auger provided for digging the hole in which the anchor post is set. The auger is about 5 feet long and weighs about 15 pounds. (See fig. 39.7.)

g. Trestle shoe anchor line.—This is ½-inch steel cable, used to prevent the trestle shoes from slipping, particularly when they rest on

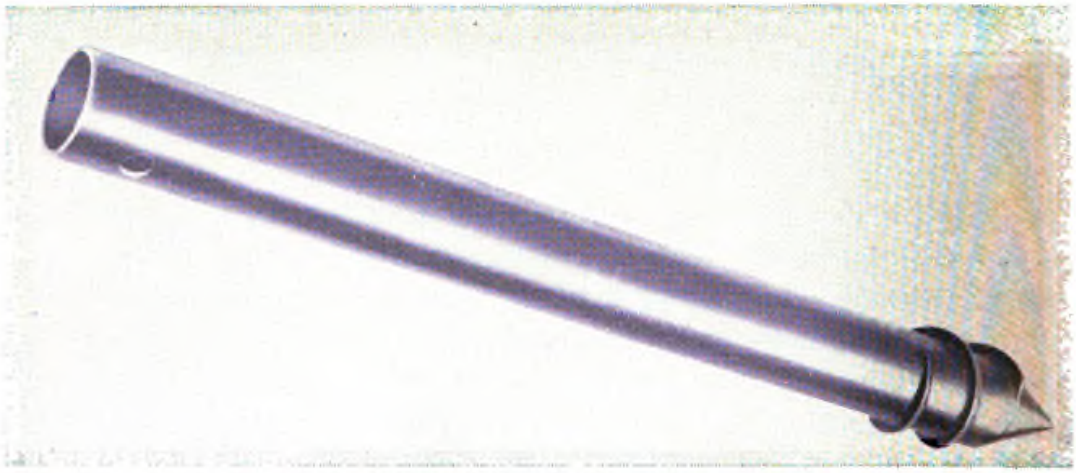


FIGURE 39.6.—Anchor post.

[A. G. 062.11 (4-10-43).] (C 1, May 26, 1943.)

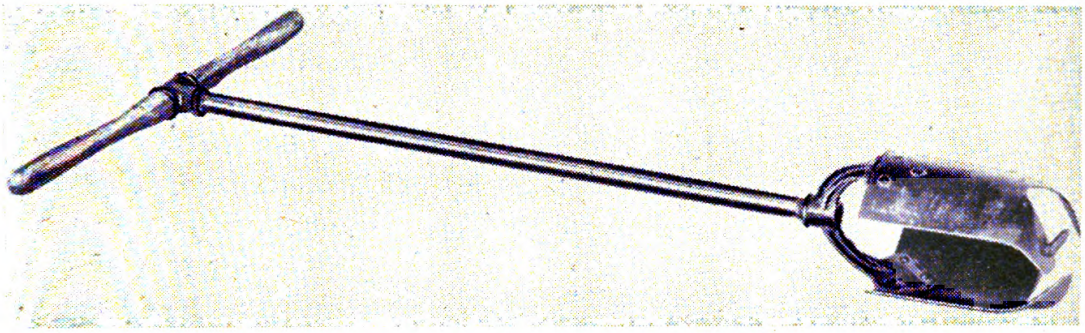


FIGURE 39.7.—Post hole and well auger.

[A. G. 062.11 (4–10–43).] (C 1, May 26, 1943.)

sloping foundations. The cable is fastened to the rings of the trestle shoe and to a natural or prefabricated holdfast on shore (or to the anchor post). The cable is tightened with a ratchet chain hoist and cable grips, and made fast with cable clips. (See fig. 39.8.)

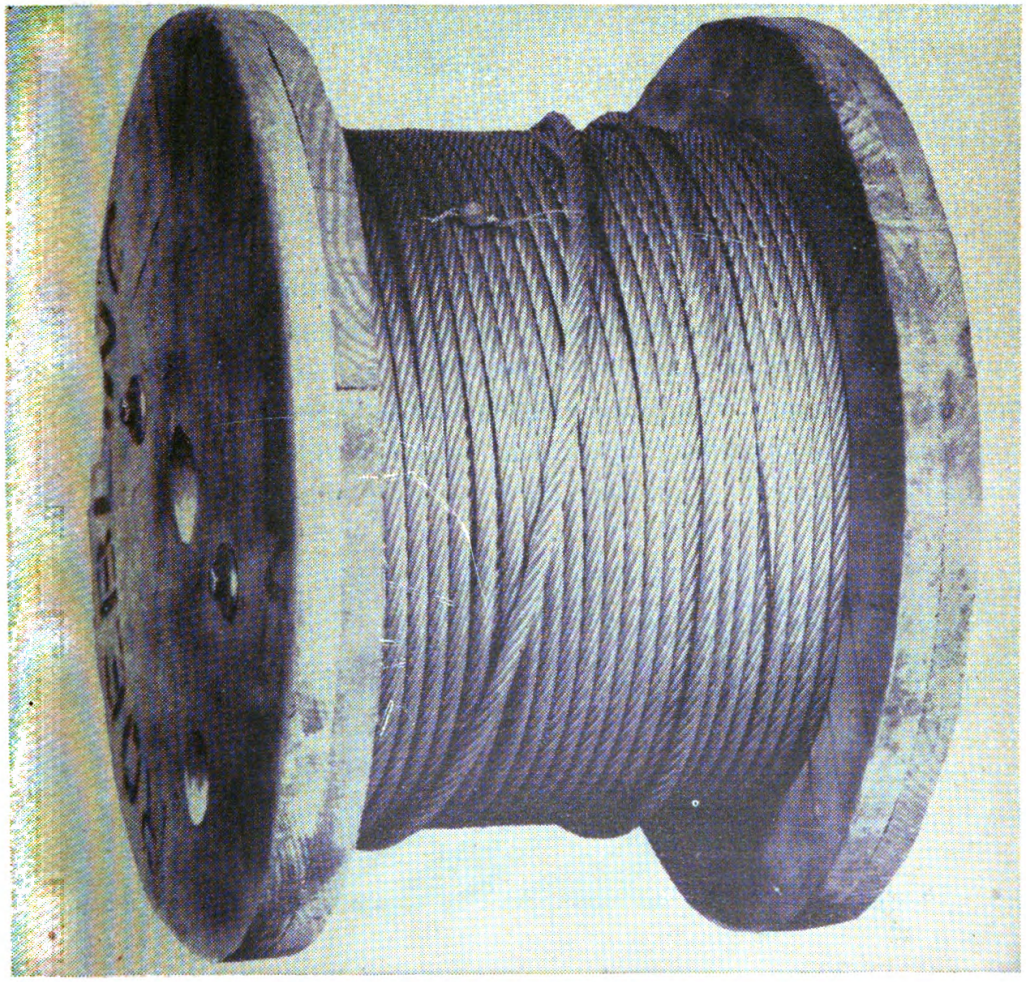


FIGURE 39.8.—Trestle shoe anchor line.

[A. G. 062.11 (4–10–43).] (C 1, May 26, 1943.)

h. Block, snatch.—This is an ordinary snatch block for 7/8-inch manila rope. It is used on the shore end of the trestle shoe anchor cable, to facilitate tightening the anchor cable. (See figs. 7.7 and 39.9.)

i. Holdfast.—This is a metal plate with holes drilled into it for driving nine steel pickets. Each picket is 1¼ inches in diameter, 40 inches long with a handle at one end to facilitate removal. This prefabri-

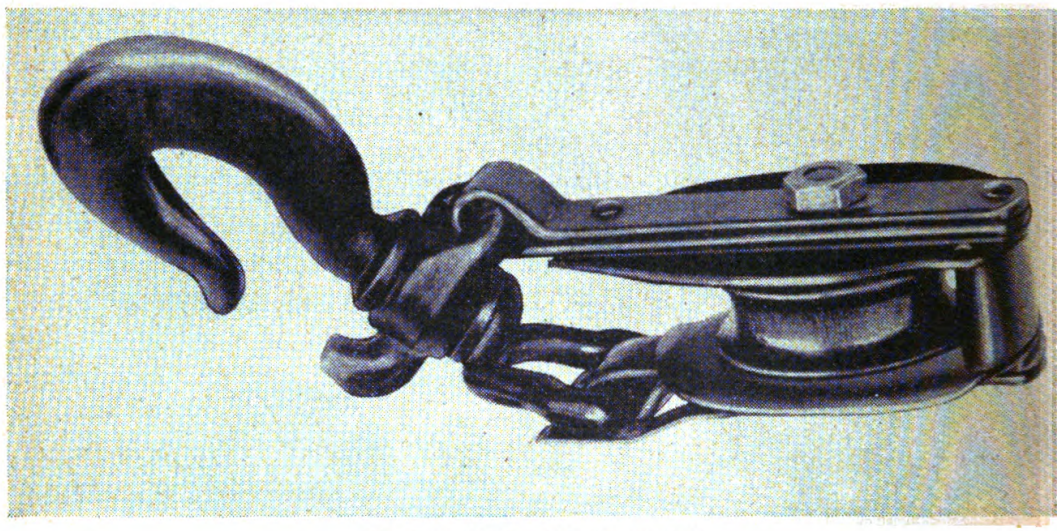


FIGURE 39.9.—Block, snatch.

[A. G. 062.11 (4-10-43).] (C 1, May 26, 1943.)

cated holdfast is used to anchor the trestle shoe anchor line on the shore. It is often omitted from trestle bracing sets, reliance being placed on natural or improvised holdfasts and on the anchor posts to serve its purpose. The plate weighs about 25 pounds and each picket weighs about 15 pounds. The entire holdfast weighs about 160 pounds. (See fig. 39.10.)

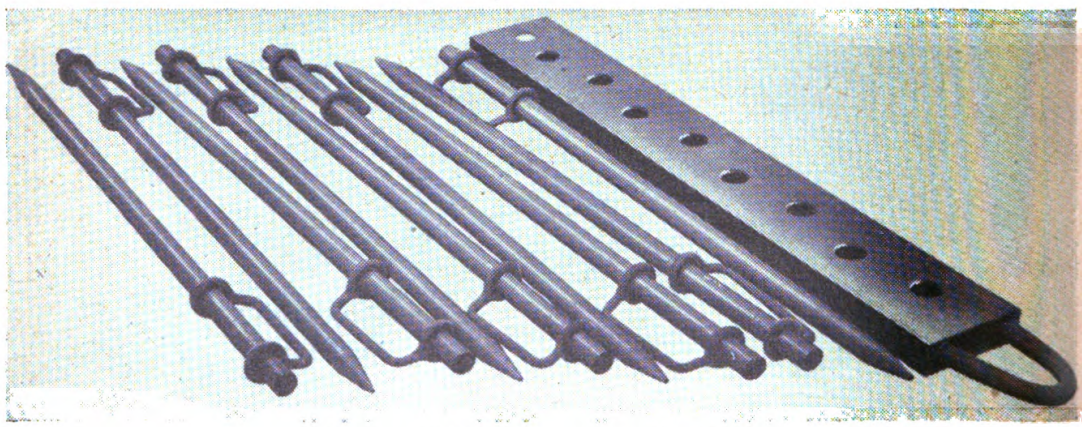


FIGURE 39.10.—Prefabricated holdfast.

[A. G. 062.11 (4-10-43).] (C 1, May 26, 1943.)

j. Ratchet chain hoist (see fig. 39.11).—This is the hoist used to adjust the height of the trestle transom. It is used to tighten the trestle shoe anchor cable. For tightening, it is fastened to the cable by means of two cable grips, one grip attached to the free end and one to the standing part of the cable. (See fig. 7.8.) Before tighten-

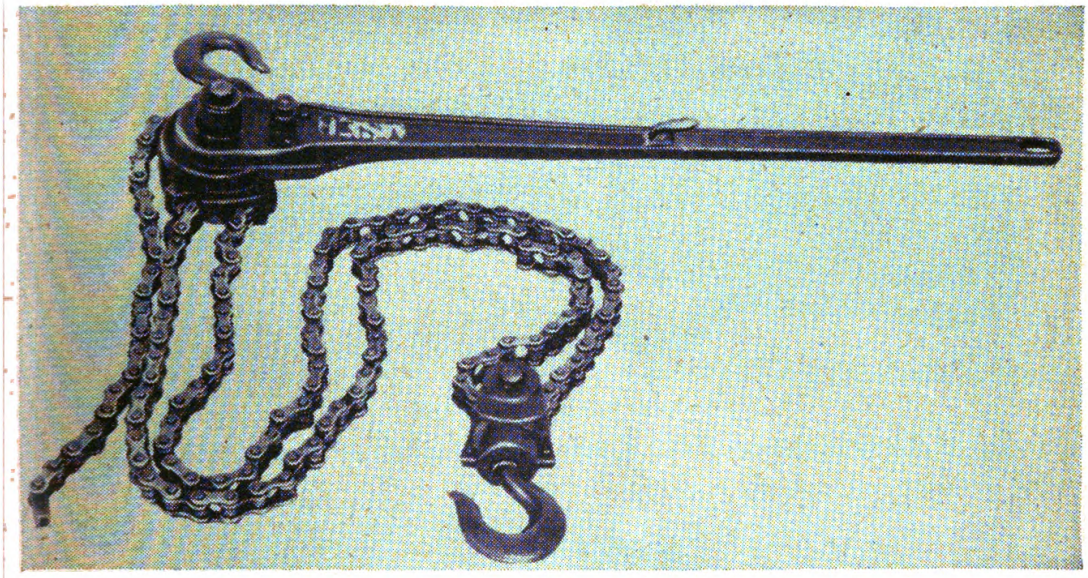


FIGURE 39.11.—Ratchet chain hoist.

[A. G. 062.11 (4–10–43).] (C 1, May 26, 1943.)

ing, cable clips should be loosely fastened in place. After the cable is taut, cable clips are made fast and the ratchet chain hoists and cable grips are removed.

k. Cable grips (see fig. 39.12).—This cable grip (or "come along") for ½-inch wire has a 3-inch gripping surface and is used to allow the ratchet chain hoist to be attached to the wire cable for tightening. Usually two grips are required for this, unless the free end of the cable ends in an eye, when only one grip is sufficient.

l. Cable clips (see fig. 39.13).—Cable clips for ½-inch wire are used to securely fasten two sections of wire cable together. Two or three should be used together spaced about 3 inches apart. The grip of the clip should bear against the standing part of the cable. (See fig. 7.7.) These clips should be fastened into place loosely before the cable is tightened. After the cable is taut they are securely fastened by means of the crescent wrench.

m. Wrench crescent (see fig. 39.14).—This is a commercial type open-end single-head, adjustable wrench, 10 inches long. It is used to tighten the nuts of cable clips.

[A. G. 062.11 (4–10–43).] (C 1, May 26, 1943.)

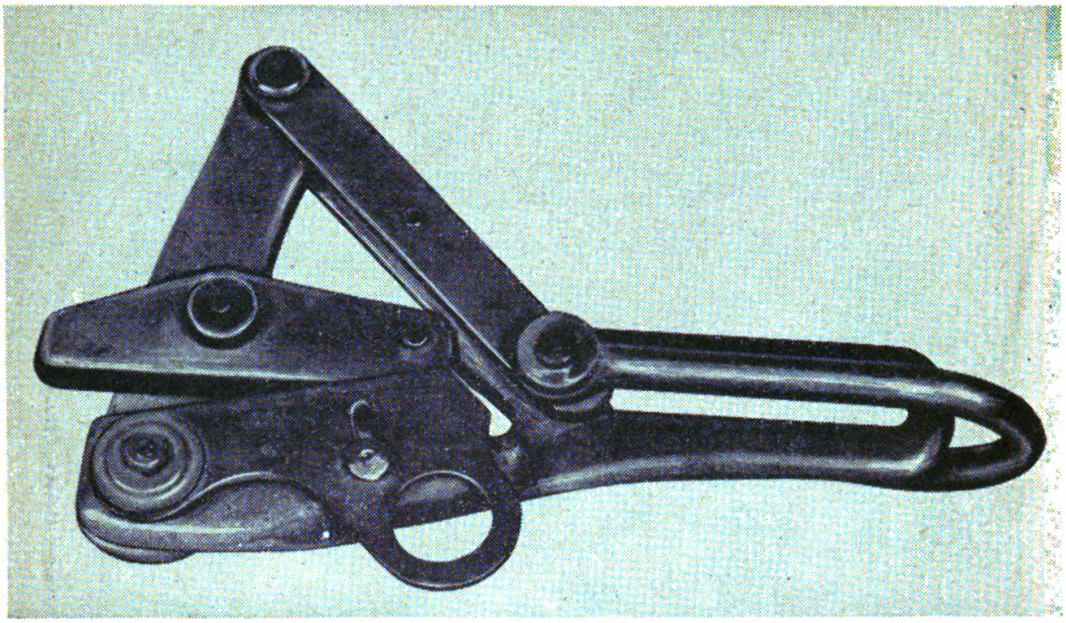


FIGURE 39.12.—Cable grip.

[A. G. 062.11 (4-10-43).] (C 1, May 26, 1943.)

FIGURE 39.13.—Cable clip.

[A. G. 062.11 (4-10-43).] (C 1, May 26, 1943.)

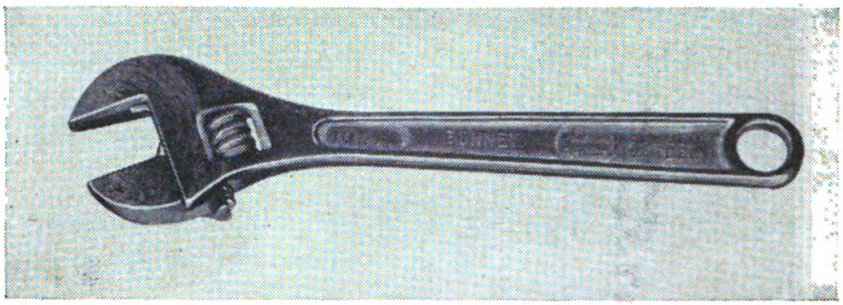


FIGURE 39.14.—Wrench crescent, 10-inch.

[A. G. 062.11 (4-10-43).] (C 1, May 26, 1943.)

CHAPTER 2 (ADDED)

10-TON PONTON BRIDGE MODEL 1938

SECTION I

GENERAL

89. General.—Sections XXII to XXVI cover the 10-ton ponton bridge model 1938. This bridge is similar in design to the 25-ton bridge, but of a lighter construction. It is discussed here only in so far as it differs from the 25-ton bridge.

90. Purpose.—The normal use of this equipage is to provide a rapid means of stream crossing for most vehicles of an infantry division. Although the normal capacity of the bridge is 10 tons, it may be reinforced to accommodate loads up to 20 tons.

91. General features of design.—The 10-ton ponton bridge differs from the 25-ton ponton bridge as follows: (See fig. 40 and fig. 47.) Figure 40 is rescinded and the following is substituted therefor:

a. All component parts are lighter.

b. Eight trestle balk stringers are used per fixed and per hinge span, and eight ponton balk stringers per floating span.

c. Clear width of roadway is 9 feet 10 inches.

d. Transverse balk are not employed.

e. Length of abutment span, trestle span, and hinge span is 15 feet; length of each floating span is 15½ feet.

92. Issue.—Two units of this bridge equipment may be issued to light ponton companies as a substitute for the ponton bridge, pneumatic M3, with which they are normally equipped. Pontons for this bridge are no longer being manufactured. Existing equipage is kept in depots and issued as required.

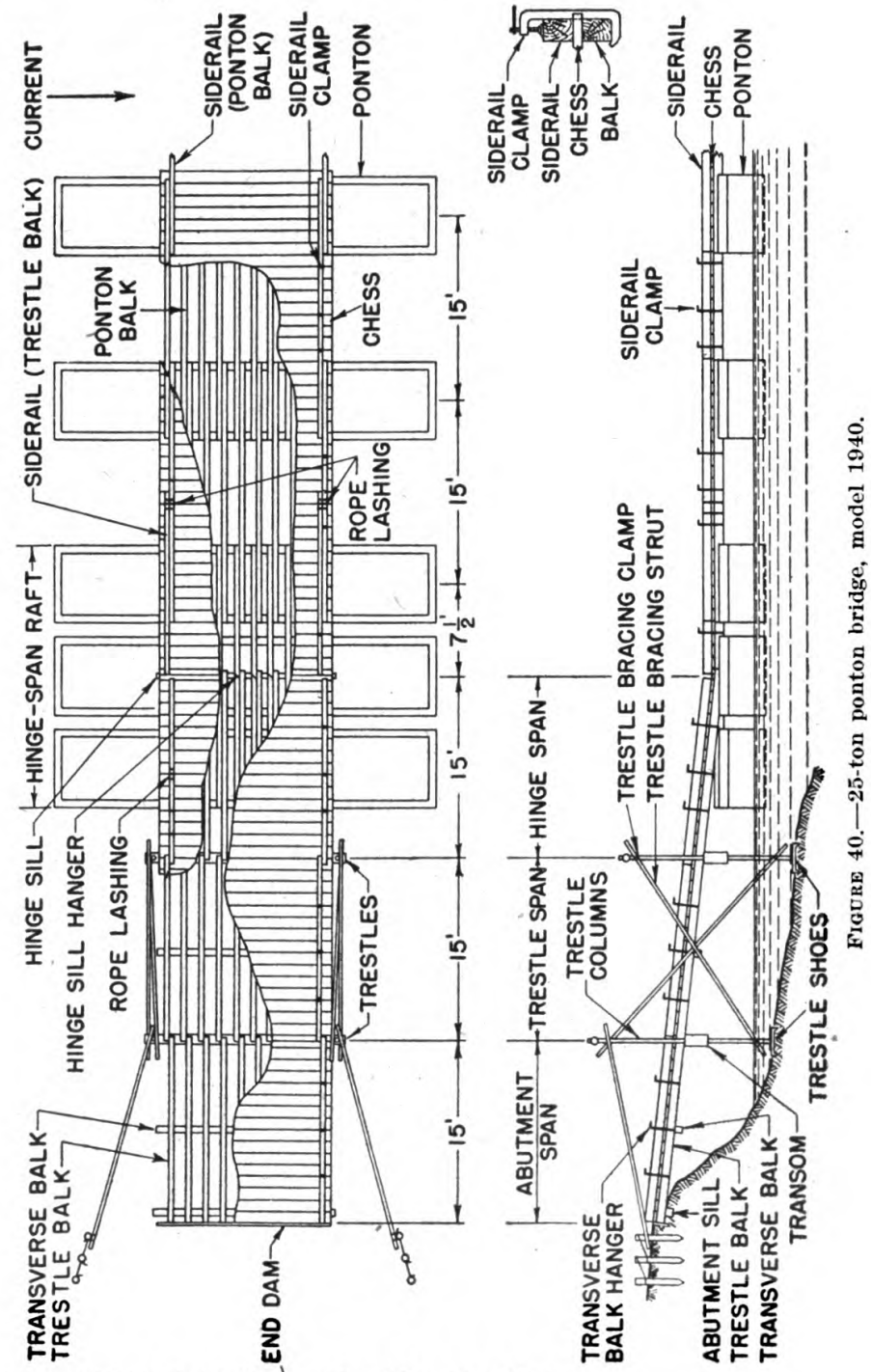


FIGURE 40.—25-ton ponton bridge, model 1940.

[A. G. 062.11 (4-10-43).] (C 1, May 26, 1943.)

SECTION II

DESCRIPTION OF EQUIPAGE

93. General.—Component parts of 10-ton ponton bridge equipage are similar to corresponding parts of 25-ton bridge equipage described in section XXI, Chapter 1. Naturally, these parts have smaller

dimensions since they were designed for a lighter load. 10-ton bridge parts, so far as they differ from 25-ton equipage, are briefly described below.

94. Ponton.—*a. Aluminum ponton.*—The ponton is 28 feet long, 5 feet 6 inches wide, and 2 feet 8 inches deep. There are no capstans on the 10-ton ponton. Each ponton is provided with 32 ratchet-type balk fasteners and 8 turnbuckle-type spare balk fasteners. The pon-

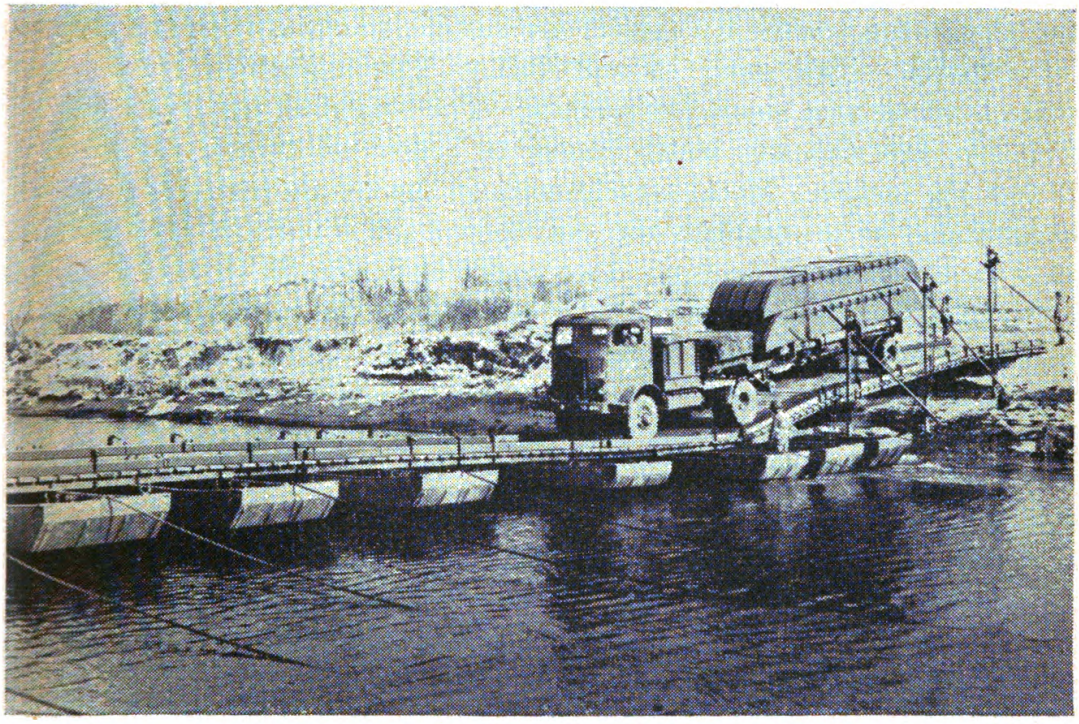


FIGURE 47.—10-ton ponton bridge, model 1938.

[A. G. 062.11 (4–10–43).] (C 1, May 26, 1943.)

ton weighs approximately 1,450 pounds and has a total displacement of 23,000 pounds. When used as a ferry with an outboard motor it provides space for approximately 50 men with full equipment besides the boat crew. The following table gives the ponton displacements for various weights and freeboards:

Draft	Displacement	Freeboard amidship
Inches	*Pounds*	*Inches*
4, 000	8	24
8, 200	14	18
12, 700	20	12
17, 500	26	6
23, 000	32	0

b. Ponton accessories.—Each ponton is equipped with two anchors, two anchor cables, two boat hooks, seven oars and oarlocks, and one bail pump. These are identical with 25-ton ponton accessories except that anchors weigh 100 pounds and oars are 13 feet long.

95. Pneumatic float.—Twelve-ton pneumatic floats are supplied for use in reinforcing the bridge. These floats are identical to the ones supplied with the 25-ton ponton bridge. (See par. 74.1.)

96. Trestles.—*a. General.*—The 10-ton trestle M1 (aluminum) and the 10-ton trestle M2 (steel) are similar to the corresponding 25-ton trestles. (See pars. 75 and 75.1.) The assembled trestle less chain hoist weighs about 750 pounds. The height of the trestles is 15 feet 3 inches and the width center to center of trestle columns is 13 feet 1½ inches. Metal attachments on the trestle transom tube are so arranged as to establish the position of the 8 pairs of trestle balk used in the normal bridge. Two extra balk can fit in the interval between attachments so that it is possible to fit 15 pairs of trestle balk on the transom (that is, each trestle span may be reinforced to 15 balk stringers per bay). Ratchet chain hoists are used with both types of trestles; chain-hoist supporting brackets with the trestle M2 only.

b. Trestle M1 (aluminum).

Diameter of column—4½ inches.
Dimensions of transom—13 feet 10 inches long by 9 inches wide by 15 inches deep.
Dimensions of shoe—24 inches by 24 inches.

c. Trestle M2 (steel).

Diameter of column—4½ inches.
Dimensions of transom (tubular type)—13 feet 10 inches long by 19 inches deep.
(diameter of tubing.—3½ inches.)
Dimensions of shoe—27 inches by 27 inches.

d. Ratchet chain hoist.—For adjusting the height of 10-ton trestle transoms the hoist should be connected so that a single strand of chain takes the load (1½-ton capacity—see fig. 39.2). In this manner the full 12-foot length of the chain can be utilized.

e. Chain-hoist supporting bracket.—This bracket is not necessary with the 10-ton trestle M1 since the ratchet chain connected singly is long enough to reach the swiveled hanger at the top of the trestle column. Brackets are furnished with the 10-ton trestle M2.

97. Trestle bracing.—Trestle-bracing parts for the 10-ton trestles are identical with the trestle-bracing parts furnished with the 25-ton trestles except:

a. Ten-ton trestle-bracing clamps are slightly smaller so that they can fit the smaller diameter of the 10-ton trestle column.

b. Ten-ton anchor posts are smaller in diameter so that 10-ton trestle-bracing clamps will fit them.

98. Superstructure.—*a. Balk, ponton.*—Dimensions—4 inches by 6 inches by 21 feet 5 inches.

Weight—140 pounds (carried by two men).

b. Balk, trestle.—Dimensions—4 inches by 6 inches by 15 feet 4⅜ inches. Weight—100 pounds (carried by two men).

c. Chess.—Dimensions—2⅛ inches by 11⅞ inches by 12 feet. Weight—75 pounds (carried by one man).

d. Chess, half.—Dimensions—2⅛ inches by 5⅝ inches by 12 feet. Weight—35 pounds.

e. Sill.—Dimensions—5¾ inches by 7¾ inches by 13 feet. Weight—135 pounds (carried by two men).

99. Fasteners.—*a. Siderail clamps.*—Dimensions—14-inch jaw. Weight—9½ pounds.

b. Hinge sill hangers.—Weight, 16 pounds.

c. Stirrups.—Weight, 2 pounds.

100. Construction aids.—*a. Outboard motors.*—See paragraph 69.

b. Powerboats.—See paragraph 70.

c. Cranes.—See paragraph 88.

SECTION III

TRANSPORTATION AND LOADING

101. Description of vehicles.—*a. General.*—The equipage for one unit of bridge is transported on six semitrailers drawn by 5- to 6-ton, 4 x 4 tractor trucks, and four two-wheel ponton-type trailers drawn by 4-ton, 6 x 6 cargo trucks. (See figs. 48 and 49.) Each unit consists of six ponton loads, two trestle loads, and two abutment loads.

Two-wheel dollies may be used to convert the semitrailers into four-wheel trailers. The semitrailers can then be maneuvered over unfavorable ground by light or medium tractors. For movement over unfavorable ground, the two-wheel trailers may be detached from cargo trucks and pulled by the tractors.

b. Semitrailers.—In general, the semitrailer used to transport the 10-ton bridge is similar to that used to transport the 25-ton bridge except that in the 10-ton trailer there is no depression in the trailer body. Also instead of a compartment at the rear, there is a removable chest at the front of the trailer which is used for tools and auxiliary

bridge materials such as anchors with cables, oarlocks, pumps, and siderail clamps. Two pontons placed one on top of the other are the chief load of one semitrailer. The pontons are held securely in place by 2 steel cables drawn taut by reel-type, ratchet-operated cable tighteners. Each cable (load binder) has a protecting sheath of ½-inch steam hose 9 feet long. In addition there are four shorter load binders which are used to secure the balk and chess of the ponton load in place. The top ponton is separated from the bottom ponton by six spacer

FIGURE 48.—4-ton cargo truck and two-wheel trailer with abutment load (10-ton ponton bridge).

[A. G. 062.11 (4–10–43).] (C 1, May 26, 1943.)

blocks secured to the oarlock sockets on the top ponton gunwales, three per gunwale. A hand-operated pump operates two hydraulic jacks, one at each rear corner of the semitrailer, which elevate or lower a 2½-inch diameter roller upon which the ponton gunwales rest. The jacks are used to raise the rear ends of the pontons to facilitate loading and unloading the pontons by hand.

c. Two-wheel trailer.—The two-wheel trailer has a rectangular-shaped special cargo body, and an adjustable-length drawbar, supported on pneumatic tires. Auxiliary lashing rings are welded to the four corners of the chassis to assist in manhandling the trailer and in

lowering it down steep grades. These rings also can be used for improvised lashings to secure the loads should the mechanical load fastening devices be lost or broken. The drawbar is of a telescopic type, permitting three adjustments in length. A rest is provided for the drawbar so that the trailer may be supported in a horizontal position when unhooked from the prime mover. A load is secured to the trailer by means of clamping beams held into position with hand-operated screws and chain links. When the trailer is not loaded, the clamping beams are secured in brackets especially provided for that purpose.

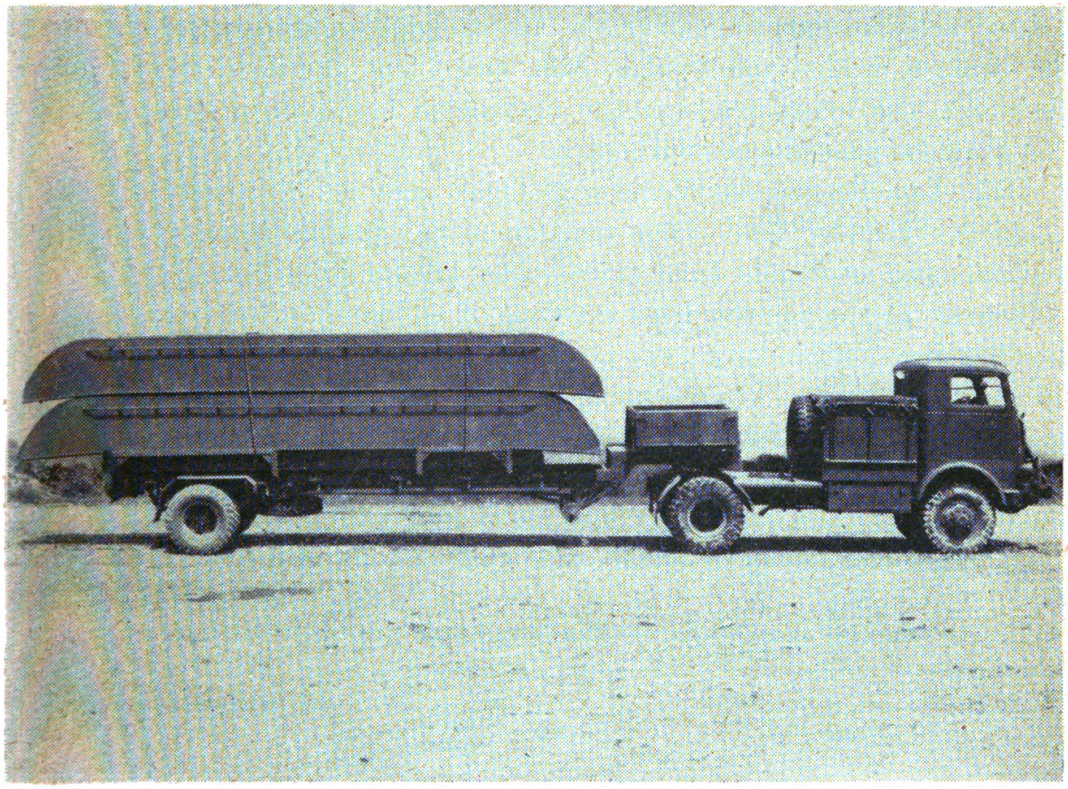


FIGURE 49.—Trailer truck and semitrailer with ponton load (10-ton ponton bridge).
[A. G. 062.11 (4–10–43).] (C 1, May 26, 1943.)

The chains that are connected to the clamping screws on the side of the trailer frame are hooked underneath the trailer and then tightened up with clamping screws to prevent rattling. Before the trailer can be loaded, all these items are removed from their keepers and placed in a convenient location for use as the trailer is loaded. The empty trailer weighs about 2,100 pounds.

d. Prime mover for semitrailer.—This is a 5- to 6-ton, 4 x 4, tractor truck, identical to the one used with the 25-ton bridge.

e. Prime mover for 2-wheel trailer.—This is a 4-ton, 6 x 6, cargo truck with a 12-foot, 3-inch loading bed which will accommodate standard chess.

f. Dollies.—See paragraph 86.

g. Loaded weights.—Vehicles when properly loaded weigh as follows:

	Pounds
Tractor truck with semitrailer with ponton load	33,000
Four-ton cargo truck with two-wheel trailer with trestle load	31,000
Four-ton cargo truck with two-wheel trailer with abutment load	30,000

These loads are so distributed through three or four axles that the loaded vehicles can pass over the 10-ton ponton bridge, model 1938; the ponton bridge pneumatic, M3; and light portable steel bridge. However, the loads are near the maximum for each of these bridges and must be passed over with care.

102. Loadings.—*a. General.*—There are three types of trailer loadings: ponton load (semitrailer only), trestle load (two-wheel trailer), and abutment load (two-wheel trailer).

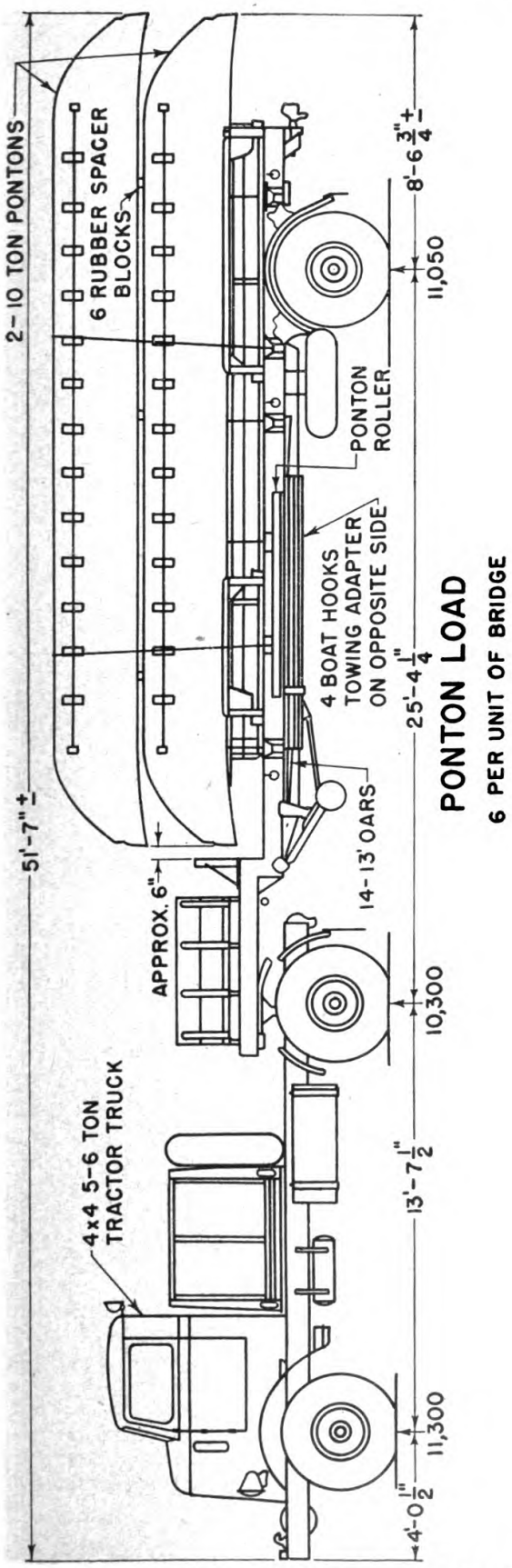
In general the ponton load consists of equipment for two complete floating bays, including two pontons; the abutment load consist of equipment for one abutment span and one trestle span, including one trestle and one abutment sill; and the trestle load consists of equipment for one trestle span and one hinge span, including one trestle, one hinge sill, trestle bracing, and an assault boat.

b. Detailed loading of semitrailer (see also fig. 50).

Table of contents for semitrailers, 10-ton ponton bridge unit

Item	Unit	Total required	Trailer numbers and equipment					
			1	2	3	4	5	6
Adapter, towing	Each	4	1	1	1	1		
Anchor, Danforth, 30-lb	Each	2	1	1				
Anchor, Kedge, 100-lb	Each	24	4	4	4	4	4	4
Balk, ponton	Each	120	20	20	20	20	20	20
Block, spacer, for pontons	Each	36	6	6	6	6	6	6
Chain, sling, ½ in. by 16 ft. with hook and eye	Each	4	1	1	1	1		
Chess (total req. 288) [1]	Each	192	32	32	32	32	32	32
Clamp, siderail (total req. 114)[1]	Each	72	12	12	12	12	12	12
Hook, boat, ball point, 10-ft	Each	24	4	4	4	4	4	4
Oar, ponton, 13-ft	Each	84	14	14	14	14	14	14
Oarlock, ponton	Each	96	16	16	16	16	16	16
Ponton	Each	12	2	2	2	2	2	2
Rope, manila, ½ in., ft. (total req. 4,800') [1]	Each	3,600	600	600	600	600	600	600
Rope, manila, 1 in., ft. (total req. 12,000') [1]	Each	10,800	1,800	1,800	1,800	1,800	1,800	1,800
Stirrup, detachable, for balk	Each	96	16	16	16	16	16	16

[1] See cargo truck.



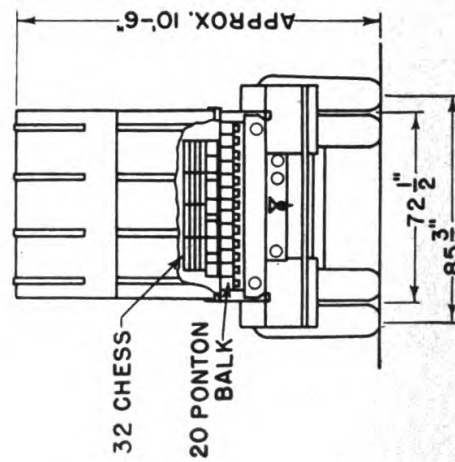
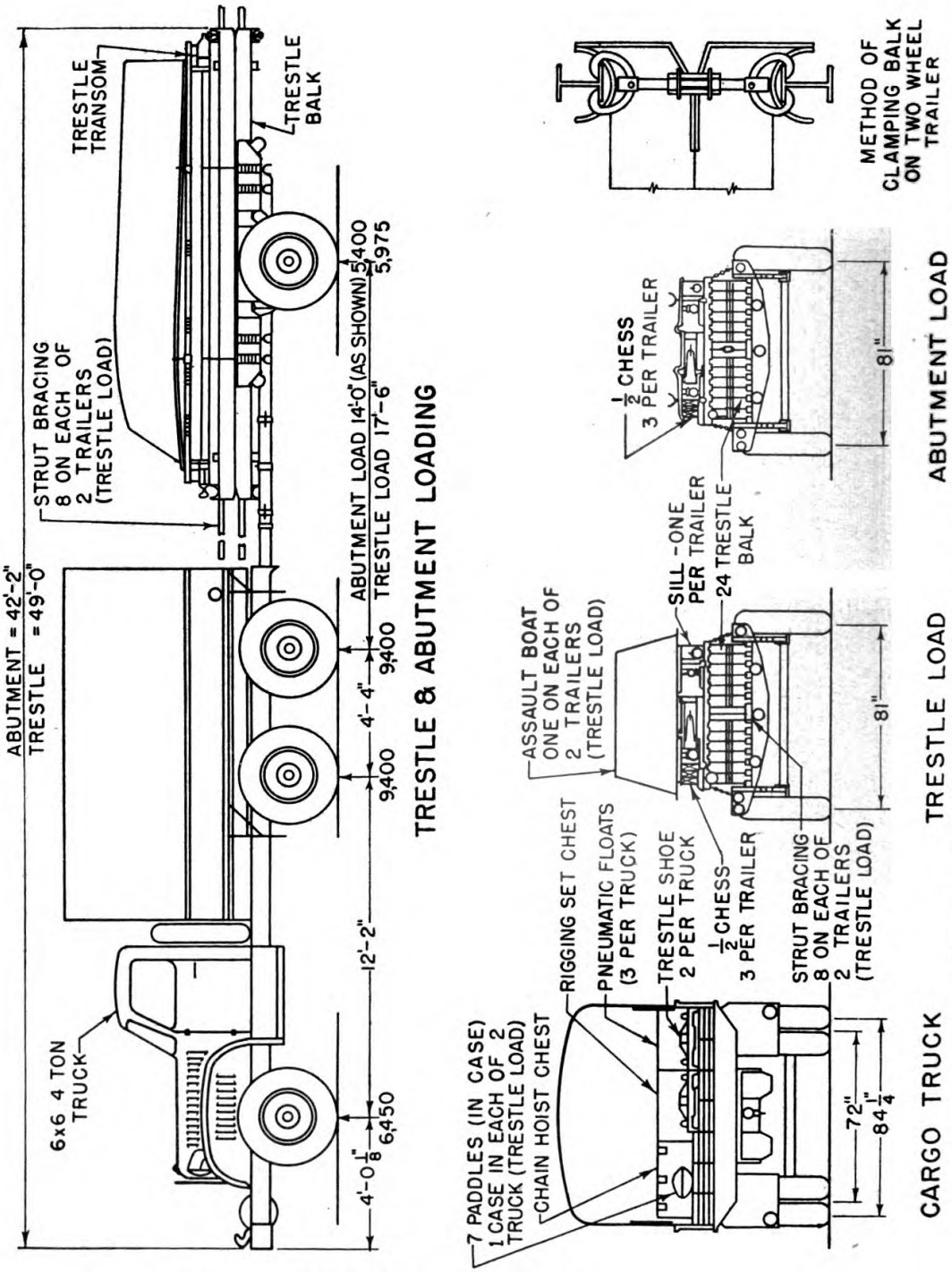


FIGURE 50.—Ponton load (10-ton ponton bridge).



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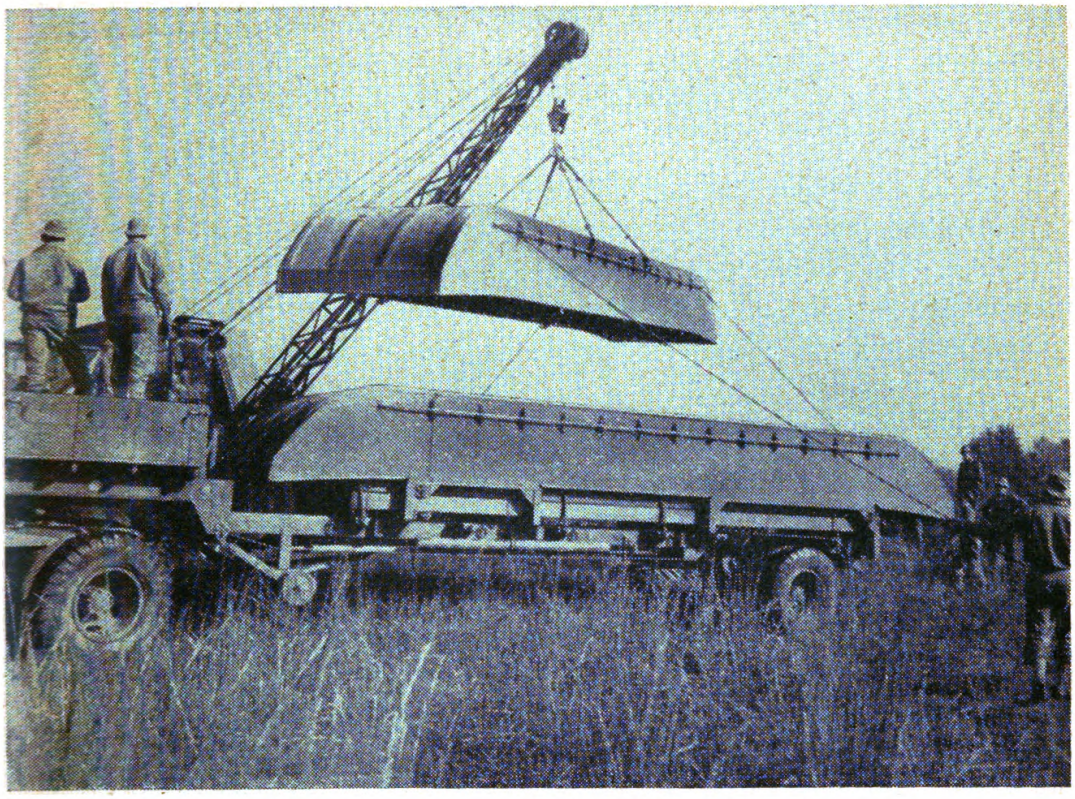

FIGURE 52.—Unloading 10-ton ponton with crane.

[A. G. 062.11 (4–10–43).] (C 1, May 26, 1943.)

c. *Detailed loading of truck tractor.*

Table of contents for tractor truck 10-ton ponton bridge unit

Item	Unit	Total required	Truck numbers and equipment					
			1	2	3	4	5	6
Bracket, reflector, ponton gunwale type	Each	78	13	13	13	13	13	13
Bracket, stern attachment, 22 hp. motor	Each	4	1	1	1	1	------	------
Buoy, life	Each	2	1	1	------	------	------	------
Chest, spare parts and accessories (total req. 8) [1]	Each	6	1	1	1	1	1	1
Flare, electric (total req. 60) [1]	Each	36	6	6	6	6	6	6
Kit, repair, ponton	Each	1	1	------	------	------	------	------
Lamp, electric, flasher	Each	5	3	2	------	------	------	------
Lamp, electric, debris patrol	Each	2	1	1	------	------	------	------
Lantern, electric, dry cell, 6-volt	Each	3	2	1	------	------	------	------
Marker, safety, reflector, red	Each	78	18	12	12	12	12	12
Motor, outboard, 22 hp., complete with chest and accessories	Each	4	1	1	1	1	------	------
Pump, bail, ponton	Each	16	3	3	3	3	2	2
Pump, water, portable, complete with 2 hose and spanner wrench	Each	1	1	------	------	------	------	------

[1] See cargo truck.

d. Detailed loading of 2-wheel trailers (see also fig. 51).

Table of contents for 2-wheel trailer load

Item	Unit	Total required	Trestle abutment			
			1	2	3	4
Balk, trestle	Each	96	24	24	24	24
Boat, assault, M2, with 9-paddle in carrying case	Each	2	1	1	----	----
Chess, half	Each	12	3	3	3	3
Sill	Each	4	1	1	1	1
Strut, bracing	Each	16	8	8	----	----
Trestle, complete (w/o hoist and shoes)	Each	4	1	1	1	1

e. Detailed loading of cargo truck (see also fig. 51).

Table of contents for cargo truck load

Item	Unit	Total required	Trestle abutment			
			1	2	3	4
Bracing, trestle, set, less strut bracing	Each	1	½	½	----	----
Chess	Each	96	24	24	24	24
Clamp, siderail	Each	42	21	21	----	----
Clip, wire rope, ½-in	Each	48	-----	-----	24	24
Chest, spare parts and accessories	Each	2	1	-----	1	----
Flare, road	Each	24	6	6	6	6
Hanger, hinge sill	Each	20	10	10	----	----
Set, 2 hoists, with chest	Each	4	2	2	----	----
Picket, steel, 36-in	Each	64	-----	-----	32	32
Pole, ranging 6-ft., 2-sections	Each	2	-----	-----	1	1
Rigging set, complete with chest	Each	1	-----	-----	1	----
Rope, manila, ½-in feet	Each	1, 200	600	600	----	----
Rope, manila, 1-in do	Each	1, 200	600	600	----	----
Rope, wire, ½-in. diameter, steel do	Each	500	-----	-----	500	----
Shoes, trestle	Each	8	2	2	2	2
Tape, metalic, 50-ft	Each	2	-----	-----	1	1
Float, pneumatic, 12-ton, complete with emergency kit, carrying case and 9 paddles in case.	Each	12	3	3	3	3
Manifold, inflation-deflation	Each	1	1	-----	----	----

f. Loading equipage.—(1) *General.*—All the equipage of the 10-ton bridge can be quickly loaded on its trailers by hand. If a crane is available and if site conditions permit, a crane may be used to load or unload pontons.

A detail of two noncommissioned officers and 23 men can place a complete ponton load on a trailer in about 10 minutes, manhandling all equipage. By using a crane to lift the pontons into place one noncommissioned officer and 4 men, who stand on top of the trailer and place material, as handed to them, can load a trailer in about 10 minutes.

(2) *Loading the pontons.*—(*a*) *Loading by hand* (see fig. 53).—Twenty-five men are required in loading the pontons by hand, the first ponton is inverted and placed with the front end resting on the semitrailer and the rear end resting on the ground. The second ponton is inverted and slid into position on top of the first (six spacer blocks should be attached to oarlock sockets of second ponton; use a chess as a skid in sliding one ponton on top of the other). An auxiliary roller, designed to roll along the tops of the chess loaded topmost on the trailer, is placed under the bottom ponton. The roller at the rear end of the trailer is raised with the hydraulic jacks. The two pontons are then rolled onto the trailer. The auxiliary roller is removed, the rear roller is lowered, and the load binders are made secure.

(*b*) *Loading ponton by crane.*—The pontons are first inverted, either by crane or by hand. The crane then picks up the pontons one at a time using previously prepared slings. Guy lines attached to the pontons guide them into place on the trailer. The top ponton should have six spacer blocks secured to its gunwales before it is loaded. (See par. 23.)

g. Unloading ponton.—(1) *Unloading ponton with crane.*—See paragraph 23 and figure 52.

(2) *Unloading ponton by hand.*—Twenty-five men are required to unload each ponton load. In the process of unloading pontons, the rear end of the pontons is raised with the hydraulic jacks, the forward end of the pontons is then raised by hand, and an auxiliary roller is placed under the bottom ponton. The two pontons are then rolled to the rear and the rear ends of the pontons lowered to the ground by the unloading detail. The men then support the front end of the two pontons until the semitrailer is pulled forward by its prime mover from under the load. The front end of the combined load is then lowered to the ground. The top ponton is then lifted or slid off the bottom ponton.

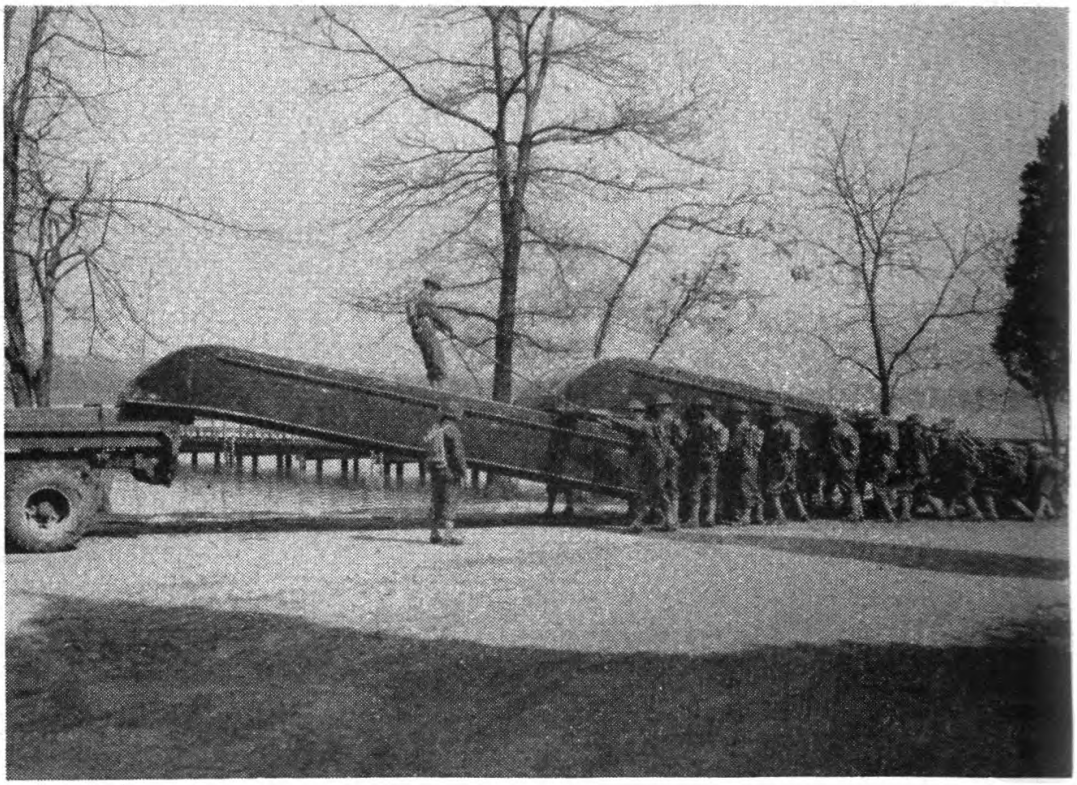

FIGURE 53.1.—Loading 10-ton pontons by hand.

[A. G. 062.11 (4–10–43).] (C 1, May 26, 1943.)

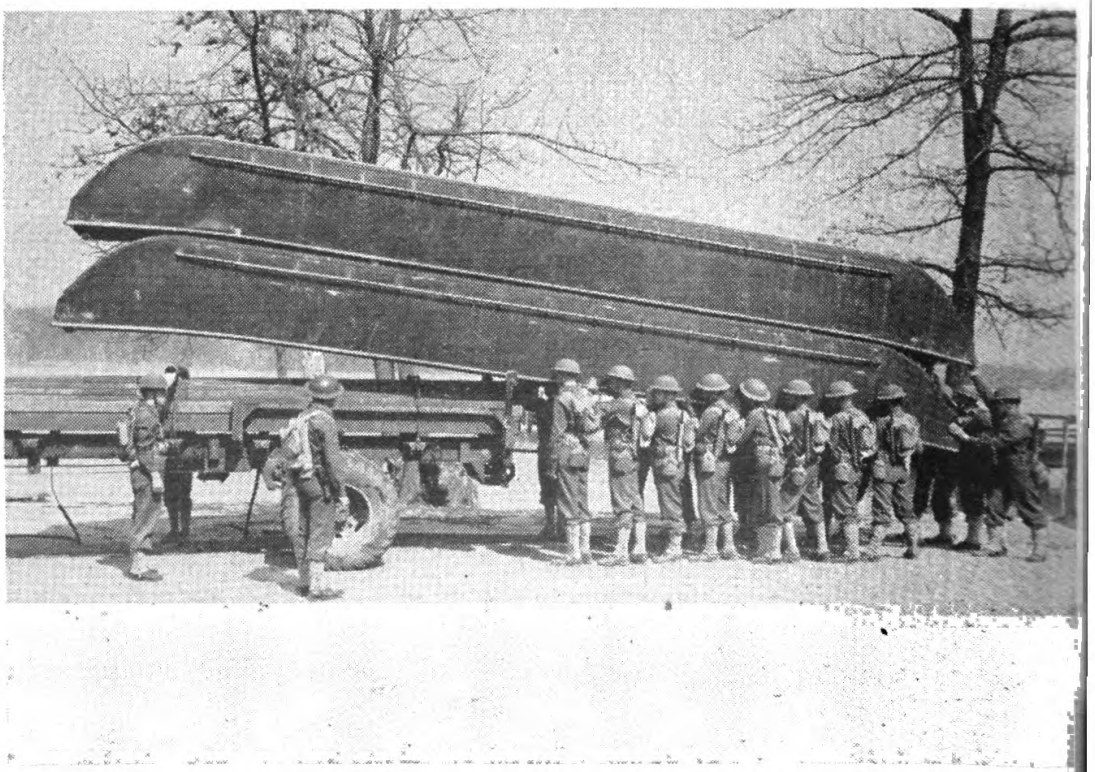

FIGURE 53.2.—Loading 10-ton pontons by hand.

[A. G. 062.11 (4–10–43).] (C 1, May 26, 1943.)

SECTION IV

CONSTRUCTION

103. General.—Construction of the 10-ton ponton bridge is generally similar to the construction of the 25-ton ponton as described in sections V, VII, VIII, and IX.

104. Construction by successive pontons.—Following is a suggested organziation for construction of the 10-ton bridge by the method of successive pontons:

Section	*NCO*	*Men*	*Duties*
Abutment (near-shore)	1	8	Install near-shore abutment sill. Assist in erection of near-shore trestles. Install near-shore end dam. Adjust height of transoms. Place trestle-bracing anchor posts and hold-fasts. Adjust trestle bracing.
Abutment (far-shore)	1	10	Obtain materials needed for far-shore abutment sill and end dam and take them to far shore in a pontoon. Cast one upstream and one downstream anchor for use on far-shore hinge-span raft. Assist in erection of far-shore trestles and all spans between abutment and hinge sills.
Trestle (using one near-shore shallow-water trestle)	1	10	Erect near-shore trestle. Complete loading of far-shore hinge-span raft. Move raft to far shore and erect abutment, trestle, and hinge spans with the assistance of the far-shore abutment section.
(using two or more near-shore shallow-water trestles) (two sections)			If two shallow-water trestles are used, first section constructs first near-shore shallow-water trestle and then moves to far shore and completes construction of far-shore abutment, trestle, and hinge spans as shown above. Second section erects second near-shore shallow-water

Section	*NCO*	*Men*	*Duties*
			trestle and then erects trestle bracing. If three shallow-water trestles are used, first section erects first and third trestles and trestle bracing. Second section erects second trestle and then completes construction of far-shore abutment, trestle and hinge spans.
Balk-fastener ----	1	8	Deliver hinge sill, hinge-sill hangers, and detachable stirrups to near-shore hinge-span raft. Construct near-shore raft. Assemble deep-water trestle on raft. NCO in charge directs moving of raft to center line of bridge. Place deep water trestle, assisted by abutment, cable, and anchor sections. Secure balk to pontons on all remaining spans.
Balk-carrier------	2	16	Deliver balk to near-shore hinge-span raft. Deliver balk for each span of bridge.
Chess-carrier-----	2	18	Deliver parts for deep-water trestles to near- and far-shore hinge-span rafts. Deliver balk to far-shore raft. Procure, carry, and lay chess on all spans of bridge.
Cable----------	1	4	Aline pontons during construction of near-shore hinge-span raft. Move raft to bridge site under direction of balk-fastener NCO. Hold raft in position as deep-water trestle is being placed. After trestle is placed, aline raft and successive pontons by means of upstream and downstream anchor cables.
Anchor----------	1	3	Cast upstream and downstream anchors for near-shore raft. Enter riverward ponton of raft and assist in alinement as deep-water trestle is being placed. Turn over cables to cable section. Cast downstream anchors for remaining pontons of the bridge.

Section	*NCO*	*Men*	*Duties*
Ponton (3 sections)	3	21	First section: deliver three pontons to near-shore raft construction site. Second section: deliver three pontons to far-shore raft construction site. Assist in construction of far-shore raft. All sections: cast upstream anchors and deliver pontons to cable section for all remaining spans.
Siderail	1	6	Assist in construction of far-shore hinge-span raft. Place and fasten siderails to all spans of bridge. Lash trestle balk to transoms.
Rescue boat	0	4	Anchor below bridge for safety purposes.
	14	108	
Telephone	1	2	(When needed.) Connect telephones for communication between construction end of bridge and near shore.
	15	110	

105. Reinforced bridges.—The 10-ton ponton bridge is reinforced in a manner similar to that used with the 25-ton ponton bridge (par. 47).

When the normal bridge is reinforced with two additional balk per floating bay, one on each side of the roadway, it will carry tank loads up to 13 tons. When the normal bridge is reinforced by inserting 12-ton pneumatic floats or extra pontons in each floating bay, by adding six extra trestle balk in each fixed and in each hinge span (to make a total of fourteen trestle balk per fixed and per hinge span) and by adding two extra balk in each floating span, one on each side of the roadway, the bridge will carry maximum loads of about 20 tons.

SECTION V

EQUIPMENT FOR ONE BRIDGE UNIT

106. List.

Items	Quantity
Adaptor, towing	4
Anchor, Danforth, 30-lb	2
Anchor, Kedge, 100-lb	24
Bag paddle, 9-paddle capacity	14
Balk, ponton	120
Balk, trestle, 10-ton	96
Battery, dry cell, 6-bolt, electric lantern	3
Block, spacer for pontons on semitrailer	36
Boat, assault, M2	2
Bracing, trestle, set, containing:	1
Auger, post hole, 6-in. capacity	2
Block, steel for ⅞-in. manila rope, 7-in., snatch	4
Clamp, column, -bracing, 10-ton	32
Clip, wire rope, ½-in w/¾-in. nut	40
Grip, cable, for ½-in. wire rope	4
Pin, assembly, strut shoe	19
Post, anchor, 10-ton	4
Rope, wire, ½-in., steel, 250 ft	2
Shoe, bracing strut	16
Strut, bracing	16
Wrench, adjustable, open end, single head 10-in. (crescent)	4
Bracket, reflector, ponton gunwale type	78
Bracket, stern attachment, 22 hp. motor, ponton, 10-ton	4
Buoy, life, ring, 24-in	2
Chain, sling, ½ in. by 16 ft., w/hook and eye	4
Chess, ponton, 10-ton	288
Chess, ponton half, 10-ton	12
Chest, spare parts and accessories	8
Clamp, siderail, complete 10-ton	114
Clip, wire rope, ½-in	48
Flare, electric, emergency	60
Float, pneumatic, 12-ton, complete with emergency kit and carrying case	12
Hanger, hinge sill, 10-ton	20
Hoist, chain ratchet, 1½–3–T, 2 hoists in chest set	4
Hook, boat, ballpoint, 10-ft	24
Kit, repair, ponton with chest	1
Lamp, electric, flasher	5
Lamp, electric, debris, patrol	2
Lantern, electric, dry cell, 6-volt	3

Items	Quantity
Manifold, inflation-deflation, 4-hose complete	1
Marker, safety, reflector, red	78
Oar, ponton, 13 ft. long	84
Oarlock, ponton	96
Paddle, boat, single-blade, 5-ft	126
Picket, steel	64
Pole, ranging, 6-ft., 2-section	2
Ponton, 10-ton	12
Pump, water bail ponton	16
Pump, centrifugal, 2-inch, 55 G. P. M., complete w/25 ft. by 1½ in. discharge hose and 10 ft. by 1½ in. suction hose and spanner wrench	1
Rigging equipment	1
Rope, manila, ½ in.[1] feet	4, 800
Rope, manila, 1 in.[1] do	12, 000
Rope, wire, ½ in. diam., steel do	500
Sill, abutment, 10-ton	4
Stirrup, detachable, for balk, 10-ton ponton	96
Tape, metallic, 50 ft., in feet and inches	2
Trestle, complete (w/hoist), 10-ton	4

[1] Expendable items.

SECTION VI

TECHNICAL DATA

107. Capacities.

Type of construction	Rated capacity	Maximum loads
a. Bridges.—(1) *Normal construction.*—(8 balk per bay).	10 tons	All vehicles with gross weights of 10 tons or less. 4-ton cargo trucks loaded (gross =12 tons). 13-ton tanks (under close supervision). 6-ton cargo trucks unloaded (11½ tons) (under close supervision). Tractor trucks and semitrailers loaded with 10- or 25-ton ponton equipage (gross=15 tons) (under close supervision).
(2) *Reinforced floating deck.*—(8 balk per fixed pan) (10 balk per floating pan).	13 tons	13-ton tanks. 6-ton cargo trucks unloaded. Tractor trucks and semitrailers loaded with 10- or 25-ton ponton equipage.

Type of construction	Rated capacity	Maximum loads
(3) *Reinforced with 12-ton pneumatic floats.*—(14 balk per fixed span, 10 balk per floating span).	20 tons	All vehicles with gross weight of 20 tons or less. Light tanks. Loaded 6-ton cargo trucks.
(4) *Reinforced with extra pontons.*—(14 balk per fixed span, 10 balk per floating span).	20 tons	All vehicles with gross weight of 20 tons or less. Light tanks. Loaded 6-ton cargo trucks.
(5) *Reinforced trestle bridge.*—(15 trestle balk per span, adequate trestle bracing).	25 tons	All vehicles with gross weight of 25 tons or less.
b. Ferries.—(1) *Single ponton.*—(with outboard motors).	Space governs	50 men with full field equipment.
(2) *Single ponton.*—(with oars).	Space governs	25 men with full field equipment.
(3) *2 ponton—1 span*	Space governs	Light vehicles only.
(4) *3 ponton—2 span*	10 tons	2½-ton cargo truck loaded. 4-ton cargo truck unloaded.
(5) *5 ponton—2 span*	20 tons	6-ton truck loaded. Light tank.
(6) *4 ponton—3 span*	10 tons	Truck-drawn guns with gross weights less than 10 tons.
(7) *5 ponton—4 span*	10 tons	Truck tractors with semitrailers loaded with 10- or 25-ton bridge.

NOTE.—Number of balk given do not include siderails. Capacities must be reduced in currents exceeding 4 mph.

108. Allowable crossing speeds on bridge.

	m. p. h.
Light vehicles	10
Cargo trucks (2½-ton loaded)	5
Loads near the maximum capacity of bridge	2

109. Interval between vehicles when crossing bridge.—Distance from front bumper to front bumper—30–37 ft. (2 floating spans).

NOTE.—This distance must not be 60–75 ft. as wave action introduces maximum balk stresses at that spacing.

110. Lengths of bridge.

1 unit of bridge provides 214 ft. of bridge (90 ft. fixed + 124 ft. floating).
2 units of bridge provide 460 ft. of bridge (150 ft. fixed + 310 ft. floating).
3 units of bridge provide 706 ft. of bridge (210 ft. fixed + 496 ft. floating).
4 units of bridge provide 952 ft. of bridge (270 ft. fixed + 682 ft. floating).

With ⅓ of equipment kept as a reserve:

4 units provide 629 ft. of bridge (195 ft. fixed + 434 ft. floating).

NOTES

Each bridge unit consists of 4 trestles and 12 pontons.

Each fixed span=15 ft.
Each floating span=15½ ft.

The above lengths apply to—

1. Normal bridge (10 tons).
2. Normal bridge with reinforced deck (13 tons).
3. Bridge reinforced with pneumatic floats (20 tons).

111. Time and labor requirements.—*a.* The table which follows shows the time and labor requirements for constructing the bridge. The figures given are to serve as guides only. They apply to work in daylight with personnel fairly well trained in their duties, familiar with the equipment, and in good physical condition. Estimates include time for unloading equipment but not for preparing approaches. For a ponton bridge whose construction will require more than 5 to 6 hours, plans should be made to provide reliefs for the working parties in order to avoid exhaustion.

b. General time and labor requirements.—(1) *Construction of bridge.*—(*a*) *Time required* (*hours*).

	150 ft.	*300 ft.*	*500 ft.*	*1,000 ft.*
Daylight	2	3	4	7
Night	4	5	7	12

(*b*) *Construction personnel required.*

1 Light ponton company.
1 General engineer company.

(2) *Construction of ferry.*—(Two rafts and two landing stages).
(*a*) *Time required.*—Daylight—1½ hrs., night—2⅓ hrs.

(*b*) *Construction personnel required.*

1 Bridge platoon of light ponton company.
2 General engineer platoons.

[A. G. 062.11 (4–10–43).] (C 1, May 26, 1943.)

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: 1943

TECHNICAL MANUAL

25-TON PONTON BRIDGE, MODEL 1940, AND 10-TON PONTON BRIDGE, MODEL 1938

CHANGES No. 2

WAR DEPARTMENT,
WASHINGTON 25, D. C., 1 July 1943.

TM 5–273, 1 July 1942, is changed as follows:

64. Raft ferries.

* * * * * * *

e. Landing stages.

* * * * * * *

(4) (Added.) *Special trestle type landing stage.*—(*a*) *Purpose.*—Whenever stream banks are such that metallic and pneumatic ponton rafts cannot be loaded directly from them, a landing stage can be constructed using 10- or 25-ton ponton trestle equipment.

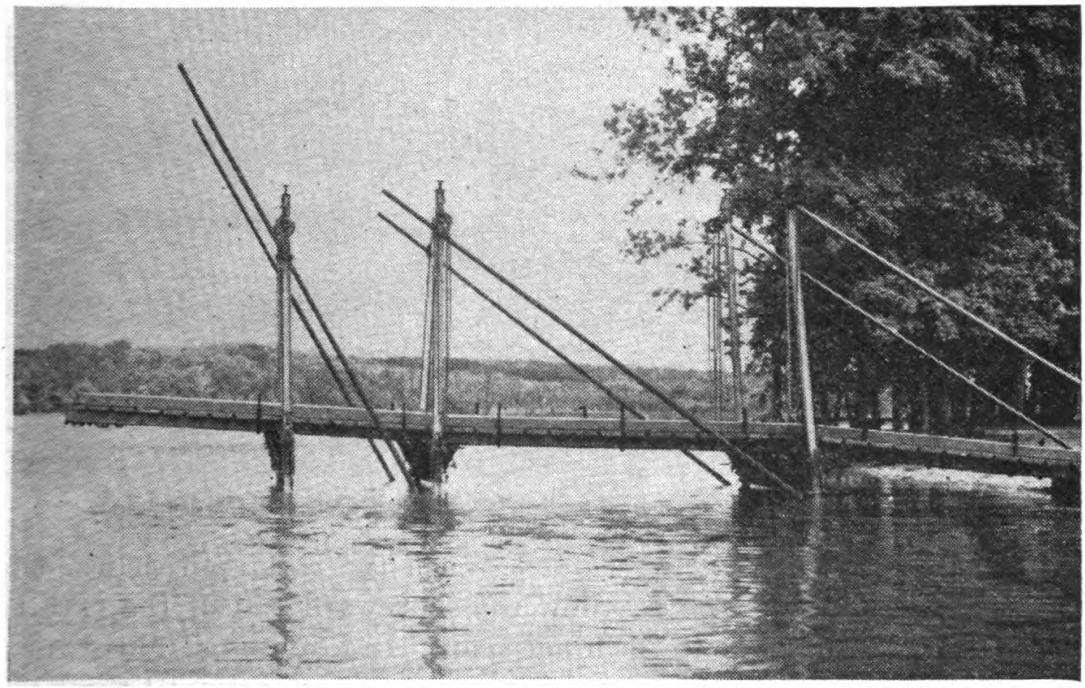

FIGURE 31.1.—Landing stage.

(*b*) *General design.*—The landing stage is always built with a hinge span and sometimes with one or more fixed spans (fig. 31.1). The hinge span is supported by a trestle placed so the balk protrude 6 to 7 feet beyond it. This trestle carries no live load; it is used only to raise and lower the hinge span. Each balk is secured to the transom by a detachable stirrup and a lashing. The shoreward ends of the balk are attached to the transom of the adjacent trestle in the normal manner. They should be approximately level with the top of the raft. The number and position of the balk in the landing stage match those of the rafts. Chess and siderails are placed on the hinge span in the

usual manner. Two siderail clamps are placed on each siderail on the shoreward side of the supporting trestle. Either guy lines or trestle bracing may be used to brace this trestle. Chain hoists are used to raise and lower the transom.

(*c*) *Construction of raft.*—Balk should not project beyond the sides of the raft. Decking must be stripped off far enough back to allow the trestle balk of the landing stage to engage the riverward gunwale of the shoreward ponton on metallic rafts, and the riverward float sill of the shoreward float on pneumatic rafts.

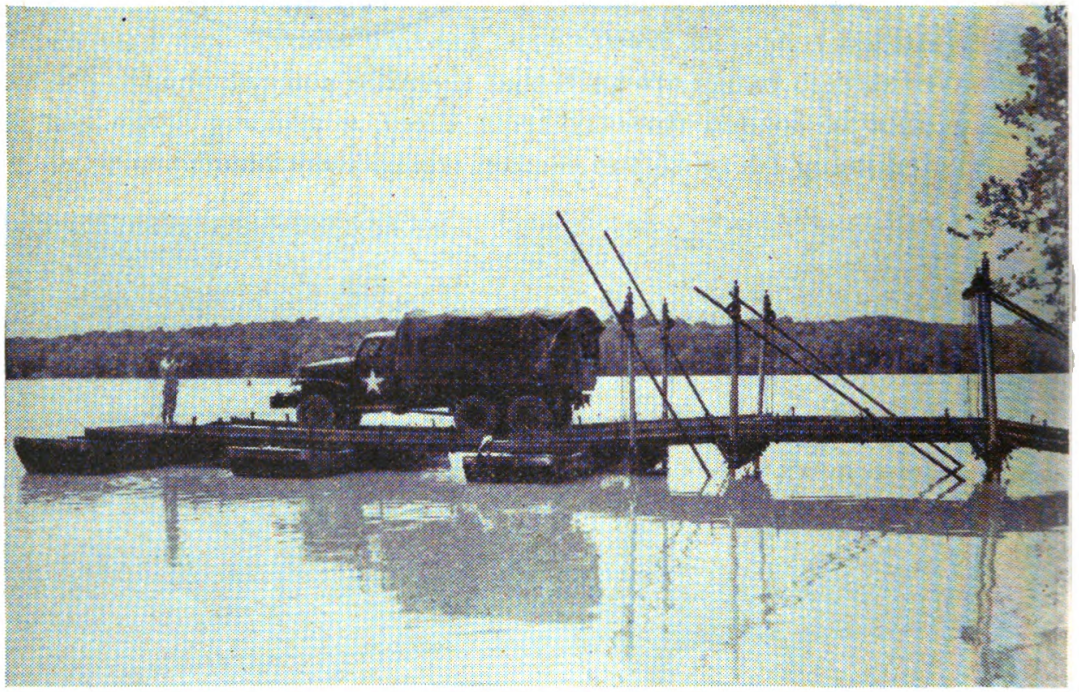

FIGURE 31.2.—Truck being loaded from landing stage to metallic ponton raft.

(*d*) *Operation of landing stage.*—When the raft approaches, the transom is raised enough to allow the shoreward end of the raft to come into position beneath the hinge span. In loading or unloading a metallic ponton raft (fig. 31.2), the transom is lowered until the balk rest on the gunwales of the shoreward ponton, with the riverward gunwale between the metal fittings of the balk. The pneumatic ponton raft is loaded in a similar manner. The hooks of the chain hoists are disengaged from the transoms, and the hinge span is free to move up and down as the load moves onto the raft. After the raft is loaded, the chain hoist hooks are engaged and the transom is raised enough for the balk to clear the raft and allow it to float free (fig. 31.3).

(*e*) *Loading and unloading rafts.*—The approaching raft is guided into loading position and held in place by guy lines to the shore from both ends of the shoreward and riverward pontons. Guy lines should

form an angle of approximately 45° with the raft. While vehicles are moving on and off the raft, the guy lines are anchored to suitable holdfasts. In a swift current, anchors may supplement the guy lines to hold the raft. When the raft is of reinforced rather than normal construction, the reduced clearance between the balk requires additional care in guiding the raft into position. This can be done easily by men assisting from alongside the raft.

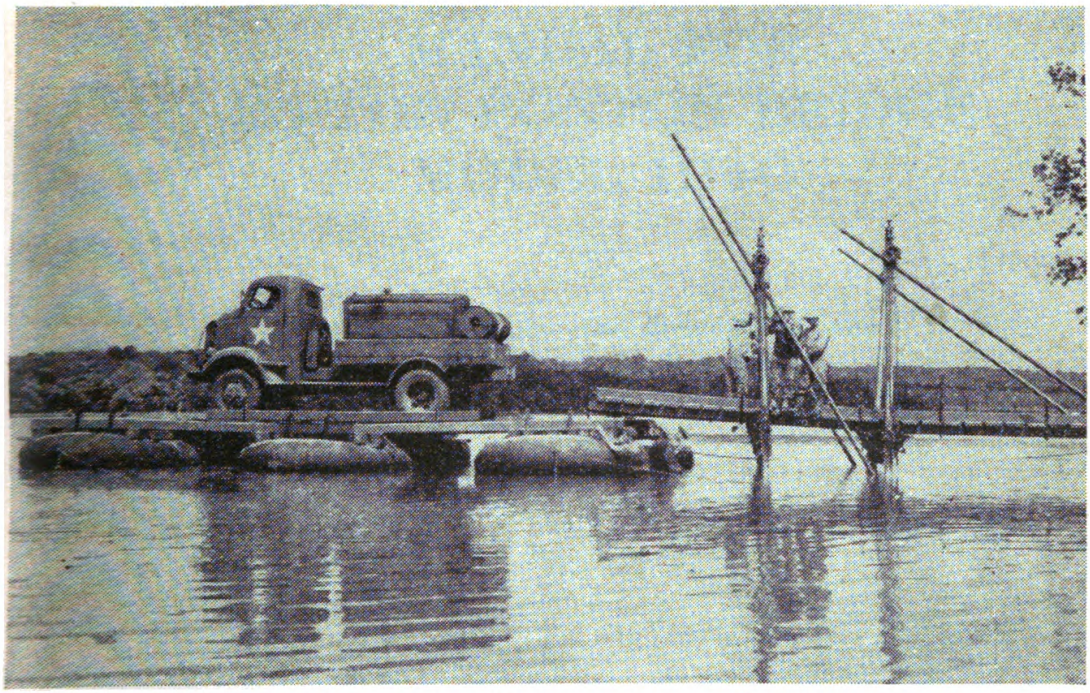

FIGURE 31.3.—Loaded raft being floated free of landing stage.

(*f*) *Time and labor requirements.*

1. The hinge span of the landing stage can be erected in about 20 minutes by experienced personnel with equipment stacked at the site. One noncommissioned officer and fourteen men are required as a working party.

2. Rafts can be placed and loaded at the landing stage in about 5 minutes.

[A. G. 300.7 (2 Jun 43).] (C 2, 1 Jul 43.)

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: 1943

TM 5-273

TECHNICAL MANUAL

MANUAL FOR 25 TON PONTON BRIDGE MODEL 1940

Prepared under the direction of the Chief of Engineers

WAR DEPARTMENT

Washington, July 1, 1942.

MANUAL FOR 25 TON PONTON BRIDGE MODEL 1940

Table of Contents

Section I

PURPOSE, COMPOSITION AND ASSIGNMENT OF EQUIPAGE

1. PURPOSE.— The normal use of this equipage is to provide a rapid means of stream crossing for military vehicles and particularly those incapable of passing over a light ponton bridge. Although the normal capacity of the bridge is 25 tons it may be reinforced to accommodate tank loads up to 35-40 tons.

2. GENERAL FEATURES OF DESIGN.— The 25-ton ponton bridge is identical in general design with the 10-ton ponton bridge. The 25-ton bridge, however, has provisions for placing a transverse balk at mid-span which increases the load capacity of the decking particularly in trestle bays. As described in Section X, the bridge may be reinforced to handle loads heavier than the rated 25 tons. It may occasionally be advantageous to employ the lightened construction (see paragraph 48) A detailed description of parts of the equipage will be found in Section XXI.

3. BRIDGE UNIT.— The principal components of one unit of bridge are 4 trestles, 12 pontons, and the necessary balk and chess for the floor system, which equipage is transported on 16 semi-trailers. One unit of equipage provides about 210 feet of 25-ton bridge providing all 4 trestles can be employed. Each additional unit provides an added 180 feet of floating span. By inserting pontons in the floating spans, one unit of equipage is sufficient for about 157 feet of reinforced bridge, again providing 4 trestles can be employed. Each additional unit provides an added 90 feet of floating span (reinforced). Each bridge unit contains 16 — 4 x 4 tractor trucks, for use with the semi-trailers, in addition to cargo trucks for personnel and miscellaneous equipment. It also includes a power boat and outboard motors for maneuvering pontons in the water. The power boat is carried on a two wheeled trailer towed behind a 2½-ton cargo truck.

4. ISSUE.— Two units of equipage are assigned to each heavy ponton lettered company thus providing four units for each heavy ponton battalion. Two heavy ponton bat-

talions are assigned to each Field Army, with additional battalions held under GHQ control for assignment as the situation demands.

Section II
TRAILER LOADINGS

5. GENERAL.— *a.* The equipage for one unit of bridge is transported on 16 semi-trailers. Each unit consists of 12 ponton loads, 2 trestle loads, and 2 abutment loads.

b. For moving trailers over considerable distances the semi-trailers are connected to and drawn by 4 x 4 tractor trucks especially designed for the purpose. For maneuvering semi-trailers at the bridge site, if additional mobility beyond that of the tractor truck, semi-trailer, hookup is desired, the forward end of the semi-trailers may be supported on two-wheel dollies, thus converting the vehicle into a four-wheel trailer. As such it can be conveniently handled by the tractor, by connecting the dolly draw bar to the tractor pintle. When no backing is involved the trailer loads, when supported on dollies, can be connected to and towed behind any prime mover provided with a rear pintle.

6. TRAILER LOADS.— There are three types of trailer loads:

a. The ponton load (See Figure 1) consists of one ponton, 16 chess, 12 ponton balk, and one transverse balk loaded on the trailer deck. Two anchors with anchor lines, 4 siderail clamps, 2 transverse balk hangers, one picket, 8 oarlocks, one bail pump, and one fifty ft. ½″ hand line, are carried in the anchor compartment and the recessed box on the trailer. Seven oars are carried in the under carriage of the trailer, and two boat hooks are carried in the stirrups of the two outside ponton balk or are secured below the stirrups if they will not fit in them.

b. One outboard motor is carried in the short cargo body of each of the first four ponton tractor trucks. One outboard motor bracket is carried on the trailer deck in rear of the balk on each of the first four ponton trailers. The transverse balk and hangers are omitted from the last two ponton loads and carried instead on the two trestle loads.

c. The abutment load (see Figure 2) consists of 23 chess, 8 half chess, 24 trestle balk, 1 transverse balk, 2 abut-

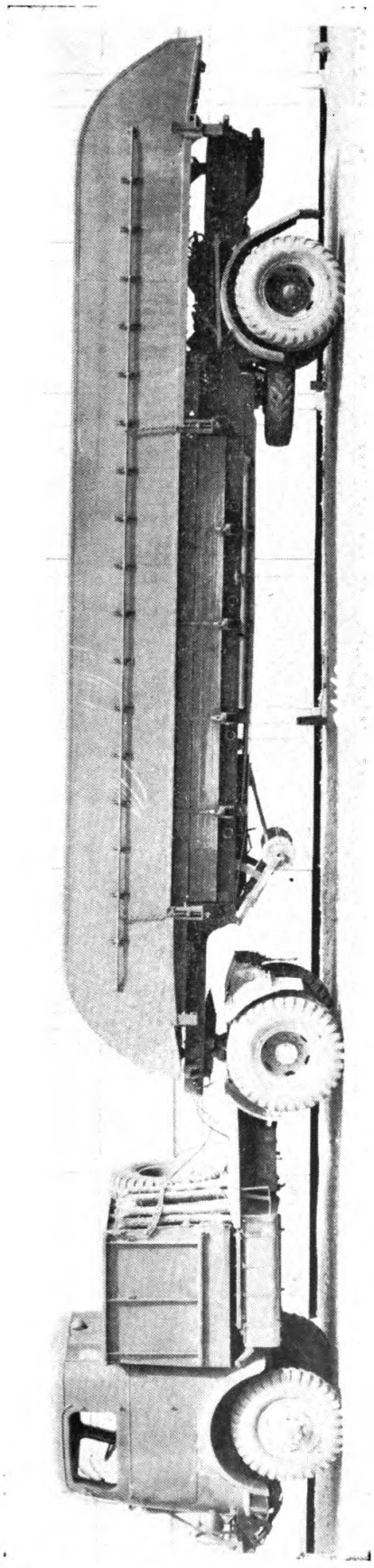

Figure 1. Tractor truck and ponton trailer.

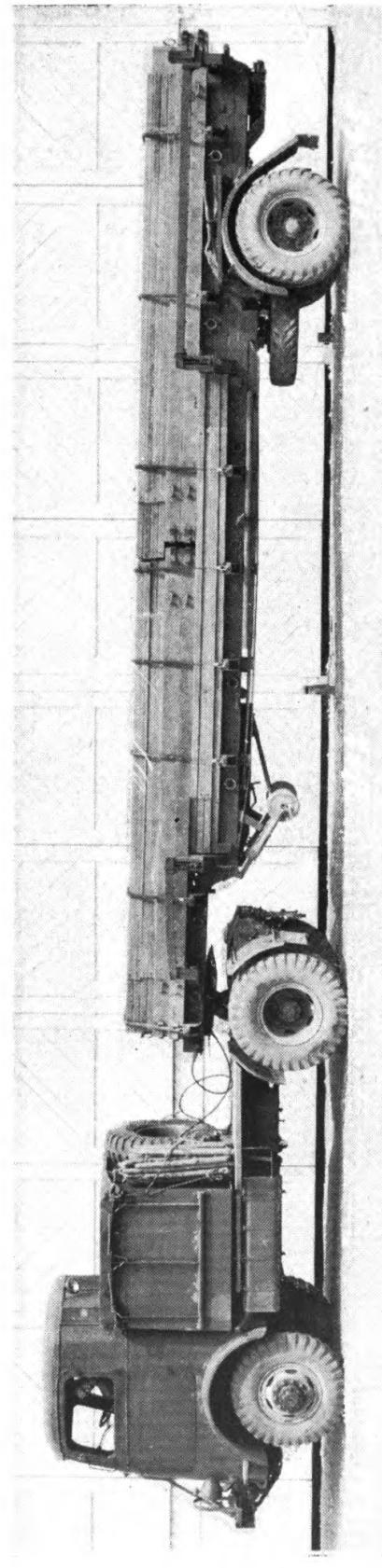

Figure 2. Tractor truck and abutment load trailer.

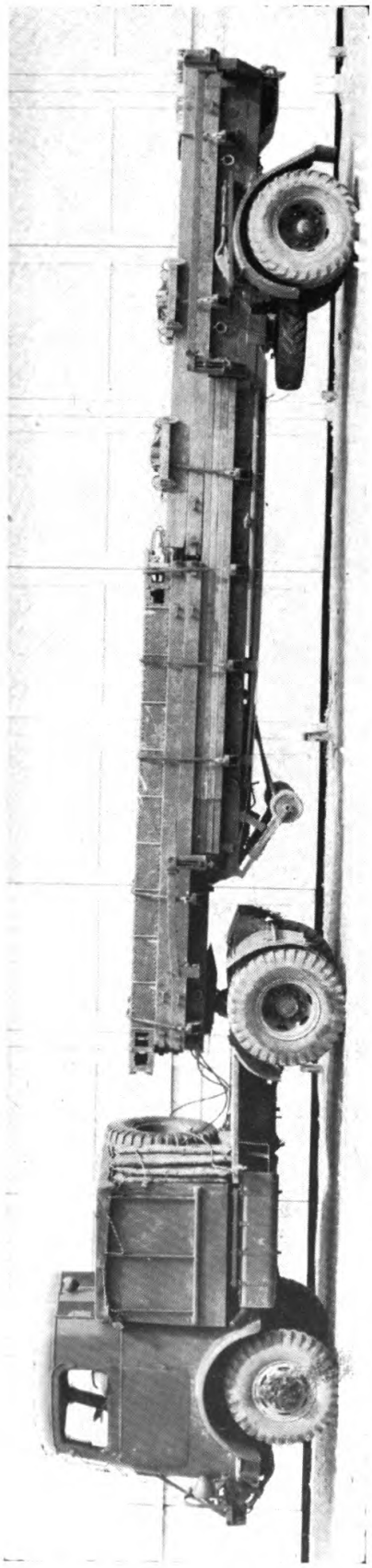

Figure 3. Tractor truck and trestle load trailer.

ment sills and one assault boat loaded on the deck of the trailer. Two anchors (spare) with anchor lines and 1 bail pump are carried in the anchor compartment. Twelve siderail clamps, 13 hinge sill hangers, 2 transverse balk hangers, 16 steel pickets, 24 detachable stirrups, four 1″ x 100′ guy ropes and 7 assault boat paddles are carried in the short cargo body of the truck tractor. Two boat hooks are carried lashed on either side of the oar carrying racks.

d. The trestle load consists of 32 chess, 24 trestle balk, 2 transverse balk, 2 transoms, 4 columns and 4 column shoes carried on the trailer deck. Two anchors (spare) with anchor lines, and 1 bail pump are carried in the anchor compartment. Two chain hoist chests with chain hoists, 12 siderail clamps, 4 transverse balk hangers, 24 detachable stirrups, 16 steel pickets, 40 rope lashings ½″ x 20′ and 4 guy ropes 1″ x 100′ are carried in the short cargo body of the tractor trucks. Two boat hooks are carried as on the abutment load.

7. SUMMARY OF LOADINGS.—

a. Ponton Trailer.—1 complete ponton bay with accessories.

b. Abutment Trailer.—1 complete abutment bay with all accessories including 1 hinge sill with hangers, plus one extra bay of balk and chess and 8 half chess.

c. Trestle Trailer. — 2 complete trestle bays with all accessories.

8. ANGLEDOZER AND POWERBOAT TRAILERS. — In addition to the trailer loads of ponton equipage proper, angle dozers (see Figure 4), tractors, and power boats (see Figure 5) are transported on trailers.

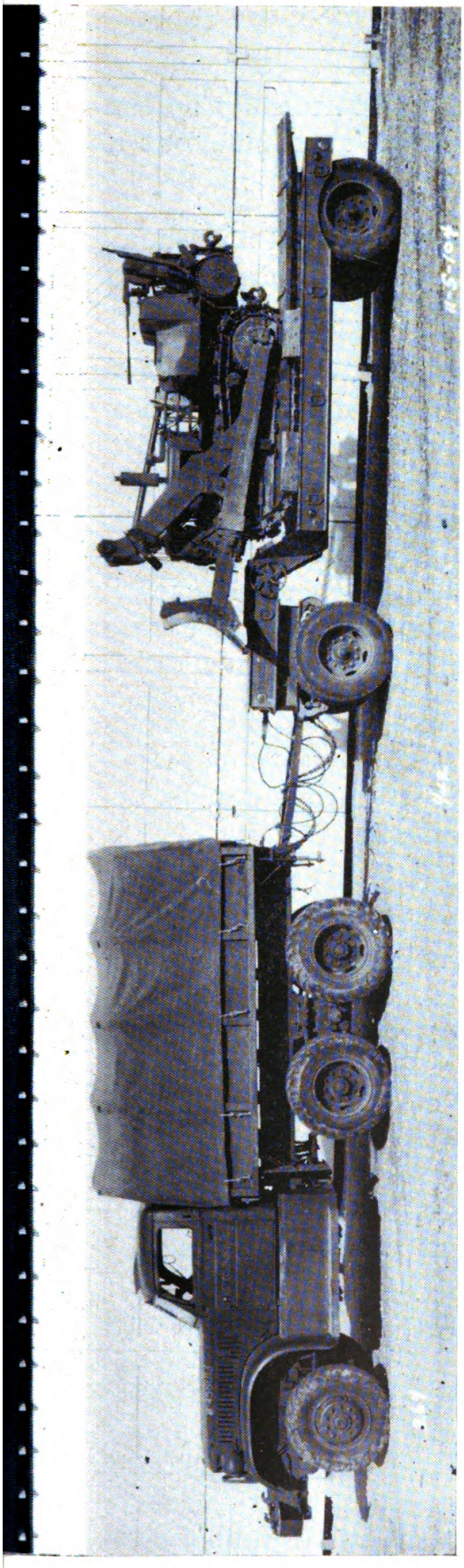

Figure 4. Trailer with angledozer.

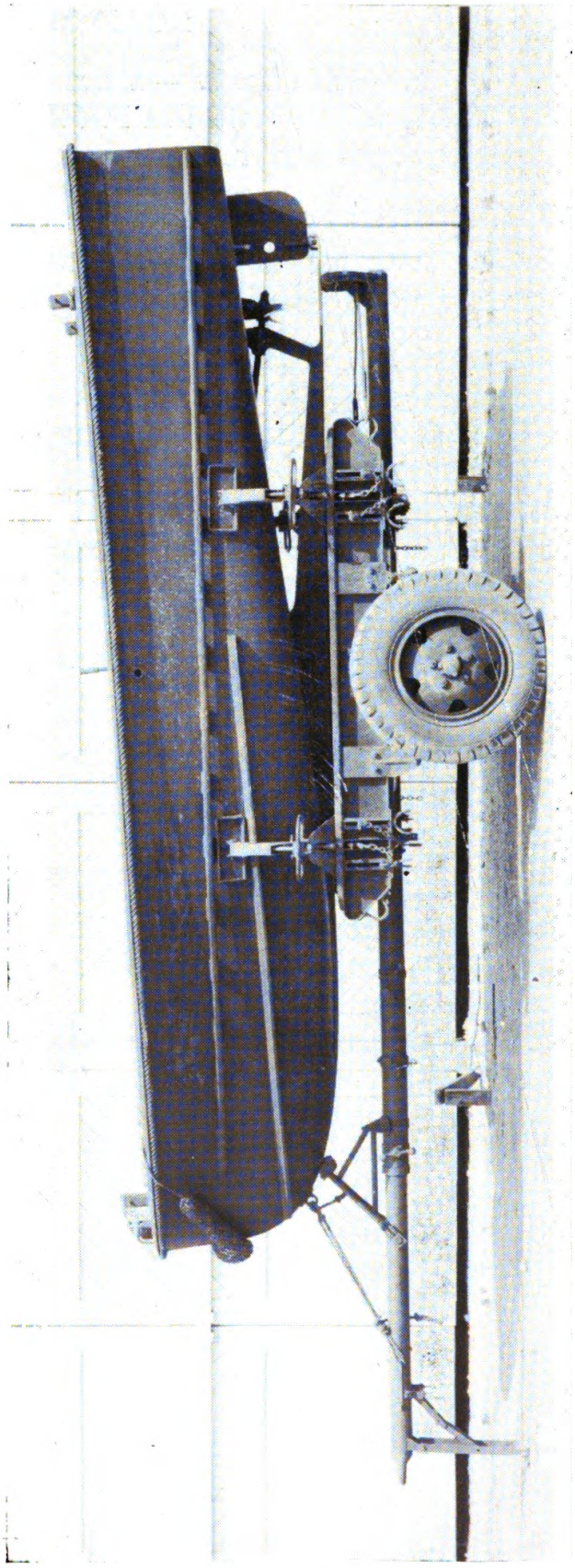

Figure 5. Trailer with Powerboat.

Section III

ROAD MOVEMENT

9. GENERAL.— Road movement will normally be conducted as prescribed in FM 25-10 with such modifications as special vehicles may require.

Markers and traffic guides are very essential and should be used extensively. Sustained high speeds during long movements should neither be permitted nor required.

10. ORGANIZATION OF COLUMN.— *a. For long* marches, the vehicles of the organization should be separated into separate march units, each such unit being composed of similar type vehicles. For instance, it is generally advantageous to group tractor trucks and semi-trailers together into a march unit of 16 vehicles; to group the cargo trucks with tractor, angledozer and powerboat trailers together in another march unit; and to group personnel carrrying cargo trucks in still another march unit.

b. For movement to the bridge site, the vehicles should be arranged in column in the order of employment on arrival at the site. As a general rule, angledozers, truck cranes, and personnel carriers should head the column.

11. ROAD PROCEDURE.— Hills of any kind will slow down this type of convoy much more than a lighter one and allowance should be made for this in march time tables and speeds of leading vehicles. In travelling through hilly country if the heavy vehicles are allowed to increase speed above the normal convoy speed when going down hill the additional momentum will carry them well up the next hill and materially increase the rate of march without excessively increasing the speed of the individual vehicles. In this respect a maximum allowable road speed should be prescribed. Sharp turns should be avoided where possible but when unavoidable, a guide should be stationed to make sure that the trailers swing wide enough so that the trailers have sufficient clearance. This sometimes involves swinging out into the opposite lane, a dangerous move unless properly guarded. Before attempting to move a column of vehicles of this type through a community of any great size, contact should be made with state agencies and local police. Underpasses should be checked for clearances as the height of the cabs, ponton or crane may be critical.

12. NIGHT MOVEMENT.— Movements of ponton convoys will often be made under cover of darkness with only blackout lights available. Here again the column must be slowed down so that drivers may have time enough to see the road ahead and make allowance for the cutting in of the trailers on all turns.

Section IV

SELECTION OF BRIDGE SITE

13. GENERAL.— The selection of a bridge site is governed by both tactical and technical requirements. Selection should be preceded by a thorough study of the tactical plan. If practicable, the entire stretch of the river involved should be photographed from the air and studied under the stereoscope. A ground reconnaissance is essential. Observation from the air is desirable. The engineer must be prepared to make recommendations on the best site and possible alternatives. Tactical requirements will normally fix the general area in which the bridge will be built. Technical requirements will usually fix the exact location and may, in some cases, be of such importance as to eliminate the sites considered best from the tactical point of view. Final decision rests with the tactical commander of the unit the bridge will serve.

14. TACTICAL REQUIREMENTS.— See FM 5-5.

15. TECHNICAL REQUIREMENTS.—The following factors influence the selection of a bridge site from a technical point of view:

a. Approaches.— Short, easily constructed approach roads from the site to the existing road net on both sides are of primary importance. Within 150 feet of the bridge, approaches should be straight and without excessive grades, particularly on the far shore. The prior construction of the near approach is often essential in order to get the ponton equipment to the river. The time required to construct approaches is often the controlling factor in the selection of the site. In extreme cases, such as when the approach roads are long and narrow causeways over swamps, the most feasible scheme may be to unload at water perhaps miles away and boat the equipment to the site.

b. Current.— The current should be steady, parallel to the bank and moderate. A location in a straight reach or gentle bend is favorable.

c. Bed.— The bed of the river should be free from snags, rocks, shoals, and other obstructions which would interfere with the movement of the pontons. It should be sufficiently firm to hold the anchors and support the trestles. Before construction a careful under-water examination should be made, particularly in the area to be occupied by trestles, so that obstructions such as stumps and snags may be located and removed if necessary.

d. Banks.— Banks should be firm enough to support the sill and approach. They should not be so high or steep as to require excessive grading for the approach. They should not be so low that normal rises will overflow the site or unnecessarily increase the required length of bridge.

e. Launching pontons.— A 15-foot stretch of bank having a gentle slope to the water either at the site or convenient to it is needed for launching pontons. In a swift current, a point well upstream is desirable.

f. Mooring pontons.— A place for mooring pontons along the bank is necessary about 250 feet from the site. Mooring points may be upstream or downstream of the site, or both, depending upon the plan for casting anchors or for using the anchor cable. Easy access from the land side, deep water, free from snags or other obstructions, and suitable anchorages along the bank are desirable.

g. Stacking balk and chess.— A cleared area on the near shore at the site is needed for unloading and stacking balk, chess, and other equipment.

h. Transportation park.— Provision must be made for moving trucks and empty semi-trailers completely away from the site or parking them nearby under cover.

i Holdfasts.— The presence of large trees or other holdfasts near the bank is desirable for fastening the maneuver cable.

j. Rise and fall of water surface.— Selection of the site must consider the effect of normal changes in the water surface on the construction and operation of the bridge. Tides, floods, drought, and the manipulation of dams may change the level many feet.

k. Existing ponton ferries.— If ponton equipment in existing ponton ferries is to be used in the construction and maintenance of the bridge, a site downstream from the ferry favors the movement of this equipment.

l. Demolished bridge sites.— The ponton bridge should be located far enough away from a demolished bridge site so that there will be no interference with the reconstruction of the fixed bridge.

m. Tributary stream.— A site just below the mouth of a tributary stream favors launching boats and constructing parts or rafts in the tributary under cover and floating them down into position when needed.

16. RECONNAISSANCE.— Reconnaissance must be made well in advance of construction, having in mind both tactical and technical requirements. If practicable, the tactical commander and the engineer, or their assistants, and an officer of the ponton battalion, should make a joint reconnaissance to insure that all factors are considered on the ground. The engineer, or his assistant, and the officer from the ponton battalion, must make a careful technical reconnaissance in any case. The following technical data should be obtained as far as the need for secrecy will permit.

a. Width of stream.— This must be obtained with sufficient accuracy to determine the amount of equipment to be used. If the needs of secrecy do not preclude sending a small party by boat to the far bank, the width of a narrow stream can best be measured by stretching a line across and the width of a wide stream can be easily obtained by transit and stadia (if available). Otherwise, the width can be measured by one of the following methods:

(1) 45° or 30°-60° right triangle method. This method utilizes the known properties of the 45° or 30°-60° right triangle with the width of the river representing one leg of the triangle.

(2) *Planetable method.*— With any piece of cardboard such as the back of an ordinary writing pad, the width of a stream can easily be obtained with satisfactory accuracy by ordinary planetable methods.

Figure 6. Planetable method of measuring width of stream.

The point B is any easily recognizable object on the far shore, such as a tree. A stake is driven at A on the near bank directly opposite B and a second stake at point C from which both A and B can be seen. The distance AC is measured by taping or by pacing. The cardboard planetable is set up over stake A on any sort of improvised rest. A sight is taken along the edge of a ruler from A′ to B and a line is drawn from A′ as shown representing the direction AB. Without disturbing the orientation of the cardboard, a sight is then taken on the stake C and A′C′ is laid off to scale and in the proper direction AC. The cardboard planetable is then moved to stake C and set up with point C′ directly above the stake. The cardboard is oriented by sighting in line C′A′ on stake A. A sight is then taken from C′ to the object B on the far bank and a line is drawn from C′ in the direction CB as shown. Its intersection at B′ with the line representing the direction AB locates the object B. The length of A′B′ converted by the scale utilized in laying off A′C′ directly gives the distance AB.

For maximum accuracy the distance AC should be as large as practicable.

(3) *Natural tangent method.*— This method necessitates an angle measuring means such as a prismatic compass or a pocket sextant and makes use of the fact that for angles not greater than 25°, the natural tangent is approximately 18/1000 times the number of degrees in the angle.

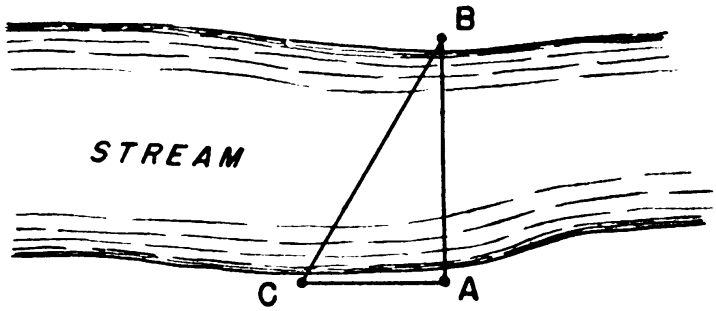

Figure 7. Natural tangent method.

Assume in Figure 7, that AB is the width from stake A to point B on the far bank. Lay out the base line AC at right angles to AB, picking the point C on the line so that angle ACB is somewhere between 75° and 65°. This will make angle ABC somewhere between 15° and 25°. Measure the distance AC.

$$AB = \frac{AC}{\text{Tan angle ABC}} = \frac{1000\ AC}{18\ (90\text{-}C)}, \text{ where } C = \text{number of degrees in Angle ACB.}$$

b. Velocity.— A satisfactory approximation can be made by timing the speed of a floating object over a short course. Eddies should be noted.

c. Depth.— Depth is of importance near the bank or near shoals to determine boat movements and the number of trestles needed. Sounding poles or lines are useful. The character of the bed and the necessity of snagging or dragging should be noted.

d. Banks.— The character and shape of the bank should be determined with sufficient accuracy to establish where the sills must be placed to avoid being submerged by high water, because this affects the amount of equipment needed.

e. Rise and fall below present water level.— These data can be obtained by noting drift and marks on trees or structures, by questioning local inhabitants and consulting tide tables and flood records.

f. Determination of amount of equipage.— Sufficient equipage should be made available to not only construct the bridge but also to provide a reserve of at least one third. The accuracy of determination depends greatly upon whether or not the needs of secrecy allow the obtaining of an accurate cross section of the stream. If such a cross section is available, the basic amount of equipage is easily determined. Scale the distance in feet from the 30-inch depth line at the near shore to the 30-inch depth line at the far shore, both based on the lowest river stage expected during the period of current operations.

The first unit of equipage provides approximately 141 feet of floating span (two hinge span rafts each approximately 18 feet long from shore gunwale of shore ponton to centerline of riverward ponton plus seven floating spans of 15 feet each).

Each additional unit of equipage provides 180 feet of floating span. (12 spans of 15 feet each).

From the foregoing, determine the number of units required to furnish the floating span between the lines of 30-inch depth. Add one-third for reserve to obtain the total number of units required. Next make a check as to whether sufficient trestles are available in this number of units to provide fixed spans at each bank from the hinge sill to above the high water mark. It has been found by experience that the

fixed spans are almost invariably well in excess of the number required, including reserve. However this should always be checked.

If a cross section is not available, it must be assumed, for safety in estimation, that the entire width of the river must be spanned with floating spans.

g. Approaches.— The length should be paced off and an estimate prepared of the men, materials, and transportation needed for construction.

h. Tributary streams.— The location, approach, and stream characteristics should be noted, if tributary streams are to be used for launching equipment.

i. Location of main current.—The thread of the current generally occupies a deep channel meandering from bank to bank and occupying relatively a small portion of the width of the stream bed. In planning the location and construction of any bridge, it is of prime importance to locate and delimit this line since the force of its greater current has a preponderent effect upon the maneuvering of pontons during construction as well as upon the stability of the completed structures.

j. Maneuver cable.— In streams with a current in excess of one m.p.h. it will usually be desirable to place a maneuver cable of ½″ or ⅝″ wire cable across the stream about 5-10 feet below the line of upstream anchors. This cable can be made fast to trees, stumps or an emplaced "deadman" or holdfast. The selection of the best location of the cable should be included in the initial reconnaissance.

k. Character of bottom.— The character of the footing under the trestle shoes should be carefully determined in this reconnaissance so that preparations may be made to introduce a spread footing under the shoe if necessary. The nature of the stream bed especially in the swiftest current should be determined to estimate the holding power and number of anchors needed.

l. Data from reconnaissance.— A form for use in recording the data from the reconnaissance is shown in Appendix I.

Section V

CONSTRUCTION METHODS AND GENERAL CONSIDERATION THEREOF

17. GENERAL.— *a.* The two recommended methods of construction of the 25-ton ponton bridge are: (1) by successive pontons, and (2) by parts.

b. Construction by successive pontons is particularly advantageous for bridging narrow streams.

c. The method of construction by parts is advisable in bridging wide streams, and will be particularly applicable if a tributary stream, which provides concealment and defilade, is available in friendly territory. In such a situation it might be possible to construct all of the floating parts of the bridge during the earlier phases of the river crossing operation and float them into place very quickly after the construction of the ponton bridge is authorized. Except under the most favorable conditions some form of power boat must be available for maneuvering the parts into their final position.

18. TRESTLES.— If more than one trestle is needed, succeeding trestles may be added by means of the truck crane. By backing the crane onto the fixed spans additional trestles may be placed with the crane until desired depth is reached in which to float the hinge span. If the crane is not available the trestles may be placed as outlined in Par. 35.

19. ANCHORS.— *a.* The normal method of securing the bridge against current and wind action is by anchors with 1-inch rope anchor lines. The spacing of the anchors on the line of upstream anchors will vary according to the velocity of the current. The downstream line of anchors is necessary to provide cables for the manipulation of pontons, maintain the alignment of the bridge during construction, and prevent pontons from weaving in the current. The downstream anchors are usually cast from every third ponton. These anchors also provide security against the action of high winds.

b. In tidal estuaries where the current may flow in both directions, the anchors should be spaced on each side of the bridge as required by the maximum currents which are to be expected.

c. The distance of the lines of anchor from the center line of the bridge will vary depending upon the maximum depth of water to be encountered on the lines. The distance

of the line of upstream or downstream anchors from the center line of the bridge should never be less than ten times this maximum depth. This distance should be increased if the nature of the river bottom is such as to allow considerable dragging of the anchors before they finally take hold.

d. The line of upstream anchors and the line of downstream anchors should be located by reconnaissance prior to the construction of the bridge. For the convenience of the anchor sections the location of the lines of anchors should be marked by ranges of signal cloth on one side of the river or by stretching a light line well above the water so as not to interfere with traffic.

e. Unless the anchor cables generally follow the directions of the current, there is a tendency to move the floating part of the bridge longitudinally. Anchors therefore should be dropped directly upstream from the final positions of the pontons to which they are to be affixed. Small deviations of an anchor cable from the direction of the current will do no harm. Every effort should be made to avoid crossing of anchor lines in order to avoid difficulty in raising the anchors. It is not necessary that the anchors be exactly spaced on the line of anchors.

f. Where good holding ground is not available in streams of appreciable current, special measures must be taken to secure the bridge. This may be done by casting additional anchors for each ponton or group of pontons, or by attaching more than one anchor, each with a separate lead, to each anchor cable. If the width of the stream will permit, long cables may be made fast at several points along the bridge and their other ends attached to trees or suitable holdfasts on both banks upstream of the abutments.

g. Panniers of stone, picks lashed together, cribs filled with stone and similar expedients may be used as a substitute for anchors. A rail bent in the form of a V makes a powerful anchor. It may sometimes be advisable to use piling for an anchorage. In this case either single piles or clusters of piles are driven and the cable is attached as near the bottom as practicable. Anchorages out of the water are preferable as they are more readily inspected and made secure. An island or a bridge pier makes an excellent anchorage.

20. UPSTREAM AND DOWNSTREAM BALK.— *a.* Balk (stringers) are laid parallel to the center line of the

bridge. Since all balk except those in the two abutment spans lap over the balk of adjacent spans at both ends, it is necessary that they be laid either upstream or downstream of some reference point on the trestles or the pontons. On the trestles the points of attachment are arranged in pairs which automatically fix the position of the trestle balk if laid parallel to the bridge center line. On each gunwale of the ponton are ten balk fastener retainers for the ten pairs of balk fasteners. An imaginary line drawn parallel to the axis of the bridge through the center of these retainers results in a reference line for the up and downstream balk positions. In the first floating span and all odd numbered floating spans, the balk should always be laid so that the downstream edge is directly above the reference line. In the second floating span and all even numbered floating spans, the balk are laid so that the upstream edge is against the downstream edge of the balk of the odd numbered spans and directly above the reference lines. The balk in the odd numbered spans are referred to as "upstream" balk since they lie entirely upstream of the reference lines, and the balk in the even numbered spans are referred to as "downstream" balk for a similar reason. (See Figure 40.) It follows that the trestle balk of the hinge span will be downstream balk and that the next fixed span shoreward will be upstream balk, whether it is laid between two trestles or between a trestle and the abutment sill. Where one or more trestles are used in th shore connection, the construction parties building the shore connection must exercise care in placing the balk of the abutment span in order to insure the placement of downstream balk in the hinge span.

b. An exception to the rules for upstream and downstream balk must be made in closing the gap (See par. 41 e), if the floating bay on one side of the gap has upstream balk and the floating bay on the other side of the gap has downstream balk. Generally, it will be possible by manipulation of anchor ropes to so adjust the line of the bridge that the closing balk can be placed without difficulty as an upstream balk on one side of the gap and as a downstream balk on the other side of the gap. For a very short gap, it may be necessary that the deviation from normal placement of balk be accomplished in either one of the full floating spans adjacent to the gap. The operation consists simply of shifting the balk on the gunwales of the river ponton of the floating span from upstream to downstream (or vice versa).

21. THE MANEUVER CABLE.— The normal construction of the 25-ton ponton bridge can often be aided by the use of a ½" or ⅝" steel cable. This cable spans the river 5 to 10 feet below the line of anchors and upstream of the center line of the bridge. The far shore end is carried across by means of the power boat. The spool end is unrolled from a stand constructed of short balk. The purpose of the maneuver cable is twofold. By means of this cable pontons may be put into their final positions without the use of oarsmen.

Three crews of five men each can supply enough boats, in the successive ponton method, to keep the rest of the construction crew working hard. During night construction luminous ribbons may be tied on the cable marking the places above which to cast anchors. The maneuver cable may be used in construction by parts to maneuver the parts into their proper place on the line of anchors, or to move the far shore raft to the far shore by employing the trail ferry principle.

Section VI

UNLOADING OF EQUIPMENT

22. METHODS.— Two situations will govern the unloading of the ponton equipage.

a. Where the equipage is to be unloaded and placed in such a position that it is convenient for drill purposes.

b. Where the bridge is to be constructed under simulated or actual war conditions with a minimum of material handling.

23. DRILL PROCEDURE.— *a.* Under the conditions of the first situation it is assumed that the bridge site has been selected far in advance and prepared to such an extent that the equipage can be unloaded from the trailers and placed conveniently near by. Under these circumstances the truck crane is usually available for unloading ponton and trestle loads. However, if the crane is not available, at least fourteen men are needed to unload a single trailer expeditiously.

b. Where the crane is available the ponton trailer is brought near the position where the ponton is to be placed in the water. One of the crane crew then places four slings, two on each side of the ponton opposite the 6th carrying rail bracket from each end. The crane hook is dropped in place

above the ponton and engaged in the four sling loops. While this is being done the binders holding the ponton on the trailer are unclamped and removed, and guy lines are fastened to the carrying rail at opposite ends and on opposite sides of the ponton to facilitate guiding the ponton to the ground. The crane then picks the ponton up off the trailer and places it on the ground. The ponton can be turned over either by crane or by hand. A convenient and speedy method of turning over the ponton by crane has been worked out as follows. As the ponton is lowered and just before it touches the ground it is pulled inward toward the base of the boom of the crane by the crew on the guy lines. As soon as the ponton is rested on the ground, the two slings to the far side carrying rail, i.e., the rail farthest away from the crane, are released. The crane then lifts the two slings attached to the near side carrying rail and, in the process, rolls the ponton almost completely over so that it is balanced on edge by the pull of the crane hook on the slings. The crane then gradually lowers the hook and allows the ponton to come to rest with bottom down. All guy ropes and slings are removed and replaced on the crane. An efficient layout and system for unloading pontons and moving them into the water is shown in Figure 8. The loaded ponton semitrailers are brought up successively to position for unloading, as shown. The ponton is lifted off the semitrailer, is placed on the ground, and is

Figure 8. Unloading pontons.

then turned over, so as to be right side up and perpendicular to the shore line as shown. Meanwhile the first semitrailer is moved away and a second loaded semitrailer is moved into position for unloading. Immediately thereafter an angledozer or tractor, equipped with snubbing logs to protect the pontons, pushes the unloaded ponton into the water. This system of unloading operates swiftly, smoothly and efficiently.

The balk and chess are unloaded and placed in piles convenient to the bridge site. The balk should be stacked close to but clear of the axis of the bridge to minimize the carry.

c. Where the crane is not available 30 men can easily unload the ponton. There are two rollers with each trailer, one in the rear and one attached along side of the trailer bed. The roller in the rear is placed in the brackets provided for this purpose at the rear of the bed of the trailer, while 14 men raise the rear of the ponton up clear of the trailer. The ponton is then lowered until it is in contact with the rear roller. The three rearmost loadbinders over the balk are then removed. The other roller is then placed between the ponton and the balk about midway of the load. The unloading detail then rolls the ponton off over the rear of the trailer or allows the prime mover to pull the trailer out as the ponton is being rolled off. In either case the ponton is lowered easily to the ground and turned right side up, after which it is launched and moored to the bank.

d. It is also practicable to unload pontons from the side. For this purpose, one end of the boat is raised and a ponton balk inserted under it, so that it just extends beyond the opposite gunwale. The operation is repeated under the other end. The outer ends of the two balk are then depressed and the boat slid off. It can be turned over particularly readily just at it reaches the ground. A crew of 14 men is large enough to lift one end of the ponton at a time and unload it by this method.

e. The trestle and abutment loads are unloaded by hand and the equipment is placed in convenient positions. The crane can with slings facilitate unloading the trestle load by picking up the transoms and placing them on the ground where they can be ready for use. If the crane is not available 16 men can easily handle the transoms by unloading over the sides of the trailer.

24. SERVICE METHOD.— *a.* Under service conditions, there may be occasions where time will not permit elaborate preparation of the bridge site. In this case the cleared space may limit the unloading to one or two trailers at a time. In this case the trailers stand by and are unloaded when the equipage is called for. The equipage is unloaded as in paragraph 23 above. As soon as the abutment trestle and hinge span are completed and successive pontons have been unloaded from the ponton loads, the trailers are backed to within 20 feet of the last boat of the hinge span and the balk removed from the trailer. The trailer is then backed to a position just clear of the bridge, at which point it is stopped and the chess are removed and stacked.

b. In case the site is of such a nature that pontons cannot be unloaded any place other than along the axis of the bridge, it is desirable to load the pontons right side up on the trailer before the convoy leaves its bivouac. To facilitate this the top layer of balk is removed from the trailer and the balk spacer withdrawn from its position above the transverse balk. The six balk removed from the trailer are loaded in the ponton so as to rest on the bulkheads and are lashed in place. While the balk on the trailer are being lashed down with the load binders, the crane picks up the ponton (with balk) and places it upon the trailer right side up. The ponton is then secured with the clamps engaging the carrying rail in the usual manner. In order to unload the ponton at the end of the bridge it is necessary to lay chess to the river gunwale of the last ponton in the bridge. For safety reasons siderails are then placed and clamped to hold this extra chess in place. The trailer is backed on the bridge by means of the track-laying tractor and dolly until the rear of the trailer is within 10 feet of the last chess. The six balk are removed and placed along the side of the bridge. After the ponton hold-down clamps have been removed, a detail of 14 men lifts up the ponton and places the roller between the ponton and its supporting layer of balk. The rear roller is then placed in its brackets and the ponton rolled off into the water. Guy ropes should be tied to the forward end of the ponton to guide it during the launching.

c. When the ponton has been loaded on its trailer right side up as described above it is feasible to catapult the ponton over the rear of the trailer directly into the stream from the ponton launching site. In this case the rear roller is seated

as before, but the intermediate roller is not required. The six balk lashed inside the ponton should be removed before the ponton is launched. Before releasing the ponton holding clamps, a half-inch line is made fast to the forward end of the carrying rail and passed through one of the rings on the front of the trailer frame and there secured by a quick-release knot. This procedure is necessary to prevent the ponton from moving backward on the trailer before the proper time. Best results will be attained if the ponton is held well back on the load with the bottom resting on the rear roller. A minimum number of load binders should be left in place over the balk, particularly on the rear half of the load. The trailer is then backed down to the water's edge (using either a truck or tractor). If the brakes are applied suddenly just as the quick-release knot is pulled, the ponton will roll over the end of the trailer and slide into the water. A suitable hand line should be attached to the ponton before launching to control its course after entering the water. The method just discussed obviously involves certain risks to the ponton particularly if not carefully executed. The procedure is well suited for launching pontons where speed is a vital consideration and where the river bank has a reasonably gentle slope to the water's edge.

Section VII

CONSTRUCTION BY SUCCESSIVE PONTONS

25. GENERAL.—Construction by successive pontons from one bank constitutes the formal, precise, method of building the 25-ton ponton bridge. It can be done as a drill, and when men have mastered this drill, they are in a position to build the bridge by other, less formal, ways; or by combinations thereof. Personnel should therefore be first trained in this method when being instructed in heavy ponton work.

26. CONDITIONS SUITED TO USE.— Apart from its value as a drill, the method of successive pontons is advantageously employed at sites which have the following characteristics:

a. Stream width not in excess of 300 feet.
b. Swift current.
c. Lack of bank areas suitable for building parts.
d. Limited spaces for the storage of material.

For the purpose of prescribing a drill and preparing an organization therefore, the following conditions are assumed

in the following discussions: One trestle to be set at each end of the bridge; bridge to be closed on hinge span raft at far shore; a current in excess of one mile per hour; banks high enough to keep a properly secured maneuver cable out of the water; all boats in the water; equipment piled near the bridge site; a truck crane available; material handing dollies not employed; and adequate working space available.

27. BRIDGE CONSTRUCTION PERSONNEL.— The following table shows the required party for the bridge under the conditions listed in paragraph 26 above. A smaller party can construct the bridge by assigning men or sections to duties not normally theirs. A corresponding increase in the time of construction will take place. Depending somewhat on the physical conditions of the men, as the bridge approaches a total length of about 300 feet, fatigue on the part of the balk and chess carrying details will become a limiting factor. Under greater conditions of length to insure continuation of construction at maximum speed the numbers in these details should be increased.

OFFICERS.— 1, in charge, where needed.
1, far shore abutment, trestle and raft.
1, near shore or head of bridge.

NAME OF SECTIONS.	*NCO's*	*PRIVATES*	*TOTAL*
Abutment Section. (later becomes transverse balk section.)	1	6	7
Near Trestle Section. (3 of whom are crane crew) (later becomes cable section)	*2	9	11
Hinge Span Section. (become balk fasteners)	1	10	11
Balk Carrier Section.	2	40	42
Chess Carrier Section.	2	34	36
Maneuver Line Section. (Later side rail section)	*2	10	12
Anchor Section.	*4	15	19
Far Shore Section. (1 trestle)	*2	20	22
Telephone Section.	1	2	3
Rescue Boat Section.	1	4	5
TOTAL.— One Trestle.	*18	150	168

* Of the 18 (or 20) NCO's, at least 4 should be Sergeants, or higher distributed 1 each in sections marked with asterisk.

28. FORMATION OF SECTIONS FOR CONSTRUCTION.— The detail is formed in three ranks in line, and is then divided into sections. Non-commissioned officers in charge of sections take post in front thereof, other non-commissioned officers take post in a fourth rank behind their proper sections.

If the detail and the non-commissioned officer(s) come from different organizations, it is desirable to give the latter an opportunity to learn and write down the individual names. In any event, the non-commissioned officers should check that they have the correct number of men, and the men should understand to which section they belong and know who is their section leader.

If a report is desired at this time, section reports should be successively made in the form "Abutment section ready," etc. at the command "Report."

29. CONSTRUCTION.— The actual building of the bridge is initiated at the command "Construct the bridge" given by the officer in charge. Thereafter the procedure should be automatic, each section leader seeing to it that his section performs its operations in sequence at the proper time. A fundamental requirement for the rapid construction of the bridge is that boats, balk, and other material be ready at the point needed when the time comes to place them in the bridge. At the same time every effort consistent with the above should be made to keep the bridge always free of unneeded men and material.

Section VIII

DUTIES OF SECTIONS

30. GENERAL.— In this section the detailed duties of personnel in construction by successive pontons are shown in two ways:

a. In a diagram showing the chronological sequence.

b. By a detailed description of the duties of each section.

31. CHRONOLOGICAL SEQUENCE FOR CONSTRUCTION.— See Table, "Duties of Sections in Erection of the 25-ton Ponton Bridge by Successive Pontons."

32. DUTIES OF OFFICERS.— *a. The officer in charge* supervises the entire construction of the bridge. Before construction is begun he has suitable range poles set. He is directly in charge of the alignment of the bridge.

b. The head of bridge officer directly supervises the setting of the abutment, the placing of the trestles, the setting of the hinge span raft, and all activity at the near end of the bridge as construction progresses.

c. The far shore officer supervises the construction of the far shore raft, its loading with necessary materials, its movement to the far shore, and all construction thereon prior to the connection with the main bridge.

d. Other officers may be assigned if available; if there is only one he should be assigned to the anchor section. In night construction the number of officers should be increased.

33. ALIGNMENT OF THE BRIDGE.— *a.* In the simplest case, where the banks rise fairly abruptly, range poles may be used to mark the center line of the bridge. Two may be set on the near shore; or one on the near shore and one on the far; or two on the near shore and one (or two) on the far. It is essential that the near shore poles be set so as to be clear of the flow of traffic to and from the bridge as well as of the movement of the truck crane.

b. An auxiliary range consisting of two poles should be set 7′ 9½″ to one side of the main range on the near shore. This is used to line up the near shore trestle (or trestles) by sighting along the sides until the individual column is in line. This range can be removed as soon as the near shore trestles are set. A similar range may be used on the far shore.

c. An additional auxiliary range lined on any convenient point on each boat, such as the upstream end, is often convenient.

d. It is particularly important that the near shore trestles and hinge span raft be accurately located, in order to assure good alignment. The bridge is sufficiently rigid horizontally to make it very difficult to correct later any substantial error in alignment at this point.

e. Vertical alignment of the bridge is discussed in subsequent paragraphs, particularly in paragraph 35.

f. The actual work of alignment is performed by the cable (near shore trestle) section. (See par. 35 *j.* (3).)

34. ABUTMENT SECTION (1 NCO and 6 Privates).—*a.* The abutment section obtains the following and moves them to a convenient place, close to the location of the near shore abutment.

1 Sill
4 Chess
16 Pickets, steel
2 Mauls
4 Shovels
2 Picks
1 Tape, 50′
2 Poles, range (if not previously set)

b. The range poles are set as directed by the officer in charge.

c. The sill is set on the ground as nearly correctly as can be judged by eye and then squared exactly by swinging a tape from a point on the bridge center line to the ends of the sill. The position of the sill is then outlined with a pick on the ground, the sill set to one side, and excavation made for the sill. The excavation for the end dam chess may be done at the same time, or may be deferred till later.

Figure 9. Abutment, with trestle balk resting on sill and chess used as end dam.

Excavation is held to the minimum necessary to provide a secure footing and space for the sill (and end dam).

A number of pickets are then driven along the river side of the sill, up to a total of eleven if considered necessary. Two pickets are then placed against the shore side. Care should be taken to drive pickets midway between score marks (balk points) of abutment sill to avoid interference with trestle balk. As soon as the ten underbalk of the abutment span have been placed, the end dam chess is secured against the ends of the balk with two pickets against its shore side. The whole abutment is then backfilled and carefully tamped.

The excavation for the end dam chess should allow for the fact that the balk end irons cause the ends of the balk to extend 5½″ beyond the shore side of the sill. The end dam chess is placed so that its upper edge is level with the top surface of the first chess.

d. Upon the completion of the abutment, the section assists the near trestle section as the officer at the head of the bridge may direct. They will usually construct the holdfasts to which the trestle is guyed.

e. When relieved from duty assisting with the trestle, the section becomes the transverse balk section.

(1) The tools needed for this work are two pickets, and two 16′ lashings with an eye splice in one end of each.

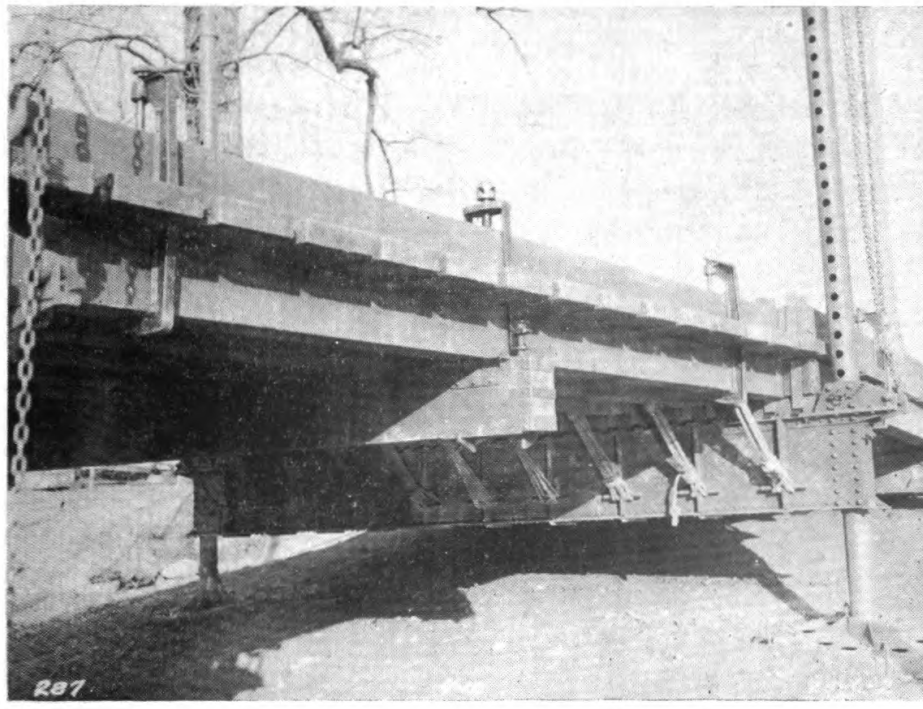

Figure 10. Transverse balk in place.

(2) Each transverse balk placed requires one transverse balk and two transverse balk hangers.

(3) One transverse balk is placed in each trestle to abutment or trestle to trestle span at the chess opening nearest to the center of the span. (See Figure 10). A transverse balk is not placed in the hinge span because of interference with the shore ponton.

(4) Transverse balk are placed at the middle of each ponton span, if so directed by the officer in charge.

(5) To place a transverse balk, the transverse balk hangers are put in place with the stirrup hooks lowered and turned outward so as to pass through the center opening of the transverse balk. The eye end of the lashings are then connected thru and at the ends of the transverse balk. The balk is then passed under the bridge by dropping it off the upstream side and holding on to one lashing; or it may be accomplished by men wading, or from an assault boat. The balk is then raised, using both the lashings, threaded thru the stirrup hooks and the latter engaged on the metal bearing plates of the balk. The lashings are then cast free and the transverse balk hangers tightened in place with pickets. Care should be taken not to get the hangers too tight.

f. The officer in charge should observe the progress of the personnel in the section and supplement them with additional personnel if they appear to be falling behind the general progress of the bridge.

35. NEAR TRESTLE SECTION.— (2 NCO's and 9 Pvts.).— *a. Crane.*— (1) If the truck crane is available, its crew of three are included in the personnel for this section. This crew consists of:

1 Crane operator
1 Truck driver
1 Ground man

The driver and operator take signals from the ground man only, and all instructions to them while operating should be transmitted thru him. The crane is equipped with previously prepared slings of suitable length for handling a trestle.

(2) The crane crew are used only for the crane's work, and the term "section" does not hereafter include them except in their functional capacity.

(3) The crane when directed picks up the assembled trestle, moves it to the bridge site, (final delivery being made with the crane moving backwards toward the bridge), and then sets the trestle as directed by the head of bridge officer.

b. Trestle erection—crane method.— (1) The section assembles the trestle with the transom lying on its side on balk or sills. If necessary to move the transom by hand, personnel are borrowed from the balk or chess sections for this purpose. If convenient, this assembly may take place with the transom parallel to and approximately 18′ off the center line of the bridge, shoes on the center line side.

(2) The transom pins are not inserted, the trestle being held by pickets placed thru the columns a short distance above center thereof, and above the transom. The shoes are placed and hooked on by their chains.

(3) Slings are then attached to the transom, and guy and tag lines to the columns. The guy lines consist of a double one-inch line to the top of the column for a shore guy and a single one-inch line to the top for a guy in the direction of the bridge. The tag line is a one-inch line passed around the column thru the loops of the shoe teeth, and then returned to shore. The shore guys are made double so that they may be readily windlassed tight upon being secured to picket holdfasts or other suitable anchorages.

c. When directed by the head-of-bridge officer, the crane picks up the trestle, which is steadied by the guy and tag lines, each of which is manned by one man from the section. Waders are provided for the two men who hold the river guy lines. The trestle is then set upright approximately in position. The crane lowers the transom into approximately its final position, the columns being steadied by the guy lines while this is done. The transom pins are inserted. Any minor adjustments is made by moving the transom with the crane or rotating the columns with a picket. Never place fingers in holes of columns to check adjustment.

Keeping trestles vertical is of the greatest importance in the bridge. With a sloping bottom, manila lines cannot be drawn up tight enough to hold the columns vertical under the most severe loadings and trestle shoes may slide outward or sideways.

Wire cable, such as may be found on the winch of the tractor or truck tractor of the battalion, will hold the trestles and shoes if securely fastened.

If severe loadings and unfavorable bottom conditions are encountered two wire cables should be placed around the bottom of each column and made fast after tightening on two appropriate anchorages on shore; or one end may be left attached to tractor if space or other considerations permit.

d. The end irons of two trestle balk are then engaged on the transom, one near each end. Under the assumed conditions, i.e. one trestle only employed, they are both upstream balk and are so located.

e. The trestle is then set in its final position, the exact spacing from the abutment being measured horizontally by engaging the two balk mentioned above on the sill. Care should be taken to align the trestle columns vertically. This may be done by having a man stand some distance up or down stream and signal when both are vertical as viewed from his location. The alignment of the trestle with respect to the center line of the bridge is determined by siting along the auxiliary range poles, (See paragraph 33 b) and the trestle columns.

f. (1) If bottom conditions indicate the necessity of spread footings, these may take the form of logs about five feet long which may be staked down prior to the setting of the trestle, or may be lashed to the trestle shoe prior to setting. In extreme cases an additional trestle transom may be set with pins in the lowest holes. The lower surface of this transom will greatly increase the bearing area, which may be further increased by logs or planks under the transom like mudsills under a trestle bent. 3″ x 12″ x 5′ planks make excellent footings. Eight (two for each shoe) should be carried in the short cargo body of each truck towing a trestle load.

(2) In emergency, chess or half chess, or balk, may be used to spread the footings.

(3) If the ground at the site of the footing has considerable slope or is of soft material, it should be dug out when water depths do not prohibit, until approximately level, or firm material is reached.

g. Any necessary final adjustments are made in the trestle, the transom slings disengaged, and the crane moved

away. Eight additional balk are then placed in the bay by the balk section. The trestle shoe lines are then tightened with rack sticks. The shore guy lines are removed unless footing conditions are unfavorable or unless the transom is adjusted more than halfway up the columns.

h. The chain hoists are rigged, and the transom height adjusted. The hoists are then disengaged from the transom, and habitually left so, except while ajustments are actually being made. (See Figure 11) The correct adjustment is achieved when it provides a smooth entryway onto the bridge. The transom should be high enough to avoid the hinge span trestle balk bearing on the shore gunwhale of the shore ponton. It should be low enough to avoid a decided hump at the trestle itself. This generally results in an adjustment so that after the trestles are settled the balk are four to six inches off the shore gunwale of the shore ponton. The transom is later raised or lowered with changes in the water level to keep this adjustment.

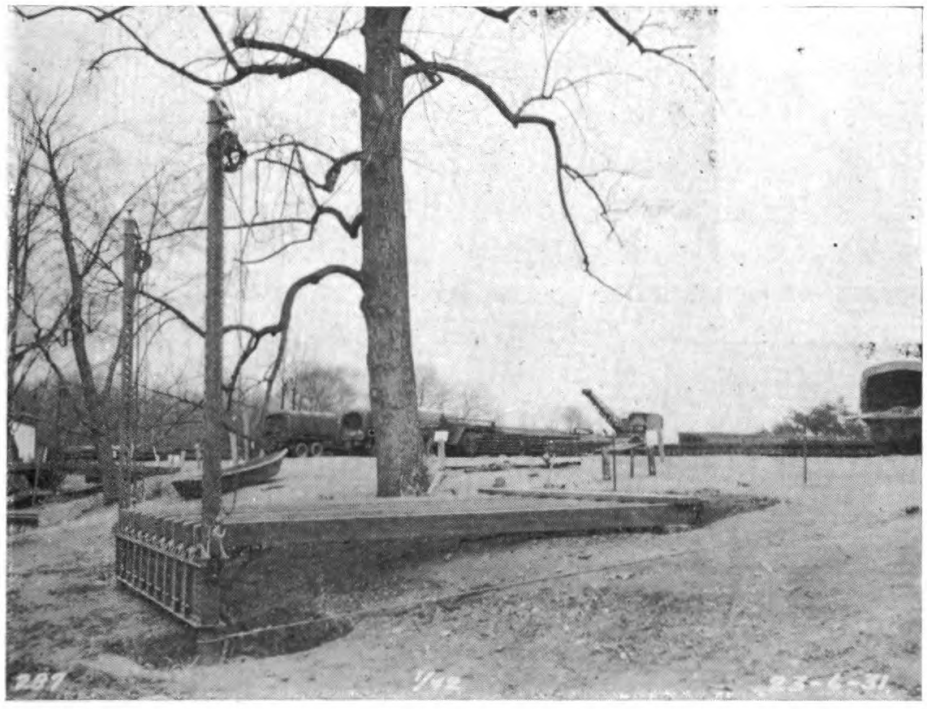

Figure 11. Trestle erected and trestle balk installed.

i. To install additional trestles, if required, proceed as described for the first trestle. The crane is run out on the last completed bay in order to place the succeeding trestle in place. Figure 12 shows a second trestle in place with trestle balk laid for the trestle span.

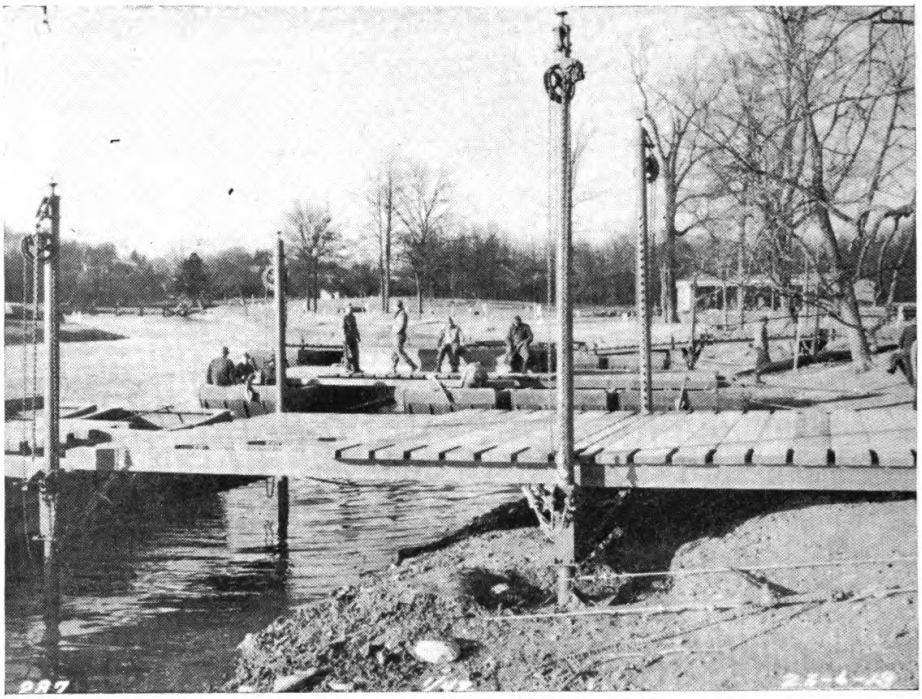

Figure 12. Second trestle erected and trestle balk installed.

j. Subsequent duties.— (1) Cranemen—After setting the trestle or trestles the crane moves off to other work.

(2) (a) Two privates lash the trestle balk on both sides of the trestle transom to the transom lashing bars, using 16′ lashings with an eye splice at one end for this purpose. The number of balk lashed is as directed by the officer in charge. Those on the shore side may be lashed tight, (provided no great footing settlement is anticipated), but those on the river side should allow for some play in the hinge span. Too tight lashings here may result in the lashing stirrups of the trestle balk pulling out.

(b) Except in emergency this lashing should not be tied while vehicles are passing on the deck.

(c) Upon completion of these duties, all men report to the section leader for instructions.

(3) *Balance of section.*— The remaining two noncommissioned officers and four privates become the CABLE SECTION. As such they are responsible for the proper alignment of the bridge.

(a) The senior NCO takes post on the main range line as set on the near shore (see paragraph 33, *a* and *c* subparagraphs). The remaining men move out onto the

bridge, where the junior NCO takes post at the marker point of the far boat of the hinge span raft. Two men take station at the downstream anchor cable capstans, and two at the upstream ones of the first and third pontons. The hinge span raft is then aligned, and this alignment verified from the near boat marker point.

(b) Upon completion of this alignment, the men step into the fourth boat (for the next span) which should be lying alongside the hinge span raft at this time. They remain at the same relative ends of the boat. At the command "Shove Off" they slack off the lashings which hold the boat to the bridge proper. As soon as the boat has been pushed out, and the first series of five balk dropped in place, the alignment procedure is repeated. Unless directed otherwise the downstream anchor men take the nearest available downstream anchor cable and place it on the capstan as soon as they enter the boat. Upon completion of alignment this cable may be returned to its original location, or left in the boat, or placed in its ultimate location as may be directed by the officer in charge.

(c) As soon as this boat is aligned, the section steps into the next boat, if alongside, and at the proper time repeats the procedure. This is continued until completion of the bridge.

j. If the crane is not available the trestle may be placed by either the shallow water or deep water methods.

(1) *Trestle erection—shallow water method.*— The trestle is assembled as described in paragraph 35 *b* except that the transom pins are engaged in the columns, usually in the lowest practicable set of holes, allowing for a difference in the elevation of the footings on which the column shoes are to rest.

At the proper time the trestle is lifted by the trestle section, with such additional help from the balk carrier section as is required, and carried to its proper place. Guy and tag lines are placed and manned as described in paragraph 35 *b*.

(2) *Trestle erection—deep water method.*— After erecting the shallow water trestle, the near shore trestle section takes charge of the hinge span raft upon which the deep water trestle has been floated to the centerline of the bridge. The deep water trestle is plumbed and steadied with the guy

lines as described for the shallow water trestle and spaced with balk Nos. 1 and 10. These balk are carried and placed by four men of the balk carrier section as directed by the noncommissioned officer in charge of the near shore trestle section. As soon as the center of the transom is on the centerline of the bridge the columns are dropped by pulling on the slip knots holding up the columns. Balk are placed as previously discussed.

36. HINGE SPAN RAFT SECTION.— (1 NCO and 10 Pvts).— *a. Initial duties.*— This section constructs the hinge span raft at such a location as may be designated by the Officer in Charge. If bank conditions permit, a desirable location is a short distance upstream from the bridge and below the maneuver line. When a trestle is to be erected by the deep water method, the balk fastener section assembles the trestle on this raft.

(1) The following materials are required to construct and equip this raft:

3 Pontons
10 Ponton balk
1 Sill
10 Hinge Sill Hangers
2 Boat Hooks
3 50′, ½″ Lines
6 Anchor Cables
4 Detachable Balk Stirrups

(2) The three pontons are placed in position alongside each other parallel to the bank and temporarily lashed. The hinge sill is placed across the bulkheads in the middle of the center ponton. The ten ponton balk are placed across the gunwales of the three pontons and secured in place to the far ponton gunwales. They are always located as upstream balk. The far ponton is then pushed off and the ten ponton balk secured in place on the near ponton gunwales. The center ponton is then secured in place by using detachable stirrups on balk numbered one and ten at each gunwale. This firmly secures the center ponton to the raft at four points.

(3) Two hinge sill hangers are then dropped in place and their tie bars engaged under the sill. The balance of the hangers are then installed. Care should be taken to insure that all bars are level and bear firmly along the sill.

(4) The raft is now ready to drop into the bridge on signal from the head of bridge officer. Prior to so doing two upstream anchors should be cast, either directly or from an assault boat, depending on the situation. Two shore lines or long lashings should be attached, one upstream and one downstream. Four men, two to each line, remain ashore to handle the lines; the others board the raft.

(5) When required, the raft is brought approximately on the center line after dropping a downstream anchor, and at least two trestle balk are engaged on the hinge sill.

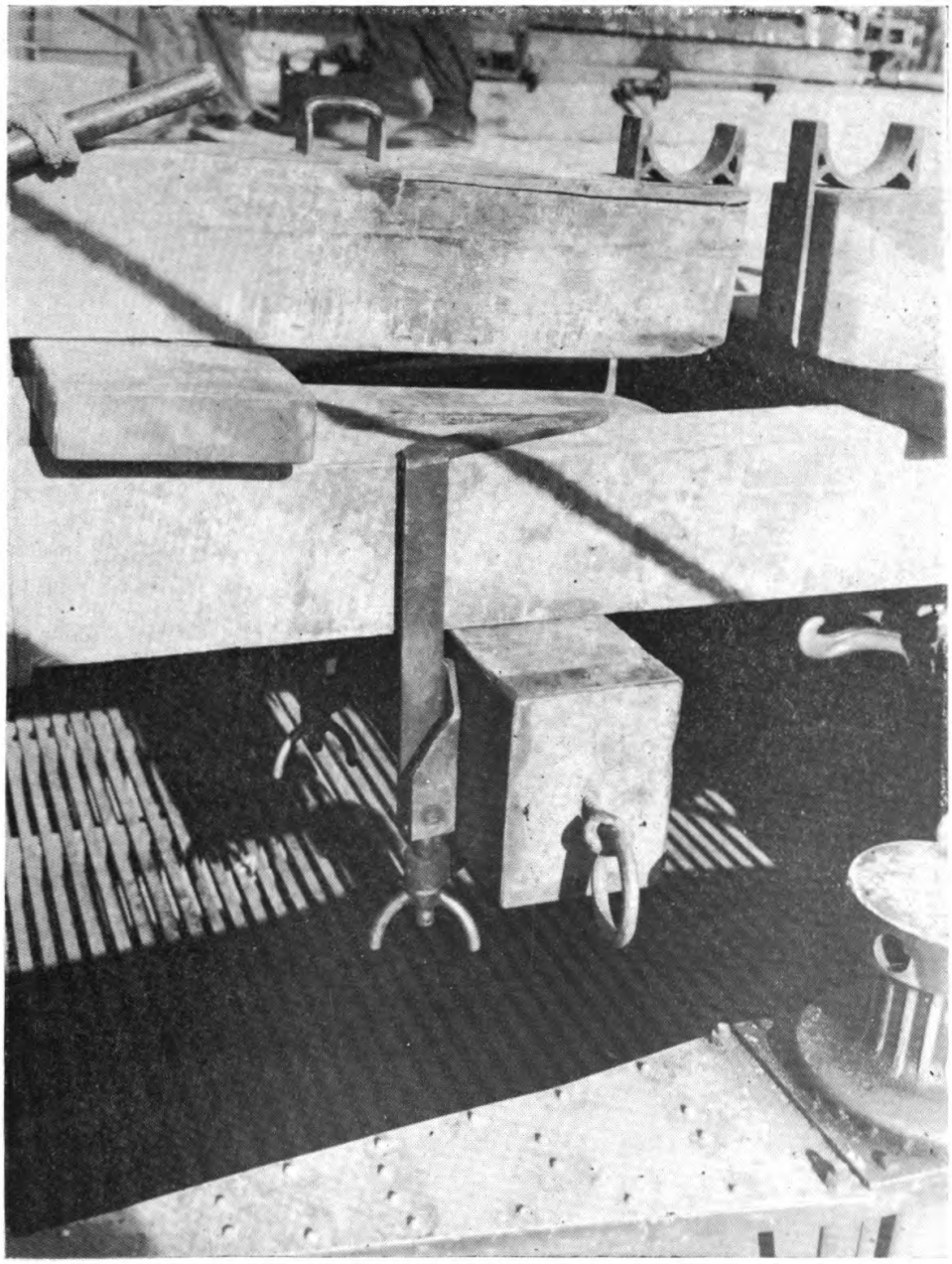

Figure 13. Hinge sill, hinge sill hangers, and engagement of trestle balk on hinge sill.

The raft is then pushed out by the balk carriers, and the balk engaged on the trestle transom.

(6) The raft is now aligned by the cable section. Great care should be exercised to make the alignment as accurate as possible.

(7) The section now receives the balance of the trestle balk as passed out and engages them on the hinge sill. (See Figure 13) Upon completion of this duty, five transfer to the first boat beyond the raft, (fourth boat from shore), which by now should be lying alongside. The men who handled the shore lines join the section. When the bridge is completed, the relation of the hinge span raft to the trestle is as shown in Figure 14.

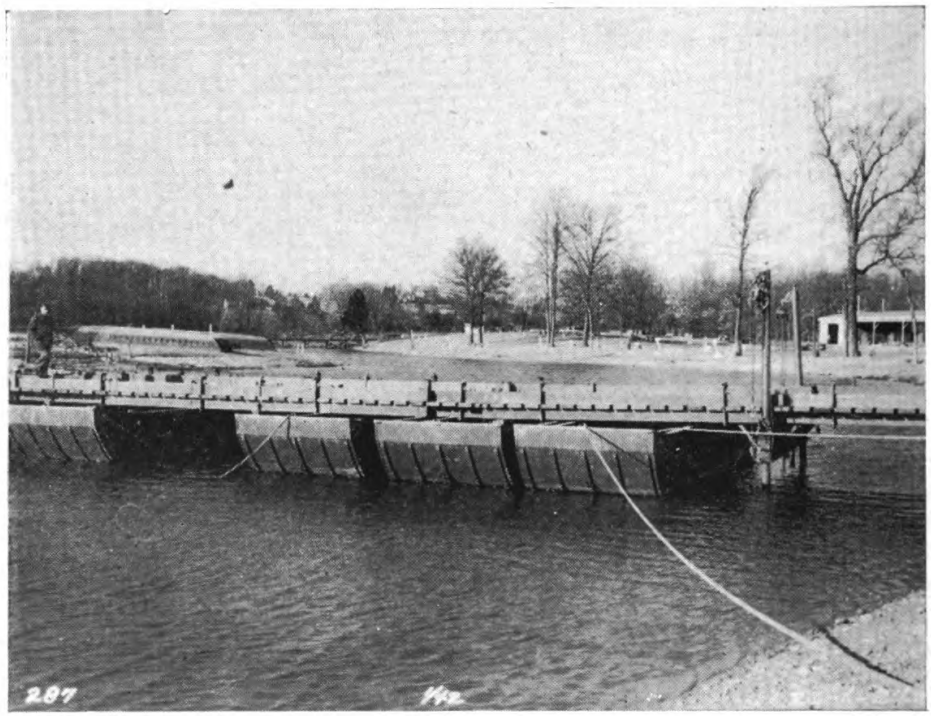

Figure 14. Hinge span raft and trestle in completed bridge.

b. Subsequent duties.— The section now becomes the BALK FASTENER SECTION. (1) The privates are numbered from upstream down, 1 to 10, and Nos. 1, 3, 5, 7, and 9 take station close to the point in the boat where the similarly numbered balk come in, while even-numbered men Nos. 2, 4, 6, 8, and 10 remain in the river boat of the raft.

(2) The balk are received in two groups, the first being Nos. 1-3-5-7- and 9, likewise numbered from upstream down.

(3) Upon receiving the first group of balk, No. 1 places No. 1 balk at the correct point on the river gunwale, with the balk stop clip outside the gunwale, and engages the hook of the balk fastener in the lashing hook eye on the balk. (See Figure 15) Once engaged the hook is not tightened until later.

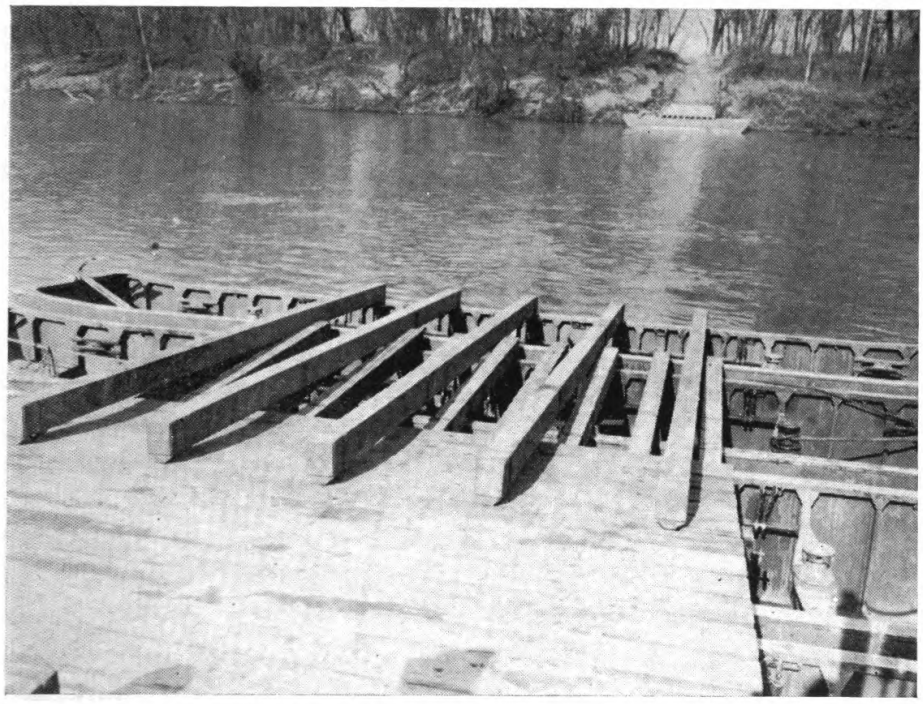

Figure 15. Odd numbered balk attached.

(a) The first bay engaged will be downstream balk; thereafter bays will be alternately upstream and downstream. A balk is correctly placed for downstream if the balk lashing hook eye is directly over the downstream end of the balk fastener retainer rod and over the upstream end for upstream balk.

(b) Nos. 3, 5, 7, and 9 place their balk similarly at the same time.

(4) As soon as the first five balk are engaged, the boat is shoved off, and the balk engaged in the shoreward boat by the balk carriers under supervision of the head-of-bridge officer. (See Figure 16)

(5) The second series of balk Nos. 2, 4, 6, 8, and 10 are brought up and similarly engaged, after having been pushed across, stirrup side up, on the balk already in place.

(6) The balk fasteners now proceed to make all balk fast. (see Figure 17)

(7) Upon completion of making fast, all balk fasteners move out one boat, and the operation is repeated.

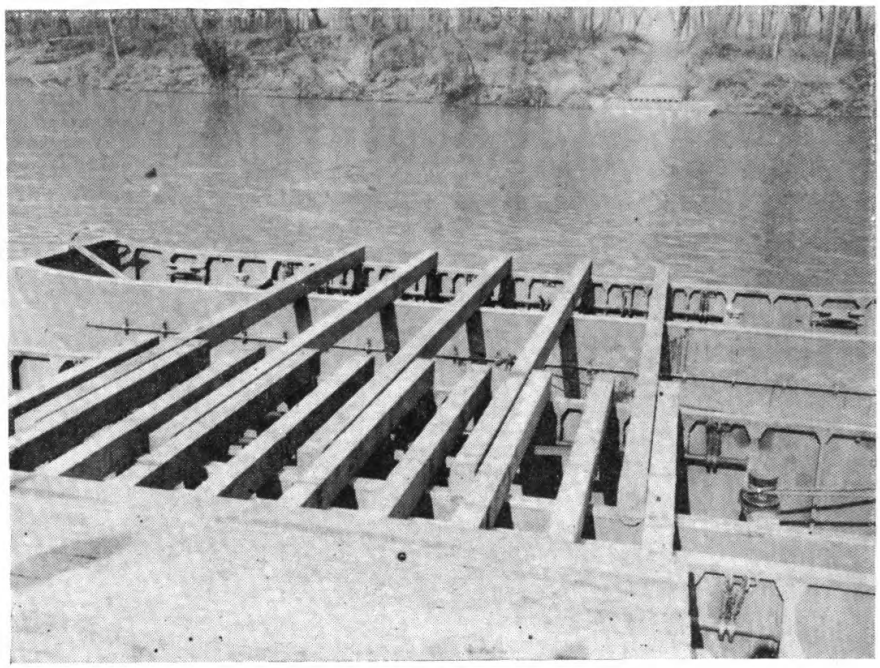

Figure 16. Ponton shoved off and odd numbered balk attached to shoreward ponton.

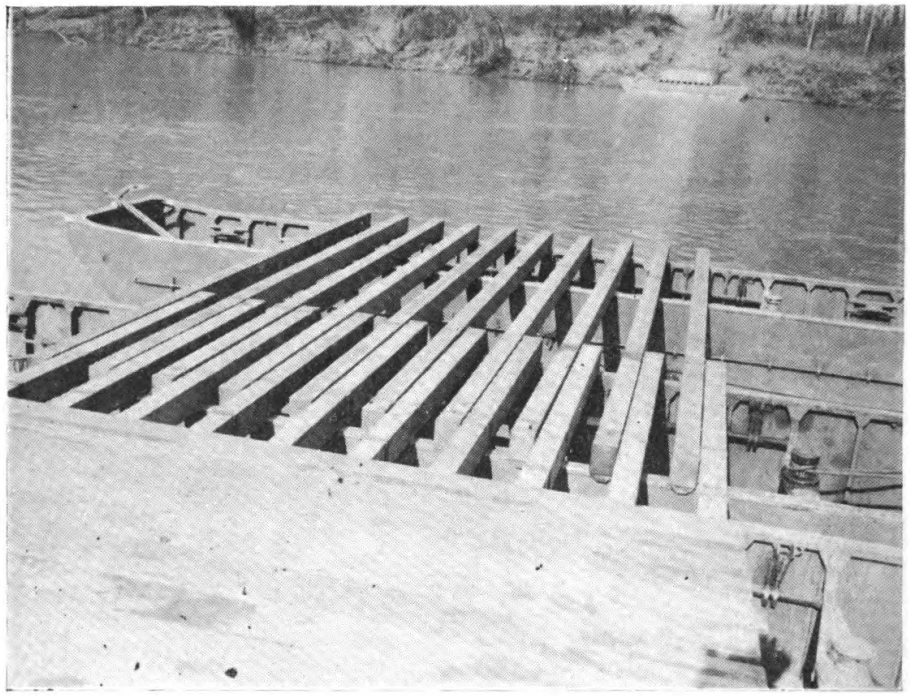

Figure 17. All balk installed.

(8) As an alternate to (7) above, Nos. 1, 3, 5, 7, and 9 can stand fast, and Nos. 2, 4, 6, 8, and 10 move two boats—that is, to where they will receive balk for the next bay.

Either method is satisfactory. The first leads to less confusion, the second more evenly divides the work.

c. If a trestle is to be placed by the deep water method the following procedure is used. The hinge sill hangers are now placed on balk Nos. 2, and 9 and these two balk are extended shoreward the width of a ponton and lashed in place by the balk lashing hooks. The transom is placed on its side, parallel to the ponton, with its bottom toward the shore and its top directly over the shore gunwale of the shore ponton. The trestle columns are then handed onto the raft with their upper ends riverward and are run through the wells in the ends of the transom so that about 2 feet of the trestle columns project shoreward beyond the bottom of the transom. The trestle shoes are assembled to the columns and secured in place with the hooks chained to the shoes. Guy and tag lines are fastened as prescribed in par. 35 *b*. The transom pins are not inserted but the columns are kept from dropping when the trestle is in a vertical position by short lashings tied from the column shoe to the D ring of the transom in a slip knot.

The raft is then maneuvered into position where the near shore trestle section takes charge of it.

d. Type of men detailed.— The work of the hinge span and balk fasteners section requires quickness, strength and intelligence, and the men detailed should be carefully selected.

37. BALK CARRIER SECTION.— (2 Non-Commissioned Officers and 40 Pvts).

a. This section is organized in two groups, each consisting of one non-commissioned officer and five carrying parties of four men each. The first group consists of the carrying parties for the odd balk Nos. 1, 3, 5, 7, and 9; and the second group, for the even Nos. 2, 4, 6, 8, and 10. The senior noncommissioned officer takes direct charge of the first group; the other noncommissioned officer of the second. It is desirable to have all men in any one carrying party of about the same height.

b. After organization, and until its services are needed in its prescribed work, the section assists as directed by the officer in charge. This assistance may consist of moving trestle transoms, abutment sills, delivery of balk to the hinge span raft, etc. If not required for such additional duties, the section stands by in the vicinity of its material piles.

c. Carrying of balk.— (1) The ten balk required per bay are removed from the material stacks and laid out on the ground two or three feet apart, in two ranks of five balk each. If it does not interfere with other operations, a convenient place is on the approach to the bridge, with the long axis of each balk approximately parallel to the bridge center line thereof.

(2) Ten trestle balk are originally laid out, and delivered as required by the near trestle section . Two men can carry a trestle balk, and only half the section is therefore needed. The balk are delivered as called for by the head of bridge officer.

(3) An additional 10 trestle balk for the hinge span are then laid out and delivered.

(4) The section now prepares to deliver ponton balk.

(a) The balk are laid on the ground as described above, stirrup side up. Personnel stand beside their balk close to the point where they are going to grasp it. If using balk carrier hooks two men stand on either side of each balk.

(b) At the command "Lay Hold, Raise," given by the noncommissioned officer with the section, the balk carriers of the first rank raise their balk off the ground and at the command "Forward March" move out on the bridge. The balk may be carried with balk carrier hooks, or entirely by hand. Though physically possible, it is not usual to shoulder the balk, owing to the hazard this offers to others, particularly when lowering the balk. The 5 balk are advanced approximately abreast but the width of the bridge may not permit them to do so exactly, particularly when balk carrier hooks are used.

(c) Upon arriving at the head of construction the five balk are passed out to the balk fastener personnel (See par. 36 *b* (3) supra), and on their signal are turned over on the far gunwale of the far boat, and engaged there. This is not necessarily done simultaneously.

Two men from each party clear the bridge, moving on the downstream side (as do all construction personnel leaving the bridge). The remaining two in each party remain and manipulate the shore end of the balk as directed.

As soon as all five balk are engaged, the Head of Bridge Officer commands "Lay Hold, Push Off." At the latter

command the two men remaining on each balk push the ponton off and drop the near end of their balk in position on the near gunwale of the near boat. When the respective balk fastener personnel have been helped with the location of their balk each pair leaves the bridge without further command.

(d) As soon as the first group of balk carriers start on the bridge, the second group similarly pick up even balk Nos. 2, 4, 6, 8, and 10 and move out on the bridge. The non-commissioned officer with this group should have his balk ready when needed, and yet not interfere with the construction of the bridge. The second group deliver their balk as did the first, except that the balk are slid out bottom side up, along the balk already in place to the balk fastener personnel, and then rotated into place.

(e) The entire operation is then repeated for each bay of bridge.

(f) *Safety Precautions.*— (1) While the balk carrier groups run no particular risk themselves, they should be particularly careful to avoid hurting others when lowering and placing their balk, such as shoving a balk against someone, pinching a hand when rotating it, or rotating it on balk fastener personnel working under the near boat.

(2) A ponton balk should not be carried by fewer than 4 men, nor a trestle balk by fewer than 2 men.

(g) The work of the balk carriers is fatiguing, especially on a long bridge. Under many conditions it may be desirable to add a third group of five balk carrying parties, thus giving any given party a rest every third bay of bridge.

38. CHESS SECTION.— (2 Non-Commissioned Officers and 34 Pvts).— *a.* This section is organized as follows:

1 Non-commissioned officer in charge
1 Non-commissioned officer assistant on bank
16 Chess carrying parties of 2 men each
2 Chess layers

b. After organization and prior to the beginning of their duties, the section either stands by or assists as directed by the officer in charge. Assistance may be rendered the near trestle section or other sections. Under certain conditions chess may be carried for the far shore raft.

c. (1) When chess laying is about to begin, the two chess layers take their places standing on balk Nos. 1 and 2 and Nos. 9 and 10, respectively, facing toward the near shore.

(2) Each pair of chess carriers picks up a chess, the men carrying it under their right arms, one man near each end of the chess, and keep on the upstream side of the bridge. A few feet short of where the chess is to be laid, the leading chess carrier swings over to the downstream side of the bridge. The carriers then hand the chess to the layers, and move off keeping on the downstream side of the bridge, and return to the chess pile on shore.

(3) The chess layers lay the chess firmly against the last chess laid (or the end dam). It is aligned laterally by placing the score marks vertically over the downstream edge of No. 1 balk, if an upstream balk or the upstream edge of No. 1, if a downstream balk.

(4) Chess laying ceases approximately one chess short of the shore gunwale of the river boat, or of the trestle transom. This space or gap is necessary to permit the placing of the shore ends of the next bay of balk.

The dispatch of the proper number of chess to maintain this gap, and at the same time have no chess left over or leave too wide a gap, is one of the most important duties of the two non-commissioned officers in this section. The shore non-commissioned officer should count carefully the number of chess he sends out, and stop sending at the correct number.

The chess are theoretically 11-⅝″ wide, and unless shrinking or warping upsets their placement close to each other, 15 of them will be required in every bay with a 16th about every 6th bay. In practice the shore non-commissioned officer sends out 15 chess every time unless otherwise instructed by the chief of section.

The equipment of this bridge includes half chess 5-⅝″ wide, which are useful at joints, and at places where the bridge changes slope. The shore non-commissioned officer should assure himself of the location of these half chess so that he can supply them promptly on call.

Orders from the chief of section to the shore non-commissioned officer may be transmitted verbally, by pre-arranged signal, or by telephone. As the bridge grows in length, the telephone becomes more desirable.

d. Upon completion of the work in each bay, the chess layers and non-commissioned officer in charge step into the nearest boat, out of the way of other work. The balance of the section usually draws fifteen chess from the material pile and stands by at the most convenient place.

e. When working in a limited space which prohibits removal of the chess from the material pile prior to use, two men may be added to the section (or the sixteenth pair of chess layers used) to slide chess off the material pile into the hands of the chess carriers.

39. MANEUVER LINE SECTION.— (2 Non-commissioned officers and 10 Pvts).— *a.* (1) The general duty of this section is to pass a maneuver line from the near to the far shore and secure it. The cable is located at a suitable distance upstream from the bridge. It serves as a line under which to move the far shore raft as a trail ferry, and as an aid to maneuver successive pontons into place.

(2) After securing the maneuver line, the section becomes the siderail section.

(3) The maneuver line may be omitted if the Officer in Charge elects to use power boats or outboard motors for the purpose. It is of little value in still water.

b. Passing the maneuver line.— The section procures the following items and places them at a convenient location:

1 reel of ½" wire rope sufficiently long to span the stream
1 wire rope sling with eye in one end and a self-mousing hook at the other
1 come-along or Buffalo grip for ½" wire rope
4 wire rope clips for ½" wire rope
1 socket wrench for wire rope clips
1 power boat
1 winch truck

It is assumed that trees or other suitable anchorages are available. If not, a "dead man" must be placed on the far shore. If none is available on the near shore the truck itself will furnish a satisfactory substitute.

(1) *(a)* The reel of wire rope is set up on the improvised stand as shown in Figure 18.

One noncommissioned officer and five men enter the power boat taking with them the wire rope sling and the end of the ½ inch wire rope which has been spliced to form an

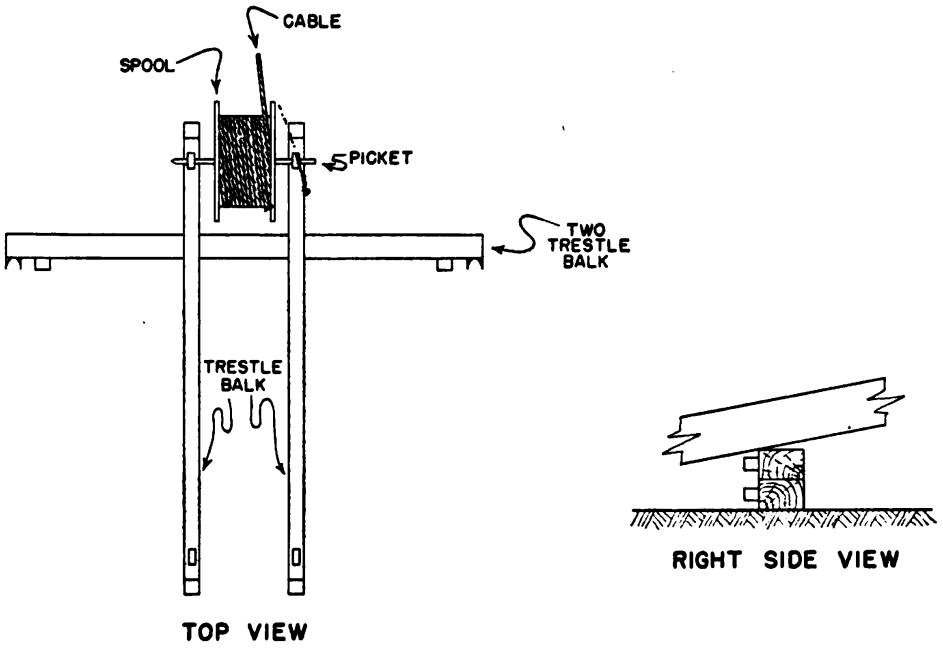

Figure 18. Stand for maneuver line.

eye. Sufficient extra wire rope to reach from the boat to the anchorage where the boat has been grounded is kept coiled in the power boat. The wire rope is made fast to the snubbing posts of the power boat. The boat heads for the far shore. The crew remaining on the near shore pay out the wire rope from the reel as needed.

(b) Upon reaching the far shore one member of the detail carries the sling to the anchorage, passes the end around the anchor, leads the hook through the eye and holds the hook ready for the eye in the lead end of the maneuver line itself which the other members have brought from the power boat. The eye of the maneuver line is placed in the hook, and the cable is thus quickly made fast at the far shore. When the current is strong the line should not be turned loose from the power boat until the end is made fast.

(c) Upon the signal from the far shore that the line is fast the detail at the near shore fastens to it the winch line from a truck. The come-along or Buffalo grip used for this purpose is set well out so that when the line is pulled in the grip will be riverward of the anchorage. The winch hauls in on the maneuver line, the line is made fast to the anchor-

age and the winch line is cast off. The maneuver line should hang so that its lowest point is about four feet above the water.

(2) *(a)* If a winch truck is not available or if the terrain prevents utilization of mechanical power a block and tackle may be used to haul in the line.

(b) A power ponton or power driven assault boat may be employed in place of the power boat but care should be taken to prevent fouling the line in the motor. In the event that no power is available and the current is swift the line may be readily passed by first taking across in an assault boat the bight of a ½-inch manila rope. The bight is placed in a snatch block that has been made fast to the anchorage and the maneuver line is pulled from the near shore. The line is then drawn up as before.

c. Subsequent duties as siderail section.— The section now divides into two sub-sections, of 1 noncommissioned officer and 5 privates each. Each section places the side rails on one side of the bridge.

(1) Each subsection requires the following equipment:

(a) Per floating span —

1 ponton balk;
3 siderail clamps (when transverse balk are used, omit 1 siderail clamp).

(b) Per fixed span —

1 trestle balk;
2 siderail clamps (since transverse balk are always placed in fixed bays).

(c) Per hinge span —

1 trestle balk;
1 siderail clamp;
1 ½″ lashing 18′ long;
1 picket or rackstick.

(2) As soon as construction of the bridge deck has advanced to a point where siderails may be placed without interference to other sections, the siderail section brings up the balk and necessary clamps. The balk is placed over the No. 1 (or No. 10) balk of the span, stirrups up. Two siderail

clamps are placed at the nearest chess opening to the quarter points, and made fast. The third clamp is then placed at the center point unless transverse balk hangers are used. The correct adjustment of clamps is to tighten them securely by hand, and then slack off half a turn. Clamp handles should point downward off the bridge so as not to interfere with traffic or men walking outside the siderails. (See Figure 19) A rope lashing tightened by means of a rack stick should be used near the hinge on the upstream side instead of a siderail clamp.

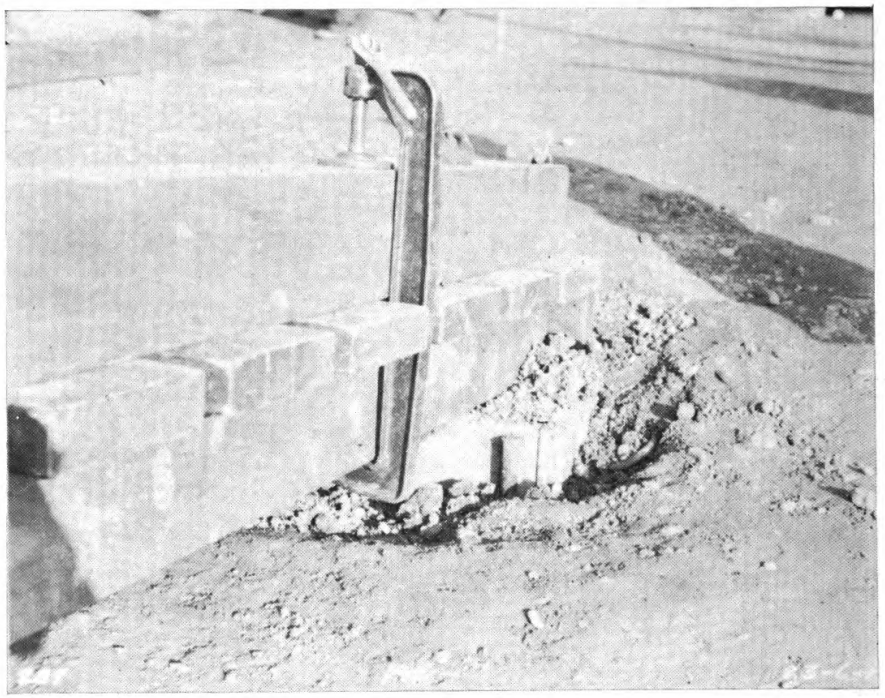

Figure 19. Siderail clamp in place.

(3) Trestle balk are used as siderails on abutment spans, trestle spans, hinge spans, and on hinge span rafts. All other siderails are ponton balk. (Caution: It is important that the siderails of the hinge span be placed with the riverward end an inch or so short of reaching the break in grade. Similarly, the shore end of the siderails of the hinge span raft should be located just short of the break in grade.)

40. ANCHOR SECTION.— (4 Noncommissioned officers and 15 Pvts).— *a. General.*— This section delivers successive pontons to the bridge as required.

b. Organization.— The section is organized with one noncommissioned officer in charge into three boat crews numbered 1, 2, and 3 (each of one noncommissioned officer and 5 privates).

c. Under many conditions, the section is organized as above, and operates as will presently be explained. Under different conditions there may be wide variations in this section's employment, as may be directed by the Officer in Charge.

d. Detailed duties.— (1) The section has no duties in connection with the hinge span raft.

(2) Assuming the boats are in the water above the maneuver line, each boat crew enters a boat carrying with it the following equipment:

5 oars
5 oarlocks
2 ½″ lashings, 50′ long
2 boat hooks

The boat is immediately checked to see that it already contains:

2 anchors (one at each end)
2 anchor cables, neatly coiled, each cable secured to an anchor and the near cleat of the ponton.

(3) (a) On signal from the chief of section on the near bank, approximately at the intended line of upstream anchors, crew No. 1 drop their boat down with the current close to the shore, using a shore line as necessary for control, under the maneuver cable. They then work out along this cable, using a lashing around the cable if necessary, to á point directly above their final position in the bridge. Then, on signal from the shore noncommissioned officer, they cast loose, dropping downstream with the current, and casting anchor as directed by the chief of section. Once the anchor is cast they drop downstream and control their movement by paying out the anchor cable. The anchor cable must not be tangled. They continue to drop downstream below the bridge, until over the line of downstream anchors, where they cast a downstream anchor. It may be necessary to join upstream and downstream cables to each other temporarily to secure enough rope for this purpose. Use should be made of the capstan for taking in or paying out the anchor cable.

(b) The boat is then pulled back to the line of the bridge, where it is drawn in against the outer boat, and secured to it with two short lashings, one at the upstream and one at the downstream cleat.

(c) At this point the boat is turned over to the cable section. The anchor section crew gathers up their oars, oarlocks, and boat hooks, and leave the boat by way of the downstream side of the bridge at the earliest opportunity. They return to the area of boats, where they repeat the process when directed.

(d) Upon entering the boat the section will usually find that the balk fasteners have not been loosened. Prior to leaving the boat these fasteners should be freed and allowed to hang loose. This may be done at any convenient time at the direction of the non-commissioned officer in charge of the boat crew.

(4) Boat crews Nos. 2 and 3 follow the same cycle of operations as boat crew No. 1, except that they omit the downstream anchor unless otherwise directed.

(5) The objective of the section is to have successive boats in position and ready when needed. As one boat is dropping its anchor, the next crew should be coming out along the maneuver line, and the third should be preparing their boat. As the first crew leave their boat in the bridge, the second boat should cast off their anchor, and the third boat head for the line. It should be remembered that 25-ton ponton boats are difficult to row and maneuver, and that they should be kept under complete control at all times.

e. The above organization and duties should be modified as directed by the officer in charge to suit local conditions.

41. FAR SHORE SECTION.— (One officer, 2 NCO's, and 20 Pvts).— *a. General.*— The far shore section builds the far shore hinge span raft, loads it with the necessary materials for the construction of its shore connection, moves it to the far shore, places the raft, and erects the connection.

b. Detailed duties.— (1) *(a)* At a convenient place, usually slightly upstream from the maneuver line, the section spots three ponton boats, and on them builds the far shore hinge span raft. This raft is identical with that for the near shore (par. 36) except that it is initially chessed from the far shore gunwale of the far shore boat to the far shore gunwale of the near shore boat.

(b) The list of materials used to construct the raft are as follows:

6 anchors
6 anchor cables
15 chess
4 detachable stirrups
1 hinge sill
10 hinge sill hangers
10 ponton balk
3 ponton boats

(2) On this raft are loaded the following items:

Figure 20 Drawing Number	Name of Item	Number 1 Trestle	Required 2 Trestles
1	Chess	5	
2	Abutment Sill	1	
3	Ponton Balk	2	
4	Transom	1	2
5	Column	2	4
6	Trestle Shoe	2	4
7	Chain Hoist	2	4
8	Steel Picket	16	
9	Shovel	4	
10	Pick	2	
10-A	Maul	2	
11	½″ Lashing	22	42
12	1″ Rope, 50′ long	2	
13	1″ Rope, 100′ long	2	4
14	Transverse Balk Hanger	2	4
15	Side Rail Clamp	6	10
16	Trestle Balk	24	36
17	Chess	25	40
18	Half Chess	4	
19	Transverse Balk	1	2

They are located as shown in Figure 20. Personnel from the chess and balk sections may be used to expedite the loading if desired.

The loading should be carefully checked to make sure that all items are present.

(3) The raft is now dropped down to the maneuver line, on which it is taken across as a trail ferry. It is brought

up on the far shore approximately on line with the bridge, and as close to the bank as it can be pulled.

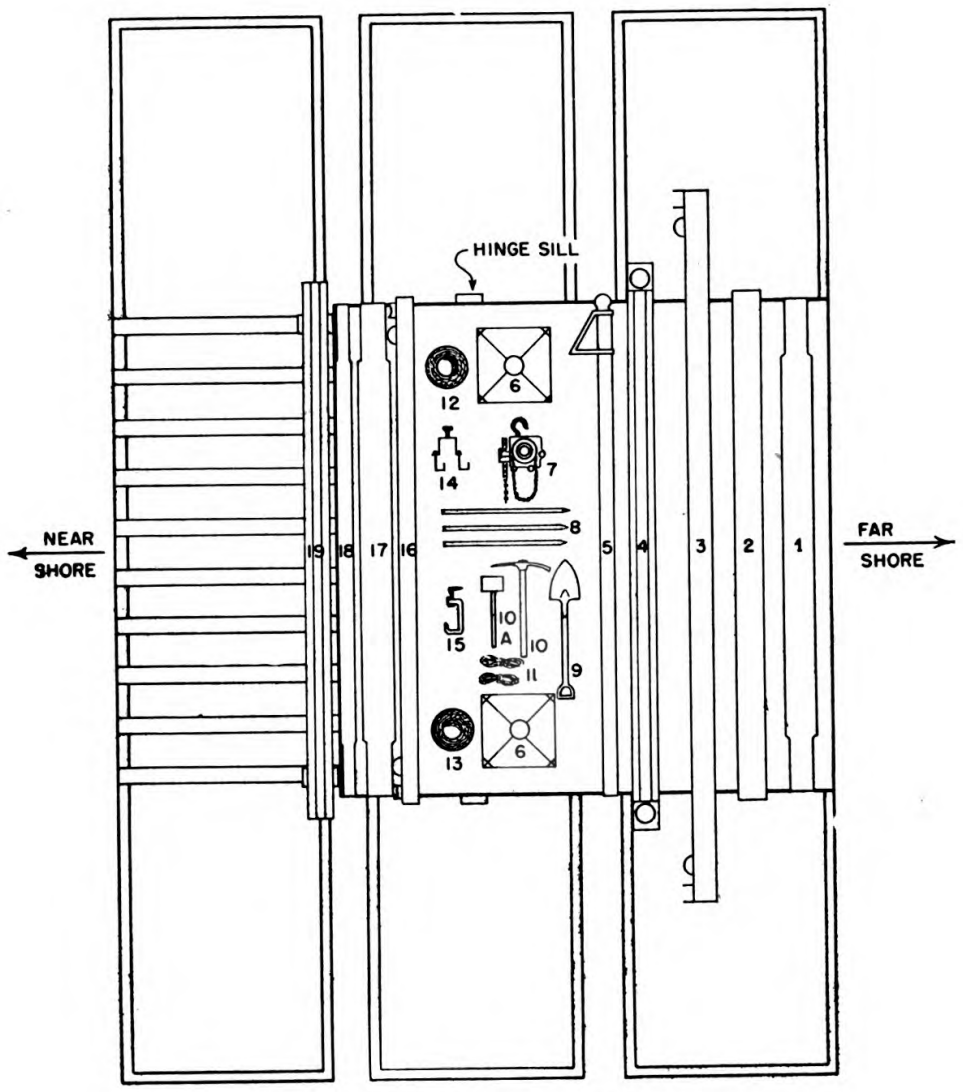

Figure 20. Far shore hinge span raft loading.

(4) The five chess on pile 1 (Figure 20) are now unloaded to form a walk-way to shore. The abutment sill (pile 2) is unloaded. The two ponton balk (pile 3) are placed over the gunwales of the boat and on the shore at about the same level. The trestle transom is slid out on the balk until over its designed location. It is turned on its side and columns and shoes placed. A lashing is tied from the mud shoe to the clevis of the transom with a slip knot. The transom is then turned vertical and the slip knots pulled out, which releases the columns to fall to bearing. Chain hoists are now rigged and guy ropes secured. The transom is raised off the balk, the balk removed, and the transom set at the desired elevation. In the meanwhile the abutment sill excavation has been under

way, and the trestle and abutment are lined up as decribed for the near shore (par. 35).

(5) The abutment span is now filled out with balk and chess from the raft. As an alternate method, the abutment balk and chess may be unloaded to the shore when the raft lands and built from shore. This method will require an appropriate modification in the loading of the raft.

(6) The raft is now shoved off, accurately aligned, and the hinge span balk and chess placed.

(7) Transverse balk are inserted in the abutment and trestle spans.

c. The section now stands by until the arrival of the head of bridge, where it assists as directed by the head of bridge officer.

d. If the bridge is less than 300′ long, or if the far shore presents time-consuming difficulties on the abutment, approaches, or trestles, progress at the far shore will probably govern the time of construction of the bridge. In this case it will save time if the fourth ponton placed in the water is converted to a power ponton, using an outboard motor, and the abutment sill, pickets, range poles, and pioneer tools together with the officer in charge of the far shore construction, 1 noncommissioned officer and 6 privates ferried to the far shore as soon as possible to start placing the abutment. Additional time may be saved when the pontons are slow in arriving by using the power ponton on its next trip to carry to the far shore a transom, two columns and shoes, four 100 foot 1 inch guy ropes, and two trestle balk for use as spacers. Additional men should be carried so that the far shore trestle can be raised by the shallow water method. If more than 400′ long, the bridge itself will determine the time of construction.

e. The final closing of the bridge is made as follows:

Since the far shore abutment was placed because of its location with respect to the water level and bank characteristics, and the hinge sill is always in the center of the center boat of the hinge span raft, it follows that the distance between the hinge raft and the last boat to go into the bridge will seldom be such as to allow a ponton balk to fit exactly in place. The last gap to be spanned must be less than 8′6″. If this is not the case an additional ponton must be used. In order to span the short gap place ten balk in their normal

position in the off shore boat of the hinge span raft, letting them extend as they will over the gunwale of the last boat in the main portion of the bridge. The balk are fitted in their proper intervals between the balk already in position. If the last balk in the main portion of the bridge is downstream, however, it may be necessary to adjust the alignment by the use of the anchor lines. After the balk are in place the detachable stirrups are placed over the balk at both gunwales and the balk lashing hooks engaged and secured. (See Figure 21) Chess is then laid over the gap. It is well to have a half chess available in case the last chess interval is greater than six and less than twelve inches. It sometimes happens that the gap to be spanned is such that the fixed stirrup on the ponton balk rest squarely on the gunwale of the last ponton in the main portion of the bridge. In this case it is necessary to disengage the balk from the gunwales of the off shore ponton of the hinge span raft, slide the ponton shoreward about six inches, and make the connection using detachable stirrups in both boats.

f. If conditions at the far shore require two trestles the section should be increased in strength to 4 noncommissioned officers and 32 privates, or a total of 36 men.

g. The officer in charge of the far shore construction should be specially selected for his ready familiarity with

Figure 21. Closure of gap utilizing detachable balk stirrups.

heavy ponton equipage and ponton bridge construction. Success or failure in the time of 25-ton ponton bridge construction often depends upon this officer and the far shore section.

h. The procedure outlined may be modified to suit local conditions.

42. TELEPHONE SECTION.— (1 Noncommissioned Officer and 2 Privates).—

a. This section procures two field telephones and a suitable amount of wire. One telephone operator remains at a convenient place on the near shore, usually in the vicinity of the balk and chess piles. The other operator takes station at the construction end of the bridge, moving out as construction progresses.

b. The operators transmit all directions and orders from the head of bridge.

c. The noncommissioned officer supervises generally, and in particular makes sure that the wire is secured, is not damaged by construction work, and can be readily fed out as needed.

d. The wire is most conveniently strung on the downstream side of the bridge and is placed outside the number ten balk. It is readily laid by setting up the reel on shore. The shore operator feeds out sufficient slack for the bridgehead operator to pull as needed.

43. RESCUE BOAT SECTION.— (1 Noncommissioned officer and 4 Privates).—

a. This section enters an assault boat, taking with it 5 paddles, 2 short lashings, a boat hook, and a ring life preserver. The boat is then moved out to the head of construction where it ties up on the downstream side with an easily-freed lashing. The boat is moved out as construction progresses, the section remaining therein.

b. The duties of the section are self-explanatory. All members should wear life jackets and be strong swimmers. Not less than two should be trained in rescue of drowning persons and resuscitation to the extent of qualifying for the Red Cross life saving certificate.

c. It is well to use the power boat, if available, for an additional rescue boat section. The power boat may be engaged in general water operations in the vicinity of the head of construction, or by casting downstream anchors. In any event, it may be called upon to assist in rescue operations.

44. ALTERNATE PROCEDURE IN CONSTRUCTION BY SUCCESSIVE PONTONS.— Under field conditions, it is often advisable to erect trestles by hand by the shallow water method or deep water method so as to leave the truck cranes free for unloading pontons. For erecting a trestle by the deep water method, it is advantageous to construct a two-bay hinge span raft with four pontons as shown in Figure 22 in order to have more working space available.

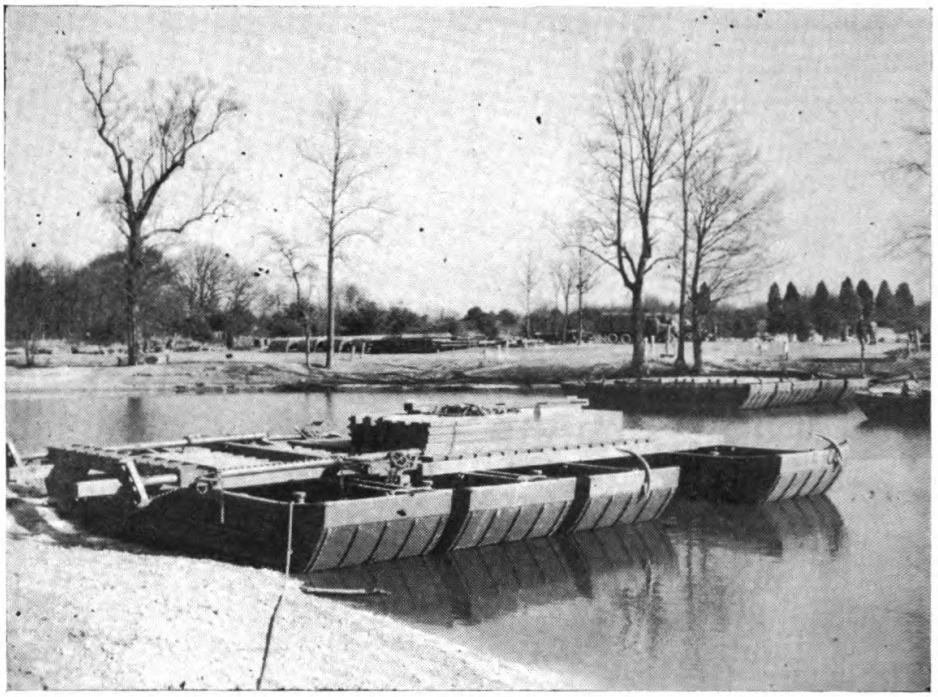

Figure 22. Hinge span raft (two-bay) with deep water trestle.

Section IX

CONSTRUCTION BY PARTS

45. GENERAL.— *a.* In this method the bridge is started as in the method of successive pontons. Simultaneously, at other points on the near shore or in a tributary stream, other floating parts of the bridge are constructed. These parts are built by the method of successive pontons generally as in the normal case.

b. Preparation of site.— The preparation of a site to permit building by parts will differ at every individual location. However, the sketch in Figure 23 is considered typical of the general arrangement required. It is necessary to provide a cleared area for the abutment site and each parts building site, proper approach roads, a turn around, and road connections to each cleared area.

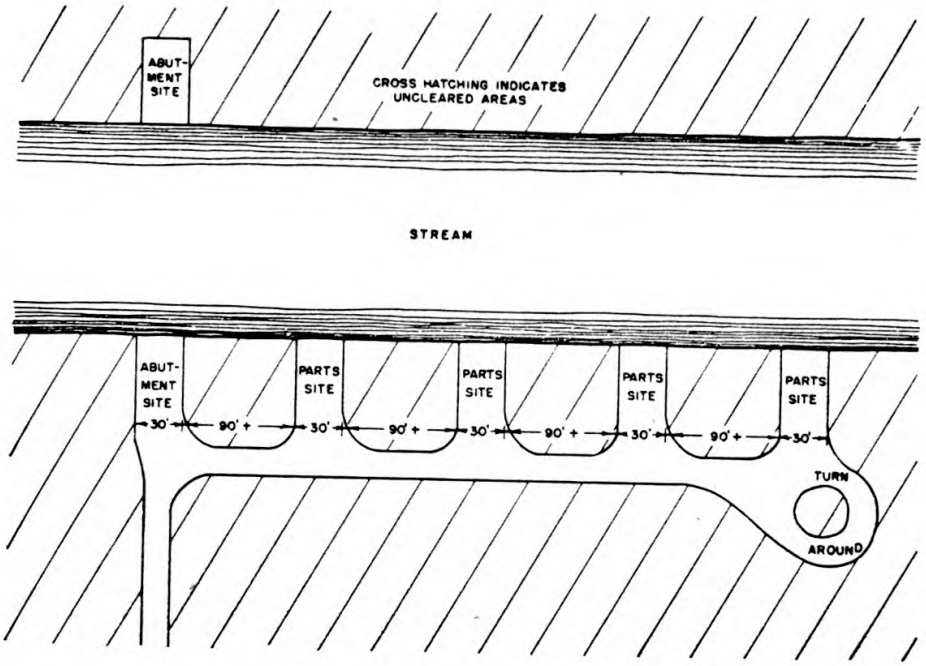

Figure 23. Layout of site.

c. The floating part of the bridge built out from the abutment and all parts constructed separately should begin and end with upstream balk in order to prevent confusion in joining successive parts of the bridge. It follows that each part and the part built out from the abutment must consist of an odd number of spans made up of an even number of pontons. Figure 24 shows a part under construction.

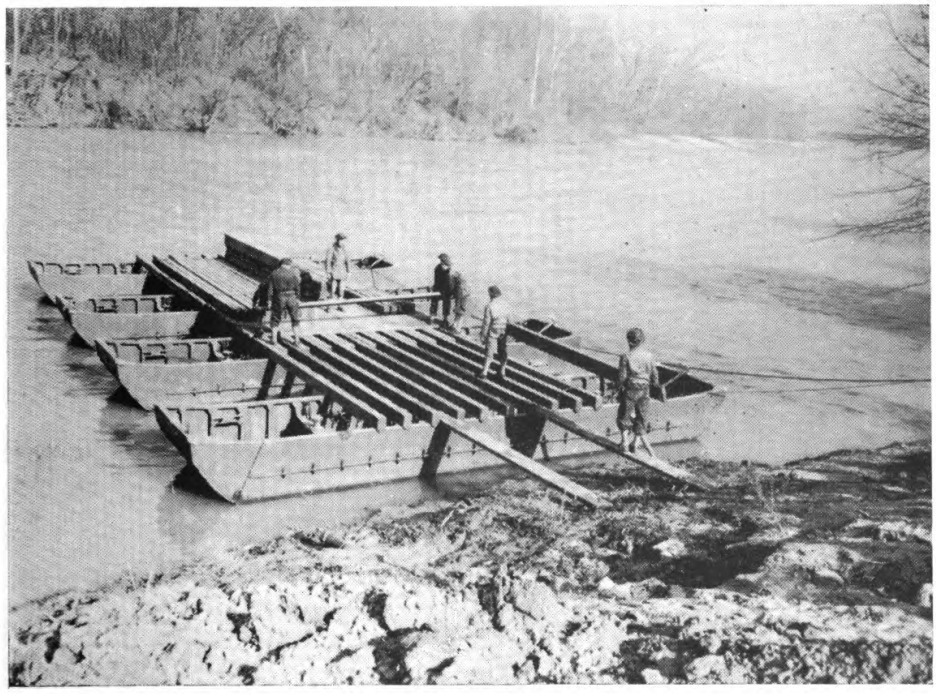

Figure 24. Four boat — 3 bay part under construction.

d. Each working party constructing a part should have its full complement of balk fasteners, balk carriers, chess carriers, siderail carriers and fasteners, cable men, and the necessary anchor sections to provide the requisite number of pontons and to deliver the pontons successively to the head of the part. In addition to the foregoing, the working party which starts the bridge from the abutment should include all of the sections which are necessary for expeditious construction by the method of successive pontons.

e. Any appreciable decrease in the number of men assigned to the construction of a part will materially decrease

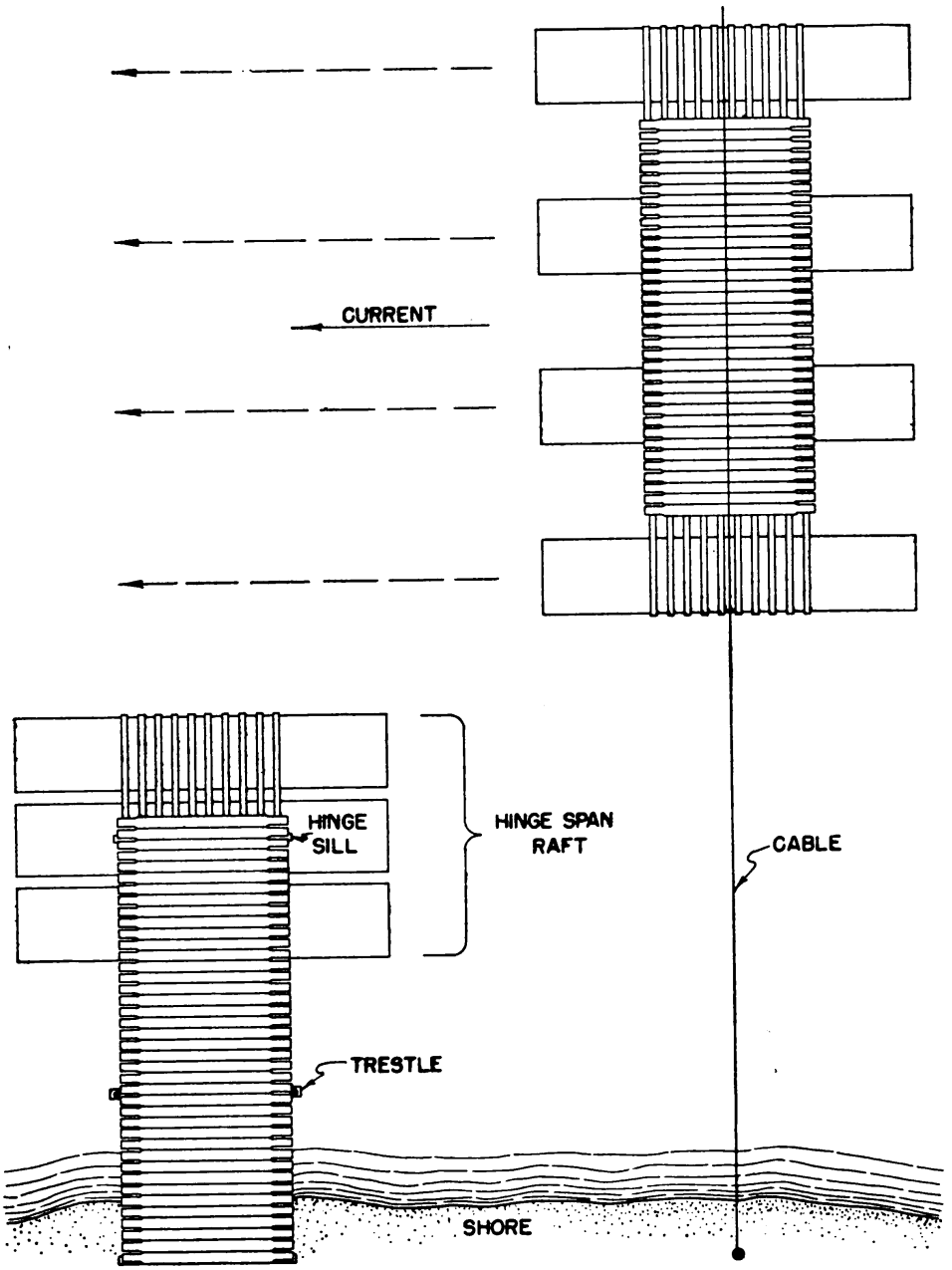

Figure 25. Construction by parts.

the speed of construction and defeat the ends to be gained by the use of this method.

46. *ASSEMBLY OF PARTS AND INCORPORATION INTO THE BRIDGE.— a.* As the parts are constructed they

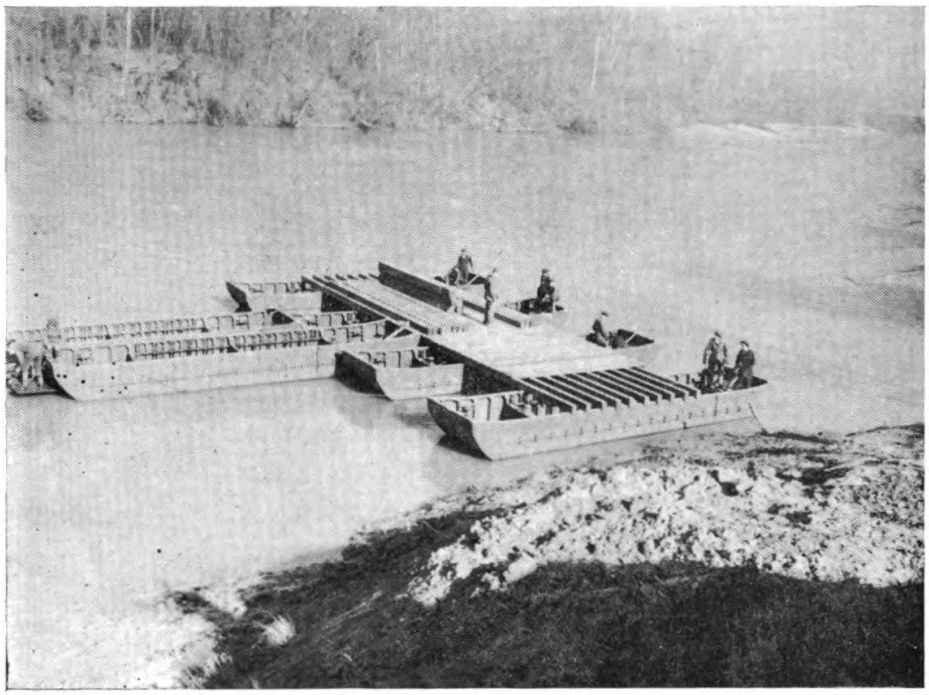

Figure 26. Completed four boat-three bay part.

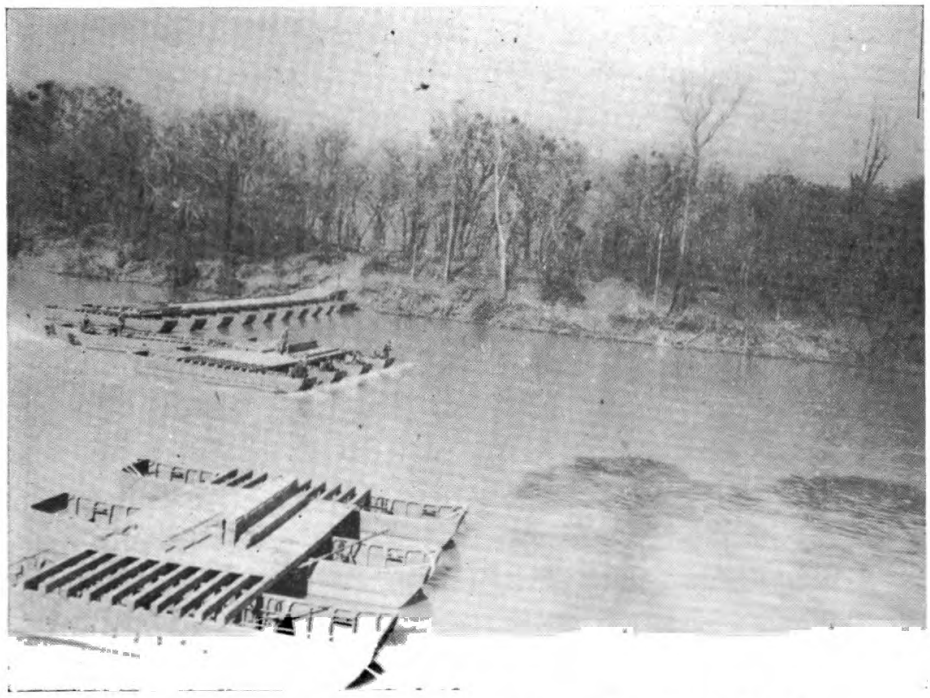

Figure 27. Part in position to be moved into bridge.

are maneuvered to the maneuver cable with shore lines, power pontons, or power boats. (See Figure 25) The construction

crew moves the part the desired distance into the stream, casts anchors upstream of the cable and by means of the anchor ropes moves the part to its position in the bridge. Downstream anchors are cast either with the aid of the power boats or by allowing the part to drift downstream far enough to cast downstream anchors. The construction crew may then revert to additional parts construction if more are needed. The necessary balk, chess, siderails, transverse balk, and metal parts with which to make the connection to the extended bridge are loaded on the part before it is moved to the maneuver cable. (See Figures 26 and 27) The rate of construction of a long bridge may be greatly increased by building simultaneously from both banks and making the junction near the center by using balk with detachable stirrups. In fact, this method of procedure should be the rule in the construction of any bridge appreciably longer than 300 feet.

b. Maneuvering Parts with Power Equipment.— A careful reconnaissance of the river should be made, with the power boat if available, to locate piling, logs, cables, weeds, shoals, or other obstructions to the raft and the propellers of the power equipment. These obstructions should be marked. Operators must be cautioned to beach rafts only while moving upstream. In emergency if outboard motors cannot be reversed or motors cut out and the raft is floating free in the current, anchors may be dropped. Loss of control of a large raft near a ponton bridge under construction may prove fatal to the operation. The maneuver line, if installed, should always be used for final control of large rafts near the bridge. Noncommissioned officers in charge of rafts should remember to utilize the current to gain one bank or the other by turning the raft across the current in accordance with the trail ferry principle.

Section X
REINFORCED BRIDGES AND LIGHTENED BRIDGES

47. *a.* The normal bridge can be reinforced to carry the 30-ton medium tank by adding 2 balk in each floating span, one additional balk being placed on each side of the roadway. (See Figure 28) These balk are fastened in place with the spare balk fasteners. If the weight of the medium tank is increased in future apppreciably above 30 tons, the bridge should be reinforced by inserting an extra ponton in each floating span and four extra trestle balk in each fixed span.

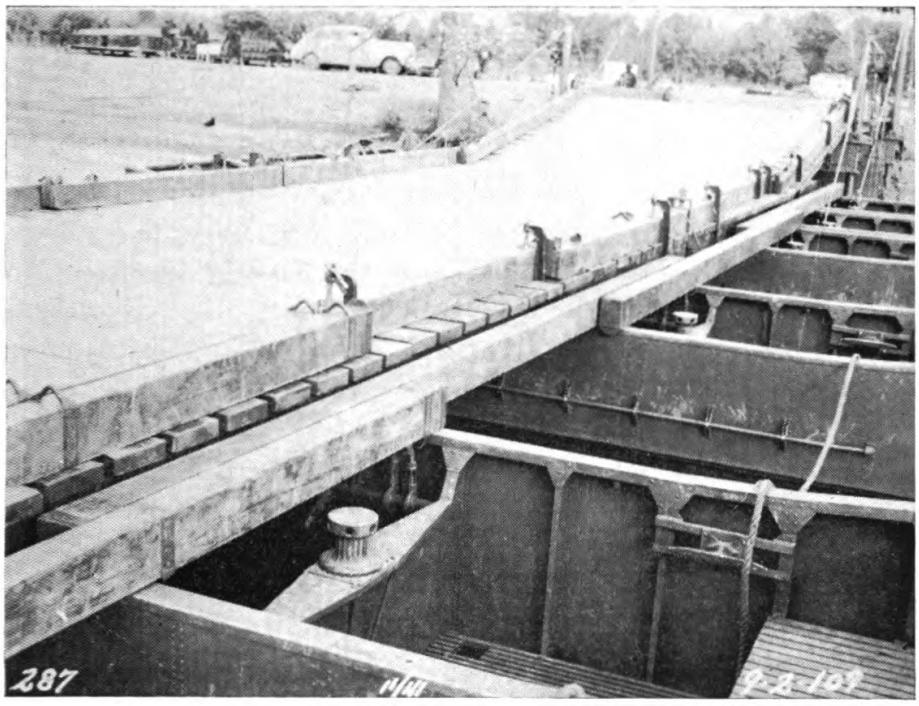

Figure 28. Method of placing one additional balk on each side of the roadway.

b. The bridge reinforced by inserting an extra ponton in each floating span and 4 extra trestle balk in each fixed span (between balk 2-3, 3-4, 7-8, and 8-9) will carry a tank load in the neighborhood of 35 to 40 tons. In its construction, there will generally be a problem in closing the gap left after the last complete reinforced floating span has been put in. The gap will often be too small to permit insertion of a reinforcing ponton and yet be of such extent that the unsupported length of ponton balk across the gap is comparatively great. (NOTE: in the reinforced bridge, the unsupported length of balk between adjacent pontons is approximately one foot measured between outside edges of gunwales of adjacent pontons.) If the unsupported length across the gap is appreciably greater than one foot, 14 balk should be utilized in closing the gap.

When practicable, the best method for the construction of this type of bridge is that of a combination of "By parts" and "By successive pontons". The floating spans of a normal bridge can be reinforced with additional pontons by submerging them partially by using loads of men or water and removing the loads after the pontons are inserted in the bridge.

c. The stability of the trestle should be assured by using rough timber or constructed timber footings on prepared earth for the shoe assemblies to bear upon. Tight shoe lines

of wire cable should be employed to keep the shoes from sliding off the footings and to keep the trestle erect. If necessary, the cables should be kept tightened by the winches of trucks placed perpendicular to the stream and at a practicable distance from the water's edge. For soft footings, two transoms per trestle can be used with the lower transom engaged in the lowest holes of the column. This provides additional bearing surface in the event the trestle footing proves inadequate. The employment of the two transoms also prevents the possible bending of the columns in compression.

48. LIGHTENED BRIDGES.— *a.* The normal bridge may be constructed with more than the normal interval between pontons, thereby obtaining a greater length per unit of bridge with a corresponding decrease in capacity.

b. When the bridge is to serve only light loads or there exists a shortage of pontons, the following methods can be used as valuable expedients:

(1) Partially extend the normal bridge span so that the span between boats is 15′ instead of 8′ 6″ by placing ponton balk across three gunwales of each two successive pontons. The 10 ponton balk per bay of bridge are staggered so that any two adjoining balk do not cover the same three gunwales. Transverse balk are always placed to add rigidity to the floor system. The lightened bridge is capable of carrying 15 tons with an effective length per span of 21 feet.

(2) Fully extend the normal bridge so that the span between boats is 21′ 6″ instead of 8′ 6″ by placing ponton balk across two gunwales of each two successive pontons. The 10 ponton balk per bay of bridge are used. The gaps across the gunwales of each boat are bridged with available short balk from the extra bay carried on each abutment load, by available extra transverse balk, available extra chess, or logs, improvising from available materials found by engineer reconnaissance. Five balk or substitutes are sufficient to bridge the gap between gunwales. These extra balk preserve the rigidity of the bridge and eliminate excessive hinge action at the boats. Transverse balk are always placed to add rigidity to the floor system. The light bridge is capable of carrying 10-tons with an effective length per span of 27 feet. The light bridge is extremely flexible and difficult to keep aligned.

(3) *(a)* The hinge span raft for both lightened and light bridges are built with 2 pontons at normal interval with 10 balk across four gunwales. The hinge sill is hung in the

8′ 6″ span between the two boats permitting some flexibility in the length of the bridge.

(b) Abutment and trestle spans are normal 15′ bays fitted with transverse balk and guyed.

c. When so weakened below its normal strength the bridge must be conspicuously marked with a sign to indicate its maximum allowable loading. A well-instructed bridge guard should be on duty to prevent overloading.

d. It should be noted that in the lightened bridges, there may be a shortage of chess when all of the trestles are employed. In these rare cases it will be necessary to improvise further by laying some of the chess tread style and moving the side rails toward the bridge axis to assist vehicles in staying on the tread roadway.

e. Either lightened bridge type may be reinforced to double its loading capacity by placing additional pontons in the intervals between pontons although the necessity of lightened construction will usually not exist if sufficient pontons are available. It may happen, however, that in the initial crossing, a lightened type will be built to cross the bulk of the light traffic, while the heavy loads are ferried. In the meantime additional equipment may become available from supply sources. It then may satisfy the immediate bridging needs to reinforce the lightened bridge rather than build a new bridge. When the situation permits, if sufficient material is available, the normal bridge should always be built to replace the reinforced lightened type and save equipage.

f. The trestle bridge may be extended from the normal 15′ span to a span of 21′ if ponton balk are used instead of trestle balk type. Ponton balk are not fitted with balk end irons of trestle balk type, but are fitted with balk stop clips and lashing hook eyes near each end. These two metal fittings are far enough apart to permit the balk to rest squarely on the transom tube with about 2″ of play. While the wood ends of the ponton balk will bear directly on the metal balk supporting tube the traffic to be passed will consist of light vehicles not exceeding 10 tons and the damage suffered by the ponton balk in bearing will be negligible. Transverse balk are always placed in each bay to add rigidity to the floor system. The lightened trestle bridge is capable of carrying 10-tons with an effective length per span of 21 feet. It is extremely rigid.

Section XI

DRAWSPAN IN BRIDGE

49. GENERAL.— It will sometimes be necessary to remove a part of the bridge to provide an opening for the passage of navigation or large floating objects likely to damage the bridge. To do this, one end of a swing line is attached to the upstream end of the center ponton of the part to be removed, and the other end to the downstream end of that ponton behind which the part will be swung. To open the draw, remove the bays of siderails, balk, and chess, which connect the part to be removed to the rest of the bridge and ease off on the upstream anchor cables of the part. When the part has dropped down clear of the bridge, the swing line is tightened and the anchor cables are loosened. The part will then swing over behind the ponton to which the swing line is attached. To replace the part, the slack is taken out of the anchor lines and the swing line is loosened. When the part has swung out below its place in the bridge, it is pulled upstream to the axis of the bridge by means of the anchor cables and reconnected. Special connections may be devised to facilitate this operation if it occurs frequently.

50. USEFUL SUGGESTIONS.— *a.* Where the removed section of bridge involves a considerable number of ponton bays, the power boat will be found useful in maneuvering the part into its open as well as its closed position. This is particularly true in streams having a swift current.

b. When the necsssity for providing a drawspan in a 25-ton ponton bridge can be anticipated, one end of the proposed removeable section should be constructed with a connecting span approximately three feet shorter than the normal. This can be done readily by employing detachable stirrups to connect the balk to the balk fasteners. The purpose of this special feature is to make allowance for apparent stretching or shrinking of the bridge length resulting from maneuvering the drawspan. The construction here described will permit ready replacement of the drawspan which might otherwise prove difficult if the bridge opening varied by as little as one inch.

c. During hours of darkness appropriate lights should be installed to mark the navigable opening in the bridge while positive means (barriers, or gates on approaches) should be taken to keep bridge traffic off the bridge while the drawspan is open.

Section XII

MAINTENANCE OF BRIDGE

51. GENERAL.— *a.* An engineer officer with a suitable detail of engineer troops is assigned to the supervision, maintenance, and guard of each completed bridge. This officer is responsible for the safe and speedy passage of traffic and his orders and those given by the bridge guard, pursuant to his instructions, must be strictly complied with by all persons using the bridge.

b. A bridge guard is detailed from the engineer detachment assigned to the bridge. The bridge guard posts a sentinel in an observation post near each end of the bridge to give warning of the approach of columns and one or more sentinels should be stationed on the floating part of the bridge to watch for floating objects likely to cause damage. These sentinels give warning when the bridge is in danger from any cause and see that the regulations for passage are complied with.

c. To prevent damage to the bridge from floating objects a detachment in boats or pontons is stationed about 1,000 yards above the bridge. The detachment is provided with cables, anchors, grapnels, hammers, axes, explosives, and other materials and equipment which conditions may suggest. Dangerous floating objects should be towed ashore well above the bridge if possible. If this cannot be done an anchor line should be made fast to the object which will prevent its movement downstream until it can be broken up with explosive or towed ashore and made fast.

d. Patrols should be sent well upstream to watch for dangerous floating objects whenever this appears desirable for the safety of the bridge.

e. The work of the bridge guard may be lightened by constructing a boom above the bridge composed of timbers or logs, united by chains and forming a continuous barrier to floating objects. It should form an angle of about 20° with the current, which will require the length to be about two and three-quarter times the width of the river. If constructed in this manner large floating objects will slide along the boom and be forced to the shore at the point where the downstream end is made fast.

f. A strong fish net, or wire screen attached to the boom and weighted along the bottom edge so that it hangs downward at least 3 feet below the surface, will provide further protection against partially submerged mines or other objects.

g. The engineer unit furnishing the bridge will also supply as many weapons as possible to safeguard the bridge.

h. The maintenance detail should maintain a constant inspection of the bridge to adjust anchor cables and the elevation of trestle transoms, to tighten loose siderail clamps, and to generally maintain the bridge in proper operating condition.

52. TRAFFIC CONTROL.— *a.* At a ponton bridge which must be utilized for two-way traffic, the ponton unit commander should set up the following traffic control agencies:

(1) Two-way traffic control detail.

(2) Detail to enforce requirements of speed and spacing on the bridge proper.

b. Two-way operation of a ponton bridge is best handled by an alternate one-way dispatch system. A traffic park should be established some distance from the bridge on the approach road on both sides of the stream. A traffic post will be located at each traffic park and the posts should be connected by telephone with each other and with the bridge proper. The traffic park should be located at the best available spot so as to provide cover and concealment for halted columns of vehicles waiting their turn to cross. While vehicles are halted, careful instructions should be given to the drivers as to speed and vehicle spacing when crossing the bridge. It is the responsibility of the traffic posts to prevent traffic from entering the controlled lane unless it is free of traffic coming from the opposite direction. It is also their responsibility to turn away any vehicles of weights beyond the capacity of the bridge. Traffic is sent forward in the form of a march unit or column. A distinctive object such as a sign, flag, or baton must be carried by the last vehicle in each group of vehicles using the lane. No group of vehicles is allowed to move on the controlled lane until this object has been retrieved from the last vehicle of the column clearing the lane from the other direction.

c. The detail charged with enforcing the requirements of speed and spacing is of great importance not only in safeguarding the bridge, but also in promoting the flow of traffic.

A guard should be posted at the head of the bridge to again caution the driver of each vehicle in the column to maintain the proper speed and spacing. Additional guards should be stationed in the pontons in order to maintain continuous control of the spacing and speed of vehicles.

d. The traffic priority schedule for the use of the bridge is established by proper authority, usually by the division or higher commander. Priority as to direction is especially important. Questions of priority not covered by standing instructions from higher authority should be decided by the officer in command of the bridge detail.

e. Poor approach roads often decrease the flow of traffic far below that which the ponton bridge could easily handle. Advance planning should provide for necessary improvement and maintenance of approach roads by general engineer troops.

f. That portion of the chess which lies outside of the siderails forms a walkway on each side of the bridge which is reserved for the use of the bridge detachment.

53. USEFUL SUGGESTIONS.— *a.* Since the siderails of the bridge overlap, the inside surface of the siderails is not continuous. If heavy vehicles, especially track layers, ride up on the exposed ends, the siderails will be damaged and there is danger that the vehicle will be thrown from the bridge. The maintenance detail can render the bridge much safer for wheeled and track laying traffic if they fill up the spaces between the inside line of siderail balk with 6 by 8 inch material. The inside surface of the siderails then becomes smooth and unbroken and it is much more feasible to run traffic at fairly high speed. When the 6 by 8 inch material has been cut to the proper length and fitted in the openings between the inside row of siderails, holes should be bored vertically in at least two places which coincide with the openings between the ends of the chess. Half inch rope can then be placed through these holes and made fast to the outer row of siderails.

b. A screen of brush or branches placed between the ends of the chess outside of the siderails on both sides of the bridge gives confidence to animals and aids in keeping them quiet while crossing the bridge. This is especially important for crossing cattle and loose animals.

c. The officer in charge of the bridge will frequently inspect the cables to see that they are not chafing and that the

anchors are not dragging. He will cause the mechanical balk and siderail fasteners to be tightened if they work loose and the pontons to be bailed out when they leak or ship water.

d. There should be collected near one abutment a supply of spare balk, chess, cordage, and other materials with which to repair any damage to the bridge. The supply of spare parts should be equivalent to at least ⅓ of the total number of the same parts actually in the bridge if the installation is liable to be subjected to artillery or aerial bombardment or other destructive operations on the part of enemy forces.

e. In case of severe damage to a portion of the bridge, removal of the damaged parts may be facilitated by severing the damaged section by sawing siderails and balk at the gunwales of the nearest undamaged boats. The section of bridge thus removed may then be replaced by complete parts of new bridge material. When damaged sections are sawed away from the bridge, shore lines should be attached to them so they may later be pulled ashore below the bridge and any salvagable parts reclaimed when time permits.

54. CAPACITY.—*a.* The safe capacity of this bridge is limited to 25 ton vehicles. This rating of 25 tons provides a small factor of safety to cover certain contingencies such as an accumulation of water in pontons, defective balk, failure to engage all balk fasteners, broken balk fasteners, current and wave actions and improper spacing of successive loads.

b. 25 ton loads should be exceeded only when all concerned are fully cognizant of the risks involved. The load limit should not be exceeded unless conditions are favorable and the officers and noncommissioned officers in charge of the bridge detail are thoroughly familiar with every precaution which must be taken when heavy loads are carried on the bridge.

c. When it becomes essential that loads exceeding 25 tons be allowed to cross the unreinforced bridge, the following precautions must be taken:

(1) All boats must be bailed dry.

(2) All balk must be sound. This is best indicated by a record of previous use with heavy loads.

(3) All balk fasteners must be secure.

(4) All siderail clamps must be properly placed and tightened.

(5) The speed of vehicles must not exceed 2 miles per hour.

(6) Last, and most important, vehicles must be properly spaced in column. (See paragraph *d* below).

d. When a concentrated load is placed near the middle of the bridge, well defined vertical waves will appear in the balk. The distance from crest to crest or from trough to trough of these waves is from 60 to 75 feet. Balk stresses are a maximum and ponton free boards are a minimum when the centers of gravity of the successive vehicles are spaced at this distance. Balk stresses are a minimum and ponton free boards are a maximum when the centers of gravity of the same vehicles are spaced at approximately one-half this distance. The correct spacing can be insured by having drivers maintain a distance of exactly two spans from the preceding vehicle, measured from head to head of vehicles.

e. The magnitude of the vertical wave action in the bridge deck is a function of vehicle speed as well as weight. Slow speeds lessen the amplitude of the waves.

f. The bridge officer should carefully observe the action of the bridge under the action of a succession of vehicles and require drivers to observe the speeds and vehicle spacings which place the least strain on the bridge structure. Tank drivers, unless especially trained, will tend to maintain too great an interval between vehicles in order that they may obtain a better view of the roadway ahead.

Section XIII
DISMANTLING BRIDGE

55. GENERAL.— The bridge may be dismantled and the equipment reloaded on trailers in the reverse order of the operations prescribed for the construction of the bridge.

56. PERSONNEL.— The following table shows the composition of the minimum working party necessary for smooth and continuous dismantling of the bridge by successive pontons:

Number of Sections	Name of Section	Non-Commissioned Officers	Privates	Total
1	Far shore section	2	20	22
1	Siderail section	2	10	12
1	Anchor section *(1)	1	5	6
1	Balk fastener section	1	10	11
1	Balk and chess section	1	54	55
1	Power boat section	1	1	2
1	Crane section		3	3
2	Trailer loading section	2	8	10
1	Hinge span raft section*(2)			
1	Maneuver cable section*(3)			
1	Rescue boat section	1	4	5
TOTAL		11	115	126

*(1) When power boat is not used, two anchor sections consisting of one non-commissioned officer and six privates (oarsmen) should be used.

*(2) The hinge span raft section, consisting of one non-commissioned officer and six privates, is organized from the balk and chess section, when the hinge span raft is reached.

*(3) The maneuver cable section consisting of one non-commissioned officer and six privates is organized from the balk and chess section after the hinge span raft has been reached.

57. DISMANTLING PROCEDURE.— *a.* The bridge should be dismantled in the following order:

(1) The far shore section removes the far shore abutment, abutment span, trestle, the hinge span, and the decking of the span between the third and fourth pontons from the far shore, and loads the parts therefrom onto the far shore raft. The raft is then propelled to the near shore by a power boat. When a power boat is not available the far shore raft may be trail-ferried to the near shore using the maneuver line. The far shore raft is then unloaded, dismantled and loaded onto trailers.

(2) The siderail section removes all siderail clamps, siderails, and transverse balk from the bridge and then joins the balk and chess carrying section.

(3) As the ponton boats are disconnected from the bridge, the anchor section raises the anchors and moors the

pontons along the near shore. When available, a power boat is used to propel the pontons to the near shore. Otherwise, the maneuver line is used for this purpose. The anchor section lends any necessary assistance to the crane section in loading pontons on trailers.

(4) The balk fastener section disengages the fasteners of all balk other than the ten balk in the deck of the far shore hinge span raft, beginning with the third ponton from the far shore, and works successively, as the bridge is dismantled, towards the near shore. After all balk have been disengaged, the balk fastener section joins the balk and chess carrying section.

(5) The balk and chess carrying section forms in single file along the right hand side of the bridge and carries balk and chess off on the left hand side of the bridge. No distinction is made between balk or chess carriers, i. e. these men may carry off either a balk or a chess depending upon which piece is to be removed when they reach the front of the line.

The first two men in line become chess lifters. They stand on the far end of the end bay remaining after removal of the hinge span raft and hand a chess to every two carriers as they pass by, beginning with the end chess. After the chess have been removed from the end bay of the bridge and the balk fasteners have been disengaged, the next ten men in line stand by the near shore ends of the ten balk. At the command of the non-commissioned officer in charge of the section, these men simultaneously raise the near shore ends of the ten balk and pull them towards the near shore, drawing the far shore ponton in until its gunwale is touching the gunwale of the near shore ponton. The next 30 men in line join the first ten men and carry the ten balk off the bridge in two or more groups. Similarly, chess and balk are removed from the end of the bridge successively until the near hinge span raft is reached.

Balk carrier hooks when not in use are laid on the deck near the far end of the bridge.

When the hinge span raft is reached, a section of one non-commissioned officer and ten privates is organized from the balk and chess carrying section to dismantle the hinge span raft.

At the same time, a section of one non-commissioned officer and six men is organized from the balk and chess section to remove the maneuver cable.

The balance of the balk and chess section dismantles the abutment span and lends necessary assistance to the crane section in removing and dismantling the near shore trestle.

(6) The power boat section operates the power boat, propels the far shore raft back to the near shore, and helps the anchor crew bring pontons to the near shore.

(7) The crane section loads pontons onto the trailers and removes the near shore trestle so that it can be dismantled on dry land. When the crane is not available, an additional section of one noncommissioned officer and twenty-five men should be provided to load pontons and transoms on the trailers.

(8) The four privates in the trailer loading section stand on top of the trailers, receive bridge parts from balk and chess carriers, and load them on the trailers in their proper places. The noncommissioned officer in charge of the trailer loading section checks the number of pieces on each trailer and is responsible for the proper loading thereof.

b. The rescue boat section remains in an assault boat near the end of the bridge in a position of readiness.

c. The dismantling procedure described in paragraph *a* is not recommended for general use other than as a drill for initial training of inexperienced personnel. For general use, the following described procedure is recommended both for speed in dismantling and for lessening the physical demands on the working parties. The latter consideration is of great importance in promoting high morale in the ponton units.

The hinge span raft and fixed spans are dismantled as described in paragraph 57 *a* (1).

In removing the decking from the remainder of the bridge, four or more 2½-ton cargo trucks are used in rotation. The truck is backed out on the bridge and loaded with a complete bay of decking, including chess, balk, transverse balk, siderail clamps, and transverse balk hangers. The truck is immediately run off the bridge and is backed up rear to rear to a previously spotted semitrailer. The component parts of the bay are transferred to the semitrailer. An important item in the labor saving of this method lies in utilizing the rear rol-

ler of the semitrailer to transfer the balk and chess by rolling them onto the semitrailer. The semitrailer, with its deckload, is then moved to the ponton loading site. Meanwhile, the next 2½-ton cargo truck has been backed out on the bridge and loaded in a similar manner.

As the pontons are disconnected from the bridge, they are brought to shore and pulled from the water by tractors or bulldozers and are placed by cranes on the semitrailers waiting in readiness.

For maximum speed in removing the decking, it is advantageous that chess be stripped one bay ahead of the ponton balk. In order to set up this arrangement, the chess, transverse balk and its hangers, siderails, and siderail clamps of the 1st bay riverward of the far shore hinge span raft should be removed and laid on the hinge span raft to be brought to shore therewith. The first 2½ ton truck will take the 10 ponton balk of the 1st riverward bay, and the two siderails, the siderail clamps, the transverse balk, transverse balk hangers and the 15 chess of the 2d riverward bay. During the time of moving off the 1st truck and the backing on of the 2d truck, the ten balk of the 2d riverward bay have been removed as described in paragraph 57*a* (5) and laid on the deck of the 3d riverward bay. Meanwhile the siderails and clamps and the transverse balk with its hangers have also been laid on the deck of the 3d riverward span awaiting the arrival of the 2d truck. The process is repeated for each truck load of decking removed.

58. For a very long bridge, it will often be advantageous to accomplish the dismantling by a combination of the previous method and the method of dismantling by parts. Under this arrangement, the far portion of the bridge should be dismantled by parts; the near portion by use of cargo trucks. The process of dismantling by parts is approximately the reverse of construction by parts. The original parts building sites will often be utilized for parts dismantling. On the other hand, the situation may demand that parts dismantling sites be prepared on the far bank. The ponton commander should plan in advance for efficient dismantling of the bridge. He should have the access roads to each parts dismantling site improved to permit, if possible, backing the trailer to the water's edge to allow easy loading of balk and chess directly from the parts as dismantled.

Section XIV

RELOADING EQUIPAGE AT BRIDGE SITE

59. PONTON LOADS.— *a.* A detail of 25 men and two non-commissioned officers can place a complete ponton load on a trailer in about ten minutes, manhandling all the equipage. By using a crane to lift the ponton into place one non-commissioned officer and 4 men who stay on top of the trailer and place the material as it is handed to them by balk and chess carriers can load a trailer in seven minutes.

b. To load the trailer, the transverse balk is first placed centrally in the well of the trailer between the retaining brackets installed to hold the member in position. Chess are then placed on either side of the transverse balk, in the well section, four chess to a stack, two stacks on either side of the transverse balk. The two "U" shaped spacers are next seated in the sockets provided in the trailer cross-members. Twelve ponton balk are placed on top of the chess — six on each side of the central spacers, forming two layers. Ponton balk are laid on their sides. The balk should be so placed that the balk fittings extend uniformly towards the *outside* of the trailer, except for the two balk in the central pile on each side which are reversed in order to permit the fittings of these balk to dovetail with the corresponding fittings of the balk in the inner stacks. As soon as the ponton balk are in position, the load binders are passed over the tops of the balk and tightened with the aid of the ratchet devices. While the decking is being placed the anchors and cables may be placed and secured in the space provided immediately in rear of the central well of the trailer. Siderail clamps and transverse balk hangers may be stowed in the covered chest at the rear of the trailer either before or after the ponton has been placed over the deck load.

c. To load the ponton by hand, it is turned bottom side up, with its long axis in prolongation of the long axis of the trailer. The front end of the ponton is then lifted sufficiently to clear the roller at the rear of the trailer, and the trailer is backed under the ponton until the ponton rests on the roller. The men are then gathered around the rear of the ponton to prevent its sliding backward. The trailer is backed up until the front end of the ponton almost touches the balk on the trailer. The auxiliary roller is placed on top of the balk and the front of the ponton is lifted and placed on this roller.

The men are again stationed around the rear of the ponton, the trailer is backed up until the ponton is over-balanced and lies on top of the trailer, the ponton is then pushed into its proper position and the auxiliary roller removed.

d. To reload the ponton with the crane, the process is the reverse of unloading as described in Section VI.

60. ABUTMENT LOADS.— *a.* One transverse balk, 16 chess, 2 spare anchors, and anchor cables are stowed as prescribed for ponton loads. The remainder of the equipment is stowed in the short cargo body of the tractor because the loaded balk prevents access to the covered well in the rear of the trailer before the trailer is unloaded.

b. The spacing bar is not used in the abutment load. Instead two sills resting on their edges are placed end to end in the center of the trailer over the transverse balk.

c. The 24 trestle balk are loaded in the same general manner as the balk on the ponton loads except that each of the two complete bays of balk are placed end to end, abutting over the center of the trailer. Two spacer blocks 6 x 12 are placed at each end of the trailer to support the ends of the trestle balk.

d. One extra bay of ponton balk is placed on top of the forward bay of trestle balk. Seven chess and 8 half chess are placed on top of the ponton balk.

e. Load binders are passed over the entire load and secured as soon as the last chess is in place.

f. The assault boat is placed over the rear portion of the trailer bottom side up and securely lashed with rope lashings.

61. TRESTLE LOADS.— *a.* One transverse balk, 16 chess, 2 spare anchors, anchor cables, siderail clamps, transverse balk hangers, and oarlocks are stowed as prescribed for the abutment load.

b. The deck load is divided into a forward and rear section, the two sections abutting over the approximate center of the trailer. The equipment and arrangement of the two sections differ so that each will be described in turn:

(1) The front half of the deck load contains 12 trestle balk, 2 transoms, 1 transverse balk, and 4 column shoes. The balk are stowed as in the abutment load, except that the transverse balk is inserted where the sill is placed in the abutment load. Both transoms are placed on their side on

top of the balk. When a crane is available it can be advantageously employed to swing the transoms into position on the trailer. After the transoms are in place the four column shoes are placed on top of the transoms, cleats down, and load binders secured, care being taken that a load binder holds each shoe.

(2) On the rear half of the deck load two trestle columns are laid along the center with their brackets on the forward end of the column. Two trestle balk are next placed in each side of these columns with their fittings dovetailing. The balk should be moved to the rear sufficiently far to permit the hoist brackets on the column, when rotated to a horizontal position, to clear the forward end of the balk and thus prevent any rearward movement of the columns. The remainder of the balk are placed as on the abutment load except that the columns take the place of the sill. Sixteen chess in piles of four each are stacked on top of this portion of the load and the whole section secured by the load binders.

62. GENERAL.— *a.* On all trailer loads two anchors with anchor lines are placed and secured in the space immediately in rear of the central well of the trailer. On all ponton trailer loads seven oars are placed in the rack provided on the undercarriage of the trailer and held in position by an eccentric roller. Two boat hooks are carried on each trailer load, being secured at convenient points beside the balk, or alongside the oar carrying rack.

b. The non-commissioned officer in charge of reloading a trailer is responsible that the trailer is loaded with all equipage composing its standard load and that the load binders are made fast before the trailer is allowed to move. He is the only person who should give signals to the tractor driver, when it is necessary to manipulate the trailer in loading.

Section XV
FERRYING

63. SINGLE PONTON.— *a. General.*— (1) Single pontons of the equipage may be used for the ferrying of personnel with their combat equipment and such other loads as the pontons will accommodate. The pontons are heavy and clumsy; carrying, launching, loading, and rowing them are noisy operations. Carrying pontons by hand for any considerable distance is a slow and exhausting job. The pontons are required for raft ferries and bridges and scattering them and

exposing them to damage and loss before the construction of bridges and ferries is undesirable. The assault boats are designed specifically for ferrying personnel and light equipment during the early stages of a river crossing, when the need for secrecy is paramount. Therefore, pontons should be used for this purpose only when it is unavoidable.

(2) The 25-ton ponton fully loaded cannot be propelled satisfactorily by oars. It may be propelled by an outboard motor, a power boat, or by pulling along a previously placed maneuver cable.

(3) Each ponton should be equipped with at least one anchor and its cable, two light hand lines 50 feet long, seven oars and oarlocks for emergency use in event of danger.

(4) The crew of each ponton consists of one non-commissioned officer in charge, two anchor men, and an outboard motor operator if the outboard motor is used.

b. Capacity.— (1) A ponton with an outboard motor will carry 100 men with full equipment, in addition to the ponton crew. No special provisions need be made for the 60 mm mortars and the light machine guns. In general two of the infantry heavy weapons and a supply of ammunition will displace 3 men. If oars are used, the safe capacity is materially reduced.

c. Embarking.— (1) A landing stage generally will not be required, the passengers wading from the shore directly to the boat and the materiel being handed in by wading men. In some cases chess laid from the shore to the gunwale of the boat will facilitate loading.

(2) At each embarkation point there should be an engineer officer or a non-commissioned officer to see that the personnel are properly formed for embarking and to supervise the actual embarking. It is advantageous to have at least two men standing by to secure the ponton to the shore, place the chess gangplank, if used, and to cast off the ponton when it is loaded. When the water is deep quite close to the shore it may be necessary to use chess gangplanks.

(3) The ponton is moored parallel or perpendicular to the shore in water deep enough to float the ponton after it has been fully loaded. The crew takes its post prior to the loading. When chess gangplanks are provided, they should be placed by the shore detail. At the command "Embark," given by the officer or the non-commissioned officer in charge

at the embarkation point, the men enter their respective compartments and seat themselves as directed. Rifles are carried at the trail during embarkation. The rifles and component parts of the 60-mm mortar and the light machine gun are stowed away in convenient spaces after the passengers are seated.

d. Conduct during crossing.— While the passengers are in the boat, they will promptly carry out the instructions of the engineer non-commissioned officer in charge of the boat and will remain steady in the ponton under all conditions. There will be no firing during the crossing. The passengers will maintain silence. They will avoid interfering with the oarsmen. Passenger officers and non-commissioned officers will assist the engineer non-commissioned officer in charge of the ponton and see that his orders and instruction are promptly carried out.

e. Disembarking.— (1) The ponton should be moored to the far shore perpendicular or parallel thereto as conditions may indicate. It is desirable to have two men stationed at the unloading point to secure the ponton to the shore during the unloading operation and cast it off after the unloading operation is complete.

(2) When the unloading point is reached and the ponton is secured against the shore, the passengers will debark under the instructions from the engineer non-commissioned officer in charge of the boat. In general, it will be necessary for the passengers to debark in water which is about 18 inches deep since this is the draft of the boat when fully loaded with personnel and light equipment.

64. RAFT FERRIES.— *a. General.*— (1) Rafts may be constructed with the equipage which are suitable for all loads which do not exceed the capacity of the normal or reinforced bridges. In general, the freeboard of the individual pontons in the raft should be at least 9 inches, after the load has been placed in its final position. This is the amount of freeboard available when each ponton has a live load of 15 tons. Often available floor space will govern the loading rather than the flotation capacity of the raft. Rafts are usually of the same construction as one or more ponton spans of the normally constructed bridge, reinforced if necessary.

(2) In general, a uniformly distributed load on the deck of the raft will cause the center pontons to show less free board than the end pontons. The same is true of a single

heavy vehicle. When several vehicles are loaded or when the raft is loaded with personnel, judicious distribution and spacing of the load will give a uniform freeboard on all pontons and reduce balk stresses to a minumum. When loading personnel in column of sixes (double column), this can best be accomplished by dividing the load into two columns of sixes, each closed up and placed as close to the ends of the raft as possible. This should leave an open space in the middle of the raft.

(3) When vehicles are carried on rafts, the full length of the raft cannot be occupied by the load. When vehicles are being loaded, the landing stage is first lower than the raft, and then higher as the load leaves the stage and passes onto the raft. The reverse action occurs during unloading. Accordingly, the junction between landing stage and raft must be bridged by chess or planks and space must be provided on the raft for placing them. When the trestle type (See *e* (3) below) of landing stage is used, the chess must be removed from the shore end of the raft to at least one foot beyond the hinge sill. With the trestle type of landing stage, the raft, if normally constructed, must contain a hinge sill at each end, in the same position as though it were a hinge sill raft in a bridge. If the reinforced construction is used, a hinge sill should be placed in the middle of each of the next to the end pontons.

b. Types of rafts.— (1) Two ponton — one bay. This raft consists of one normal ponton span of the bridge.

(2) Three ponton — two bay. This raft consists of two normal ponton spans of the bridge.

(3) Four ponton — three bay. This raft consists of three normal spans of the bridge.

(4) Any of the above rafts may be reinforced by placing an additional ponton within the normal intervals between every two pontons. The additional pontons are lashed in place by using four stirrups, one at each gunwale on the outside balk.

c. Propelling rafts.— (1) Rafts cannot be rowed effectively.

(2) The 22-hp. outboard motors and the power boat of the equipage provide an excellent means of maneuvering rafts of various sizes in all streams whose currents are within the power capabilities of the motors. The method of attaching the 22-hp. outboard motor to the power ponton and the

method of attaching the power ponton to the raft together with general considerations covering the use of outboard motors and power boats are discussed in Section XVIII.

(3) The power boat is very efficient in propelling rafts, and for this work requires no other additional equipment than a few lengths of towing cable.

d. Trail and flying ferries.— (1) The trail ferry principle may be used to propel the raft if the current exceeds 2 miles per hour at all points between landing stages. A cable is stretched across the stream and made fast to suitable trees or hold-fasts. If hold-fasts are used, the cable may be elevated by passing it over an A-frame erected near each end of the cable. A block and tackle is provided to take excess sag out of the cable from time to time as it stretches. A snatch block is fixed to the cable so that its sheave will be free to roll on the cable. Maneuvering lines are attached to the hook of the snatch block and are run to the ends of pontons at diagonally opposite corners of the raft as shown. To operate the ferry the raft is turned at an angle to the current by means of the maneuvering lines running to the block so that the upstream ends of the pontons of the raft incline towards the shore to which it is desired to move the raft. The current impinges upon the exposed sides of the pontons of the raft and forces it to move across the stream, the snatch block travelling on the cable. The speed of the raft increases the further the raft is pointed out of the current up to about 45°. The layout for the trail ferry is shown in Figure 29.

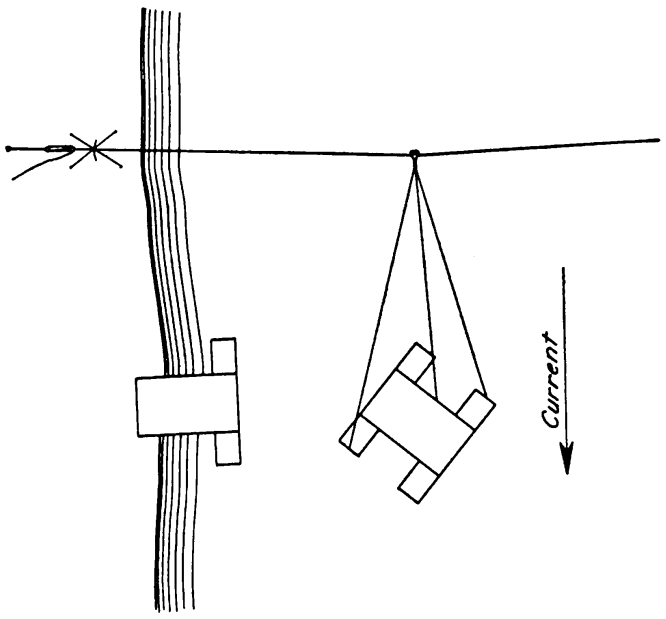

Figure 29. Layout for trail ferry.

(2) The flying ferry works upon the same principle as the trail ferry, except that the raft is held in the stream by means of an anchor cable which is made fast to an anchorage well upstream from where the crossings are to be made. If the strongest current is near one shore, the anchorage must be located near the other shore. If the current is uniform between landings, the anchorage should be located in midstream. The length of the cable must be at least one and one-half times the width of the stream. The cable is supported at intervals by pontons or other floats to keep it out of the water. The cable is made fast to the raft at its center, and maneuvering ropes for turning the raft toward one shore or the other are made fast to the cable. As the raft moves from shore to shore it swings on the arc of a circle about the anchor as a center. The flying ferry requires a current velocity of about 2½ miles per hour minimum from landing to landing, or slightly more than the trail ferry. The layout for the flying ferry is shown in figure 30.

(3) Where currents less than those indicated in (1) and (2) above are encountered, the principle of the trail and flying ferry is useful in providing security against drifting downstream, but the movement between landings should be accelerated by the use of an outboard motor.

(4) When ferrying operations are conducted on very wide bodies of water with moderate currents, it may be desirable to dispense with the trail or flying ferry and operate several free rafts propelled by outboard motors between the same set of landings. The number of free rafts which can be operated between one pair of landings without interference will depend upon the ratio of crossing time to either loading or unloading time.

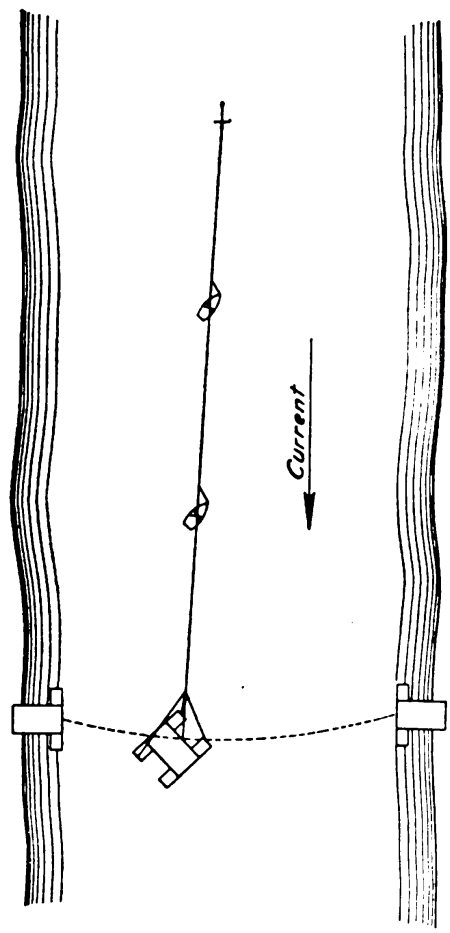

Figure 30. Layout for flying ferry.

e. Landing stages.— (1) General.— Landing stages must be provided at each bank for ferrying vehicles. For very light vehicles, the simple floating type of landing stage will suffice; however, the trestle type is preferred, and must be used for heavier vehicles.

(2) Simple floating landing stage.— *(a)* The simplest form of landing stage is constructed by laying a span of the bridge from an abutment sill on shore to the far gunwale of a ponton moored at the proper distance from and parallel to the abutment sill. Ponton balk are used for this purpose. Two ponton balk should be used as siderails and siderail clamps placed and secured at the quarter points of each siderail. A transverse balk is placed under the middle of the span. The balk fastener loops nearest the end of the ponton balk should extend shoreward of the shore edge of the abutment sill. A chess end dam is used at the abutment end of the balk. The details of this form of landing stage are shown below in Figure 31.

(b) This floating landing stage will suffice for light loads whenever deep water is available near the shore and when it is possible to place the abutment sill in firm ground with its upper surface not less than 1 foot and not more than 3 feet above the water with a reasonable amount of grading. In other cases the trestle type will have to be used.

(c) When loads move from the landing stage onto the raft and vice versa, the floors of the two structures will assume different levels because of the action of the pontons under the load. When the difference in elevation between the floor of the landing stage and that of the raft caused by a load on one or the other is appreciable, some means of transferring the load from the landing stage to the raft or vice versa must be provided. For light loads this may be accomplished by laying tracks of chess on the loaded or lower part with not over 6 inches of the ends of the chess engaged over or on the higher part. When animals are loaded, at least 10 chess should be laid side by side in order to cover the crack between the raft and the stage completely so that there is no danger of animals stepping into the opening. When the load comes on the tracks of chess, the higher floor level will be forced down so that the elevation of the stage and of the raft will be the same as the load transfers from one to the other. Where axle loads exceeding 2 tons are expected, two 6-inch by 12-inch timbers or hewed logs about 10 feet long beveled

on the ends and constructed into ramps should be used in place of chess. Two sets of ramps must be provided, one set for each landing stage.

(d) Several thick rope or truck tire buffers should be suspended along the river side of the landing stage to cushion the shock of collision between the landing stage and the raft.

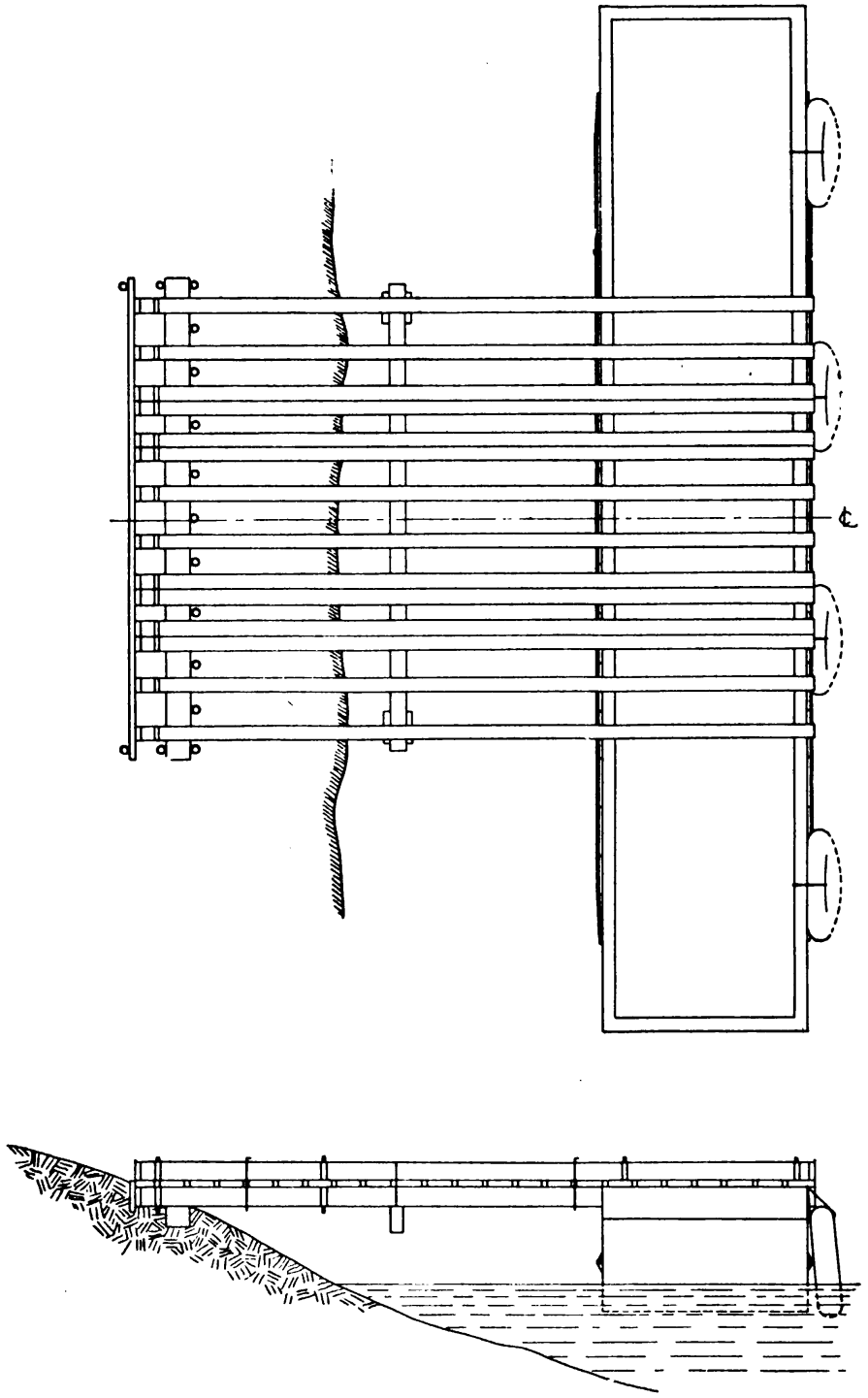

Figure 31. Landing stage for ferrying operation.

(3) Trestle type landing stage.— *(a)* In this type of landing stage, a standard abutment span is constructed and any number of standard trestle spans may be used if necessary to reach water deep enough to float the loaded raft. The raft containing a hinge sill is brought into place and a hinge span is constructed to serve as a movable drawbridge connecting the raft to the river trestle. A transverse balk is used in the hinge span in such a position that it is as near the midpoint of the span as possible and still clears the near gunwale of the near ponton when the balk of the hinge span are resting in their proper place on the hinge sill. A snatch block is suspended from the chain hoist brackets at the top of the columns. A one inch rope is placed in each snatch block. The riverward end of the ropes are made fast under balk Nos. 1 and 10 respectively, each rope being placed under the balk and over the siderail. The shoreward ends of the ropes are made fast to two chain hoists, each of which is fastened by lines either to a deadman on shore or to the transom of the next shoreward trestle. By operating the chain hoists simultaneously, the entire hinge span is lifted to clear the raft or is lowered to engage the raft.

(b) A double guy line should extend back from the top of each column of the far trestle to a holdfast on shore. This double rope should be twisted tight by means of a picket or rack stick. The chain hoist, column and guy line should all be in the same vertical plane so that a straight line pull is exerted.

(c) Each balk of the hinge spans should be lashed loosely to the transom. Tight lashings will pull the metal fittings out of the balk.

(d) The chain hoist hooks must be disengaged from the rope slings when loads are moving onto or off the raft.

(e) Two men must be stationed at each of the two chain hoists to operate them together in a coordinated manner.

(f) The landing stages are constructed by the same details as would ordinarily build the sections of a standard bridge which compose the landing stage. The far shore section thus builds the far shore landing stage in a similar manner.

f. Loading.— (1) Vehicles must be chocked to keep them from rolling while on the raft. A trestle balk or chess,

laid across the roadway of the raft on top of the siderails with its wider faces horizontal makes a good chock. It is placed against the wheels and lashed to the siderail.

(2) Nervous and otherwise troublesome animals should be led onto the raft and held by a dismounted man during the crossing. Animals should be handled by the personnel to whom they are accustomed. If a large number of animals are to be ferried, it will help to keep the animals quiet if a rope rail is placed along the sides and the ends of the raft. The addition of brush, secured to the rope rail at the top and to the siderails at the bottom, will aid in keeping them quiet. Particularly troublesome animals should be blindfolded.

(3) Personnel to be ferried are formed in columns of sixes and marched onto the raft with normal marching distance between ranks. The separate ranks close up to the distance which will give uniform distribution of the load on the roadway of the raft or which will give the most favorable load distribution. Personnel stand at ease while on the raft. The ranks resume normal marching distance as they march off.

g. Crew and equipment.— (1) An engineer officer with a suitable detail of engineer enlisted men is assigned to the supervision and operation of each raft. This officer is responsible for the safe and speedy loading, passage, and unloading of the raft.

(2) The raft should be provided with the necessary anchors and anchor cables attached with which to hold the raft in the stream in case the outboard motor fails or the trail or flying ferry cable parts. Men should be stationed at these anchors with no other duties than to cast them in case of necessity.

h. Conduct during the crossing.— From the time the loads are turned over to the engineer officer in charge of the raft for loading until they are unloaded on the opposite bank, the loads are under his orders and those of the noncommissioned officers of his crew. All instructions issued by them will be promptly and strictly complied with. All officers and noncommissioned officers who are passengers on the raft will assist the engineer officer or the noncommissioned officers under him in any way that may be necessary.

i. Expedients.— (1) Several rapid methods for loading and unloading vehicles up to and including the light tank

in size can be used with the equipment at hand in a ponton company. One such method makes use of the tractor ramps furnished for loading and unloading the medium tractors from their trailers. If the raft is constructed with a sill placed *outside* the shore gunwale of the shore boat and the raft end of the tractor ramps supported on this sill, vehicles up to and including the light tank can be readily loaded and unloaded.

(2) If any treadway sections of the armored force bridge are available, an excellent rapid means of constructing ferries is at hand. Any expedient which eliminates the use of fixed landing stages will result in a saving of time and will aid in the flexibility of the installation.

Section XVI

TIME AND LABOR REQUIREMENTS

65. GENERAL.— *a.* The tables which follow show the time and labor requirements for performing the various operations described in this chapter. It must be understood that the figures given are to serve as guides only and are based upon the conditions stated in the table. Time and labor requirements will vary widely from these figures depending upon conditions. The figures given under the conditions shown apply to work in daylight with personnel fairly well trained in their duties, familiar with the equipment, and in good physical condition. Work at night without lights and with inexperienced personnel not accustomed to the hard labor required will consume much greater time for each operation than the figures shown. In general, night operations will consume twice as much time as in daylight. For a ponton bridge whose construction will require more than 5 to 6 hours, plans should be made to provide reliefs for the working parties in order to avoid exhaustion.

b. No figures can be given for the handling of the transportation immediately preparatory to unloading. The time required for these operations depends upon the terrain, the conditions of the road or the soil, the weather, the size of the area available, and the traffic circulation which the site provides. In any plan for the use of the equipment, ample estimates must be made for this phase of the operation.

Operation	Personnel Required	Time	Conditions
Unloading Trailers			
Ponton Load	2 NCO and 25 Pvts or crane and 1 NCO and 15 Pvts	10 minutes 5 minutes	Unloading by hand. Using crane to unload ponton. Remainder by hand.
Trestle Load	2 NCO and 25 Pvts or crane and 1 NCO and 15 Pvts	20 minutes 15 minutes	Unload by hand and pile 25′ away. Crane unloads transoms. Rest by hand.
Abutment Load	1 NCO and 15 Pvts	10 minutes	All unloaded by hand.
Handling Ponton			
Carrying and launching	30 to 40 men	4 minutes first 100 feet; add 10 minutes for next 200 ft.	A clear path to the water—fairly level and even ground—no difficulties at river bank.
Loading Trailers			
Ponton Load	2 NCO and 25 Pvts or crane 1 NCO and 15 Pvts	10 minutes 7 minutes	Loading by hand. Ponton loaded with crane. Rest by hand.
Trestle Load	2 NCO and 25 Pvts or crane 1 NCO and 15 Pvts	20 minutes 15 minutes	All loading by hand. Transoms loaded with crane. Rest by hand.
Abutment Load	1 NCO and 15 Pvts	10 minutes	Loaded by hand.
Bridge Construction by Successive Pontons			
Abutment Section	1 NCO and 6 Pvts	15 minutes	Approach already prepared.
Trestle Section	1 NCO and 9 Pvts and crane or 1 NCO and 12 Pvts	15 minutes 15 minutes	Trestle assembled while abutment is being prepared and is set by crane. Trestle set by hand.
Additional Trestle	Same	Same	Same
Hinge Span	1 NCO and 10 Pvts	30 minutes	Hinge span raft assembled while abutment is being prepared.
Ponton Span		7 minutes per bay	
Far Shore connection			
1 Trestle	2 NCO and 20 Pvts	2 hours	Raft constucted on near shore and material rafted to far shore and placed.
or 2 Trestles	4 NCO and 32 Pvts	2 hours 30 minutes	Same

Operation	Personnel Required	Time	Conditions
Cable Section	2 NCO and 10 Pvts	10 minutes	River 300 feet. Current not over 3 m.p.h. Motor boats used to carry cable over.
By Parts			
Shore Connections	Same as for successive pontons		
Each Part	Party same as for successive pontons	6 minutes per bay	Parts constructed simultaneously.
Ferrying—General Conditions	River 300′ wide	Current 2 miles per hour	Water at bank deep enough to float loaded ponton.
Single Pontons			
Single ponton with infantry loaded lightly	Crew of 7 and 2 privates on each shore	10 minutes	Boat manned by 6 oars—Time includes embarking, crossing, debarking, and return trip of empty boat.
Same as above	Crew of 3 and 1 NCO and 2 Pvts on shore	6 minutes	Boat propelled by outboard motor.
Rafts			
Construction	1 NCO and 30 Pvts	25 minutes	3 Boat Raft. Normal ponton span construction only. Material for building raft conveniently segregated and stacked.
Landing stage construction	20 Privates	45 minutes to construct single ponton landing stage	All materials sorted and stacked not over 100′ from abutment.
Time to construct landing stages involving use of one or more trestles and hinge span raft	See requirements for shore connections in method of successive pontons		Unreinforced construction only. Material for building raft not over 100 feet from site.
Time to load rafts	Varies depending upon nature of load	1 to 3 minutes, depending on type of load	Raft loaded from landing stage.
Crossing time of rafts	Depends on conditions and size of raft	2 to 4 minutes, depending on size of raft	Free raft propelled by an outboard motor.
Same as above	do	2½ minutes	Trail ferry only
Same as above	do	3 minutes	Flying ferry only
Same as above	do	1½ minutes	Trail or flying ferry with outboard motor.

Section XVII

ROWING DRILL

66. GENERAL.— 25-ton pontons are much more difficult to maneuver with oars than are the light pontons. In streams having a velocity in excess of about three miles per hour, outboard motors, power boats, or maneuver cables should be employed where pontons have to be moved at a distance from shore. However, thorough training as an oarsman is essential for a well instructed engineer soldier. Even when using power boats or cables, skilled oarsmen are required to handle and place the individual pontons. Where manual operation of pontons must be relied upon 16-foot oars will be found more effective than 14-foot oars, although requiring better trained oarsmen.

67. INDIVIDUAL INSTRUCTION.— *a.* Individual instruction in the use of the oars, paddles, and boat hooks should be carefully supervised by the commissioned officers of the company to see that every part of the drill is properly taught.

b. The instructor (usually a noncommissioned officer) embarks his detachment, consisting of 6 oarsmen, and pushes out into deep water where he casts anchor. The ponton is provided with 7 oars, 2 boathooks, and 1 anchor and cable. The instructor, placing himself in the stern, details each oarsman in turn to practice with the oar, the others paying close attention to the drill.

c. At the command ATTENTION, the oarsman inserts the rowlock in the socket, and then facing aft places himself in the middle of the ponton abreast of his rowlock, assuming a standing position and trimming boat.

d. At the command UP OARS, he grasps his oar and raises it briskly to the vertical in front of the center of his body, the handle resting on the bottom of the boat and the blade parallel to the keel. The hand next to his rowlock grasps the oar at the height of the chest, elbow and wrist horizontal; the other steadies it at a point 12 inches lower.

e. At the command LET FALL, he side-steps 18 inches with the foot opposite the rowlock, and allows his oar to fall outward so that the blade strikes the water while the shaft is held clear of the gunwale. He then places the shaft in the rowlock, 3½ feet from the end of the grip, with the blade

horizontal. He next slips one hand to the grip and places the other on the oar 8 inches from it, the backs of both hands being up and the wrists lowered, and moves the foot next to the rowlock 18 inches to the rear. Only 3½ feet of the oar should be in the ponton.

f. At the command GIVE WAY, given when the oar is at the final position indicated for LET FALL (or at HOLD WATER, in which case the oar is at once brought to this position), he raises his wrists and extends his arms, throwing the weight of the body well forward, drops the blade vertically into the water, throws his weight strongly backward upon the oar, disengages it from the water, and resumes his first position. These motions are repeated with regularity, taking care to make a long sweep, to keep the oar near the water, and to feather it by depressing the wrists after every emersion until the command WAY ENOUGH or OARS is given. The instructor will take care that the oar is moved by the weight of the body and not by the force of the arms.

g. At the command WAY ENOUGH, given when the oar is in the water, the oarsman takes one stroke, raises his oar to a vertical position, and lays it gently in the ponton, the blade toward the bow.

h. At the command OARS, given when the oar is in the water, he takes one stroke if rowing, and resumes the final position indicated for LET FALL. If at the position HOLD WATER, the stroke is omitted.

i. At the command HOLD WATER, given when the oar is in the final position indicated for LET FALL, the oarsman raises the grip so as to engage the blade in the water, and holds the oar firmly at right angles to the ponton, blade vertical. The object is to check the headway when in motion.

j. At the command STERN ALL, given when the oar is at HOLD WATER, or at the final position indicated for LET FALL, he reverses the operation of rowing as described under GIVE WAY, and by pushing vigorously against the oar when immersed, gives the ponton a motion astern. The operation ceases at the commands WAY ENOUGH or OARS, which are executed as described above.

k. The command UNSHIP is given when the oar is in the final position indicated for LET FALL, and is executed by removing the oar from the rowlock and letting it trail

alongside, held by the hand next the gunwale. This position is used whenever it is necessary to prevent fouling the oars suddenly. At the command SHIP the oar is restored to its former position.

l. The command BOAT OARS may be given when the oar is in the final position indicated for LET FALL or at UP OARS. The oarsman raises his oar to the vertical, if not already there, lays it quietly on the bulkheads of the ponton, blade toward the bow, and takes the position of ATTENTION.

68. SCHOOL OF THE PONTON.— *a.* The object of this school is the instruction of the oarsman in the management of the single ponton. It is not to be taught until all of the crew are thoroughly familiar with the use of the oar as described under individual instruction. The exercise will be conducted under the close supervision of a commissioned officer. The right and left of a boat are the right and left sides when facing the bow.

b. To embark, the instructor provides his detachment with seven oars and two boat hooks, forms it in single rank, with the best oarsmen on the right, commands LEFT FACE, and marches it into the ponton. Oars and boat hooks are carried on the shoulder, blades or hooks well up. The oars are deposited in the bottom of the ponton, six with the blades toward the bow and the seventh reversed. The boat hooks are placed outside the oars, prongs toward the bow. The cable is coiled in the bow, with the lower end made fast to a bow mooring cleat and the other attached to the anchor by an anchor knot. The anchor is placed with its flukes over the bow.

c. At the command ATTENTION (executed as under individual instruction) the crew arrange themselves in the order in which they were formed on shore, the right oarsman (stroke oar) taking the after rowlock and the others alternating, the even numbers being on the left side. The instructor then directs one or two of the crew to step ashore, remove the moorings, and prepare to push the ponton from the bank.

d. At the command UP OARS (executed as under individual instruction) the instructor takes the reversed oar himself and, drawing it aft horizontally, puts the blade over the stern.

e. At the command SHOVE OFF the men on shore, aided by the instructor, and, if necessary, by others of the crew with their oars, disengage the ponton from the bank and jump in. All the oarsmen then assume the position of UP OARS, and the instructor places his oar in the stern rowlock in readiness to direct the course of the boat.

f. The command LET FALL (executed as under individual instruction) is then given.

g. The crew is next drilled to execute in unison the following movements as prescribed under individual instruction, the after right oarsman (stroke oar) giving the cadence: GIVE WAY; WAY ENOUGH; UP OARS; LET FALL; OARS; HOLD WATER; STERN ALL; UNSHIP; SHIP; BOAT OARS; REST. In order to secure the simultaneous and prompt execution of these movements the preparatory commands similar to the following may be used: STAND BY TO GIVE WAY; STAND BY TO LAY ON OARS; STAND BY TO STERN ALL. These exercises will be continued until the entire crew can execute them properly.

h. When the crew is well drilled in the foregoing simple exercises, the following more complicated movements will be taught:

(1) To turn the ponton rapidly, the oars being at the final position indicated for LET FALL, the instructor commands GIVE WAY RIGHT (or LEFT); BACK LEFT (or RIGHT). Pulling and backing oars keep stroke with the after oar of their own side. To cease turning the instructor commands GIVE WAY, at which the backing oars take the direct stroke. Assisting with his own oar, the instructor can turn the ponton with great rapidity and in a very small space by this method.

(2) To cast anchor the ponton is first headed to the current and its way checked. At the command PREPARE TO CAST ANCHOR, the right and left bow oarsmen boat their oars; the former unships the bow rowlock (if in the socket) and sees that the cable is clear, while the latter grasps the stock with both hands near the shank, and stands ready to cast it overboard. At the command CAST ANCHOR he tips it into the water and assists the right bow oarsman in paying out the cable. When the ponton has dropped astern (or been backed) about five times the depth of the water, they take a single turn around one of the bow cleats and

hold strongly upon the cable to make the flukes take hold of the bottom. When this is accomplished, they gradually pay out about as much more rope, and then secure the cable to one of the bow cleats. The instructor then commands BOAT OARS.

(3) To weigh anchor, the crew being at ATTENTION, the instructor commands: 1. PREPARE TO WEIGH ANCHOR; 2. UP OARS; 3. LET FALL. At the first command the left bow oarsman loosens the cable from the cleat and, aided by the right bow oarsman, passes it over the middle of the bow; they stand ready to haul in. The remaining oarsmen obey the second and third commands as given. The instructor then commands GIVE WAY and causes the ponton to be moved slowly toward the anchor, the bow oarsman taking in the slack of the cable and neatly coiling it away in the bow. While the cable becomes vertical, the way of the ponton is checked, and the two men, pulling vigorously, raise the anchor to the bow, where it is held by the right bow oarsman, while the left bow oarsman grasps the stock with both hands, and, aided by the other bow oarsman, lifts it to its position already described. Weeds should be removed by hand and the anchor cleaned by dipping. They then resume their oars and take the stroke.

(4) To debark on approaching the landing place, the ponton being headed in the proper direction, the instructor commands IN BOWS. At this command the bow oarsman takes one stroke, and, boating his oar as directed under individual instruction, takes a boat hook and stands ready to assist in the landing. When sufficient way has been gained, the instructor commands WAY ENOUGH, and the stroke oarsman takes the remaining boat hook to assist in the landing. The instructor with the steering oar then brings the ponton to the bank in the most convenient manner, causes the rowlocks to be unshipped and the ponton to be properly secured, and lands his men in a way similar to that prescribed for embarking them.

i. When anchoring the heavy ponton it will be found helpful to require the bow oarsmen to take one round turn around the capstan in a clockwise direction before making fast to the bow cleats. The capstan may then be used to take in the cable where positive adjustment has to be made in the position of the single ponton as is the case when placing pontons on line in bridge construction.

Section XVIII

OUTBOARD MOTORS AND POWER BOATS

69. OUTBOARD MOTORS.— *a.* Included in the organizational equipment of each unit of ponton equipage are the following:

4 22-hp. outboard motors
4 attachment brackets.

b. The 22-hp. motor weighs approximately 110 pounds and has an over-all length of about 52 inches and an over-all width of about 18 inches. It carries a three-blade propeller with a diameter of 12 inches and a pitch of about 8 inches. It is a nonreversing, twin-cylinder, rope-starting motor, rated at 22 hp. at 4,000 r.p.m. It has, however, 360° steering which permits the effect of reversing the motor. An instruction book for the operation and care of the motor is furnished with each motor and describes in detail the parts of the motor.

c. An attachment bracket is furnished for each 22-hp. motor. It is fastened to the stern of the ponton, clamping over the top of the ponton and hooking over a lug on the skids. Movable metal arms carry a board to which the motor is attached. The board is raised or lowered by a lever so that the propeller may be kept submerged at the proper depth regardless of the draft of the ponton.

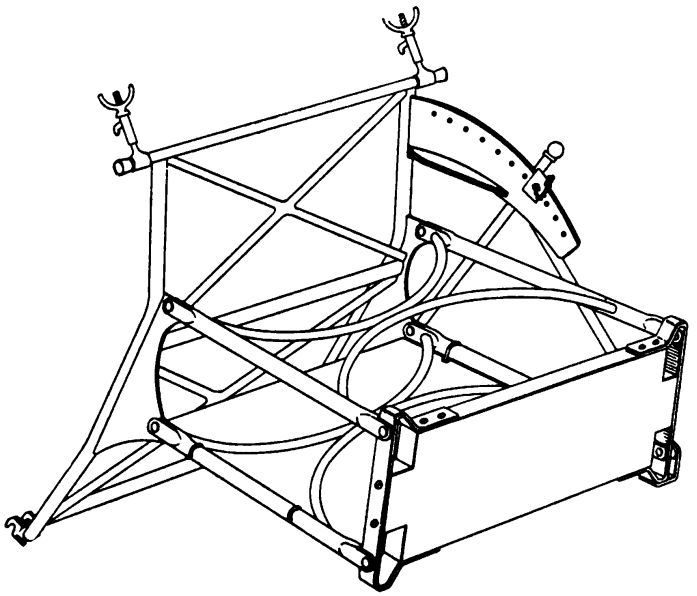

Figure 32. Outboard motor attachment bracket.

d. Successful and dependable operation of outboard motors is assured provided the directions contained in the

manufacturer's instruction book are faithfully and precisely followed, and the motors are operated only by men trained in their use. Otherwise the operation of outboard motors will be unreliable and unsatisfactory. The following points are worthy of especial emphasis:

(1) Special boxes are provided for transportation of motors by truck and always must be used. Motors must not be dropped on the ground whether in their boxes or not. Motors should be covered when not in use.

(2) The instructions of the manufacturer regarding spark plugs and the mixture of oil and gasoline are especially important and must be followed exactly.

(3) Dirty or wet spark plugs are the most frequent cause of failure of an outboard motor to start or to operate properly. The motor operator always should carry at least one extra set of clean, dry spark plugs in his pocket so as to be prepared to make immediate substitutions when necessary. It has been found that if an outboard motor does not start after four or five vigorous pulls on the starting rope the best procedure is to replace the spark plugs with dry ones, and clean the carburetor and fuel lines of any water that might have been in the gasoline. Spark plugs should be replaced after about seven hours use and all gasoline should be carefully handled to reduce the possibility of the introduction of water.

(4) Motor operators should be prohibited from disassembling the motor other than removal and replacement of spark plugs and removal and replacement of fuel line screens. Other repairs are shop jobs to be performed under the supervision of a skilled mechanic.

(5) After removal from the water the outboard motor should be carried with the propeller inclined downward until all water has been drained from the underwater exhaust system; otherwise, the water may get into the cylinders if the exhaust ports are open, and cause hard starting even if the motor is used again without delay. If the motor is stored, serious damage to the engine will result if it is stored with either fresh or salt water in the cylinders.

e. (1) This motor is for use with the ponton equipage in bridging and ferrying operations. Attached to a single ponton it has many uses, such as ferrying troops, anchor work, moving pontons to their places in the bridge, patrolling, taking

a line or detail to the far shore and similar work. In currents of three miles per hour or more, the efficiency of bridging and ferrying operations is greatly increased by the use of the outboard motors.

(2) In propelling rafts the outboards are necessary. For a two-ponton raft the motor may be attached to one ponton of the raft. For larger rafts the motor should be attached to the stern of a separate ponton, which is used as a power ponton, fastened to the rear of the center of the raft. To hold the power ponton parallel to the pontons of the raft, lines should be run from the sides of the raft to the stern of the power ponton. Training and practice are necessary for efficiency in the use of motors in ponton work.

(3) Motors can be used only in streams of sufficient depth to prevent damage to the propeller. The propeller should be raised and cleaned of weeds as often as necessary. Driftwood may damage the propeller if care is not exercised.

70. POWER BOATS.— *a.* One 16-foot utility power boat with an inboard motor is provided for use with each bridge unit. The care of the motor is fully described in the manufacturer's instructions accompanying the equipment. The power boat is for general utility work around the bridge or ferry site, making reconnaissance patrols, patrolling for debris, as safety boat, placing anchors, etc. It is not recommended for ferrying troops because of its limited capacity.

b. The power boat is transported on a two-wheeled trailer and is towed behind a 2½-ton cargo truck.

Section XIX

MAINTENANCE OF EQUIPAGE

71. GENERAL MAINTENANCE.— *a. General.*—(1) Proper care and maintenance of the ponton equipage in accordance with a routine program is essential to keep it in condition for use as required, and to avoid any possibility of failure of any of its parts either to operate properly or to carry the heavy loads that the equipment may be subjected to. This is especially true because of the number of mechanical devices included in the equipage, and the fact that factors of safety in all parts of the equipment have been kept small in order to keep weight down. Moreover, proper maintenance will insure the appearance of general smartness expected of all military equipment.

(2) A regular program of inspection, cleaning, replacement, repair, and painting should be set up and adhered to. It is especially important that all parts of the equipment be carefully inspected and corrective measures taken when the equipment is put away after extended use.

(3) It is important that all parts of the equipment be kept clean. This is particularly true of the numerous mechanical devices which often will not operate properly when foul. The equipment must be thoroughly cleaned before being stored for any considerable period or serious deterioration will result. Keeping the aluminum pontons and trestles and the wooden parts of the equipage thoroughly painted is essential. In general, the various mechanical devices are designed to operate satisfactorily without lubrication. Screw parts particularly should not be lubricated because experience has shown that this leads to an accumulation of dirt and dust in service use, which is apt to cause more fouling and damage to the screw parts than results without lubrication.

(4) The equipment should always be stored under cover, when practicable. When open storage must be used, parts of the equipment should be so disposed that water will drain from the stacks, there will be adequate ventilation, and none of the pieces of the equipment will be placed in direct contact with the ground. It is especially important that equipment is well painted when stored in the open for any extended period.

(5) Points regarding the care and maintenance of the several parts of the equipment are covered in the succeeding paragraphs.

b. Pontons.— (1) The aluminum alloy of the ponton is subject to corrosion, which not only causes a break-down of the surface of the metal, as with iron and steel, but also of the whole structure of this metal. This process is accelerated by salt or brackish water. Accordingly, care must be taken to keep the pontons painted.

(2) Periodically when in use, and invariably before storing, the ponton should be thoroughly cleaned and washed, both inside and out, and thoroughly dried. This process should include removal and cleaning of the grating.

(3) The pontons may be stored under cover, stacked or loaded on the trailers, as desired and as space permits. When stored stacked under cover, they may be placed in the

stacks either upright or inverted, with stacks no higher than three pontons. The bottom ponton in the stack should be held off the ground or floor by timbers or other materials at least 10 inches thick, placed so that the ponton will rest evenly on at least the four points where the outside bulkheads intersect the sides of the pontons. Cross timbers should be placed similarly between pontons in one stack.

(4) Pontons should never be stored in the open on the trailers nor upright on the ground. This is especially important if the pontons are stacked in the open because serious damage may result from an accumulation of rain water or snow in them. Even for temporary storage prior to use, it is desirable to place them bottom side up, to avoid having to pump them out.

(5) Care should be taken to avoid resting or dragging the ponton over sharp obstructions. When pontons are being turned over, particular care should be taken to avoid damaging the carrying rail.

(6) Balk fasteners should be kept fast in their keepers, except when actually in use. Particular care should be taken that the mousing on the spare balk fasteners remains in place to avoid their loss.

c. Trestles.— (1) The trestle is made of aluminum alloy throughout, except for a few parts of the shoes, and requires the same care to avoid corrosion as does the ponton.

(2) The trestle parts may be stored in any convenient fashion provided care is taken to prevent crushing or bending of the columns and transoms. Preferably, the transoms should be placed erect, to avoid any possibility of bending or damage to its lashing cleat castings by placing loads upon it when laid flat. Trestle shoes may be stacked or laid side by side, teeth down, the top of the columns also laid side by side.

(3) It is especially important that no load is placed on the transom, when the trestle is in use, before the pins which secure the transom to the columns have been inserted.

(4) Chests are provided for the storage and transportation of the chain hoists and they should always be used for these purposes. It is especially important that the chain and other parts of the chain hoist be kept clean or excessive wear and damage to the working parts will result. Lubrication should follow the manufacturer's instructions.

d. Balk, chess, and sill.— The factor of safety utilized in the design of these members is small. Accordingly, it is of particular importance that these items be kept well painted and stored in the proper manner so as to keep the action of decay at a minimum. Minor damages through cuts or abrasions are particularly subject to incipient decay and should be trimmed off and painted as soon as practicable. Metal parts should be kept clean and greased or painted to reduce rusting. It is of particular importance that these items be placed in well ventilated stacks well off the ground, and with one end higher than the other to allow for drainage when in storage in the open.

e. Fittings.— Chests are provided for storing and transporting the side rail clamps, hinge sill hangers, windlass sticks, oarlocks, and small trailer spare parts and should be used for these purposes.

f. Outboard motors.— The care and maintenance of outboard motors is covered fully in paragraph 69.

g. Miscellaneous items.— These include rope, anchors, oars, boathooks, and pickets. These items can be stored in any convenient fashion. The anchor should have the stock unlatched and tied to the shank. Rope should be coiled, handled, and stored as prescribed in engineer field manuals. Rope also should be washed thoroughly free of grit and dirt, periodically and before storage, which otherwise will work into the fibers, cutting them and materially reducing the strength of the rope.

h. Trailers.— (1) In general, the care and maintenance for the trailers are the same as is generally prescribed for motor vehicles. Special attention must be given to lubrication and tire inflation. The latter should be checked frequently, especially when going into service after a period of idleness.

(2) The ponton has been designed primarily to carry loads only when it is floating freely in water. The transportation of the necessary accessories for its operation should be limited to a minimum.

72. REPAIRS.— *a. Balk, chess, and sills.*— In general, repairs to these items will be limited to removing crushed or splintered wood, reshaping, and painting minor cuts and blemishes, and straightening and refastening the metal fixtures. Fittings should be removed from condemned timbers and retained for use as future replacements.

b. Trailers.— Repairs to the running gear of the trailers are comparable to similar work on other types of automotive vehicles. Repairs to the trailers, other than the replacement of parts, usually require the facilities of a depot.

c. Fittings.— Most of the repairs to the siderail clamps, hinge sill hangers, and similar fittings will consist of straightening deformations of metal parts and removing burrs from threaded parts. Taps and dies are provided in the ponton repair kit for truing the threads of the screw parts.

d. Trestle.— Slight bends in the transom and columns may be straightened in the field. Minor punctures and damage to the transom may be repaired with the equipment and material provided for the purpose in the ponton repair kit. Repairs other than these generally require the facilities of a depot.

e. Ponton repair kit.— This kit is designed for the repair of the aluminum pontons and the aluminum parts of the trestle transom. It includes dies for the screw threads of the siderail clamps, hinge sill hangers, and similar fittings. In each chest there is a small amount of sheet aluminum, impregnated fabric, plastic material for sealing seam leaks, rivets, bolts, nuts, and wood screws. All tools are manually operated and designed so that no special training is required for their use.

f. Minor and temporary repairs to the ponton.— (1) Dents in the skin have no immediate effect upon the serviceability of the ponton but should be removed as they may cause further damage. They can be removed by light blows of a hammer, mallet, or a block of wood. Care should be taken to avoid stretching the metal at the rivets, which may cause a leak that will be difficult to stop without replacing the affected portion of the skin.

(2) Usually bent framing will not render the ponton unserviceable, except in the case of extensive bending of the gunwale between the bulkheads which may prevent the engagement of the balk fasteners. This should be corrected as soon as practicable because it weakens the ponton and may lead to subsequent damage. Slight distortions can be removed by hammering or bumping with a large wooden block.

(3) The most satisfactory hasty method of stopping a leak below the water line is to stuff the aperture with wadded fabric, forcing it through in the direction from which

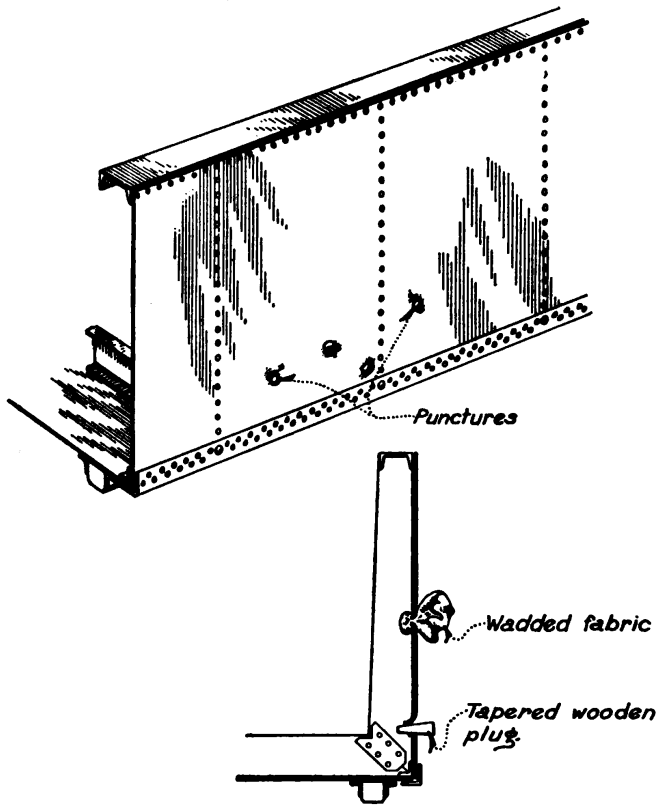

Figure 33. Plugs driven in hole from direction from which puncture occurred.

the tear or puncture was made and leaving enough on both sides to insure keying of the material about the aperture. A more durable method, usually applicable only to round holes, is to drive a conical plug of wood into the aperture from the direction from which the puncture occurred. (See fig. 33.)

(4) Often short and regular tears above the water line can be closed sufficiently for a temporary repair by peining. The dent in the material in the vicinity of the tear is first flattened; then a flat dolly is held on one side of the tear, which is closed by hammering just above and below the tear with the ball end of a pein hammer. The peining will force the material at the tear together so that the application of a heavy coat of paint or similar plastic material will form a temporary watertight joint. (See fig. 34.)

(5) A more permanent hasty repair of holes is made by placing a piece of wooden board over the opening with a piece of impregnated fabric between the wood and the aluminum skin. The board is bolted or nailed over the aperture, and if nailed, the nails are driven through the aluminum skin and clinched to the wood. Impregnated fabric is pro-

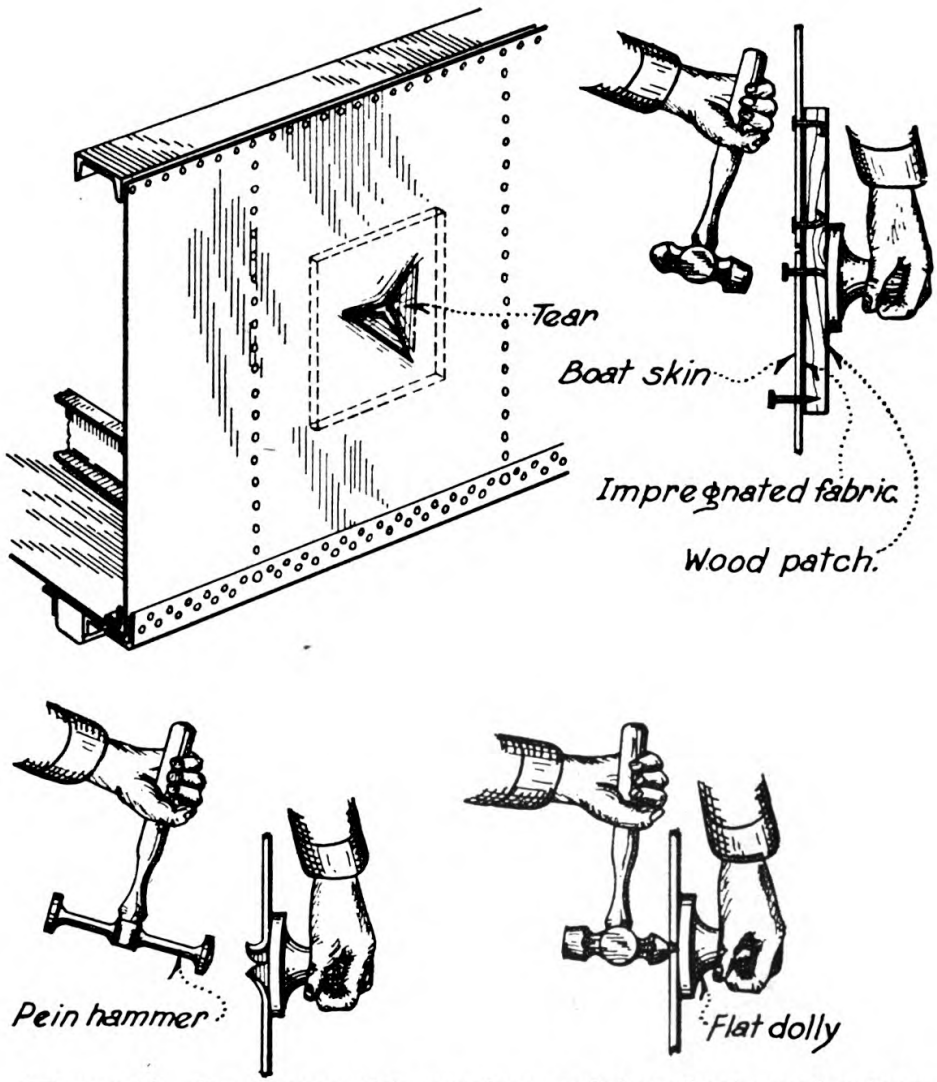

Figure 34. Temporary skin repairs: peining short regular tear above waterline; placing fabric and board patch.

vided in the ponton repair kit and is used between the wood and the aluminum skin to assist in making a watertight joint between them. If no prepared fabric is available, a piece of canvas or similar material thoroughly soaked with wet paint is a reasonably satisfactory substitute. (See fig. 34.)

g. Major and permanent repairs to the ponton.— (1) Patching with a piece of sheet aluminum, with impregnated fabric between the patch and the skin of the ponton, is the most permanent method of effecting a repair to a hole in the skin. The ponton repair kit was designed primarily to effect this type of repair, and it contains all necessary tools and supplies. The procedure is as follows: (See figs. 34 and 35.)

(a) Flatten and smooth out the distorted metal in the vicinity of the rupture and the surface of the skin to be under the patch.

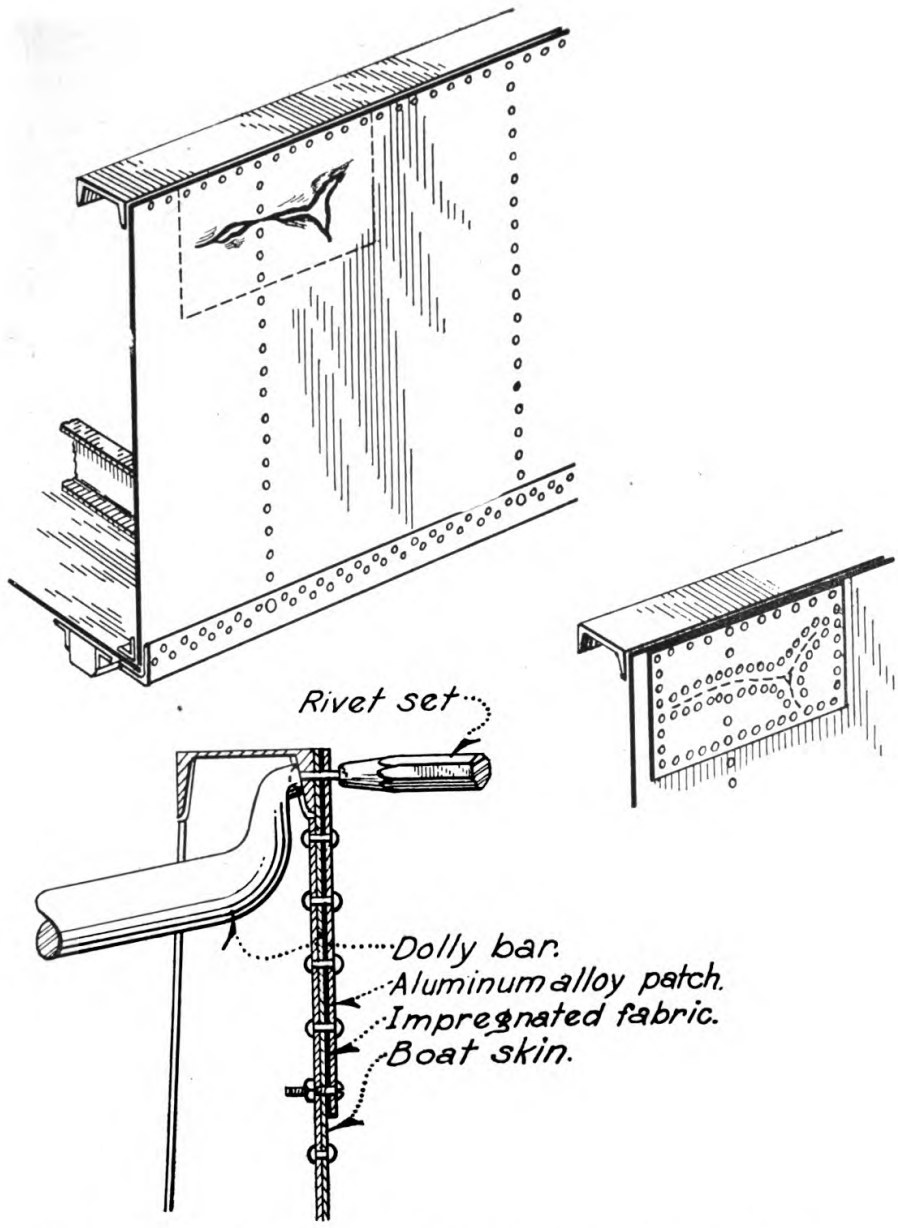

Figure 35. Permanent skin repairs: placing aluminum sheet patch.

(b) Cut an aluminum patch of size necessary to cover the hole and to provide space for the rivets to hold the patch in place. The size of the patch must be kept to a minimum because the larger it is the more difficult it is to secure a tight job.

(c) Using the patch as a templet, cut a gasket from the impregnated fabric.

(d) Lay out the rivet spacing on the patch, center punching the location for each rivet.

(e) Drill one or more of the rivet holes in the patch and then in the skin using the drilled patch as a template. Then temporarily attach the patch to the skin, with the gasket between it and the skin, and bolt in place with 3/16-inch round head stove bolts.

(f) Drill all the rivet holes and then rivet. The first rivets driven must be scattered throughout the patch followed by riveting through the intervening holes. This procedure is necessary because an attempt to drive the rivets progressively from one hole to the next will cause the patch to creep and produce a misalignment of the rivet holes in the patch and the ponton.

(2) Punctures of less than 5/16-inch diameter can be closed effectively and more simply by flattening the metal about the hole and removing burrs, drilling and reaming out the puncture, and then driving the proper size rivet in the resulting hole.

(3) In the absence of aluminum sheet, sheets of galvanized iron or plain sheet steel can be used, but these metals are likely to set up a mild electrolytic action destructive to the aluminum. It is essential that the aluminum of the ponton be thoroughly insulated from the patch by the impregnated fabric furnished with the ponton repair kit. This type of repair should be considered as temporary and replaced by an aluminum patch as soon as practicable.

(4) Bent framing will present varying difficulties, depending on the magnitude of the distortion. Minor corrections have already been covered in paragraph *f,* for which the tools supplied in the ponton repair kit are adequate. Methods of correcting more serious distortions are illustrated in figure 36. In all these cases special care must be taken to avoid loosening rivets or stretching the skin around the rivets so as to produce leaks.

h. Painting.— (1) All surfaces should be cleaned thoroughly of all loose or cracked paint, grease, oils, or other foreign substances. In addition, aluminum surfaces should be cleaned with benzol, carbon tetrachloride, naptha, or ammonium phosphate. Parts cleaned by this method should receive a final rinse in clean unused solvent. This solvent should be the same as that used in the previous operation.

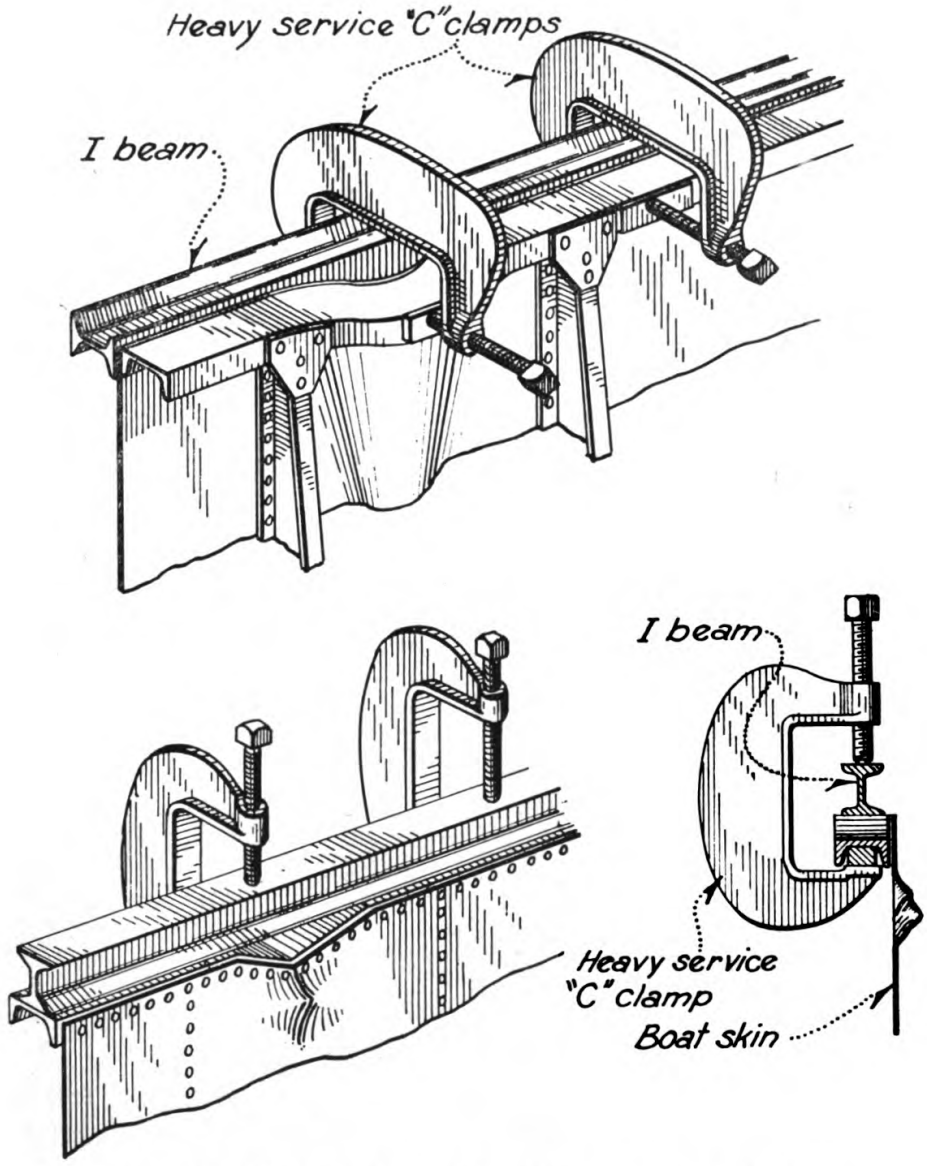

Figure 36. Method of straightening serious distortions of framing.

Aluminum surfaces of the ponton and trestle should be etched or roughened after being cleaned. Surface treatment may be accomplished by one of the following methods:

(a) With a solution made up of 10% commercial phosphoric acid, 10% ethyl or butyl alcohol and 80% water. This wash should remain in contact with the surface for 15 minutes and should then be washed with warm water (100-150°F.).

(b) Roughening the surface with No. 00 sandpaper if materials for treatment as in (a) above are not available.

(2) *Painting of Ponton and Trestle.*— The surface should be given a priming coat of zinc chromate based on the following formula:

Flat Zinc Chromate Primer

Zinc Chromate	37 per cent
Indian red	4 per cent
Abestine	16 per cent
Spar varnish	27 per cent
Solvent naptha	13 per cent
Linseed oil	3 per cent

Spar varnish should be of the water resisting type (Fed. Spec. TT-V-121) and in addition should be free from rosin or rosin compounds. The resin present should be a pure phenolic resin. (All rosins are resins, but rosins are a specific natural group of resins obtained from distilling turpentine, whereas a resin is any group of solid or semi-solid organic substances soluble in ether, alcohol, etc., but not in water.) After priming, the surfaces should receive a ground coat consisting of aluminum powder (Fed. Spec. TT-A-476) or aluminum paste (Fed. Spec. TT-A-466) mixed with a 100% phenolic spar varnish vehicle. The proportions for mixing the ground coat should be two (2) pounds of pigment to one (1) gallon of vehicle. The spar varnish should be of the type supplied for mixing aluminum paint (Fed. Spec. TT-V-81). If aluminum powder and paste are not available, finely ground mica (325 mesh) may be used in lieu thereof and should be mixed in the same ratio as the aluminum paste or powder. The surface then should receive a finish coat of olive drab 100% phenolic lusterless enamel conforming to U. S. Army Corps of Engineers Tentative Specification No. T-1183.

(3) *Painting of Chess and Balk.*— The surface should be primed with a synthetic ground primer conforming to U. S. Army Corps of Engineers Tentative Specification ES—No. 360 and given two finish coats of lusterless, olive drab, phenolic enamel conforming to U. S. Army Corps of Engineers Tentative Specifications No. T-1183.

(4) *General Remarks on Application of Paint.*— The paint when applied should provide a satisfactory film and a smooth even surface without excessive gloss, suitable for the proper application and adhesion of subsequent coats. Paint may be applied by brush or spray, but if applied by spray, each gallon of paint should be diluted by an additional

quart of Toluol (Toluene) or solvent naptha. Paint should not be applied to surfaces upon which there is frost or moisture condensation nor during rainy weather unless the part being painted is amply protected against the effect of the weather. While any painting is being done the temperature of the atmosphere in contact with the paint surface should be at or above 50°F. Also all paint when applied should be approximately the same temperature as that of the surface on which it is applied. At least 24 hours should be allowed to elapse between the priming coat and the ground coat, and at least 48 hours should be allowed to elapse between the ground and finish coat.

Section XX

LIST OF EQUIPMENT FOR ONE UNIT

73.

Article	Basic Quantity	Spares	Total Number
Anchor, Danforth, 30-lb.	2	0	2
Anchor, kedge, 150-lb.	24	8	32
Balk, ponton	126	42	168
Balk, transverse	13	3	16
Balk, trestle	72	24	96
Block, snatch, for ½" wire rope	2	0	2
Boat, assault, w/7 paddles and carrying case	2	0	2
Boat, power, utility	1	0	1
Bracing, trestle, set	1	0	1
Bracket, reflector, ponton gunwale type	66	12	78
Bracket, stern attachment, 22 HP motor	4	0	4
Buoy, life	2	0	2
Carrier, balk	50	25	75
Chain, sling, ½" x 16', w/hook and eye	4	0	4
Chess	250	52	302
Chess, half	16	0	16
Chest, 22 HP motor	4	0	4
Chest, chain hoist	4	1	5
Chest, hydraulic ram	1	0	1
Chest, repair, kit, aluminum ponton	1	0	1
Chest, rigging set	1	0	1
Chest, spare parts & accessories	12	0	12
Clamp, siderail, complete	68	28	96
Clip, wire, rope, ½ inch	48	0	48
Dolly, 2-wheel, dt., complete	2	0	2
Ferry set, complete	1	0	1
Flare, road, electric	60	10	70

Article	Basic Quantity	Spares	Total Number
Hanger, hinge sill	20	6	26
Hanger, transverse balk	30	2	32
Hoist, chain	8	1	9
Hook, boat, ball point, 10-foot	24	8	32
Lamp, flasher, electric	4	1	5
Lamp, rescue and debris, portable, electric	1	1	2
Light, bridge inspection	2	1	3
Mask, diving	1	0	1
Maul, wooden	2	0	2
Motor, outboard, 22 HP, with accessories	4	0	4
Net, camouflage, 36′ x 44′	19	0	19
Net, camouflage, 36′ x 60′	16	0	16
Oar, ponton, 14-foot	72	12	84
Oarlock, ponton	84	12	96
Picket, steel, 1-¼″ diam. 36″ long	38	38	76
Ponton, aluminum, w/spare parts	12	0	12
Pump, bail, ponton	12	4	16
Pump, water, portable, complete w/hose	1	0	1
Ram, hydraulic, complete	1	0	1
Reflectors, glass, red	66	12	78
Rigging, set	1	0	1
Rope, manila, ½″, feet	2400	0	2400
Rope, manila, 1″, feet	10800	7200	18000
Rope, wire, ½″ diam., 6 x 19 steel, feet	500	0	500
Sill	4	0	4
Stirrup, detachable, for balk	48	48	96
Tools:			
Axe, chopping, 4 lb., 36″ handle	16	0	16
Mattock, pick, large handled	16	4	20
Pole, ranging, 6-ft, 2 section	2	0	2
Shovel, general purpose, D-hdld. RP	16	0	16
Sledge, double faced, 12 lb., handled	2	2	4
Tape, metallic, 50-ft, in ft & inches	2	0	2
Trailer, semi-, 2 dt, pneumatic tires complete	16	0	16
Trailer, spare parts, set complete	0	1	1
Trailer, boat, power, utility, complete	1	0	1
Trestle, complete (w/o Hoist)	4	0	4
Trestle parts:			
Transom pin and chain	0	4	4
Truck, tractor	16	0	16

Section XXI

DESCRIPTION OF EQUIPAGE

74. PONTON.— *a.* The model 1940 25-ton ponton is rectangular in cross section between the rakes of the two scow-type ends, either of which may serve as bow or stern. The ponton is 32′9″ long, 6′5½″ wide and 3′4″ deep. Its construction is similar to that of the light pontons, being divided into four compartments by bulkheads. Each of the end bulk-

heads mounts a capstan used in tightening the anchor cable. The capstan has six rack stick holes and is operated with a steel picket or rack stick. It is provided with a rachet-type stop. The ponton itself is built of aluminum alloy sheets and shapes fastened together with rivets. A carrying rail is located midway between the gunwale and the bottom of the boat. Each ponton is provided with 48 balk fasteners, 40 of a quick acting rachet type and 8 screw-type spares. The adjacent balk are located on 18″ centers. The floor of the ponton consists of wood gratings resting on the top of the bottom rib system. Cleats are located at each end of the ponton to facilitate securing the anchor or other lines. Receptacles for oar locks are placed in the gunwales to permit the operation of six pulling oars with a steering oar at each end. The bottom of the ponton is protected by aluminum skids riveted through the skin and the framework. For normal use each ponton is equipped with two anchors, two anchor cables, two boat hooks, 7 oars, 7 oarlocks and one bail pump.

b. The ponton weighs approximately 2700 lbs., and has a maximum displacement of 41,400 lbs. When used as a ferry with an outboard motor, it provides space for approximately 100 men with full equipment besides the boat crew. The following table gives the ponton displacement for various weights and free boards:

TABLE OF DRAFTS, DISPLACEMENTS AND FREEBOARDS

Approximate displacement for each successive inch of draft.

Draft in inches	Displacement in pounds	Freeboard in inches	Draft in inches	Displacement in pounds	Freeboard in inches
1	894.9	39	21	20814.6	19
2	1810.1	38	22	21869.6	18
3	2741.1	37	23	22930.4	17
4	3682.1	36	24	23994.6	16
5	4633.1	35	25	25062.1	15
6	5593.3	34	26	26135.3	14
7	6562.3	33	27	27210.7	13
8	7539.0	32	28	28289.7	12
9	8523.3	31	29	29372.6	11
10	9514.9	30	30	30459.6	10
11	10513.5	29	31	31549.8	9
12	11518.5	28	32	32643.5	8
13	12529.5	27	33	33740.7	7
14	13547.4	26	34	34838.5	6
15	14569.9	25	35	35936.7	5
16	15599.9	24	36	37035.2	4
17	16631.2	23	37	38134.6	3
18	17670.1	22	38	39234.6	2
19	18713.8	21	39	40335.4	1
20	19761.9	20	40	41436.7	0

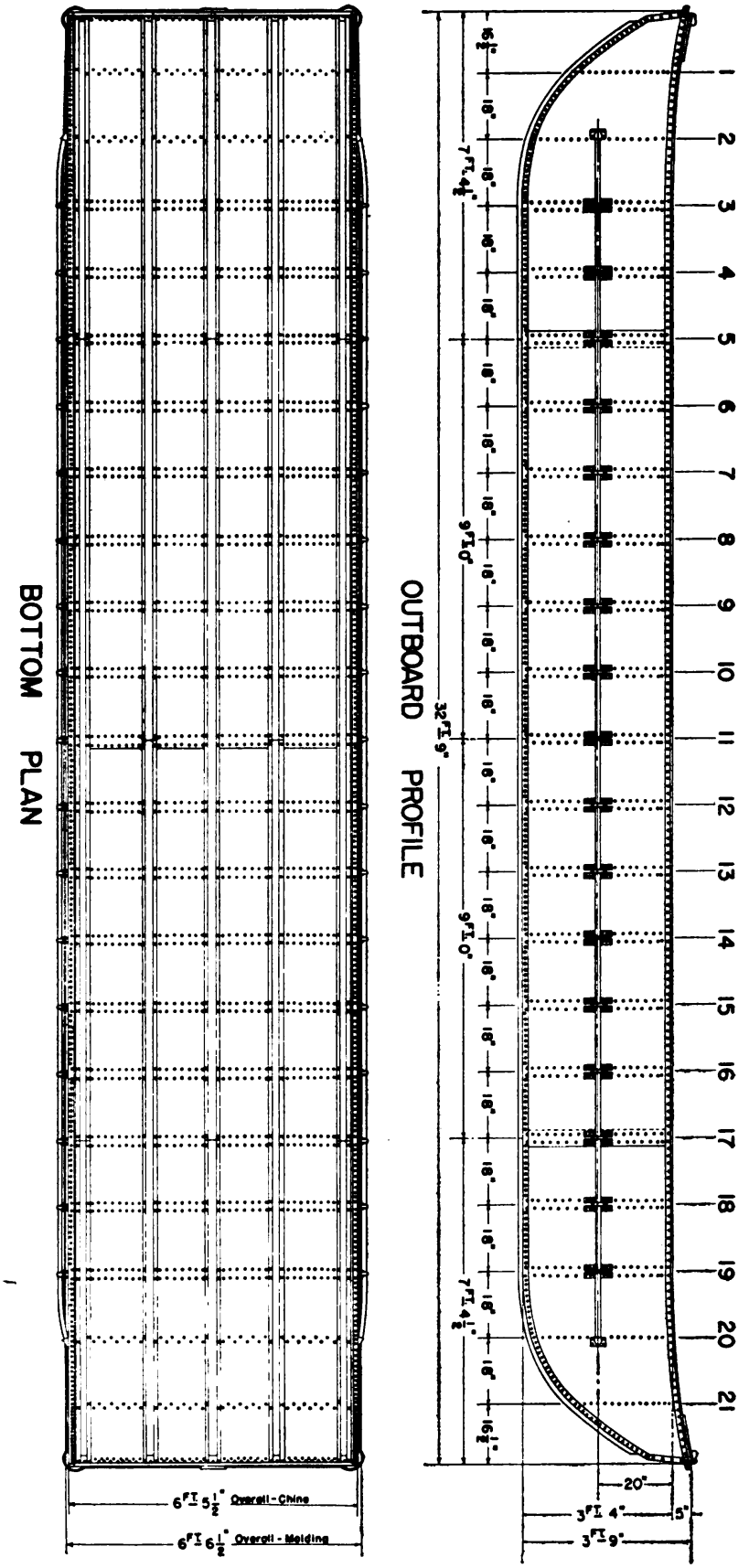

Figure 37. 25-ton Ponton, Model 1940, Outboard profile.

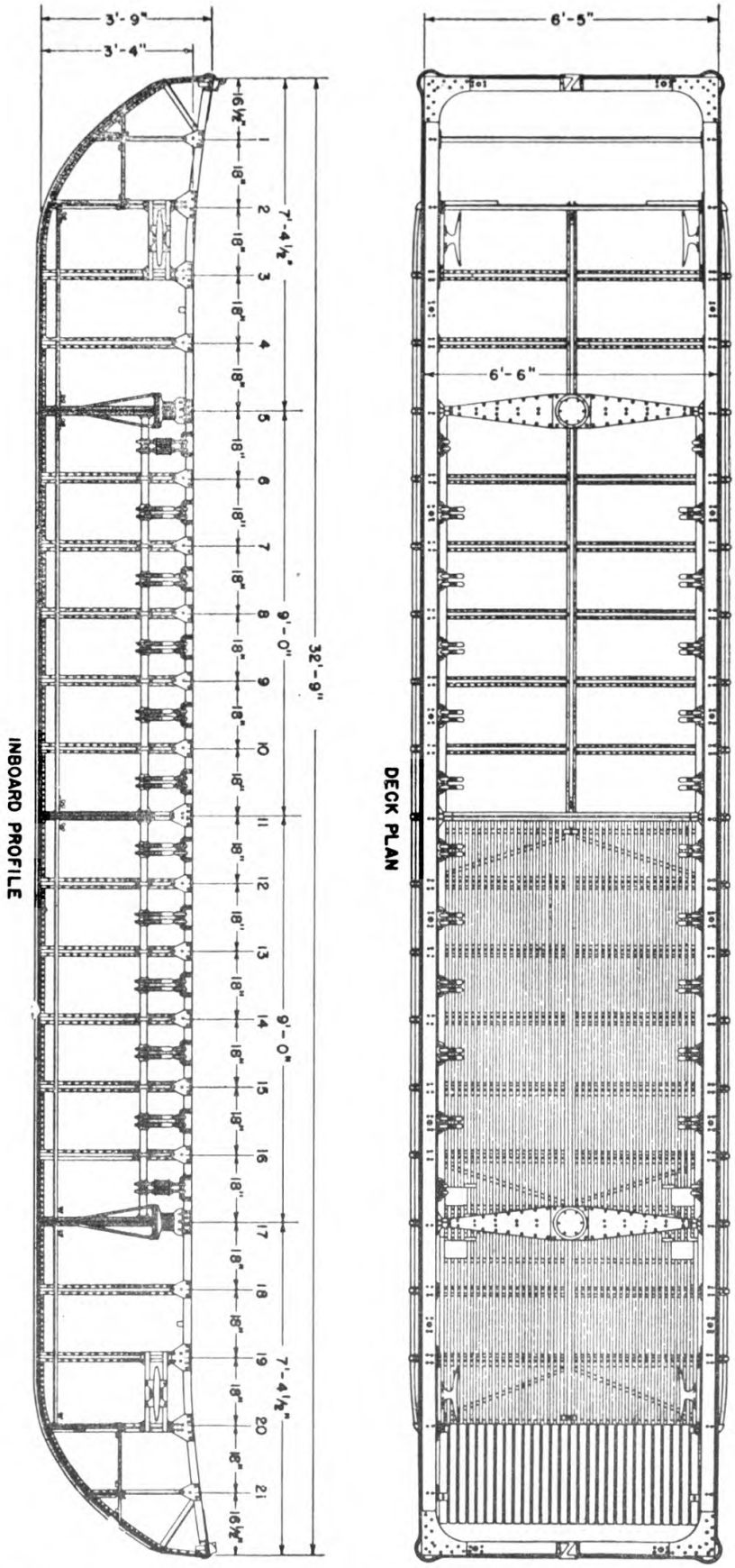

Figure 38. 25-ton Ponton, Model 1940, Inboard profile.

75. TRESTLE.— *a.* The trestle of the 25-ton ponton equipage is similar in design and size to that of the light ponton equipage except that it has a greater load capacity. It consists of a transom, two columns, two shoes, and two chain hoists.

b. The transom is a built-up beam of aluminum alloy. To the top of it a steel tube is attached. On this tube, the under fittings of the trestle balk rest. Cleats which are used in fastening the trestle balk securely to the transom by lashings are provided near the bottom of the transom. These also serve as carrying rails. The transom is 17′ 2¼″ long by 9-9/16″ wide by 24″ high. The two columns are steel tubes 5″ in diameter on which a vertical row of holes is provided on 3 ¾″ spacing. Two pin holes are located in each column well of the transom. One set of these holes passes thru the column well parallel and one perpendicular to the center line of the bridge. They are spaced 1-⅞″ apart vertically. A pin is attached to each end of the transom by a chain. Each end of the transom is held in place on the column by passing one of these pins thru one of the two sets of holes in the column well and the holes in the trestle column. A 3-¾″ adjustment in height can be made without changing holes in the transom. If for any reason, a 1-⅞″ adjustment is necessary, it may be accomplished by turning the column through an angle of 90 degrees with a rack stick and using the other hole in the transom. Two 1½-ton chain hoists are provided with each trestle for adjusting the height of the transom. The hoists are attached to swiveled hangers at the top of the trestle column and the lifting hooks engage in stirrups integrally attached to the ends of the transom. A spool is placed on the top of the trestle column for attaching guy lines. The trestle shoes are made of aluminum alloy with steel and bronze fittings and are 27″ square. A shoe is attached to the bottom of each trestle column by a ball and socket joint and is secured by a hook on the end of a chain which is attached to the shoe and is engaged in an eye on the ball end of the column. To prevent loss of the shoe, if this hook comes out, another hook, also secured to the shoe by a chain, is engaged in the first pair of holes in the column above the shoe. The complete trestle less chain hoists weighs 1415 lbs.

76. PONTON AND TRESTLE SPANS.— All spans are 15 feet in length. Fixed spans are those from the abutment

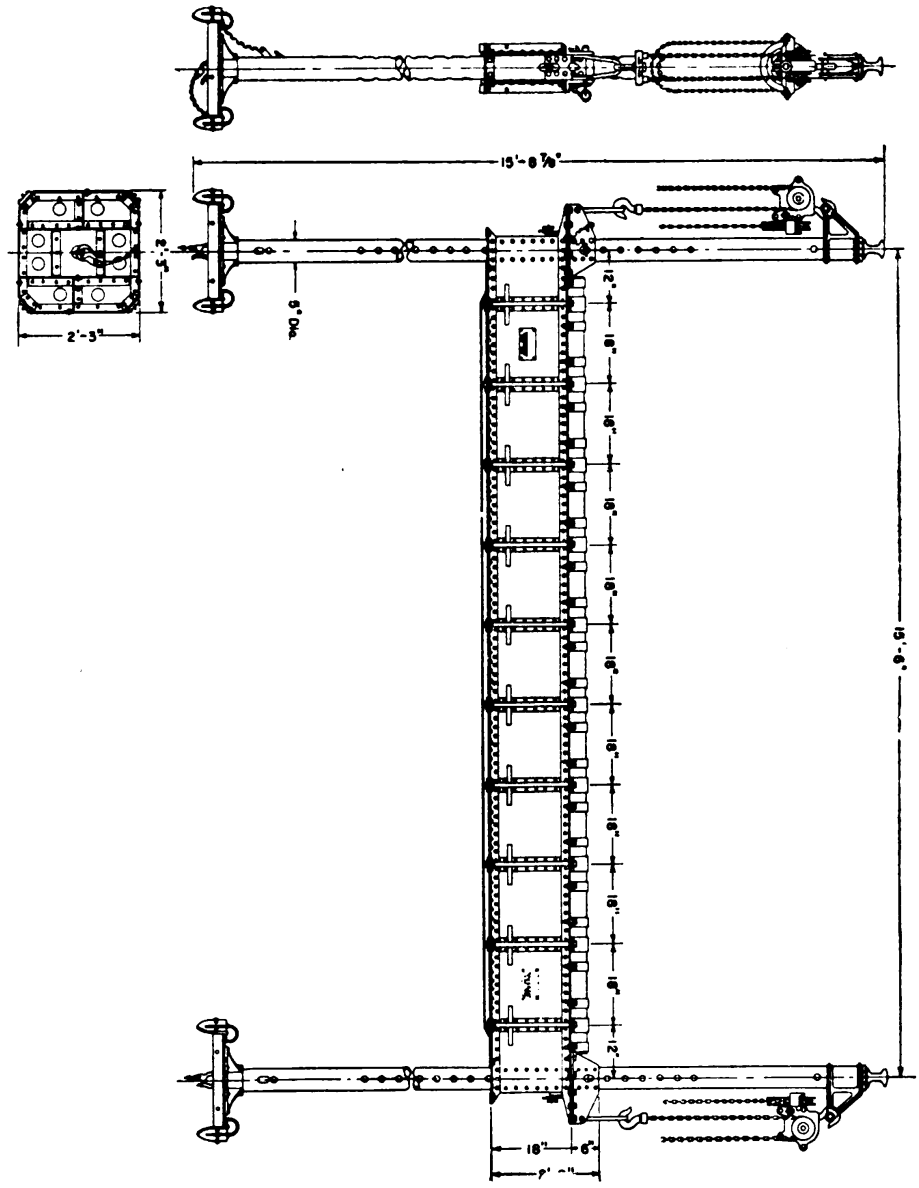

Figure 39. Assembled trestle.

sill to the trestle or from one trestle to another. The hinge span extends from the riverward trestle to the hinge sill. The decks of both the fixed and hinged spans is supported by ten trestle balk. The ponton balk span two adjacent pontons in the floating spans. In other words, the ponton balk of adjacent bays lap over at each ponton by the width of a ponton, each balk being securely fastened down on 4 gunwales. This arrangement gives continuous beam action in the floating portion of the bridge and distributes a given load over several bays of bridge. Siderails are trestle balk on the fixed and hinge spans and ponton balk on the floating spans. The siderails overlap each ponton as do the ponton balk and hold the chess in place by means of siderail clamps

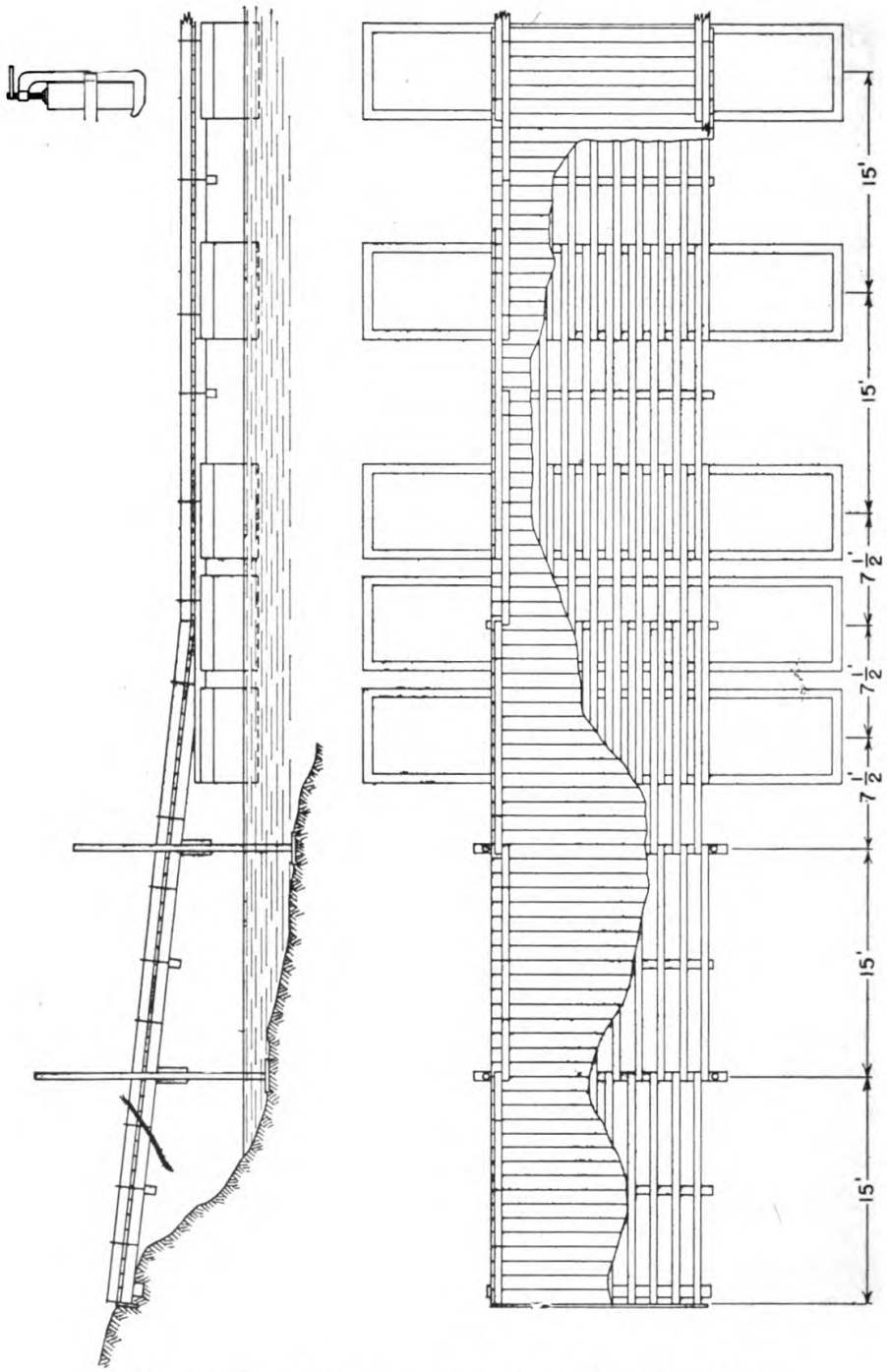

Figure 40. Elevation and plan of typical shore connection, using two trestles.

that secure them to the outside balk over which they are laid. In the fixed and hinge spans the transverse balk is placed under the trestle balk in mid-span parallel to the chess and is attached by means of transverse balk hangers over the siderails. These transverse balk hangers take the place of siderail clamps when so used. The purpose of the transverse balk is to increase the load capacity of the decking.

Its use reduces the maximum load in the balk directly under the wheels by about one third. The clear roadway width of the bridge is about 12′ 6″.

77. BALK.— *a.* Both ponton and trestle balk are 7-¾″ x 5-⅝″ in cross section. The balk are made of the best obtainable grade of Douglas Fir. The ponton balk weighs approximately 270 pounds, and trestle approximately 190 pounds. Ten balk are used in each span as stringers and two as siderails in the normal construction of the bridge.

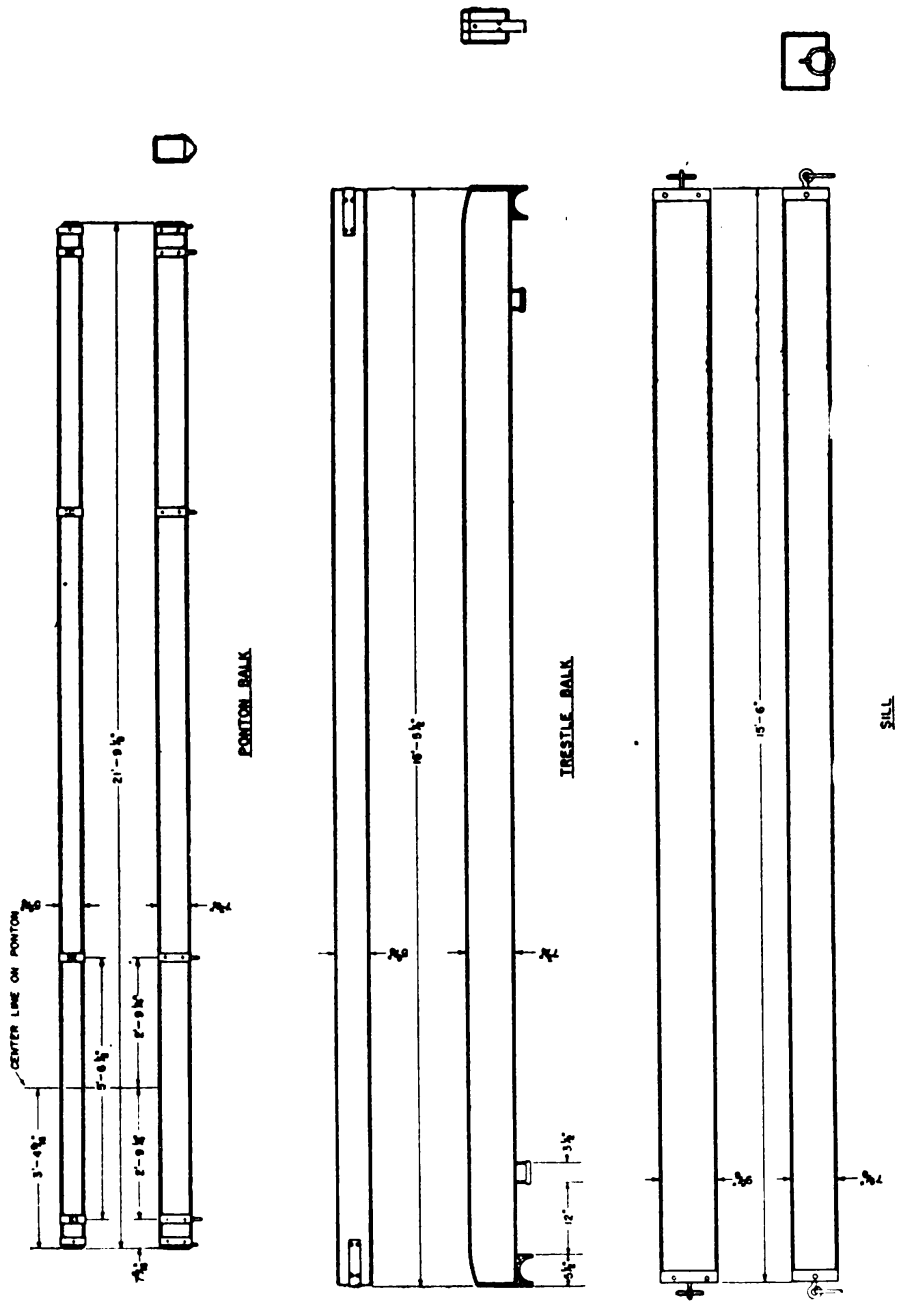

Figure 41. Ponton balk, trestle balk and sills.

b. The trestle balk is 15′5½″ in length with a metal strap secured over each end of the balk and forming a semi-circular fitting on the under side of the end. This fitting engages the tube on the top of the trestle transom. Twelve inches from the end fitting is a "U" shaped eye of metal which is secured to the under side of the balk and used in fastening the balk to the trestle transom. The two fittings so located, provide a space to receive either the abutment or hinge sill.

c. The ponton balk is 21′ 9-⅛″ long. Each end is bound with a steel collar, on the under side of which is fitted a clip which acts as a gage stop over the outside edge of the ponton gunwale, enabling the pontons to be readily assembled into bays. A similar fitting is located about 6′2″ from each end. Behind the end fitting is a metal strap around the balk, ending in an eye thru which the hook of the balk fasteners on the ponton engage. The gunwales of the ponton fit between the two fittings on each balk end.

78. CHESS.— Chess are made of high grade Douglas Fir and are 15′ long, 11-⅝″ wide and 2-⅝″ thick. At each end for a distance of 18″, the width is reduced to 9-⅝″ to provide space for placing the siderail clamps. Rivets pass thru the ends of the chess and the outer ends of the wide section to prevent splitting. A chess weighs approximately 100 pounds. Half chess, 5-⅝″ wide, are provided to fill in small spaces in the decking or for use over the transom or where the hinge span decking joins the ponton decking. These half chess weigh approximately 45 pounds.

79. SILLS.— The sills are made of high grade Douglas Fir and are 15′6″ long by 9-⅝″ wide by 7-⅝″ thick, metal bound and equipped with rings at each end. The sill is used both for the abutment and the hinge. It weighs approximately 300 pounds.

80. TRANSVERSE BALK.— A transverse balk consists of two pieces of Douglas Fir 2″ by 10″, 15′ long, fastened together with spacers so that they form a composite beam approximately 10″ x 5-¼″ x 15′. The ends are bound around with a strap of metal; bearing plates consisting of angle irons bolted thru the beam are provided at each end where the balk contacts the outer trestle balk. The under side of

the transverse balk is provided with a plate about one foot long where the fingers of the transverse balk hangers engage the transverse balk to hold it tight against the outer trestle balk. The transverse balk weighs approximately 200 pounds.

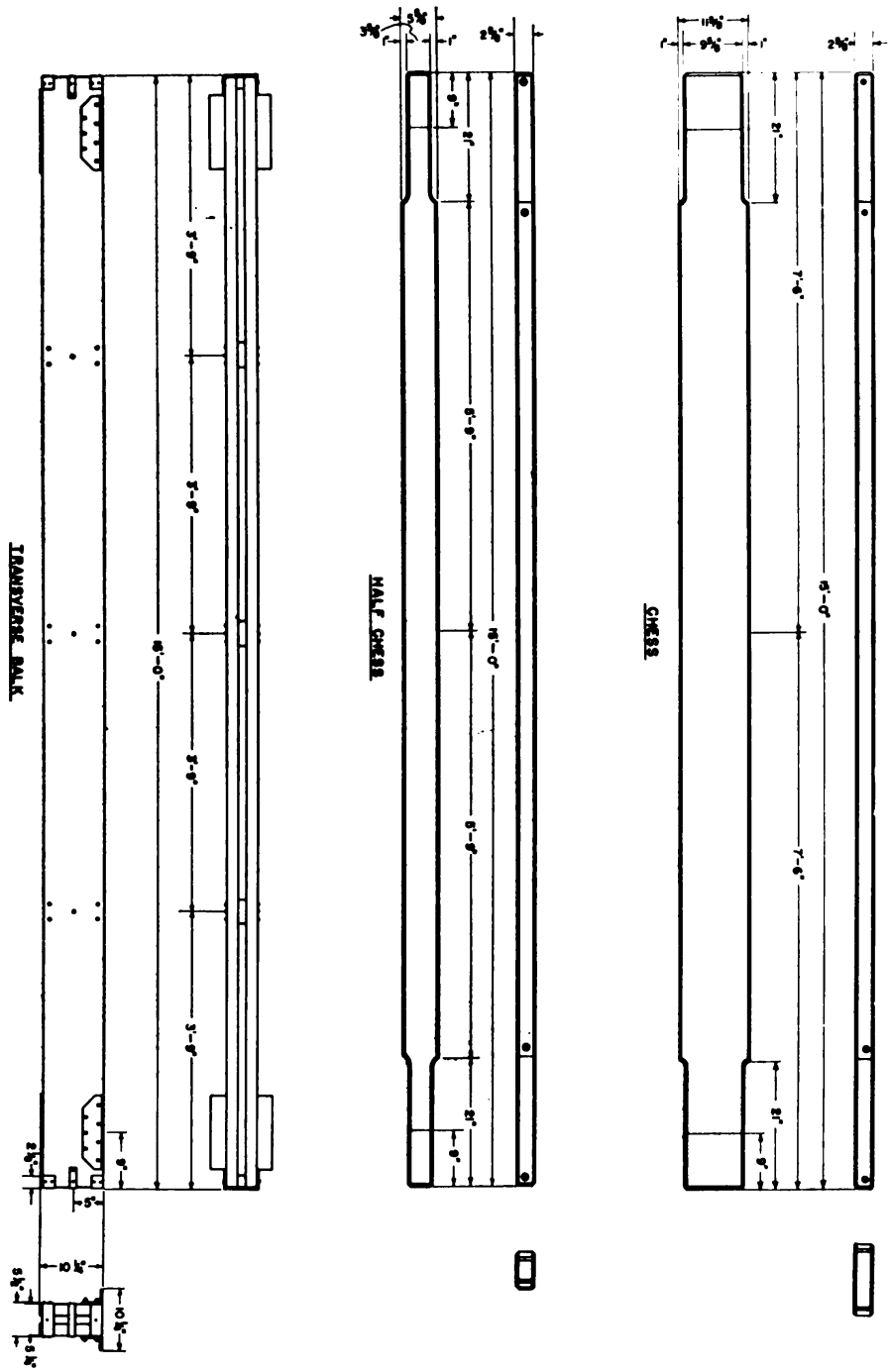

Figure 42. Chess, half chess and transverse balk.

81. SIDERAIL CLAMPS.— The siderails are secured by a screw-type fastener about 2′3″ long, which engages under the outside balk and above the siderail, clamping the chess into place between them. (See figures 19 and 40.)

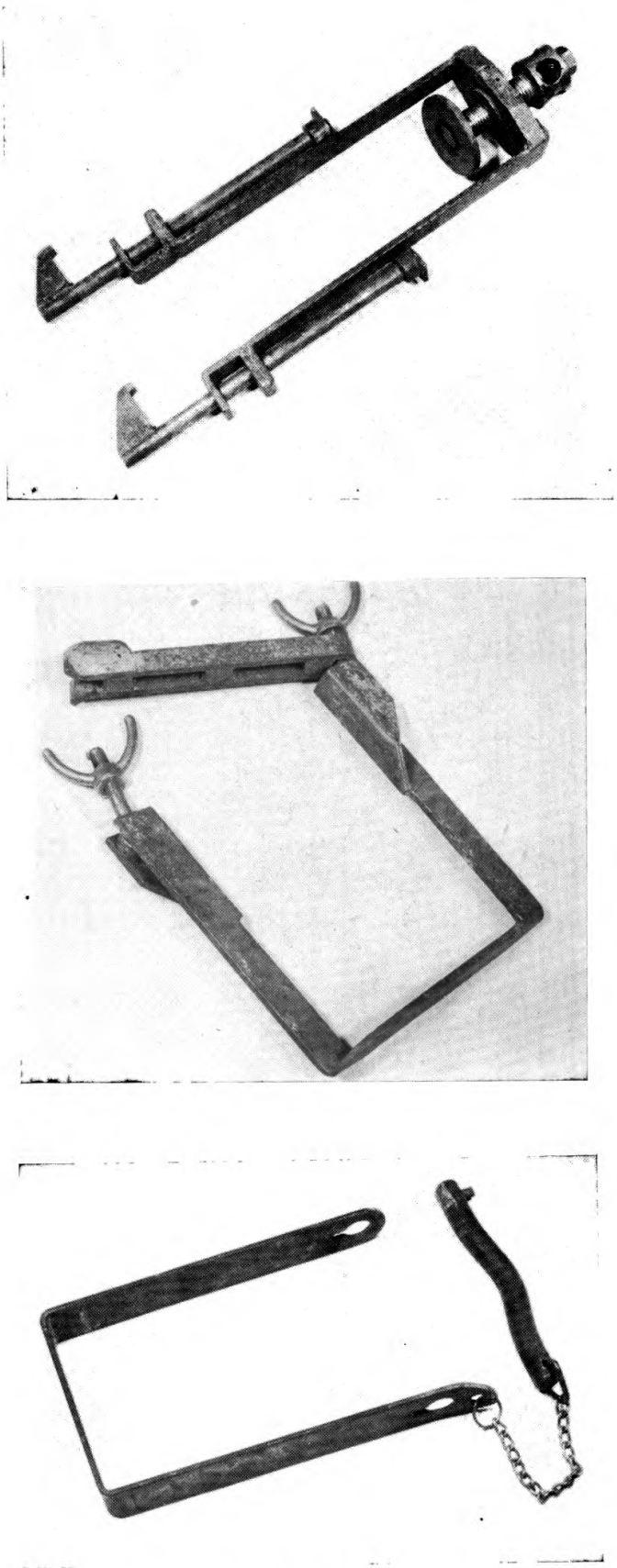

Figure 43. Transverse balk hanger, hinge sill hanger, and detachable balk stirrup.

82. TRANSVERSE BALK HANGERS.— Transverse balk hangers consist of two metal strips 21″ long attached to a plate at the top thru which a screw is fixed. Thru the bottom of each strip extensible hooks about 17″ long are placed. These hooks have a finger on the end which is so arranged that the hook, after passing thru the spacing in the transverse balk, can be turned to engage on the metal plate provided on the bottom of the transverse balk. The transverse balk is then tightened up by using a rack stick in the screw in the same manner as an ordinary clamp. (See figure 43.)

83. HINGE SILL HANGERS.— Hinge sill hangers are provided to secure the hinge sill to the ponton balk in the hinge span. These hangers consist of a stirrup which fits over the ponton balk and comes down in such a manner that a tie bar may be screwed up under the hinge sill to clamp it tightly against the ponton balk. (See figure 43.)

84. STIRRUPS.— Detachable stirrups which consist of a strap of metal formed in a "U" to fit snugly over the balk are provided for use in joining the two halves of a bridge when the balk eyes do not engage the balk fasteners in making the joint. A bent pin, attached to the stirrup, fits thru holes in the two ends and forms an eye into which the balk fasteners of the ponton are engaged. These stirrups may be attached anywhere on the balk. (See figure 43.)

85. PONTON REPAIR KIT.— This kit includes special tools, materials and fittings for the minor repair of the ponton and trestle transom. It is the same repair kit that is furnished with light ponton equipage.

86. TRAILERS.— *a.* The major items of equipment are transported on semi-trailers for towing on the highway behind a special 4 x 4 prime mover. The three types of trailer loads have been described in paragraph 6.

b. The semi-trailer has a rectangular shaped open chassis of steel members with a superstructure at front and rear to support the ponton boat. It is equipped with heavy-duty dual pneumatic tires, size 10.00 x 20, disc steel wheels, hubs and springs of a commercial truck type, air brakes with a breakaway safety feature, and a standard front prop wheel. I

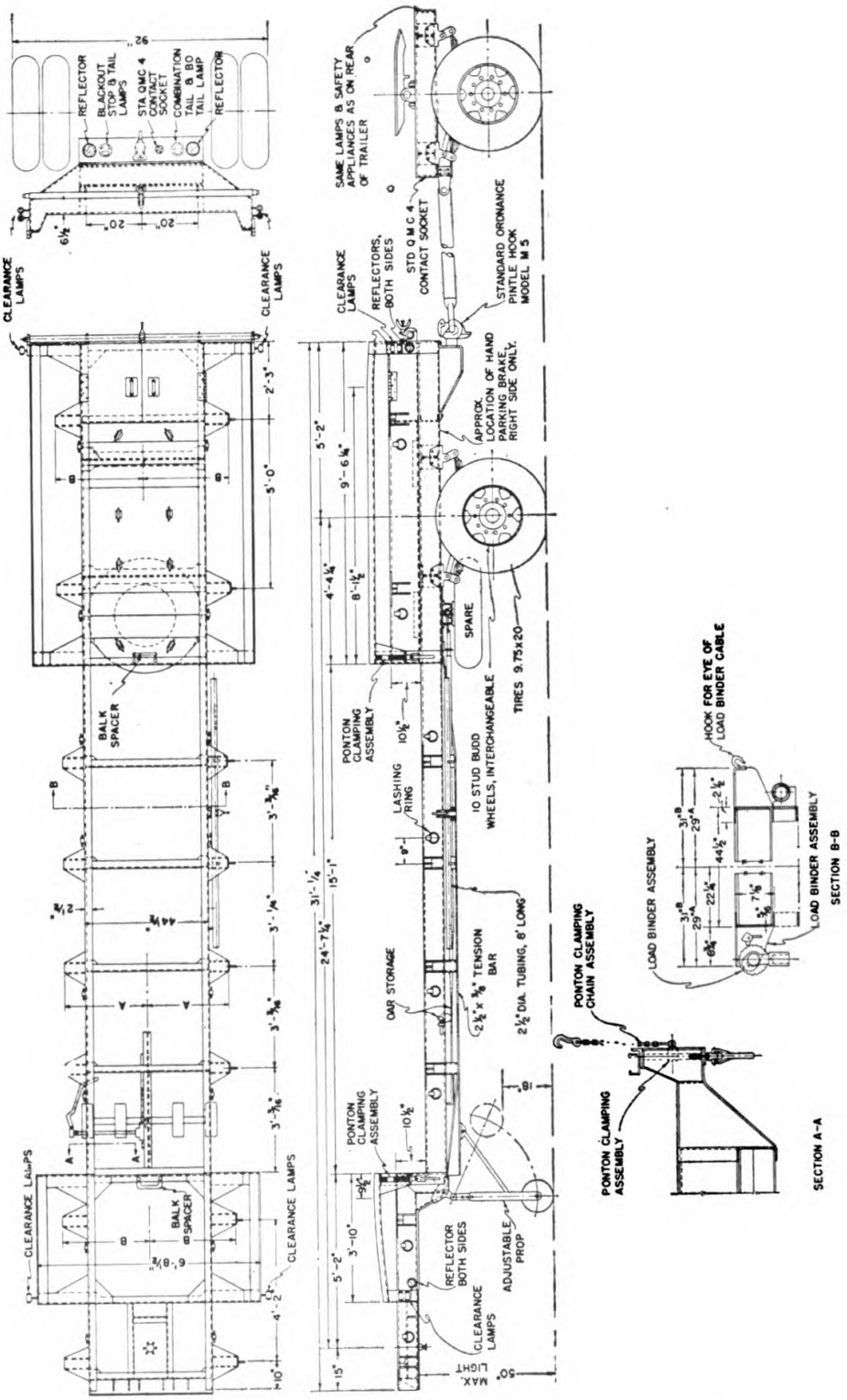

Figure 44 Semi-trailer, with dolly, 25-ton ponton equipage.

is attached to the prime mover by a standard fifth wheel arrangement. Standard air brake connectors and Quartermaster standard light cable connectors are used. The trailer is equipped with the Army standard blackout lighting system and has an auxiliary blackout switch located on the frame

near the front of the trailer. The carrying rack for oars is located under the framework and a spare tire is carried under the frame just in front of the rear wheel. Screw-type clamps engaging on the ponton siderail are provided to secure the ponton to the trailer. A compartment is provided at the rear of the trailer for carrying light cables and other small articles. Rollers are provided at the rear to assist in unloading the boat by hand. The trailer is equipped with hand parking brakes actuated by levers on both sides of the trailer. Dollies consisting of a standard fifth wheel mounted on a dual tired axle are provided for towing the trailer when using a caterpillar tractor or truck not equipped with a fifth wheel. The tongue of this dolly engages in the standard Ordnance pintle that is provided on all vehicles. The dolly is equipped with air brakes, blackout lighting system, and is normally towed behind one of the semitrailers. The chess and balk load is secured to the trailer by means of cable-type load binders on a rachet take-up. A tool rack for carrying the standard pioneer tools issued to motor vehicles in combat organizations is attached to the left rear fender of the trailer. The empty trailer weighs approximately 7200 lbs., and loaded weighs approximately as follows (exclusive of prime mover):

Ponton load: 16,300 lbs.
Abutment load: 22,500 lbs.
Trestle load: 20,600 lbs.

For the actual arrangement and method of loading, see paragraphs 58 to 62.

87. PRIME MOVERS.—The prime movers are a special short wheelbase cab-over-engine, 4x4 type truck with an engine having a piston displacement of about 550 cubic inches and having a maximum road speed of about 45 miles per hour. The gear shift is a standard five speed forward and one reverse. An auxiliary transmission is provided for a high and low range. A lever is also provided to disengage the front wheel drive when operating on paved roads. Each truck is equipped with a 15,000 pound capacity front winch. In back of the cab is a chest for tools, rope, outboard motors, and other equipment containing approximately 86 cubic feet of space. The prime mover is equipped with air brakes and the standard blackout lighting system with a weight, exclusive of trailer, of about 16,500 lbs.

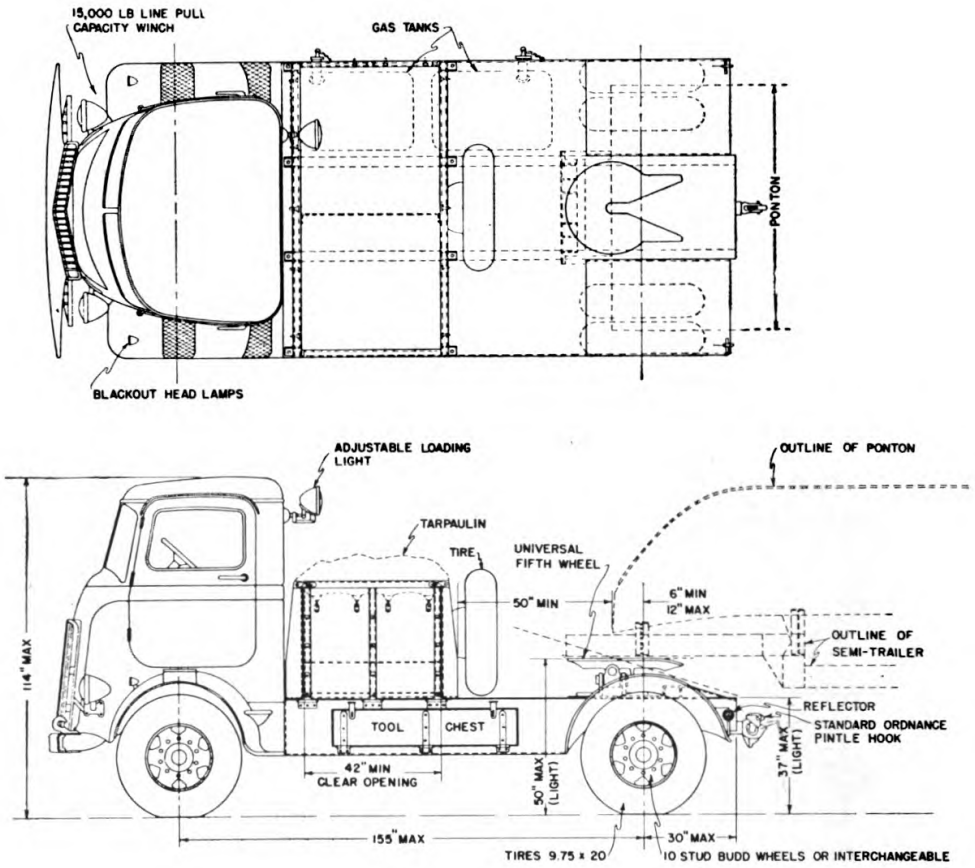

Figure 45. Tractor truck, 25-ton ponton equipage.

88. TRUCK CRANE.— The truck crane (see figure 46) is a complete truck mounted crane that is convertible to a shovel, trench hoe, dragline or piledriver. It is designed to lift 11,000 pounds over the end and 6,700 pounds over the side at a 10 foot radius; and 3,400 pounds over the end and 2,300 pounds over the side at a 25-foot radius. One crane within the battalion is equipped with a trailer as shown for transporting the shovel attachment, clamshell and dragline buckets, pile driving attachment and drop hammer.

The truck crane and trailer are designed to travel at a speed of 50 miles per hour over roads in good condition.

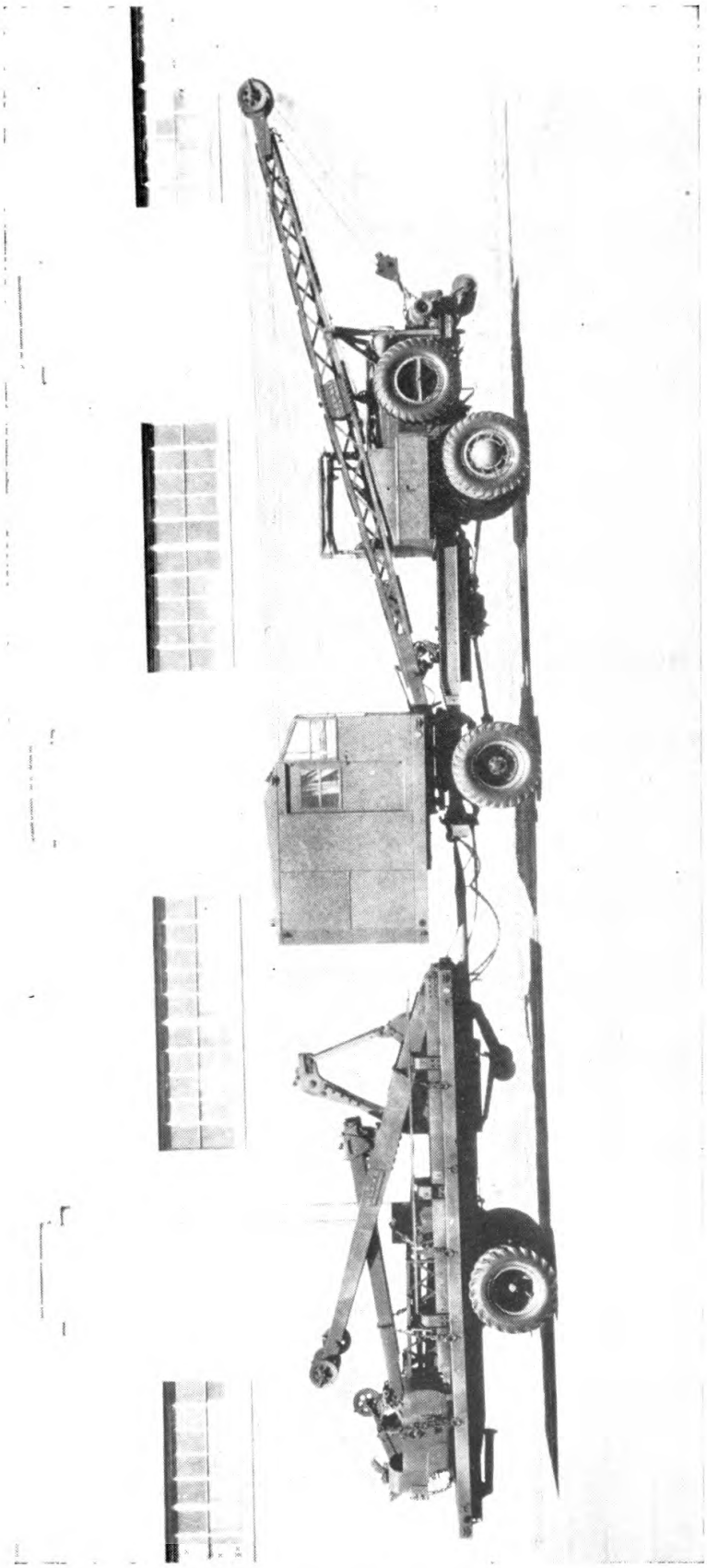

Figure 46. Truck crane and supplementary equipment.

Appendix I

TECHNICAL RECONNAISSANCE
PONTON BRIDGE OR FERRY SITE

I. INSTRUCTIONS.—
MAP REFERENCE _____
PARTY _____
EQUIPMENT FOR RECONNAISSANCE PARTY.—

Normal Items	Special Items
1 Truck (1½ ton or 2½ ton)	_____
1 Boat assault	_____
4 Paddles	_____
1 Tape, 50 ft.	_____
1 Compass, prismatic (if not in sketching case)	_____
1 Sounding pole, 8 ft., improvised	_____
Shovel, pick, mattock and axe (if not on vehicle)	_____
Map and photo (if available)	_____
Sketching case and equipment, complete	_____

II. REPORT IN DETAIL.—

LOCATION OF CROSSING SITE

1. NAME OF STREAM _____
2. LOCATION OF SITE _____

ACCESS ROADS — NEAR OR_____SIDE

3. DESIGNATION _____
4. CHARACTER: Usable width_____ft.
   Surface material _____
   Sharp curves? _____
   Maximum grade _____
   Well drained? _____
   General condition _____
   Distance from access road to bridge site _____
   Remarks _____

ACCESS ROADS — FAR OR_____SIDE

5. DESIGNATION _____
6. CHARACTER: Usable width_____ft.
   Surface material _____
   Sharp curves? _____
   Maximum grade _____
   Well drained? _____
   General condition _____
   Distance from access road to bridge site _____
   Remarks _____

APPROACHES — NEAR OR_____SIDE

7. LENGTH: Total _____; Requiring clearing or grading _____

8. CHARACTER: Maximum grade (When finished) _____
Soil _____ Clearing required _____
Length of straightaway at end of bridge _____
Maximum cut _____ Serious drainage problem? _____
Summarize improvements required _____
Total man-hours _____

APPROACHES — FAR OR_____SIDE

9. LENGTH: Total_____; Requiring clearing or grading _____

10. CHARACTER: Maximum grade (when finished) _____
Soil _____ Clearing required _____
Length of straightaway at end of bridge _____
Maximum cut _____ Serious drainage problem? _____
Summarize improvements required _____
Total man-hours _____

CHARACTER OF STREAM

11. WIDTH: _____ft. How measured _____

12. VELOCITY_____(1 mile per hour equals about 1 ½ feet per second or 90 feet per minute)

13. LOCATION OF MAIN THREAD OF CURRENT: Distance from near bank_____ft.

14. LOCATION OF EDDIES _____

15. DEPTHS: Near bank; 3 feet from shore _____ft;
6 feet from shore _____ft.
9 feet from shore _____ft;
12 feet from shore _____ft.
How far from shore to depth of 30 inches? _____ft.
Far bank; 3 feet from shore _____ft.
6 feet from shore _____ft.
9 feet from shore _____ft.
12 feet from shore _____ft.
How far from shore to depth of 30 inches? _____ft.
Maximum depth _____ft. Where? _____

16. CHARACTER OF BOTTOM: Good footing for trestles near shore? _____
Will anchors hold well? _____ Remarks _____

17. OBSTRUCTIONS: Nature and location of shoals, snags, rocks, etc. _____

18. RISE AND FALL OF WATER LEVEL: Controlled by dams? _____
Flood height (above present level) _____ft. (Note drift and marks)
Subject to flash floods? _____ Time and duration of floods or extremely low stages _____
_____ Source of information _____

19. BANKS: Near side: Character of soil _____
Firm enough for abutment sill?_____
Sketch profile on back of this sheet including approximate dimensions.
Far side: Character of soil _____
Firm enough for abutment sill?_____
Sketch profile on back of this sheet including approximate dimensions.

20. TRIBUTARY STREAMS: Location with respect to bridge site _____
Name _____
Suitable for anchoring pontons?_____How many?_____
Would pontons be concealed from ground observation? _____
Air? _____

CONSTRUCTION DATA

21. HOLDFASTS: Trees or stumps on banks suitable for anchoring cables? _____

22. MOORING PONTONS: Deepwater close to shore? _____
Snags? _____ Can rafts be constructed readily along shore? _____(Near shore) For what distance above site? _____ Below site? _____

23. BALK AND CHESS STACKS. Suitable cleared area adjacent to site on near bank?_____ Size_____ Can a site be cleared readily? _____ Man-hours? _____

24. EQUIPAGE REQUIRED FOR PONTON BRIDGE: (RESERVE NOT INCLUDED)
Units of equipage required for floating spans: _____
Trestles required: Near shore_____ Far Shore_____
Total_____ Special construction? _____

25. EQUIPAGE REQUIRED FOR RAFT (FERRY)
Near shore landing: Trestles_____ Special construction? _____
Far shore landing: Trestles_____ Special construction? _____
Remarks _____

26. EXISTING FACILITIES AT SITE: (Ferry landings, pontons, bridge abutments, barges, bridge timbers, deckings). Describe _____

27. UNLOADING:
Can semi-trailers be moved to river bank, with trucks?_____
Tractors?_____ If not, how close can they come to water edge? _____ How many can be unloaded simultaneously? _____

28. TURNAROUNDS:
Can semi-trailers be turned around at unloading site?_____
Remarks _____

29. PARKING:
Where is nearest suitable parking area for unit vehicles?_____
_____
How many semi-trailers can be accommodated? _____
Is parking area concealed from ground observation? _____
Air? _____
Does natural cover favor effective camouflage? _____
Remarks _____

30. SKETCHES: (on reverse side of sheet)

Prepare rough sketch of general map location.

Prepare large scale rough sketch of site showing condition and length of approaches, existing facilities, and recommended layout and preparation of site for construction of ponton bridge.

Draw cross-section of stream at site.

31. RECOMMENDATIONS:

General suitability of site _____

Is there a better one nearby? _____ Where? _____

Estimated time of construction:

Near Approach_____ Hours using_____men with following special equipment _____

Far Approach_____ Hours using_____men with following special equipment _____

25-ton Ponton Bridge: Daylight_____hours; Night_____hours.

Personnel required _____

Ferry including both landing stages:_____hours_____men.

Other remarks _____

_____
Chief of party

_____
Name, grade, organization

_____
Date and hour submitted

Appendix II

TECHNICAL AND LOGISTICAL DATA
25-TON PONTON UNITS

1. MOTOR MOVEMENTS

	Each of 2 Lettered Cos.	Bn. Hq. H&S Co. Att. Med.	Bn. Total
a. Arms:			
Pistol, auto cal. 45	6	18	30
Carbine, cal. 30 M1	170	179	519
b. Personnel to be moved:			
Officers & Warrant Officers	4	11	19
Enlisted Men	172	193	537
Total	176	204	556
c. Number of Prime Movers (Total):	55	55	165
(1) **Light:** (Total)	10	13	33
Motorcycles	(3)	(4)	(10)
Truck, ¼ ton	(3)	(2)	(8)
Trucks, command	(1)	(2)	(4)
Trucks, ¾-ton weapons carrier	(3)	(4)	(10)
Ambulance, field	(0)	(1)	(1)
(2) **Medium:** (Total)	7	40	54
Compressor Air Mtzd.	(0)	(1)	(1)
Shop, Motorized, Gen. purp.	(0)	(1)	(1)
Trucks, 2½-ton cargo	(7)	(38)	(52)
(3) **Heavy:** (Total)	38	2	78
Trucks, 4-ton cargo	(4)	(0)	(8)
Trucks, 5-ton tractor	(32)	(0)	(64)
Trucks, crane	(1)	(1)	(3)
Truck, 4-ton wrecker	(1)	(0)	(2)
Truck, 10-ton wrecker	(0)	(1)	(1)
d. Number of Trailers (Total):	44	32	120
Power boat (2 wheel)	(2)	(0)	(4)
Semi-(Ponton Equipment)	(32)	(0)	(64)
Tractor (4 wheel)	(2)	(0)	(4)
Cargo 1-ton (2 wheel)	(4)	(7)	(15)
Dollies (2 wheel)	(4)	(0)	(8)
Shop welding trailer mtd.	(—)	(1)	(1)
2 wheel, ponton, light equipage	(—)	(23)	(23)
Trailer, crane accessory	(—)	(1)	(1)
e. Gasoline required—gals. per 100 miles:			
See Note A—(Approximate)	1250	900	3400
f. Oil required—gals. per 100 miles:			
See Note B—(Approximate)	62½	45	170
g. Road Space (Closed up bumper to bumper):			
Yards	750	500	2000
Miles	0.44	0.28	1.16
h. Road Space (50 yards between vehicles):			
Yards	3345	3000	9690
Miles	1.90	1.70	5.50
i. Road Space—Grouped:			
(50 yards between vehicles; 1 mile between march groups; Each co. in 2 groups.)			
Yards	5055	4710	18,340
Miles	2.87	2.68	10.42

	Each of 2 Lettered Cos.	Bn. Hq. H&S Co. Att. Med.	Bn. Total
j. Time Length of Column (one March group) as in h above: 20 m.p.h. (minutes):	5¾	5½	17
k. Time Length of Column (in groups) as in i above; 20 m.p.h. (minutes)	8¾	8½	32

l. **Data For One Platoon** (bridge unit) reinforced to operate independently will be approximately one-half the figures shown above for one company.

m. Notes:

(1) Note A: Gasoline consumption based on following performance:

Medium vehicles	6 miles per gallon
Light vehicles	9 miles per gallon
Heavy vehicles	3½ miles per gallon

(2) Note B: Oil requirements assumed to be 1 quart of oil per 5 gallons of gasoline.

n. Heavy Equipment:

	AXLE LOADS (POUNDS)					WHEELBASE (INCHES)	
	FRONT	REAR		TRAILER			
		Front	Rear	Front	Rear	Truck	Trailer
Truck, 2½-ton cargo—empty	3,940	3,120	3,300	.....	.....	164	.....
Truck, with 2½-ton chess load	3,700	5,690	5,940	.....	.....	164	.....
Truck, 4-ton cargo empty	7,560	4,600	4,370	.....	.....	151	.....
Truck, with 4-ton chess load	5,460	9,600	9,800	.....	.....	151	.....
Truck, crane (no boom load)	10,290	.....	14,400	.....	.....	156	.....
Truck and trailer with attachments load	10,900	.....	16,250	.....	15,080	156	243
Truck, 5-6 ton tractor	10,900	.....	5,400	.....	.....	148	.....
Truck and trailer with abutment load	11,810	.....	11,950	.....	11,285	148	289¼
Truck and trailer with ponton load	11,180	.....	10,890	.....	10,550	148	289¼
Truck and trailer with trestle load	12,000	.....	11,970	.....	12,910	148	289¼
Trailer with tractor load	.....	.....	.....	7,500	13,350	.....	168

2. **Rail Movements**

	Each of 2 Lettered Cos.	Bn. Hq. H&S Co. Att. Med.	Bn. Total
a. Personnel to be moved:			
(1) Officers & Warrant Officers	4	11	19
(2) Enlisted men	172	192	536
(3) Total	176	204	556
b. Cargo and passenger vehicles (Total):	21	50	92
(1) Motorcycles, solo	(3)	(4)	(10)
(2) Trucks, ¼-ton	(3)	(2)	(8)
(3) Trucks, ¾-ton command	(1)	(2)	(4)
(4) Trucks, ¾-ton weapons carriers	(3)	(4)	(10)
(5) Trucks, 2½-ton cargo	(7)	(38)	(52)
(6) Trucks, 4-ton cargo	(4)	(0)	(8)

		Each of 2 Lettered Cos.	Bn. Hq. H&S Co. Att. Med.	Bn. Total
c.	Combat and special vehicles (Total):	83	36	202
(1)	Boat power	(2)	(0)	(4)
(2)	Car half track M2	(1)	(0)	(2)
(3)	Compressor air motorized	(0)	(1)	(1)
(4)	Dolly, 2 wheel for semi-trailer	(4)	(0)	(8)
(5)	Shop, motorized, general purp.	(0)	(1)	(1)
(6)	Shop, welding, trailer mounted	(0)	(1)	(1)
(7)	Tractor medium	(1)	(0)	(2)
(8)	Tractor medium w/angledozer	(1)	(0)	(2)
(9)	Trailer, 1-ton cargo	(4)	(7)	(15)
(10)	Trailer, semi (heavy ponton)	(32)	(0)	(64)
(11)	Trailer power boat	(2)	(0)	(4)
(12)	Trailer 2 wheel (light equipage)	(0)	(23)	(23)
(13)	Trailer 4 wheel (for medium tractor)	(2)	(0)	(4)
(14)	Trailer crane accessory	(0)	(1)	(1)
(15)	Truck, crane	(1)	(1)	(3)
(16)	Truck, 5-ton tractor	(32)	(0)	(64)
(17)	Truck, 4-ton wrecker	(1)	(0)	(2)
(18)	Truck, 10-ton wrecker	(0)	(1)	(1)
d.	Baggage, free checkable	17,600	20,300	55,500
e.	Car requirements—Based on four 44 car trains and two 27 car trains.			
(1)	Tourist sleeper (39 man cap.)	5	5	15
	or coach alternate (86 man cap.)	3	3	9
(2)	Flat 40′	79	45	203
(3)	Baggage for kitchen and baggage	4	4	12
(4)	Total (less coaches)	88	54	220
f.	Sidings (feet)			
(1)	27 car section	1300		
(2)	44 car section	2300		

3. **SHIP SPACE:**

a. Basis:

40 cubic feet	= one ship ton
Commercial or convoy loading	= net ship tons + 15%
Organizational unit loading	= net ship tons + 20%
Combat unit loading	= net ship tons + 50%

b. **Net Volume of Representative Vehicles:**

	Cu. Ft.	Ship Tons
Truck, ¼-ton pick-up	708	17.7
Truck, 2½-ton cargo w/winch	1518	38.0
Truck, 4-ton cargo	1700	42.5
Truck, 5-6 ton tractor	1535	38.4
Truck, crane, w/boom dismounted for shipment	1950	48.7
Semi-trailer, Hv. Pon., w/ponton load	2350	58.8
Semi-trailer, Hv. Pon., w/abutment load	1755	43.8
Semi-trailer, Hv. Pon., w/trestle load	1730	43.2

c. **Net Ship Tonnage of 1 Unit of 25-ton Ponton Equipment:**

1484 ship tons

(16 truck tractors, 12 semi-trailer w/ponton loads, 2 semi-trailers w/abutment, and 2 w/trestle loads)

d. **Net Ship Tonnage of Tactical Unit Completely Equipped:**

Per bridge platoon	1632 ship tons
Per bridge company	3804 ship tons
Per heavy ponton battalion	10031 ship tons

e. **Ship Space Required for Heavy Ponton Battalion:**

Commercial or convoy loading	11536 ship tons
Organizational unit loading	12037 ship tons
Combat unit loading	15046 ship tons

4. BRIDGE MATERIALS AVAILABLE:

a. Notation

L = Length of bridge in feet
T = Trestles used
P = Pontons used

b. **Ponton (floating) Bridges,** Normal Construction, (3 boat hinge rafts). **25-ton Capacity:**

(1) Formulae:

$$L = 15\ (T + (P-2))$$

$$T = \frac{L}{15} - (P-2)$$

$$P = \frac{L}{15} - T + 2$$

Notes: $P \geq 5$

(2) Example:

Shore Conditions permitting use of a total of —	Maximum length of one bridge using equipment of— 1 Platoon (Bridge Unit) Feet	1 Company (2 Plats.) Feet	1 Battalion (2 Companies) Feet
No trestle	150	330	690
2 trestles	180	360	720
4 trestles	210**	390	750
8 trestles	—	450**	810
16 trestles	—	—	930**

**Indicates complete utilization of equipment and no tactical reserve.

c. **Ponton (floating) Bridge,** Reinforced Construction:

(1) Formulae:

$$L = 15\ (T + \frac{P+1}{2})$$

$$T = \frac{L}{15} - \frac{P+1}{2}$$

$$P = 2(\frac{L}{15} - T) - 1$$

Note: $P \geq 5$, but increases by 2 as 5, 7, 9, etc.

(2) Examples:

Shore Conditions permitting use of a total of —	1 Platoon (Bridge Unit) Feet	1 Company (2 Plats.) Feet	1 Battalion (2 Companies) Feet
No trestle	90	180	360
2 trestles	120	210	390
4 trestles	150**	240	420
8 trestles	—	300**	480
16 trestles	—	—	600**

d. **Ponton (floating) Bridge,** Light Construction, (2 boat hinge rafts—15′ bay), **10-ton Capacity:**

(1) Formulae:

$$L = 15\ (T + 3) + 27\ (P\text{-}3) \text{ or } 15\ T + 27\ P - 36$$

$$T = \frac{L\text{-}27P + 36}{15}$$

$$P = \frac{L\text{-}15T + 36}{27}$$

Note: $P = 3$ (or more)

(2) Examples:

Shore Conditions permitting use of a total of —	Maximum length of one bridge using equipment of— 1 Platoon (Bridge Unit) Feet	1 Company (2 Plats.) Feet	1 Battalion (2 Companies) Feet
No trestles	288	612	1260
2 trestles	318	642	1290
4 trestles	348**	672	1320
8 trestles	—	732**	1380
16 trestles	—	—	1500**

Note: Space chess 3″.

e. **Ponton (floating) Bridge,** Lightened Construction, (2 boat hinge rafts—15′ bay), **15-ton Capacity.**

(1) Formulae:

$$L = 15\ (T + 3) + 21\ (P - 3) \text{ or } 15T + 21P - 18$$

$$T = \frac{L - 21P + 18}{15}$$

$$P = \frac{L - 15T + 18}{21}$$

Note: $P = 3$ (or more)

(2) Examples:

Shore Conditions permitting use of a total of —	Maximum length of one bridge using equipment of— 1 Platoon (Bridge Unit) Feet	1 Company (2 Plats.) Feet	1 Battalion (2 Companies) Feet
No trestles	234	486	990
2 trestles	264	516	1020
4 trestles	294**	546	1050
8 trestles	—	606**	1110
16 trestles	—	—	1230**

f. **Trestle Bridge,** Normal Construction, **45-ton Capacity:**

(1) Formulae:

$$L = 15\ (T + 1)$$

$$T = \frac{L}{15} - 1$$

(2) Examples:

Number of crossings to be constructed simultaneously:	Maximum length of one bridge using equipment of— 1 Platoon 4 Trestles (Bridge Unit) Feet, each	1 Company 8 Trestles (2 Plats.) Feet, each	1 Battalion 16 Trestles (2 Companies) Feet, each
1 crossing	75	135	255
2 crossings	45	75	135
4 crossings	—	45	75
8 crossings	—	—	45

(3) Note: Ponton (floating) bridges require a variable quantity of trestle parts. The utilization of unit equipment for trestle bridges may prevent simultaneous use of the remainder of the unit equipment for its primary purpose — ponton (floating) bridges.

g. **Maintenance Requirements—Service Conditions:**

(1) 25-ton ponton units do not carry with them any spare pontons or trestles. A limited quantity of spare **wood** parts accompanies each unit to repair damage due to traffic only.

(2) Hostile air or ground action must be expected to effect some damage to bridge equipage when in active use necessitating a tactical reserve.

(3) In computing the number of platoons (bridge units) required for a crossing, allowance should be made for a tactical reserve to replace portions of a bridge damaged by enemy action. The amount of the reserve should be proportionate to the importance of the bridging operation and the possible enemy reaction thereto. The reserve ponton equipage should be not less than 25% of the quantity required for the initial construction and in critical operations this reserve should be increased to 100% if possible.

Appendix III

STANDING OPERATING PROCEDURE
HEAVY PONTON BATTALION

1. **General:** The following Standing Operating Procedure is presented as a guide. It should be modified as the situation demands.

2. **Objects:**

a. To standardize operating procedure in the field;

b. To minimize field instructions for particular operations.

3. **Reference:** Cite provisions of standing Operating Procedure as "SOP _____" followed by pertinent paragraph number.

4. **Uniforms:**

a. Standard Uniforms:

(1) *Garrison:* As prescribed.

(2) *Theater of Operations:* Field hat (or helmet), wool (or cotton) underwear, wool (or khaki) shirt, identification tags, trousers with waist belt, canvas leggings, light wool socks, service shoes, service gas mask, handkerchief, belt with first aid pouch and packet, canteen with cup and cover, carbine (or holster and magazine pocket for pistol and pistol), and additional special individual equipment as issued to officers and noncommissioned officers, field bag with carrying straps with helmet attached, if not worn, containing face towel, toilet kit, mess kit, undershirt, drawers, pair of light wool socks, respirator, raincoat, handkerchief, pair of shoe laces, emergency ration, and fatigue clothes or coveralls.

b. Appearance:

(1) Cleanliness and neatness is mandatory at all times.

(2) Clothes will be worn properly.

(3) Officers and noncommissioned officers are required to rectify and report violations of this paragraph by any man in the battalion.

5. **Cleanliness:**

a. Men will shave daily.

b. Health requires frequent washing and bathing.

c. Company commanders will check feet of men periodically.

6. **Operations Instruction:**

a. Company commanders will keep men informed daily of the situation, operations planned, and the mission of the battalion.

b. A situation map will be kept posted near Company CP.

7. **Vehicle Speeds:**

a. Safe driving speeds will never be exceeded. Watch slippery streets, crowds, children, and city traffic.

b. *Maximum Speeds in Convoys:*

Congested districts, cities, and towns	12 M.P.H.
Thickly populated districts	15 M.P.H.
Open Country	40 M.P.H.

c. *Maximum Speeds—Not in Convoy:*

Reconnaissance Cars and Motorcycles:	
Cities and reservations	Legal Limit
Open country	35 M.P.H.
Trucks—All Types:	
On post and in cities—where required	10 M.P.H.
On post and in cities—where allowed	20 M.P.H.
Open country (Maximum)	30 M.P.H.

8. **Order of March:**

a. *For Battalion:* Battalion Commander's party, Company "A", Company "B", Headquarters and Service Company, Battalion Headquarters, Attached Medical, and Battalion Maintenance.

b. *Within Companies:* Company Commander, 1st Platoon, Kitchen, 2nd Platoon, Company Maintenance, and Second in Command.

c. *½-Ton Trucks Towing Tractors:* March with Headquarters and Service Company unless otherwise ordered.

9. **March Groups:**

a. *Purpose:* Control; prevention of accordion action.

b. *Composition:* 6 march groups, 2 per Bridge Company and 2 per Headquarters and Service Company, Battalion Headquarters, Attached Medical, and Battalion Maintenance.

c. Responsibility of March Group Commander: March discipline, speed, route, halts, intervals, maintaining march schedule, contact with adjacent groups, and security.

10. **Halts:**

a. When? On pre-arranged time schedule if published; at least for 10 minutes every 2 hours.

b. Why? Rest men, check vehicles.

c. Vehicle Inspection Mandatory at All Halts: Officers and noncommissioned officers supervise.

d. Each vehicle pull off pavement; clear bridges, road intersections, and defiles. Men keep off road.

e. Intervals: Vehicles stop and start together; maintain minimum interval of 50 yards, maximum of 150 yards, average of 100 yards.

f. Catching Up: At scheduled halts of longer than 15 minutes lagging vehicles or march groups close to 50 yards before halting. At least 10 minutes halt must be provided.

g. Location Report: Group commanders report condition and location of his group to next higher commander at each halt.

h. Check of Column: March group commander checks condition and location of all his vehicles at each halt.

11. **Signals:**

a. Drivers are required to give prescribed arm signal when starting, stopping, or turning.

b. Close-up Signal:

(1) *Hand:* Arms extended to front horizontally, palms inward, move hands together and repeat.

(2) *Flag:* Black and yellow flag displayed by assistant driver from right window of cab.

(3) All vehicles in rear repeat signal of lead vehicles.

(4) *Use:* When specifically ordered, to go through large cities, for special halts, and for entering administrative bivouacs.

c. Normal Interval (Extend) Signal:

(1) *Hand:* Arms extended to side laterally.

(2) *Flag:* Black and yellow flag held by assistant driver from right window of cab, moved up and down and then withdrawn inside cab and kept out of sight.

(3) All vehicles in rear repeat signal of lead vehicles.

(4) *Use:* When specifically ordered, to cause all vehicles to regain normal interval (minimum of 50 yards, maximum of 150 yards).

12. **Disabled Vehicles:**

a. Pull off road; post guard 100 feet each side of vehicle; motion following trucks to pass; at night keep lights on.

b. Await company or battalion maintenance truck if necessary.

c. When repaired, follow convoy; catch up if possible; shorten scheduled halts if necessary; observe maximum speed limits.

13. **Accidents:**

a. Stop at once, investigate all accidents.

b. Fill out Form 26 at once. Get names of all witnesses.

c. Notify next officer that passes.

d. Second in command of march group completes investigation.

e. Battalion surgeon examines and cares for civilian and military personnel involved. Forestall claims of personal injury.

14. **Personnel:**

a. Must remain seated while in vehicles — moving or halted.

Exception: Machine gun operators — one per gun.

b. Riding on trailers is forbidden.

c. Machine gun operators riding platform of Mack truck tractors must be secured by strong rope safety line.

d. Throwing notes from vehicles or shouting at passers-by is prohibited. Senior man in vehicle is personally responsible for conduct of all men in vehicle.

15. **Guides:**

a. Responsibility: Lead company commander.

b. Place At: Railroad crossings, important road junctions, city traffic lights, one-way bridges or defiles, confusing or sharp turns.

c. Purpose: Safety, control of traffic, mark proper route.

d. Identification: Black arm-band with letter "G" in red.

e. Relief:

(1) By guide pick-up truck at rear of column.

(2) Lead company commander arrange for pick-up truck by consultation with commander of rear march group.

(3) Guide pick-up truck will be marked with sign on front and both sides with word "Guides" in red on black background.

f. Instruction: Must be thorough. Responsibility of company commander.

16. **Administrative:** (No tactical situation)

a. Park vehicles as directed; usually close together; accurate alignment required.

b. Use of vehicles in camp will be minimized. Trip ticket okayed by officer required to remove vehicle from camp.

17. **Tactical:** (Subject to enemy threat)

a. Park vehicles under cover at least 50 yards apart.

b. Camouflage all vehicles and installations at once. Men remain under cover. Avoid large groups. Mess in groups of 10.

c. Lights of all kinds prohibited unless specifically authorized.

d. Security: See paragraphs 22 to 29, Appendix III.

18. **Motor Maintenance:**

a. Check all vehicles carefully at once. Officers and noncommissioned officers inspect.

b. Refill gasoline tanks and containers immediately.

c. Company commanders report at once to battalion commander any vehicle not ready to move.

19. **Sanitation:**

a. Latrines: Prepare first thing; cover 5 minutes before departure. Mark each latrine before departure.

b. Garbage Pits and Latrines: Make amply deep to provide 18 inches of cover of clean soil when backfilled. Heap dirt 6 inches above ground level when covering to allow for settlement.

c. Final inspection of camp site by battalion surgeon. He will arrange for "Clean-up Party", remedy defects, restore fences. Arrange with Headquarters and Service Company commander for engineer personnel and materials, if

required. Rejoin column when finished. Battalion surgeon will prepare certificate as to condition and submit to battalion commander.

d. Kitchens must be kept clean at all times.

20. **Camp Arrangement:**

a. Battalion Headquarters near center of battalion area.

b. Headquarters and Service Company adjacent to Battalion Headquarters.

c. Battalion Aid Station adjacent to Battalion Headquarters—near road.

d. Company Command Posts on edge of company area nearest Battalion Headquarters.

21. **Command Posts:**

a. Mark with sign at road and string tracing tape to Command Post.

b. Maintain responsible noncommissioned officer on duty at all times.

c. Report location to next higher unit commander at once.

22. **Object:** Never let enemy surprise you.

23. **On March:**

a. Responsibility:

(1) Lead company: Advance and flank guards.

(2) Rear company: Rear guard.

(3) All elements: Close defense against air, ground, or gas attack.

b. Advance (Rear) Guards:

(1) Composition: Point — motorcycle; advance (rear) party—half track car with machine guns mounted plus machine gun crews and riflemen support—2½-ton truck with machine gun mounted plus 2 squads.

(2) Conduct: Designate get-away-man for each vehicle. Move at extended intervals. Keep at least one mile ahead (or behind) main body. Give immediate warning of hostile elements. Block road if attacked by hostile vehicles. Reduce road blocks encountered in the advance.

(3) At halts: Cover main body.

(4) At bivouacs: Furnish security until relieved by outpost.

c. Manning Weapons:

(1) All machine guns will be prepared for action. Water will be kept in cooling system. Ammunition belts and boxes will be prepared for immediate use.

(2) Vehicles rifles will be loaded with 5 rounds of ball ammunition in magazine.

24. **In Bivouac, (Tactical Only):**

a. Responsibility:

(1) Battalion outpost: Bridge company not furnishing previous advance guard.

(2) Close defense: Companies or detached units.

b. Outpost:

(1) Cover routes of approach within radius of 2 miles.

(2) Security group consists of machine gun with crew—concealed. Conceal a get-away man with truck or motorcycle in rear of group.

(3) Road blocks or mine fields, when used, must be covered by fire.

(4) Outpost commander report to battalion commander location and composition of security groups as soon as posted. Furnish sketch of dispositions.

(5) Mobile reserve, with truck transportation, will be prepared for instant dispatch.

(6) Motor patrols contact security groups and adjacent units at least every 2 hours.

c. Close Defense:

(1) Guard Command Posts carefully.

(2) Stop all vehicles entering or leaving bivouac area.

(3) See pars. 25 to 28, Appendix III, for general defense measures.

(4) Remove Command Post and other signs if attacked.

25. **Warning Signals:**

a. Air Alarm: Three (3) long blasts of whistle or motor horn; point in direction of hostile airplanes.

b. Ground Attack: Four (4) long blasts of whistle or motor horn.

c. Gas Attack: Gas klaxon sounds. Shout "Gas"; runner, motorcyclist, or gas sentinel holds gas mask aloft.

d. All Clear, (From any of above): One long blast of whistle or motor horn. Runner, motorcyclist, or gas sentinel (after gas alarm) carries gas mask in hand, uncased.

e. All units, vehicles, and individuals repeat above signals when seen or heard.

26. **Air Defense:**

a. Air Guards: Detail and maintain two (2) per march group while in convoy. Post one (1) per company in tactical bivouac or at bridge site.

b. Machine guns to be located so that one-half are sited for air targets. Anti-aircraft machine gun crews must remain near guns.

c. Slit Trenches: Standard individual prone shelters or standing type.

d. In Bivouac: At air alarm personnel not manning machine guns take cover in slit trench at once moving under cover of trees. Remain quiet and concealed.

e. On March: Do not halt. Machine guns fire on enemy ships.

f. Aircraft Identification: Look for identifying marks and silhouette for type.

27. **Ground Defense:**

a. On March:

(1) Man all weapons instantly.

(2) Commanding officer and lower unit commanders investigate at once.

(3) Block main and side roads with trucks and trailers.

(4) Dismount personnel, seek cover, fight as infantry when closely threatened.

(5) Attack road blocks and vehicles from flank and rear.

(6) Notify next higher unit commander at once.

b. In Bivouac:

(1) Assemble units by squads under cover.

(2) Take action indicated in paragraph 27 *a,* above.

28. **Gas Defense:**

a. At Alarm: Mask at once; awaken sleepers and mask them. Remain masked until "All Clear" sounds.

b. Chemical Officers and Noncommissioned Officers Investigate:

(1) Determine and announce nature of chemical used.

(2) Outline contaminated area. Post guards to prevent entry into danger zones.

(3) Notify next higher unit commander of full details.

(4) Notify unit commander when "All Clear" is warranted.

29. **Bridge Site Defense:**

a. During Construction: Same as in bivouac. See par. 24, Appendix III.

b. Bridge in Service:

(1) Engineer bridge guards give alarms. See par. 25, Appendix III.

(2) Man all available weapons.

(3) Notify higher headquarters at once by telephone and runner, and radio if available.

(4) For air or gas attack: Keep traffic off bridge: direct personnel of traffic control group to disperse approaching vehicles under cover.

(5) For ground attack: Have both ends of bridge prepared for quick demolition. Prepare removable barrier for both approaches. Cover barriers with fire. As last resort blow or dismantle both approach and trestle spans to prevent use by enemy vehicles.

30. **Route Reconnaisance:**

a. Required whenever heavy vehicles move off first class highways.

b. Purpose: Check bridge capacity, underpass clearance, sharp turns, and mileage.

c. Responsibility: Senior officer of unit or detachment.

d. Battalion Marches: Commander of leading company will direct reconnaissance for battalion after consultation with battalion S-2.

e. Route sketches will be reproducted by battalion S-2 for distribution to each driver when recommended by reconnaissance officer.

f. Reconnaissance Report: Submit informally to unit commander. Include pencil sketch of route, giving cumulative mileage to principal towns, intersections, and turns; also notes on bridges, underpasses, sharp turns, etc.

g. Reconnaissance Party: Detail and fully train at least 1 per bridge platoon.

h. Tactical considerations will not be ignored. Security of reconnaissance parties must be provided.

31. **Bridge Reconnaisance:**

a. Required for every bridging operation.

b. Purpose: Check location, routes, road connections, materials required, labor required, security, and trailer unloading areas.

c. Responsibility: Senior officer of unit designated to construct bridge.

d. Reconnaissance Party:

(1) Detail and train 1 per bridge platoon.

(2) Composition: *Personnel:* 1 officer, 1 sergeant, 1 corporal with 4 men and machine gun (Security), 1 corporal and 4 men (Assault boat crew and helpers).

(3) Equipment: One 1½-ton or 2½-ton truck, 1 assault boat with 4 paddles, one 50′ tape, 1 compass, 1 sounding pole (improvised), shovel, pick and axe, maps, sketching equipment, 1 boat hook, 2 hand lines, 2 lashings, 2 machetes, 4 range poles, 1 sinker and line, 1 watch, 1 pencil, and 2 reconnaissance data forms. See paragraph 3, Appendix 1. Use motorcycle, if available, for advance guard and messenger service.

32. **Tactical Reconnaissance:**

a. Purpose: Secure information of enemy and terrain.

b. Responsibility: Senior officer of independent unit. *Exception:* Advance, rear, and flank guards must perform tactical reconnaissance without specific orders.

c. Reconnaissance Party: Same as for bridge reconnaissance except assault boat may be omitted and the assault boat crew used as riflemen. See paragraph 31 *d,* above.

33. **Responsibility:**

a. Battalion Task: Battalion commander or officer specifically designated by name for particular operation.

b. Company or Platoon Task: Commander of designated unit.

34. **Equipment:**

a. Unit equipment is available to unit detailed for bridge task. Unused equipage will be turned over to next higher unit commander for transportation and care.

b. Additional equipment will be secured from other units only after specific approval of battalion commander.

c. Special Materials or Equipment: Arrange with battalion S-4 for purchase or loan.

35. **Construction Methods (Ponton Bridge):**

a. Method "A": Successive pontons; equipment stacked on near bank.

b. Method "B": From trailers. 4 task groups:

(1)	Traffic	(H & S Co.)
(2)	Ponton Unloading	(1st Platoon, Co. "B")
(3)	Far Shore	(2nd Platoon, Co. "B")
(4)	Bridge	(Company "A")

Normal assignments for battalion effort shown above.

36. **Reenforcing Engineer Troops:**

a. Purpose: To provide manpower for major bridge tasks.

b. Employment: By units only. Men work under their own officers and noncommissioned officers. Allot specific tasks. Give instructions to leaders, not to individuals of other organizations.

c. Liaison noncommissioned officers detailed to work with other units act as consultants. Show them how. Help. Do not give orders.

37. **Organization:**

a. Assign and work men by squads (or sections) under designated noncommissioned officers. Keep squads intact at all times. Check frequently.

b. Rotate squad assignments on long jobs to avoid fatigue.

c. Squads (or units) not working will be kept together out of sight from bridge.

d. Traffic personnel will keep spectators (including soldiers) completely away from construction area. Stragglers will be rounded up and reported to officer in charge of bridge.

e. Lister bag and salt tablets will be provided at site of work. One lister bag per company. Latrine will be dug and marked.

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