CHAPTER 5

Lifting and Moving Equipment

Section I. Lifting Equipment

Equipment used for lifting includes gin poles, tripods, shears, boom derricks, and stiff leg derricks. Light hoisting equipment includes pole, brave, and jinniwink derricks.

GIN POLES

A gin pole consists of an upright spar that is guyed at the top to maintain it in a vertical or nearly vertical position and is equipped with suitable hoisting tackle. The vertical spar may be of timber, a wide-flange steel-beam section, a railroad rail, or similar members of sufficient strength to support the load being lifted. The load may be hoisted by hand tackle or by hand- or engine-driven hoists. The gin pole is used widely in erection work because of the ease with which it can be rigged, moved, and operated. It is suitable for raising loads of medium weight to heights of 10 to 50 feet where only a vertical lift is required. The gin pole may also be used to drag loads horizontally toward the base of the pole when preparing for a vertical lift. It cannot be drifted (inclined) more than 45 degrees from the vertical or seven-tenths the height of the pole, nor is it suitable for swinging the load horizontally. The length and thickness of the gin pole depends on the purpose for which it is installed. It should be no longer than 60 times its minimum thickness because of its tendency to buckle under compression. A usable rule is to allow 5 feet of pole for each inch of minimum thickness. *Table 5-1, page 5-2,* lists values when using spruce timbers as gin poles, with allowances for normal stresses in hoisting operations.

RIGGING GIN POLES

In rigging a gin pole, lay out the pole with the base at the spot where it is to be erected. To make provisions for the guy lines and tackle blocks, place the gin pole on cribbing for ease of lashing. *Figure 4-18, page 4-16,* shows the lashing on top of a gin pole and the method of attaching guys. The procedure is as follows:

- Make a tight lashing of eight turns of fiber rope about 1 foot from the top of the pole, with two of the center turns engaging the hook of the upper block of the tackle. Secure the ends of the lashing with a square knot. Nail wooden cleats (boards) to the pole flush with the lower and upper sides of the lashing to prevent the lashing from slipping.
- Lay out guy ropes, each four times the length of the gin pole. In the center of each guy rope, form a clove hitch over

Table 5-1. Safe capacity of spruce timber as gin poles

Size of Timber in (inches)	Safe Capacity for Given Length of Timber (pounds)					
	20 Feet	25 Feet	30 Feet	40 Feet	50 Feet	60 Feet
6 diameter	5,000	3,000	2,000			
8 diameter		11,000	8,000	5,000	3,000	
10 diameter	31,000	24,000	16,000	9,000	6,000	
12 diameter			31,000	19,000	12,000	9,000
6 x 6	6,000	4,000	3,000			
8 x 8		14,000	10,000	6,000	4,000	
10 x 10	40,000	30,000	20,000	12,000	8,000	
12 x 12			40,000	24,0000	16,000	12,000
Note: Safe capacity of each length of shears or tripod is seven-eights of the value given for a gin pole.						

the top of the pole next to the tackle lashing. Be sure to align the guy lines in the direction of their anchors (see *Figure 5-1).*

- Lash a block to the gin pole about 2 feet from the base of the pole, the same as for the tackle lashing at the top, and place a cleat above the lashing to prevent slipping. This block serves as a leading block on the fall line, which allows a directional change of pull from the vertical to the horizontal. A snatch block is the most convenient type to use for this purpose.
- Reeve the hoisting tackle, and use the block lashed to the top of the pole so that the fall line can be passed through the leading block at the base of the gin pole.
- Drive a stake about 3 feet from the base of the gin pole. Tie a rope from the stake to the base of the pole below the lashing on the leading block and near the bottom of the pole. This prevents the pole from skidding while you erect it.
- Check all lines to be sure that they are not snarled. Check all lashings to see that they are made up properly and that all knots are tight. Check the hooks on the blocks to see that they are moused properly. You are now ready to erect the gin pole.

ERECTING GIN POLES

You can easily raise a 40-foot-long gin pole by hand (see *Figure 5-2).* However, you must raise longer poles by supplementary rigging or power equipment. The number of people needed to erect a gin pole depends on the weight of the pole. The procedure is as follows:

- Dig a hole about 2 feet deep for the base of the gin pole.

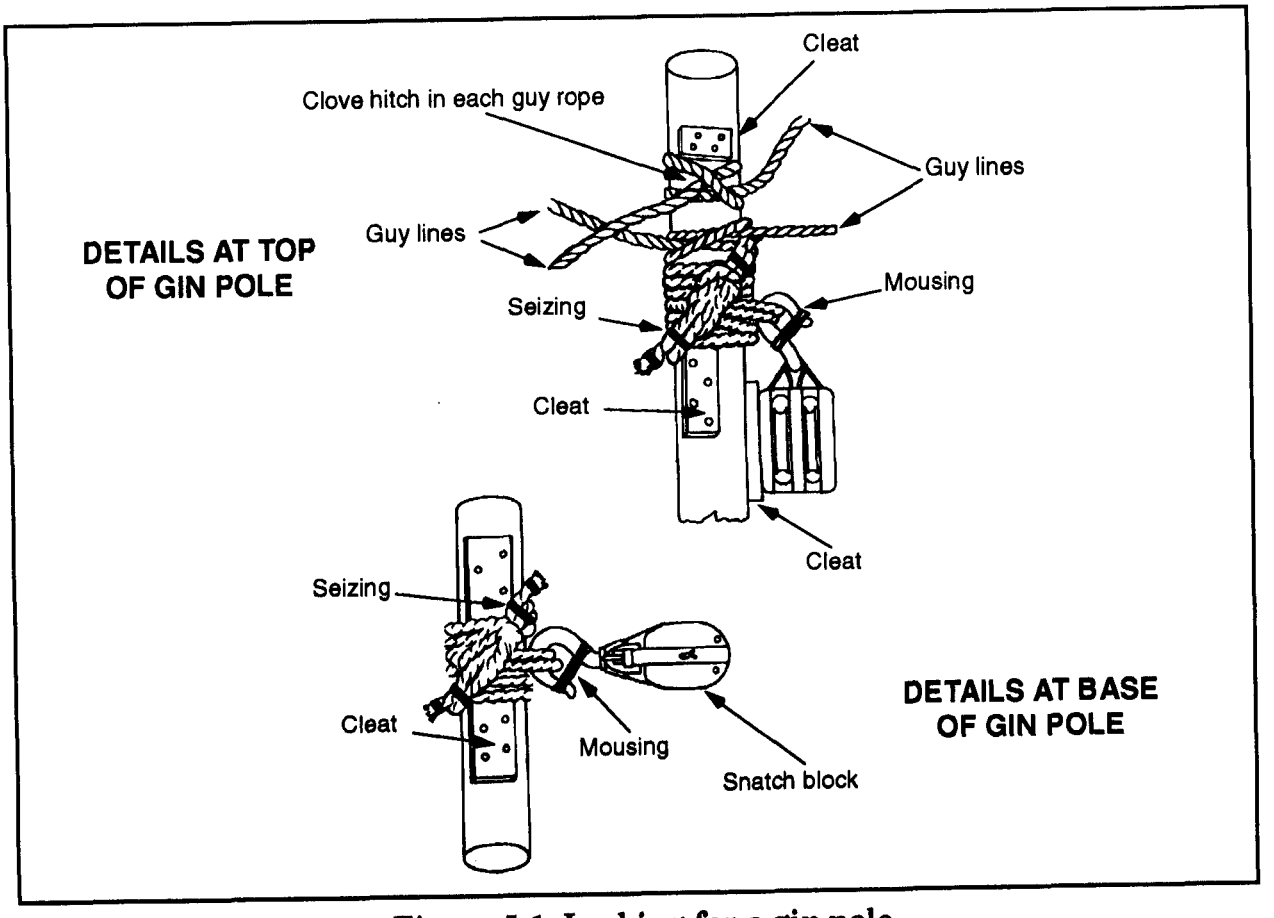

Figure 5-1. Lashing for a gin pole

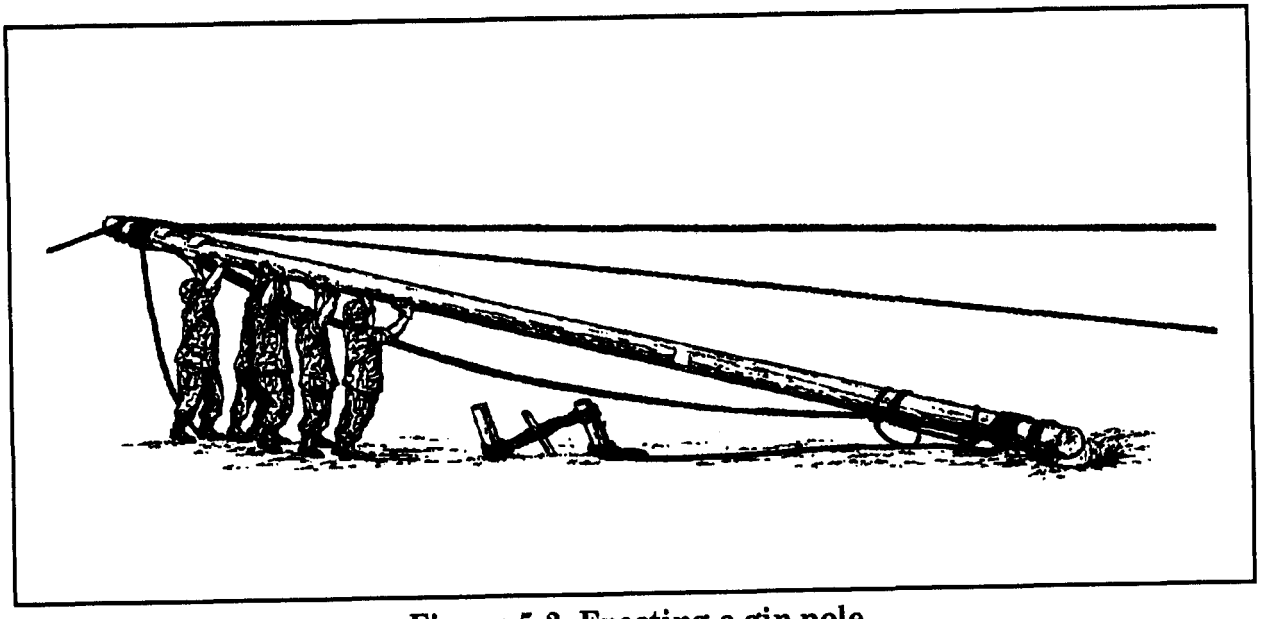

Figure 5-2. Erecting a gin pole

- String out the guys to their respective anchorages and assign a person to each anchorage to control the slack in the guy line with a round turn around the anchorage as the pole is raised. If it has not been done already, install an anchorage for the base of the pole.
- Use the tackle system that was used to raise and lower the load to assist in raising the gin pole, if necessary; however, the preferred method is to attach an additional tackle system to the rear guy line. Attach the running block of the rear guy-line tackle system to the rear guy line, the end of which is at this point of erection near the base of the gin pole (see *Figure 4-18, page 4-16).* Secure the fixed or stationary block to the rear anchor. The fall line should come out of the running block to give greater MA to the tackle system. Stretch the tackle system to the base of the gin pole before erecting it to prevent the tackle blocks from chocking.
- Haul in on the fall line of the tackle system, keeping a slight tension on the rear guy line and on each of the side guy lines, while eight people (more for larger poles) raise the top of the pole by hand until the tackle system can take control (see *Figure 5-2, page 5-3).*
- Keep the rear guy line under tension to prevent the pole from swinging and throwing all of its weight on one of the side guys.
- Fasten all guy lines to their anchorages with the round turn and two half hitches when the pole is in its final position, approximately vertical or inclined as desired. At times, you may have to double the portion of rope used for the half hitches.
- Open the leading block at the base of the gin pole and place the fall line from the tackle system through it. When the leading block is closed, the gin pole is ready for use. If you have to drift the top of the pole without moving the base, do it when there is no load on the pole, unless the guys are equipped with tackle.

OPERATING GIN POLES

The gin pole is particularly adapted to vertical lifts (see *Figure 5-3).* Sometimes it is used for lifting and pulling at the same time so that the load being moved travels toward the gin pole just off the ground. When used in this manner, attach a snubbing line of some kind to the other end of the load being dragged; keep it under tension at all times. Use tag lines to control loads that you are lifting vertically. A tag line is a light line fastened to one end of the load and kept under slight tension during hoisting.

TRIPODS

A tripod consists of three legs lashed or secured at the top. The advantage of the tripod over other rigging installations is that it is stable and requires no guy lines to hold it in place. Its disadvantage is that the load can be moved only up and down. The load capacity of a tripod is about one and one-half times that of shears made of the same size material.

RIGGING TRIPODS

The two methods of lashing a tripod, either of which is suitable provided the lashing

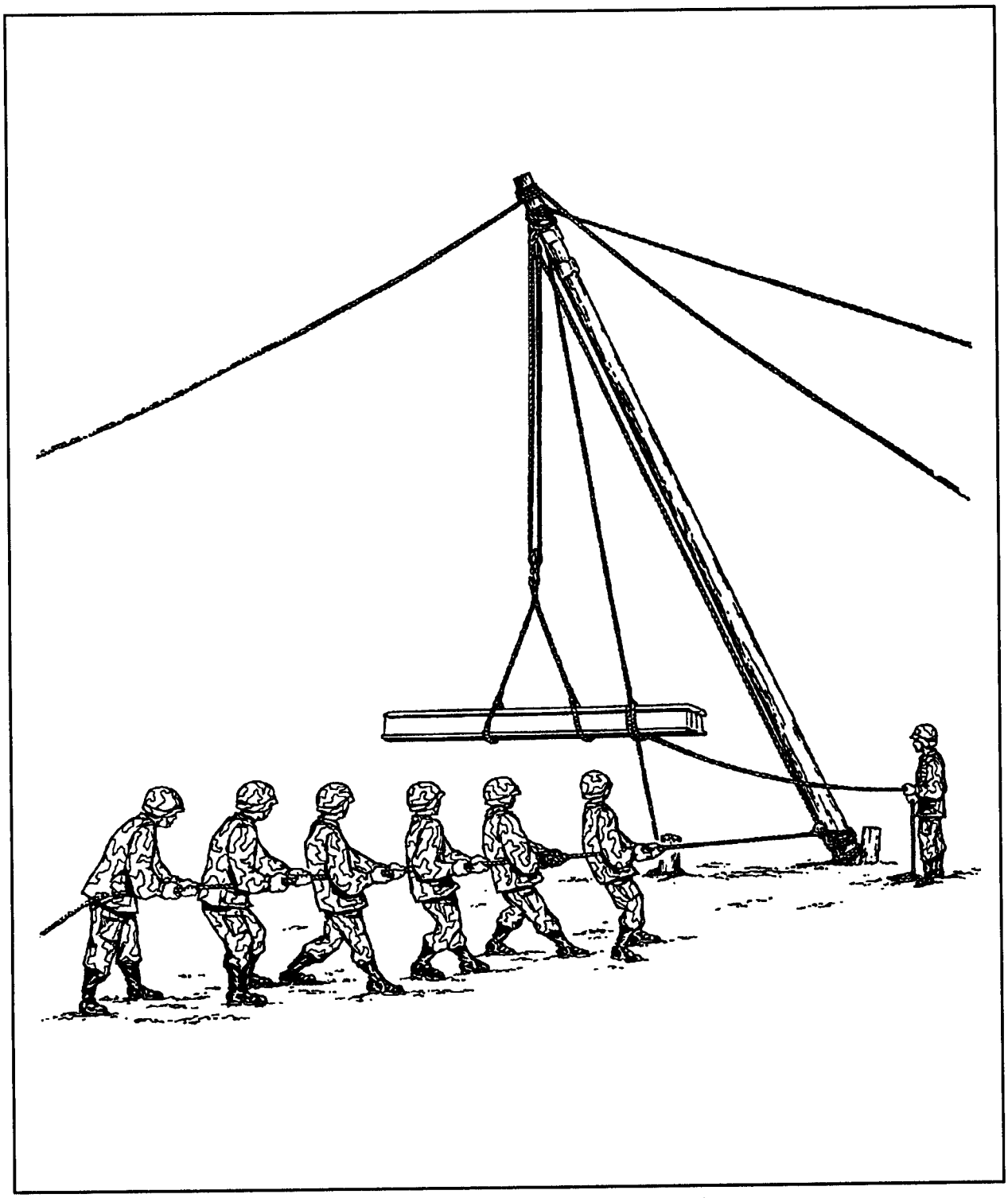

Figure 5-3. Hoisting with a gin pole

material is strong enough, are discussed below. The material used for lashing can be fiber rope, wire rope, or chain. Metal rings joined with short chain sections and large enough to slip over the top of the tripod legs also can be used.

Method 1

This method is for fiber rope, 1 inch in diameter or smaller. Since the strength of the tripod is affected directly by the strength of the rope and the lashing used, use more turns than described here for extra heavy loads and fewer turns for light loads. The procedure is as follows:

- Select three spars, about equal in size, and place a mark near the top of each to indicate the center of the lashing.
- Lay two of the spars parallel with their tops resting on a skid or block and a third spar between the first two, with the butt in the opposite direction and the lashing marks on all three in line. The spacing between spars should be about one-half the diameter of the spars. Leave space between the spars so that the lashing will not be drawn too tight when erecting the tripod.
- Make a clove hitch (using a l-inch rope) around one of the outside spars about 4 inches above the lashing mark, and take eight turns of the line around the three spars (see *Figure 5-4, A).* Be sure to maintain the space between the spars while making the turns.
- Finish the lashing by taking two close frapping turns around the lashing between each pair of spars. Secure the end of the rope with a clove hitch on the center spar just above the lashing. Do not draw the frapping turns too tight.

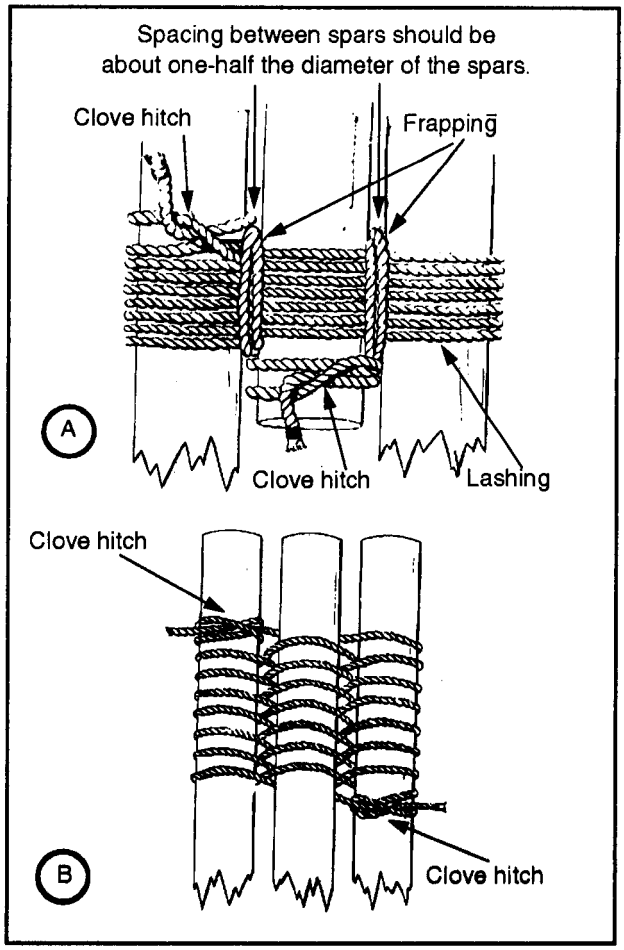

Figure 5-4. Lashing for a tripod

Method H

You can use this method when using slender poles that are not more than 20 feet long or when some means other than hand power is available for erection (see *figure 5-4, B).* The procedure is as follows:

- Lay the three spars parallel to each other with an interval between them slightly greater than twice the diameter of the rope you use. Rest the tops of the poles on a skid so that the ends project over the skid about 2 feet and the butts of the three spars are in line.
- Put a clove hitch on one outside leg at the bottom of the position that the lashing will occupy, which is about 2 feet

from the end. Weave the line over the middle leg, under and around the outer leg, under the middle leg, and over and around the first leg; continue this weaving for eight turns. Finish with a clove hitch on the outer leg.

ERECTING TRIPODS

Spread the legs of a tripod in its final position so that each leg is equidistant from the others (see *Figure 5-5).* This spread should not be less than one-half nor more than two-thirds of the length of the legs. Use chain, rope, or boards to hold the legs in this position. You can lash a leading block for the fall line of the tackle to one of the legs. The procedure is as follows:

- Raise the tops of the spars about 4 feet, keeping the base of the legs on the ground.
- Cross the two outer legs. The third or center leg then rests on top of the cross. With the legs in this position, pass a sling over the cross so that it passes over the top or center leg and around the other two.
- Hook the upper block of a tackle to the sling and mouse the hook.
- Continue raising the tripod by pushing in on the legs as they are lifted at the center. Eight people should be able to raise an ordinary tripod into position.
- Place a rope or chain lashing between the tripod legs to keep them from shifting once they are in their final position.

ERECTING LARGE TRIPODS

For larger tripod installations, you may have to erect a small gin pole to raise the tripod into position. Erect the tripods that are lashed in the manner described in Method II

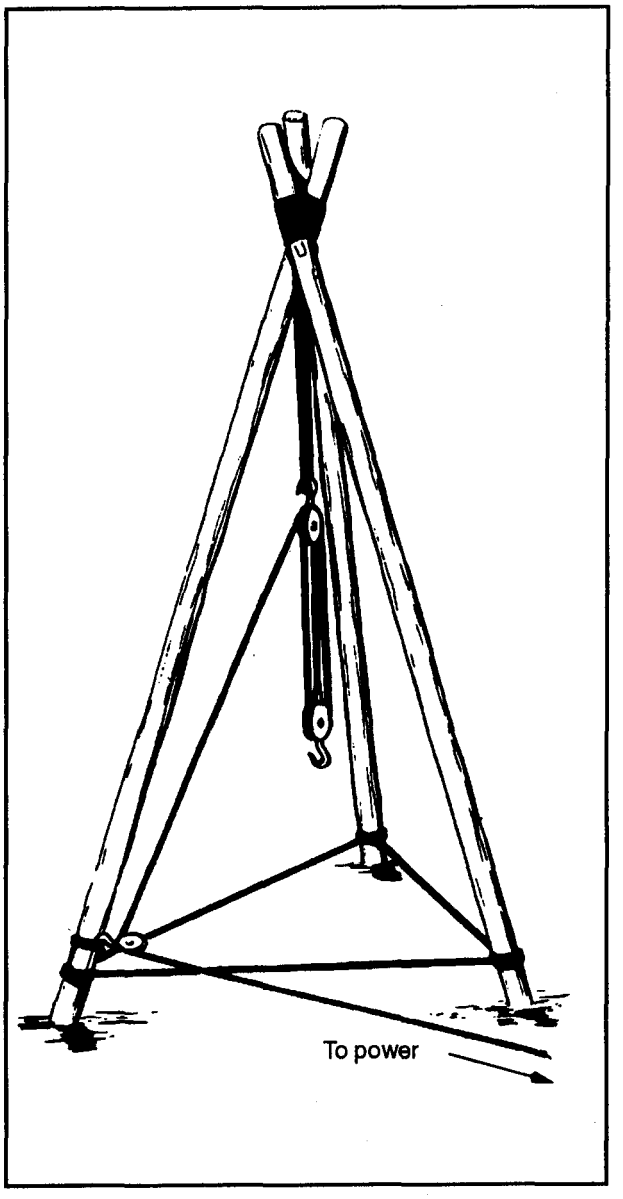

Figure 5-5. Assembled tripod

(with the three legs laid together) by raising the tops of the legs until the legs clear the ground so they can be spread apart. Use guy lines or tag lines to assist in steadying the legs while raising them. Cross the outer legs so that the center leg is on top of the cross, and pass the sling for the hoisting tackle over the center leg and around the two outer legs at the cross.

SHEARS

Shears made by lashing two legs together with a rope are well adapted for lifting heavy machinery or other bulky loads. They are formed by two members crossed at their tops, with the hoisting tackle suspended from the intersection. Shears must be guyed to hold them in position. Shears are quickly assembled and erected. They require only two guys and are adapted to working at an inclination from the vertical. The legs of the shears may be round poles, timbers, heavy planks, or steel bars, depending on the material at hand and the purpose of the shears. In determining the size of the members to use, the load to be lifted and the ratio ($L/_d$) of the legs are the determining factors. For heavy loads, the $L/_d$ should not exceed 60 because of the tendency of the legs to bend rather than to act as columns. For light work, you can improvise shears from two planks or light poles bolted together and reinforced by a small lashing at the intersection of the legs.

RIGGING SHEARS

When the shears are erected, the spread of the legs should equal about one-half the height of the shears. The maximum allowable drift is 45 degrees. Tackle blocks and guys for shears are essential. You can secure the guy ropes to firm posts or trees with a turn of the rope so that the length of the guys can be adjusted easily. The procedure is as follows:

- Lay two timbers together on the ground in line with the guys, with the butt ends pointing toward the back guy and close to the point of erection.
- Place a large block under the tops of the legs just below the point of lashing and insert a small spacer block between the tops at the same point (see *Figure 5-6).* The separation between the legs at this point should be equal to one-third the diameter of one leg to make handling of the lashing easier.
- With sufficient l-inch rope for 14 turns around both legs, make a clove hitch around one spar and take eight turns around both legs above the clove hitch (see *Figure 5-6).* Wrap the turns tightly so that the lashing is smooth and without kinks.
- Finish the lashing by taking two frapping turns around the lashing between the legs and securing the end of the rope to the other leg just below the lashing. For handling heavy loads, increase the number of lashing turns.

ERECTING SHEARS

Dig the holes at the points where the legs of the shears are to stand. If placed on rocky ground, make sure that the base for the shears is level. Cross the legs of the shears and place the butts at the edges of the holes. With a short length of rope, make two turns over the cross at the top of the shears and tie the rope together to form a sling. Be sure to have the sling bearing against the spars and not on the shears lashing entirely. The procedure is as follows:

- Reeve a set of blocks and place the hook of the upper block through the sling. Secure the sling in the hook by mousing. Fasten the lower block to one of the legs near the butt so that it will be in a convenient position when the shears have been raised but will be out of the way during erection.
- Rig another tackle in the back guy near its anchorage if you use the shears on heavy lifts. Secure the two guys to the

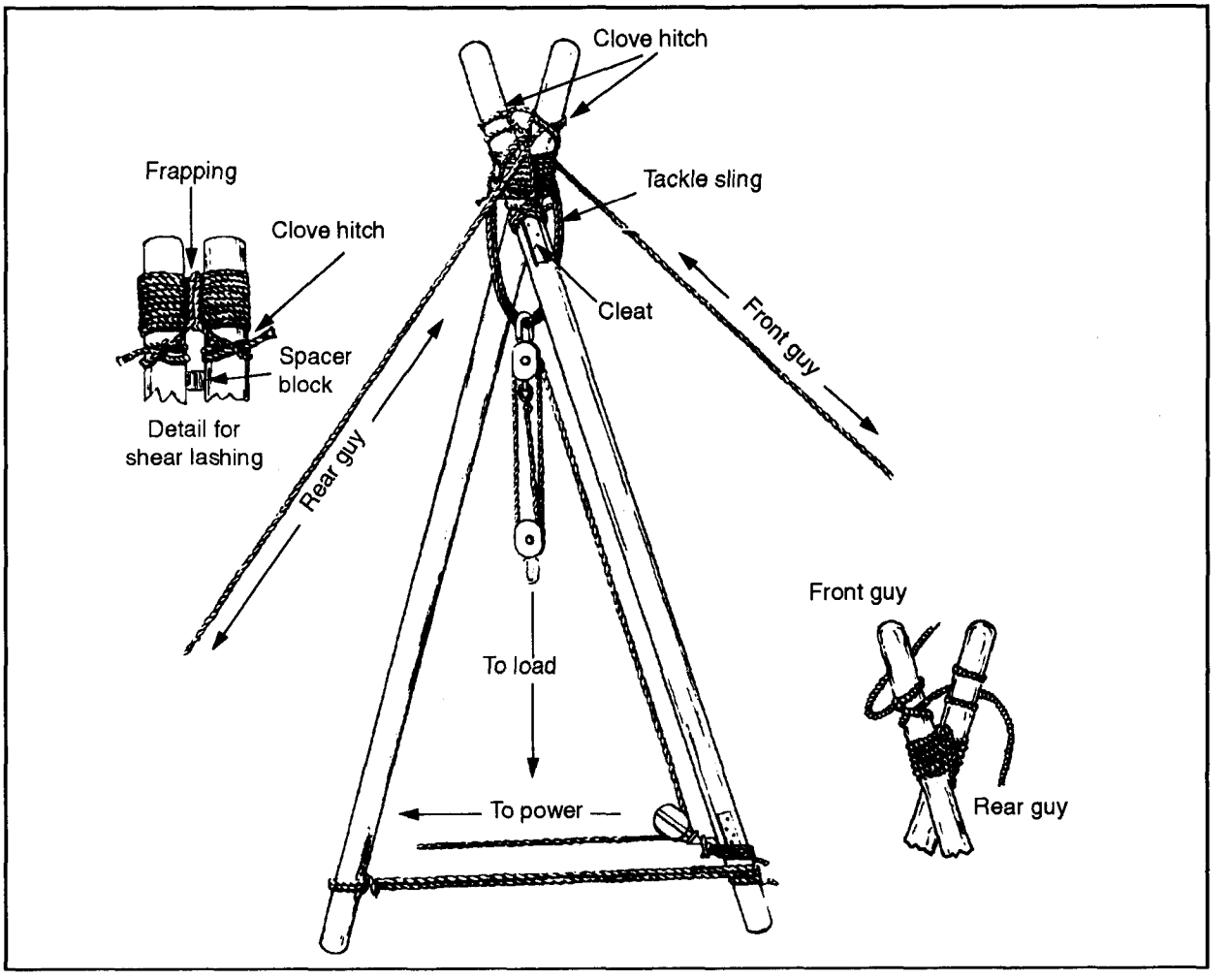

Figure 5-6. Lashing for shears

top of the shears with clove hitches to legs opposite their anchorages above the lashing.

- Lift the top end of the shears legs and "walk" them up by hand until the tackle on the rear guy line can take effect (see *Figure 5-7, page 5-10).* It will take several people (depending on the size of the shears) to do this. Then raise the shears legs into final position by hauling in on the tackle. Secure the front guy line to its anchorage before raising the shears legs, and keep a slight tension on this line to control movement.
- Keep the legs from spreading by connecting them with rope, a chair, or boards. It may be neceesary, under some conditions, to anchor each leg of the shears while erecting them to keep the legs from sliding in the wrong direction.

OPERATING SHEARS

The rear guy is a very important part of the shears rigging, since it is under a considerable strain during hoisting. To avoid guy-line failure, design them according to the principles discussed in *Chapter 4, Section II.* The front guy has very little strain on it and

is used mainly to aid in adjusting the drift and to steady the top of the shears when hoisting or placing the load. You may have to rig a tackle in the rear guy for handling heavy loads. During operation, set the desired drift by adjusting the rear guy, but do not do this while a load is on-the shears. For handling light loads, the fall line of the tackle of the shears can be led straight out of the upper block. When handling heavy loads, you may have to lash a snatch block near the base of one of the shear legs to act as a leading block (see *Figure 5-8).* Run the fall line through the leading block to a hand- or power-operated winch for heavy loads.

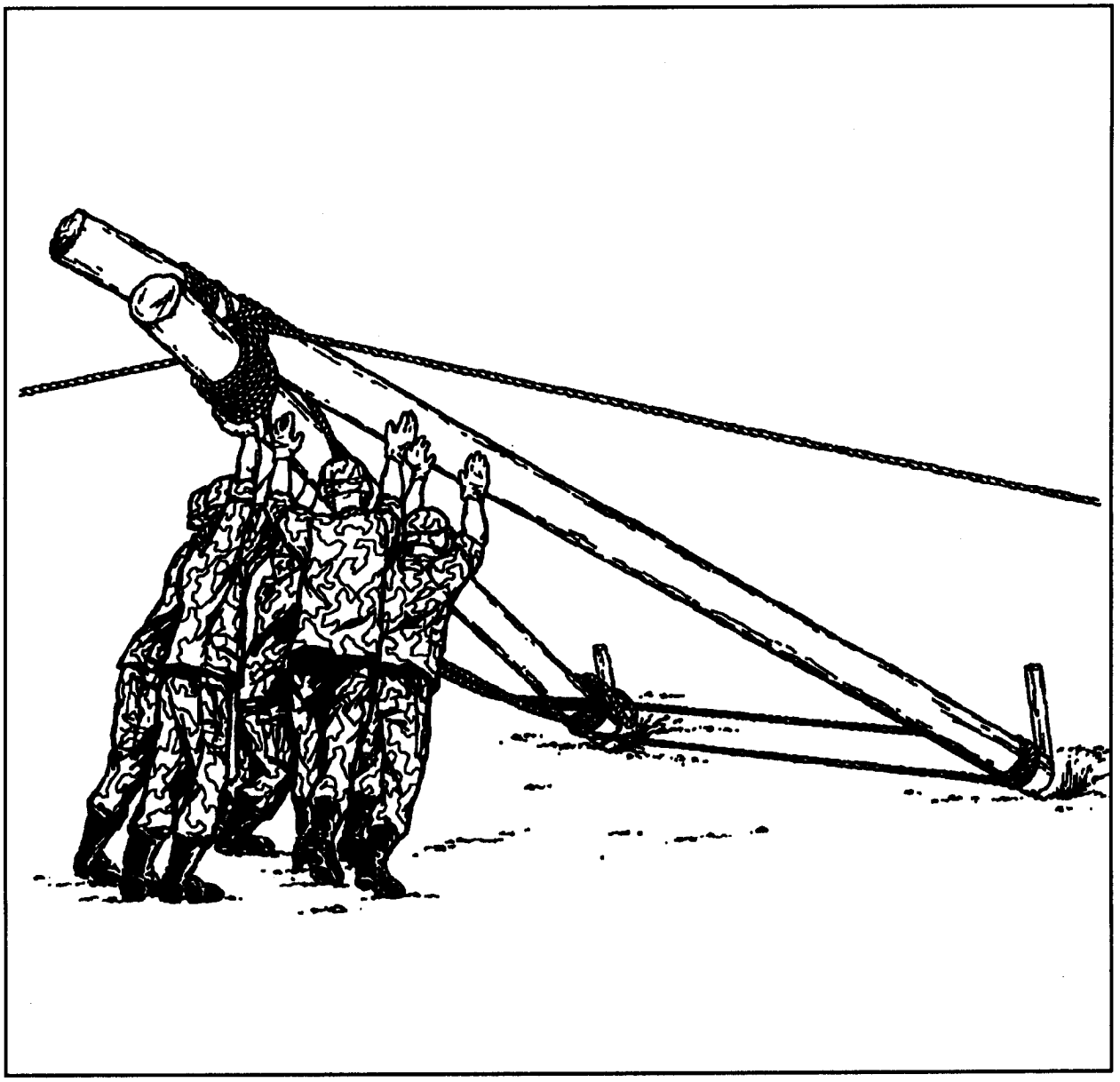

Figure 5-7. Erecting shears

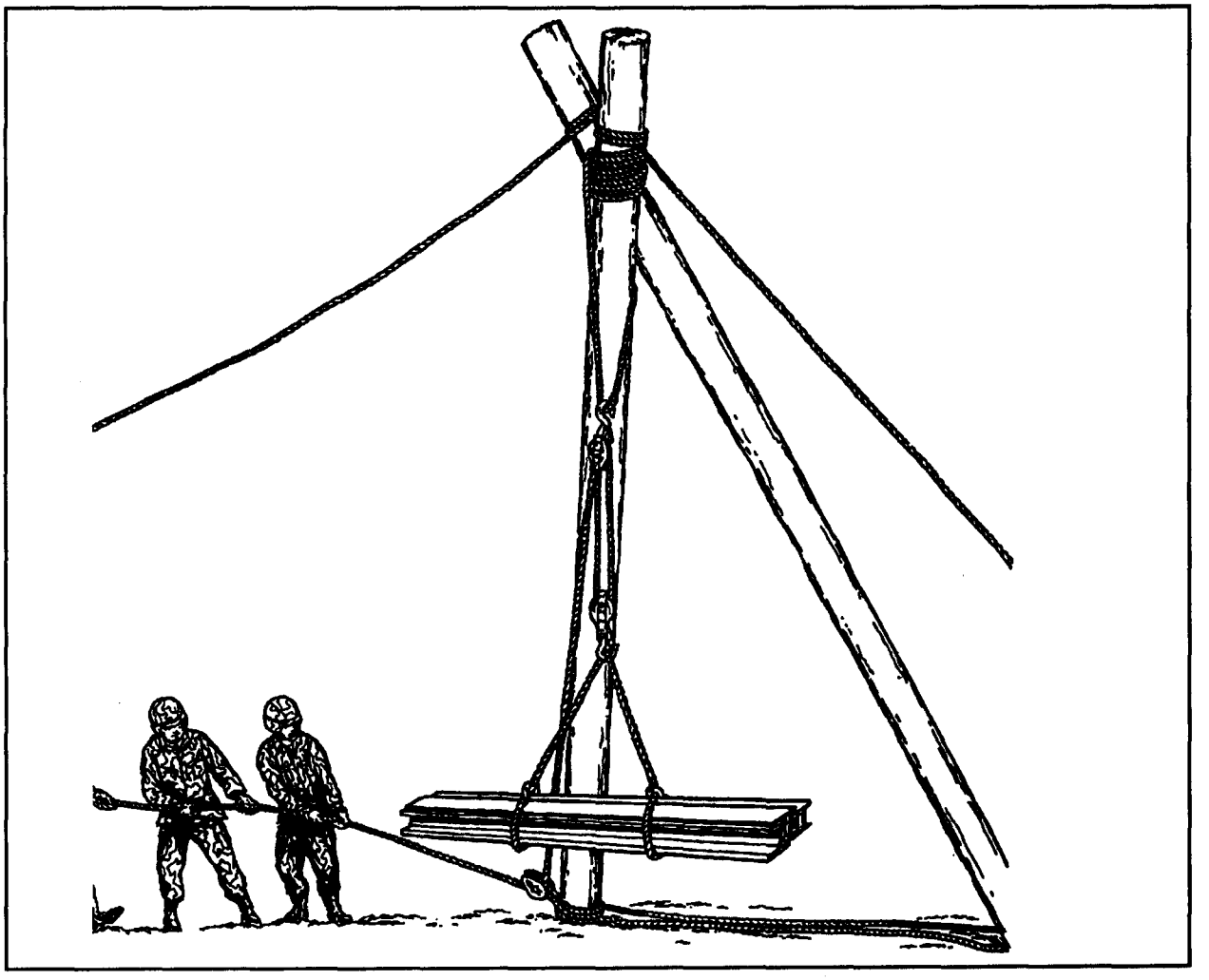

Figure 5-8. Hoisting with shears

BOOM DERRICKS

A boom derrick is a lifting device that incorporates the advantages of a gin pole and the long horizontal reach of a boom. Use the boom derrick to lift and swing medium-size loads in a 90-degree arc on either side of the resting position of the boom, for a total swing of 180 degrees. When employing a boom derrick in lifting heavy loads, set it on a turn plate or turn wheel to allow the mast and boom to swing as a unit. A mast is a gin pole used with a boom. The mast can swing more than 180 degrees when it is set on a turn plate or turn wheel.

RIGGING BOOM DERRICKS

For hoisting medium loads, rig a boom to swing independently of the pole. Take care to ensure the safety of those using the installation. Use a boom only temporarily or when time does not permit a more stable installation. When using a boom on a gin pole, more stress is placed on the rear

guy; therefore, you may need a stronger guy. In case larger rope is not at hand, use a set of tackle reeved with the same size rope as that used in the hoisting tackle as a guy line by extending the tackle from the top of the gin pole to the anchorage. Lash the block attached to the gin pole at the point where the other guys are tied and in the same manner. The procedure is as follows:

- Rig a gin pole as described on *page 5-1,* but lash another block about 2 feet below the tackle lashing at the top of the pole (see *Figure 5-9).* Reeve the tackle so that the fall line comes from the traveling block instead of the standing block. Attach the traveling block to the top end of the boom after erecting the gin pole.
- Erect the gin pole in the manner described on *page 5-1,* but pass the fall line of the tackle through the extra block at the top of the pole before erecting it to increase the MA of the tackle system.
- Select a boom with the same diameter and not more than two-thirds as long as the gin pole. Spike two boards to the butt end of the boom and lash them with rope, making a fork (see *Figure 5-9).* Make the lashing with a minimum of sixteen turns and tie it off with a square knot. Drive wedges under the lashing next to the cleats to help make the fork more secure (see *Figure 5-9).*
- Spike cleats to the mast about 4 feet above the resting place of the boom and place another block lashing just above these cleats. This block lashing will support the butt of the boom. If a separate tackle system is rigged up to support the butt of the boom, place an additional block lashing on the boom just below the larger lashing to secure the running block of the tackle system.

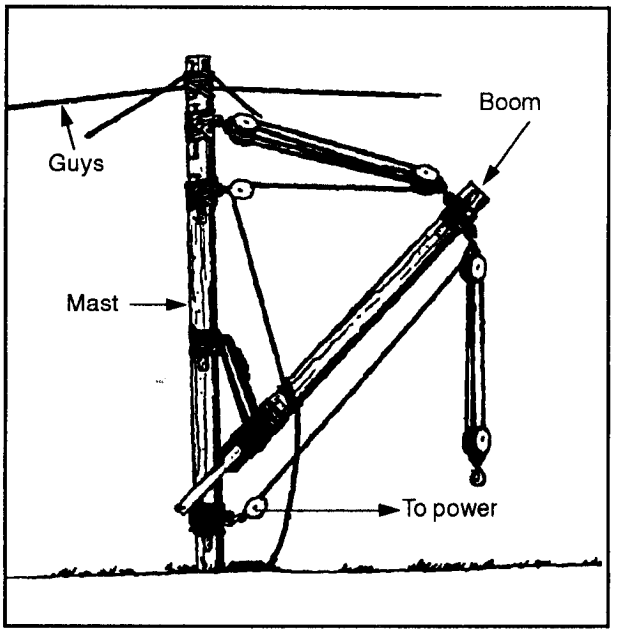

Figure 5-9. Rigging a boom on a gin pole

- Use manpower to lift the boom in place on the mast through the sling that will support it if the boom is light enough. The sling consists of two turns of rope with the ends tied together with a square knot. The sling should pass through the center four turns of the block lashing on the mast and should cradle the boom. On heavier booms, use the tackle system on the top of the mast to raise the butt of the boom to the desired position onto the mast.
- Lash the traveling block of the gin pole tackle to the top end of the boom as described on *page 5-1,* and lash the standing block of the boom tackle at the same point. Reeve the boom tackle so that the fall line comes from the standing block and passes through the block at the base of the gin pole. The use of the leading block on this fall line is optional, but when handling heavy loads, apply more power to a horizontal line leading from the block with less strain on the boom and guys.

ERECTING BOOM DERRICKS

Raise the boom into position when the rigging is finished. When working with heavy loads, rest the base of the boom on the ground at the base of the pole. Use a more horizontal position when working with light loads. In no case should the boom bear against any part of the upper two-thirds of the mast.

OPERATING BOOM DERRICKS

A boom on a gin pole provides a convenient means for loading and unloading trucks or flatcars when the base of the gin pole cannot be set close to the object to be lifted. It is used also on docks and piers for unloading boats and barges. Swing the boom by pushing directly on the load or by pulling the load with bridle lines or tag lines. Adjust the angle of the boom to the mast by hauling on the fall line of the mast tackle. Raise or lower the load by hauling on the fall line of the boom tackle. You should place a leading block (snatch block) at the base of the gin pole. Lead the fall line of the boom tackle through this leading block to a hand- or power-operated winch for the actual hoisting of the load.

STIFF-LEG DERRICKS

The mast of a stiff-leg derrick is held in the vertical position by two rigid, inclined struts connected to the top of the mast. The struts are spread 60 to 90 degrees to provide support in two directions and are attached to sills extending from the bottom of the mast. The mast is mounted on vertical pins. The mast and boom can swing through an arc of about 270 degrees. The tackles for hoisting the load and raising the boom are similar to those used with the boom and gin pole (see *page 5-11, Rigging Boom Derrick).*

OPERATING STIFF-LEG DERRICKS

A stiff-leg derrick equipped with a long boom is suitable for yard use for unloading and transferring material whenever continuous operations are carried on within reach of its boom. When used on a bridge deck, move these derricks on rollers. They are sometimes used in multistory buildings surmounted by towers to hoist material to the roof of the main building to supply guy derricks mounted on the tower. The stiff-leg derrick also is used where guy lines cannot be provided, as on the edge of a wharf or on a barge.

STEEL DERRICKS

Steel derricks of the stiff-leg type are available to engineer troops in two sizes:

- A 4-ton rated capacity with a 28-foot radius (see *Figure 5-10, page 5-14).*
- A 30-ton rated capacity with a 38-foot radius, when properly counterweighted.

Both derricks are erected on fixed bases. The 4-ton derrick, including a skid-mounted, double-drum, gasoline-engine-driven hoist, weighs 7 tons and occupies a space 20 feet square. The 30-ton derrick, including a skid-mounted, double-drum hoist, weighs about 22 tons and occupies a space 29 feet square.

LIGHT HOISTING EQUIPMENT

Extended construction projects usually involve erecting numerous light members as well as the heavy main members. Progress can be more rapid if you raise the light members by hand or by light hoisting equipment, allowing the heavy hoisting equipment to move ahead with the erection of the main members. Very light members can be

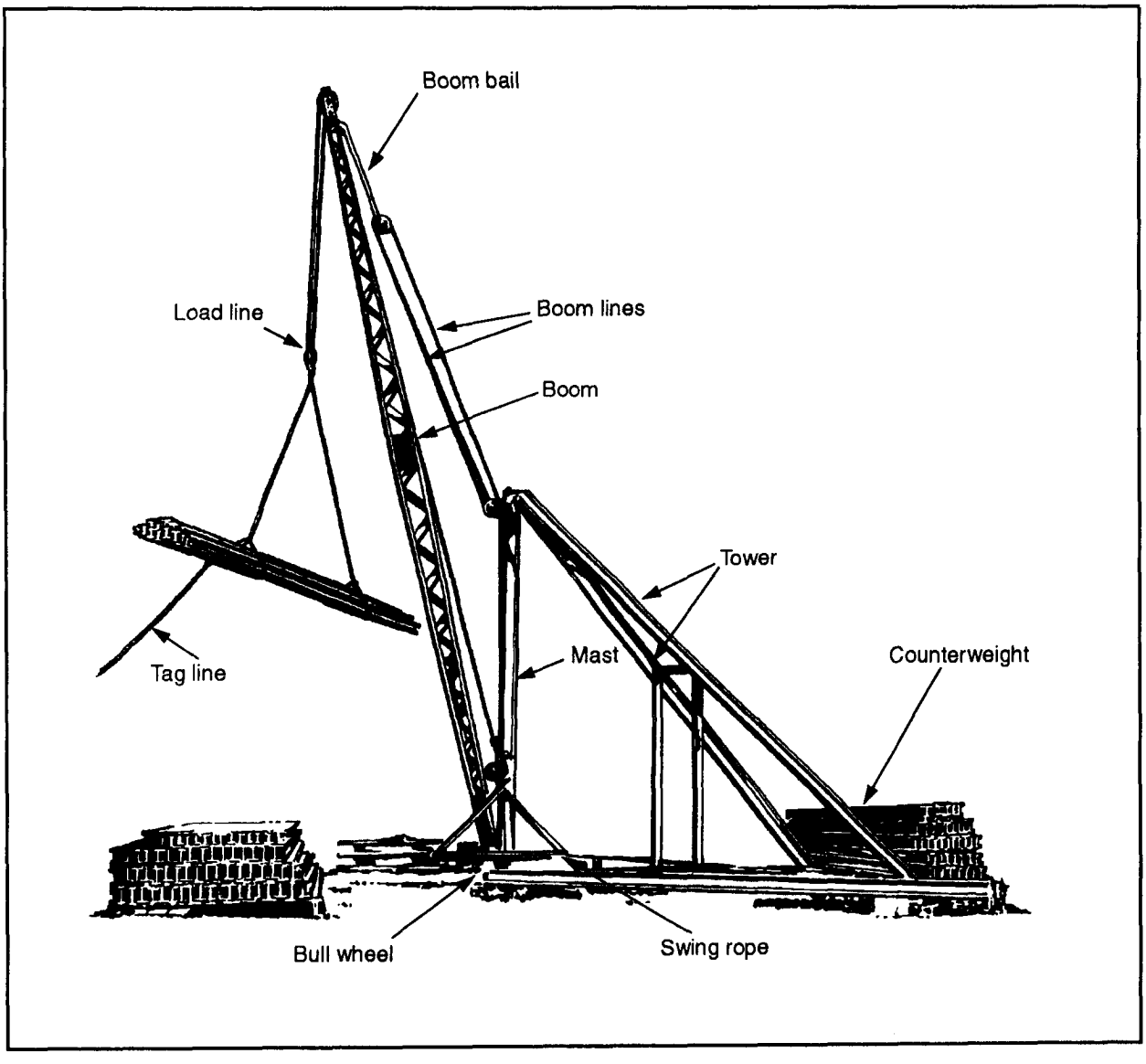

Figure 5-10. Four-ton stiff-leg derrick

raised into place by two people using manila handlines. When handlines are inadequate or when members must be raised above the working level, use light hoisting equipment. Many types of hoisting equipment for lifting light loads have been devised. Those discussed here are only typical examples that can be constructed easily in the field and moved readily about the job.

POLE DERRICKS

The improved pole derrick, called a "dutchman", is essentially a gin pole constructed with a sill and knee braces at the bottom (see *Figure 5-11, A).* It is usually installed with guys at the front and back. It is effective for lifting loads of 2 tons and, because of its light weight and few guys, is readily moved from place to place by a small squad.

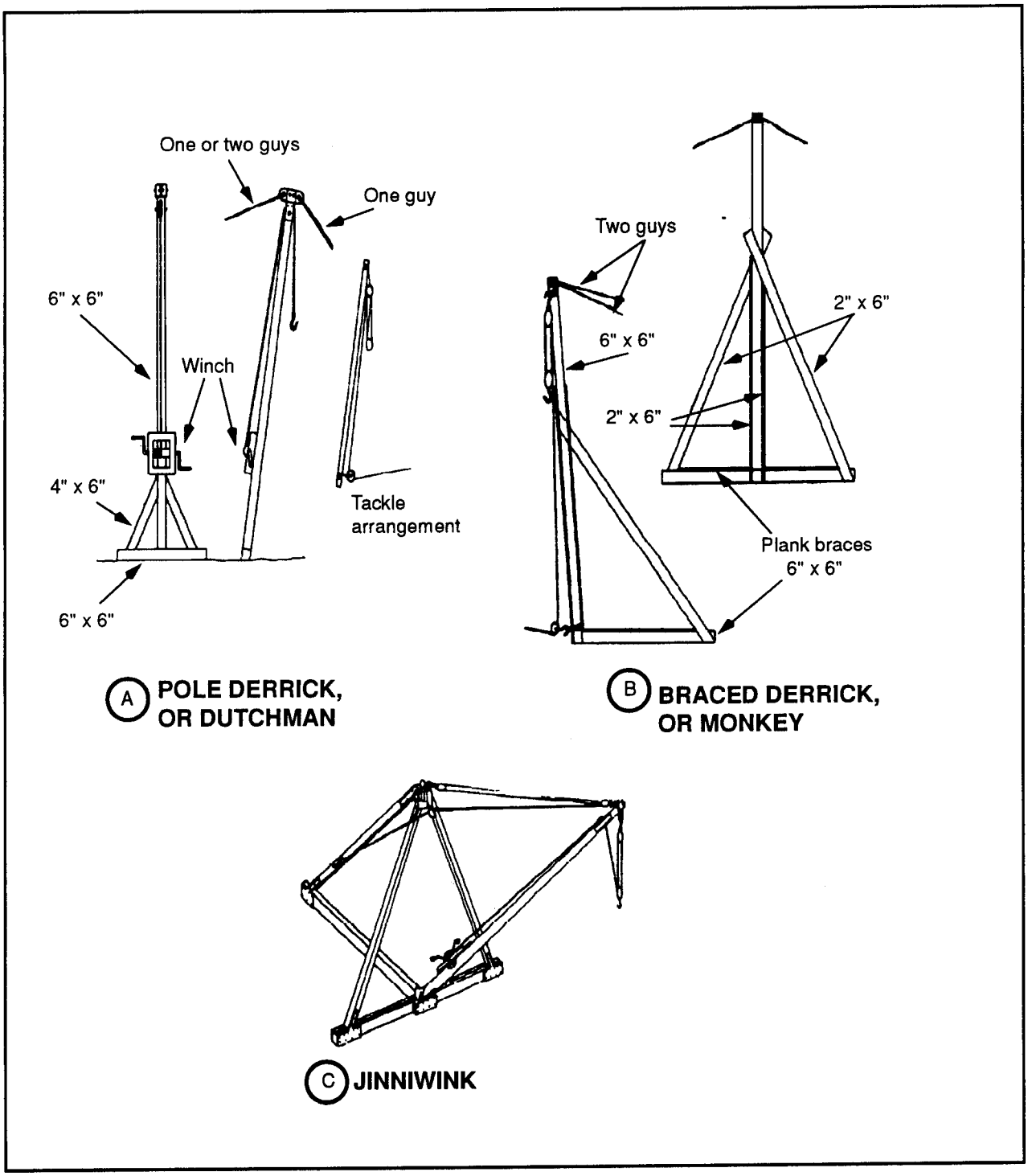

Figure 5-11. Light hoisting equipment

BRAVE DERRICKS

The braced derrick, known as a "monkey", is very useful for filling in heavy members behind the regular erection equipment (see *Figure 5-11, B, page 5-15).* Two back guys are usually employed when lifting heavy loads, although light members may be lifted without them. Power is furnished by a hand- or power-driven hoist. The construction of the base of the monkey permits it to be anchored to the structure by lashings to resist the pull of the lead line on the snatch block at the foot of the mast.

JINNIWINK DERRICKS

This derrick is suitable for lifting loads weighing 5 tons (see *Figure 5-11, C, page 5-15).* Hand-powered jinniwinks are rigged preferably with manila rope. Those operated by a power-driven hoist should be rigged with wire rope, The jinniwink is lashed down to the structural frame at both the front sill and tail sill to prevent the tail sill from rising when a load is lifted.

Section II. Moving Equipment

Skids, rollers and jacks are used to move heavy loads. Cribbing or blocking is often necessary as a safety measure to keep an object in position or to prevent accidents to people who work under or near these heavy objects. Cribbing is formed by piling timbers in tiers, with the tiers alternating in direction, to support a heavy weight at a height greater than blocking would provide (see *Figure 5-12).* A firm and level foundation for cribbing is essential, and the bottom timbers should rest firmly and evenly on the ground. Blocking used as a foundation for jacks should be sound and large enough to carry the load. The timbers should be dry, free from grease, and placed firmly on the ground so that the pressure is evenly distributed.

SKIDS

Place timber skids longitudinally under heavy loads either to—

- Distribute the weight over a greater area.
- Make a smooth surface for skidding equipment.
- Provide a runway surface when rollers are used (see *Figure 5-13).*

Oak planks 2 inches thick and about 15 feet long make satisfactory skids for most operations. Keep the angle of the skids low to prevent the load from drifting or getting out of control. You can use grease on skids when only horizontal movement is involved; however, in most circumstances, greasing is dangerous because it may cause the load to drift sideways suddenly.

ROLLERS

Use hardwood or pipe rollers over skids for moving very heavy loads into position. Place the skids under the rollers to provide a smooth, continuous surface for the rollers. Make sure that the rollers are smooth and round and long enough to pass completely under the load being moved. Support the load on longitudinal wooden members to provide a smooth upper surface for the rollers to move on. The skids placed underneath

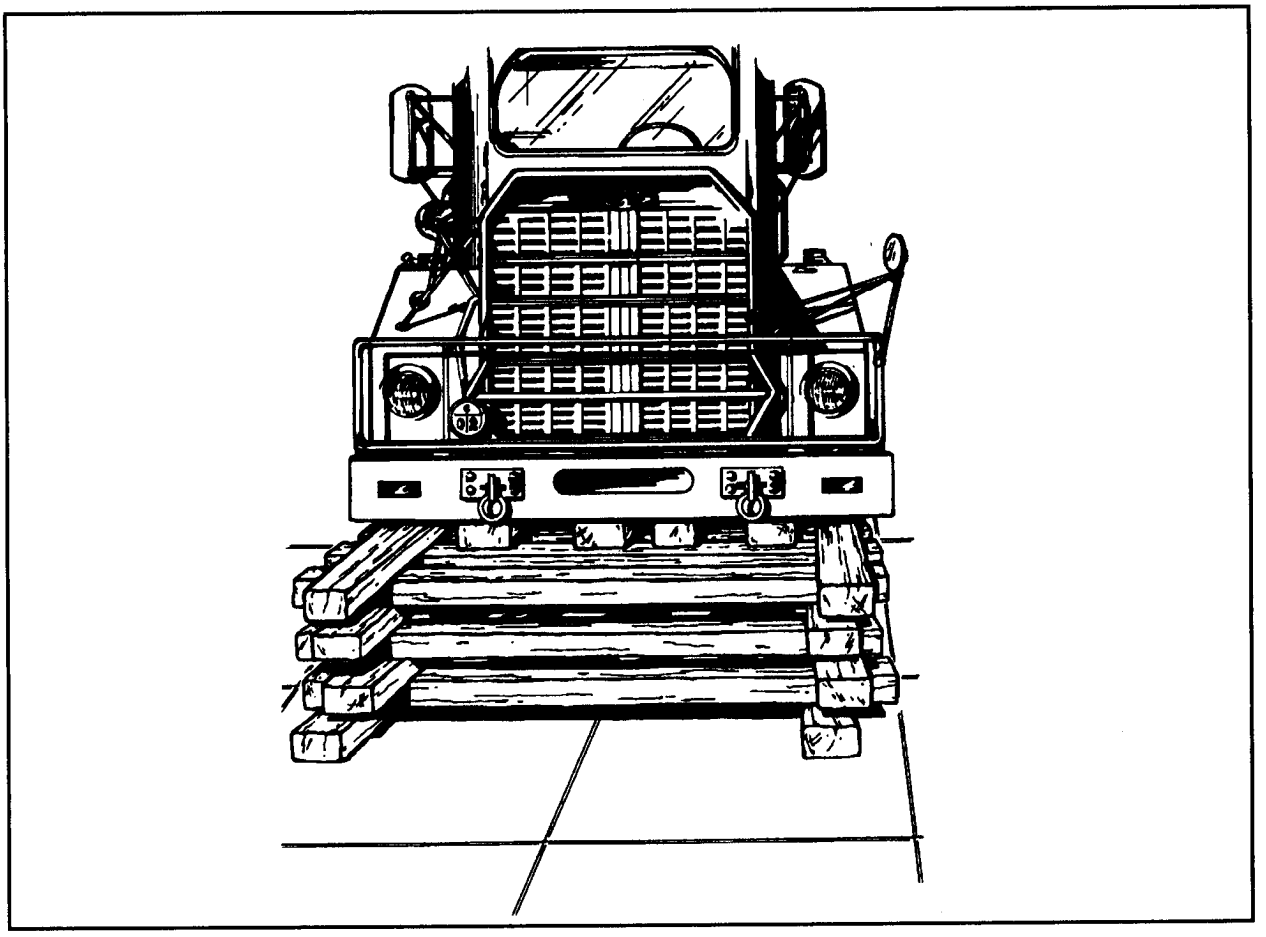

Figure 5-12. Timber cribbing

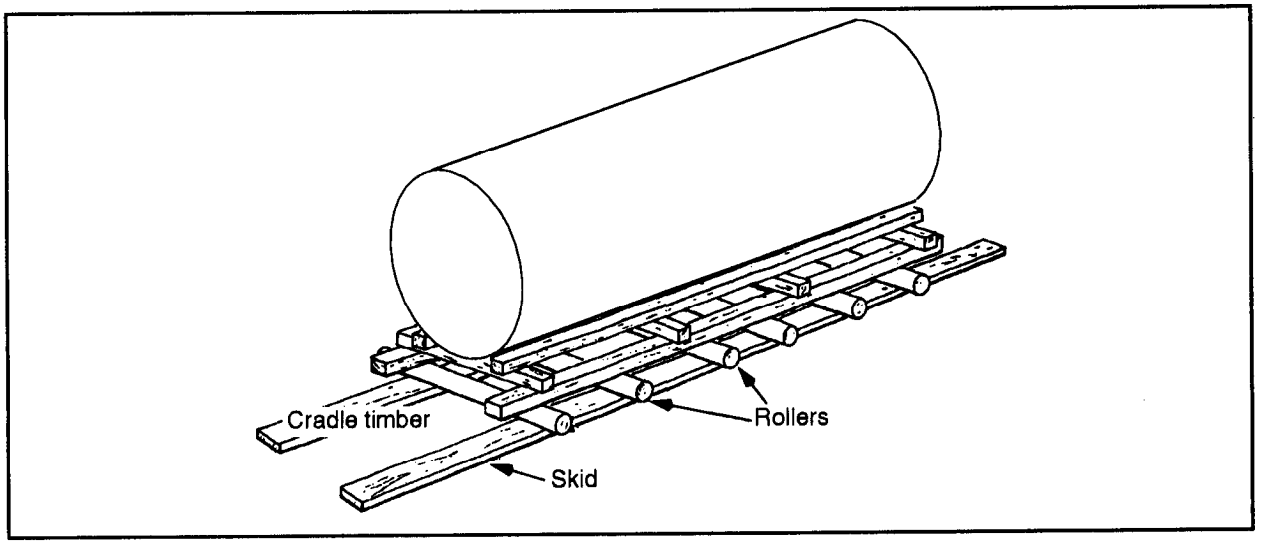

Figure 5-13. Using skids and rollers

the rollers must form continuous support. Ordinarily, place four to six rollers under the load to be moved (see *Figure 5-13, page 5-17).*

Place several rollers in front of the load and roll the load slowly forward onto the rollers. As the load passes, rollers are left clear behind the load and are picked up and placed in front of the load so that there is a continuous path of rollers. In making a turn with a load on rollers, incline the front rollers slightly in the direction of the turn and the rear rollers in the opposite direction. This inclination of the rollers may be made by striking them sharply with a sledge. For moving lighter loads, make up the rollers and set on axles in side beams as a semipermanent conveyor. Permanent metal roller conveyors are available (see *Figure 5-14).* They are usually made in sections.

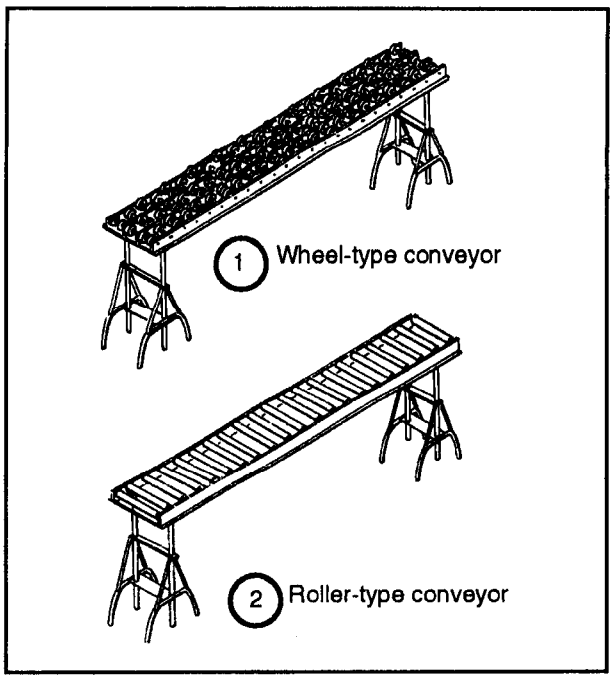

Figure 5-14. Metal conveyors

JACKS

To place cribbing, skids, or rollers, you may have to lift and lower the load for a short distance. Jacks are used for this purpose. Jacks are used also for precision placement of heavy loads, such as bridge spans. A number of different styles of jacks are available, but only use heavy duty hydraulic or screw-type jacks. The number of jacks used will depend on the weight of the load and the rated capacity of the jacks. Be certain that the jacks are provided with a solid footing, preferably wooden blocking. Cribbing is frequently used in lifting loads by jacking stages (see *Figure 5-15).* The procedure requires—

- Blocking the jacks.
- Raising the object to the maximum height of the jacks to permit cribbing to be put directly under the load.
- Lowering the load onto the cribbing.

Repeat this process as many times as necessary to lift the load to the desired height.

Jacks are available in capacities from 5 to 100 tons (see *Figure 5-16).* Small capacity jacks are operated through a rack bar or screw, while those of large capacity are usually operated hydraulically.

RATCHET-LEVER JACKS

The ratchet lever jack, available to engineer troops as part of panel bridge equipment, is a rack-bar jack that has a rated capacity of 15 tons (see *Figure 5-16, A).* It has a foot lift by which loads close to its base can be engaged. The foot capacity is 7 1/2 tons.

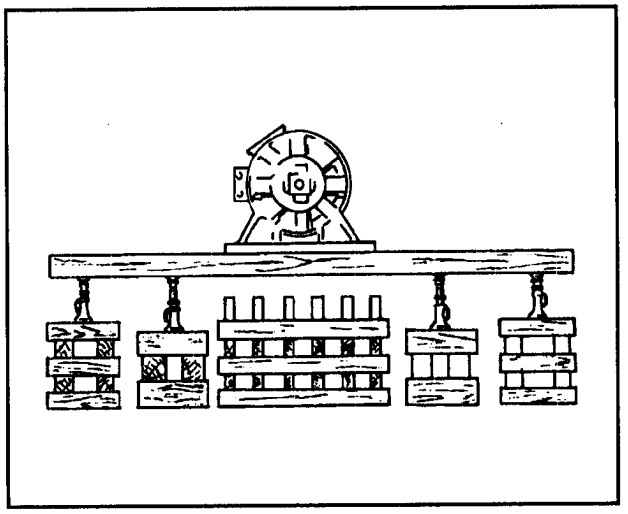

Figure 5-15. Jacking loads by stages

STEAMBOAT RATCHETS

Steamboat ratchets (sometimes called pushing-and-pulling jacks) are ratchet screw jacks of 10-ton rated capacity with end fittings that permit pulling parts together or pushing them apart (see *Figure 5-16, B).* Their principal uses are for tightening lines or lashings and for spreading or bracing parts in bridge construction.

SCREW JACKS

Screw jacks have a rated capacity of 12 tons (see *Figure 5-16, C).* They are about 13 inches high when closed and have a safe rise of at least 7 inches. These jacks are issued with the pioneer set and can be used for general purposes, including steel erection.

HYDRAULIC JACKS

Hydraulic jacks are available in Class IV supplies in capacities up to 100 tons (see *Figure 5-16, D)* Loads normally encountered by engineer troops do not require large capacity hydralic jacks. Those supplied with the squad pioneer set are 11 inches high and have a rated capacity of 12 tons and a rise of at least 5 1/4 inches. They are large enough for usual construction needs.

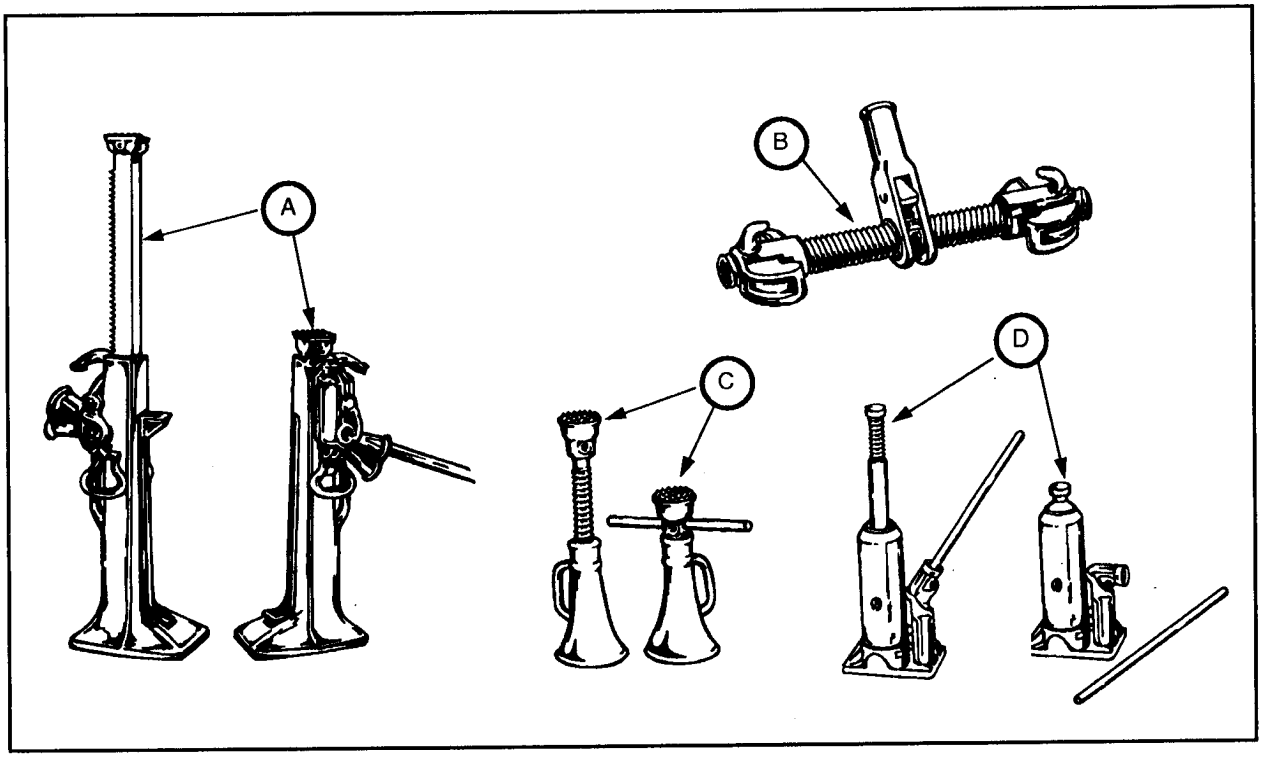

Figure 5-16. Mechanical and hydraulic jacks