

Search and Rescue Operations in mountainous terrain

VERTICAL RESCUE

Training Outline

Blue Ridge Mountain Rescue Group
Appalachian Search & Rescue Conference

Sugy stand

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Avl

Woods

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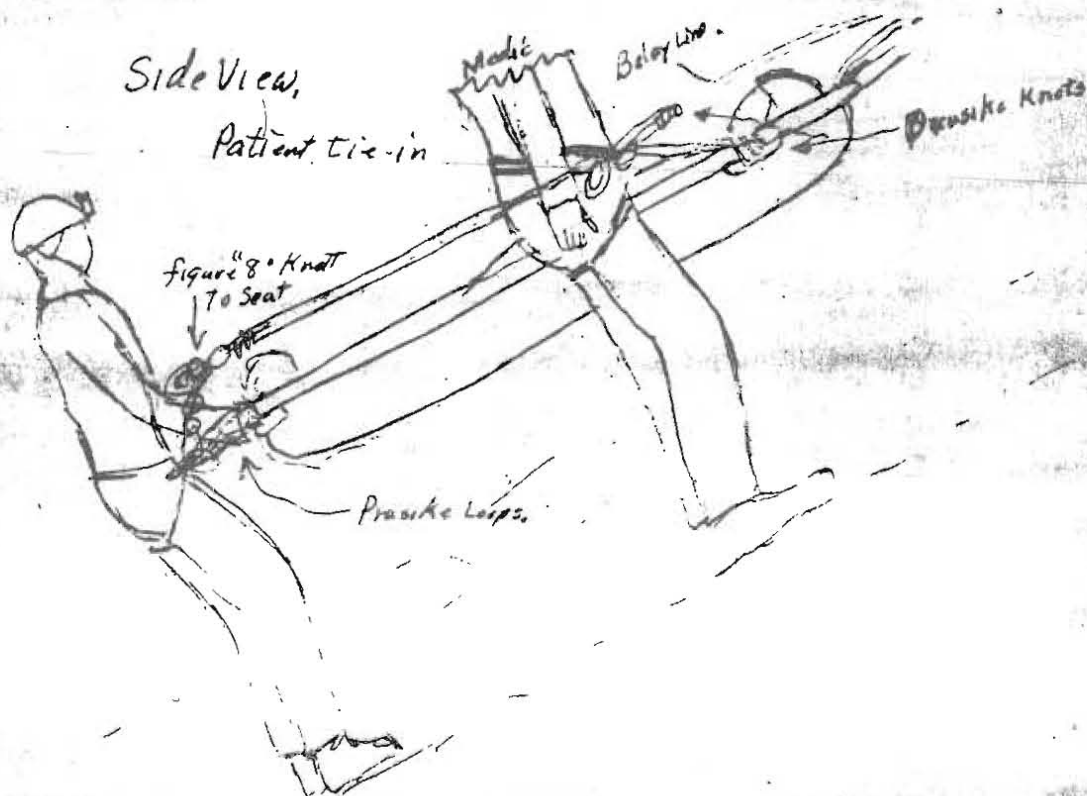
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TIE-IN FOR PATIENT AND LITTER BEARERS ON HIGH ANGLE SLOPES:

Here the patient and litter bearers should have seat harnesses on and checked. The patient is tied into the pigtail from the belay line, usually with a "figure 8" knot allowing enough slack for the belay line to free the patient face, then a beaner to the seat harness.

The litter bearers, usually a team of three persons, positioned, two at the waist and one at the feet. The two at the waist will tie in first to the litter rails using a standard prusiks loop made from 6 to 8 MM cord, 5 feet long. A girth hitch or prusiks knot is placed on the rail next to the patients shoulders and clipped to the seat harness with a locking "D." The litter bearer at the feet will join two prusik loops together and run this through the bottom of the litter as the yoke was and clip into a locking "D" to the seat harness. The litter bearers at the waist attach a second prusiks loop, using a prusiks knot to the belay line above the patient's tie-in and then to their seat harnesses. The litter bearer at the feet clips into the "figure 8" knot at the end of the belay line to the seat harness.

The placement of the litter bearers may seem unusual or a little difficult to handle the litter until the system is under load, going up or down slope.



TECHNICAL EVACUATION AND LITTER HANDLING

The term technical applied to two areas of consideration:

1. Both the litter and litter bearers are in danger of falls and injury.
2. More sophisticated rope handling techniques and equipment are required.

For this reason technical experts in rigging and technical litter handling should be made available to set up the hauling and lowering systems as well as to set up the attachments to the litter.

We will discuss several methods for various high angle hauls and lowers and preferred methods of tie ins for litter bearers and litter.

BELAY LINES AND MAIN LINES

In this environment the litter bearers and litter are completely dependent on the main line for hauling or lowering. A failure of the anchor or main line will cause severe injury or death to the litter team and patient. For this reason, independent belay lines are required. Separate anchors, directionals and breaking systems.

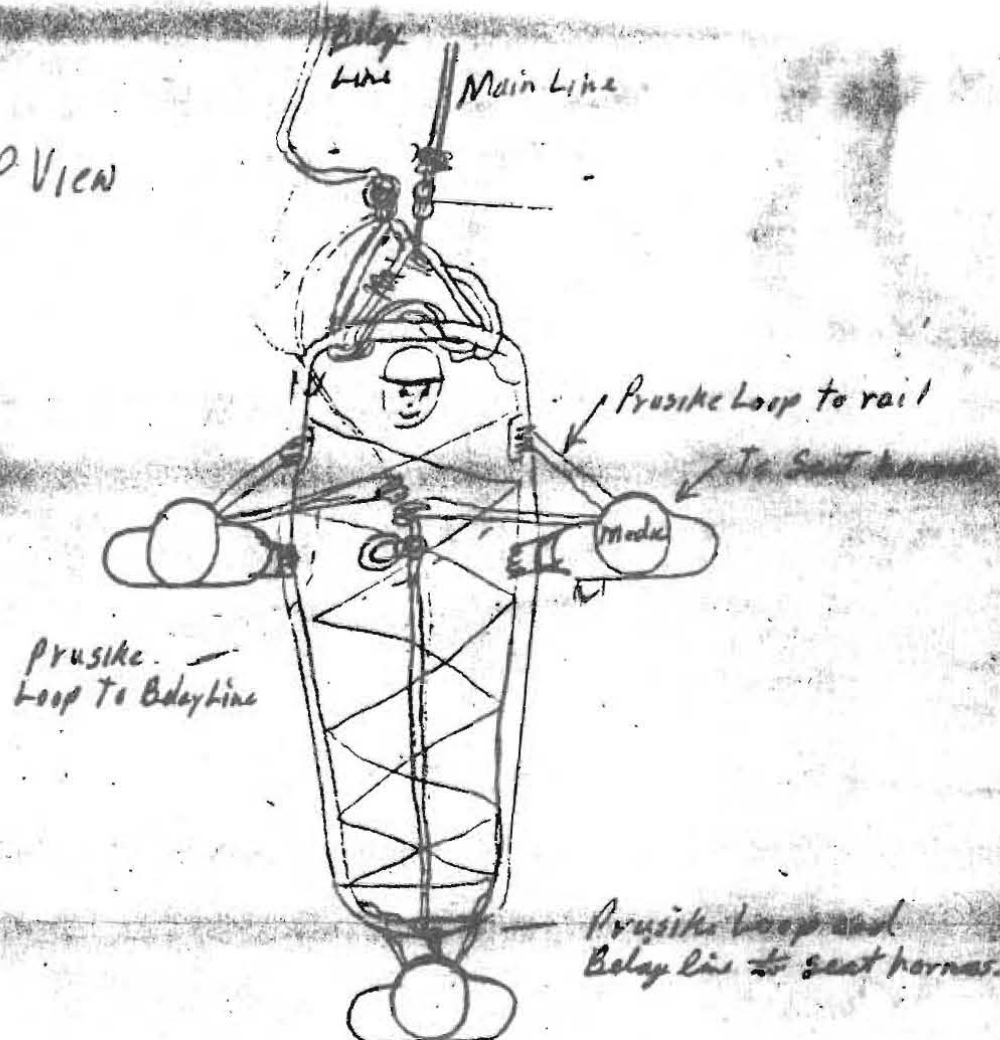
LITTER TIE-INS FOR HIGH ANGLE SLOPES AND VERTICAL HAULING AND LOWERING:

This tie-in is to be used in conjunction with litter bearers working or bracing with the litter and when the litter is raised vertically free from the rock face.



Make sure that the main line or yoke is under the belay line so that the tension on the main system does not abrade the belay line. The belay line has a ten foot pigtail for separate tie-ins to patient and litter team.

TOP View



Here the litter bearers do not need to use their arms to hold the litter. As they pull back on the litter, against the Prusike loops on the rails, the main line and the litter bearer's seat harness take the weight through the seat harness.

This method ensures that no matter what happens to the main line or the litter the patient and litter team will be supported by the belay system.

VERTICAL HAULING OR LOWERING OF LITTERS

The litter and patient are attached as before, but you have only a medic to haul or lower with the patient. If the medic is vertically competent, the medic may ascend a fixed line next to the litter. A rope walker system is preferred as it leaves both hands free to tend to the patient. In the same way the medic can repel on a fixed line. This method allows more freedom for the medic and reduces the load for the hauling team.

If the medic is to have a free ride, the medic is attached to a pigtail from the main line by ascenders and clipped into the pigtail of the belay line. This permits some up and down

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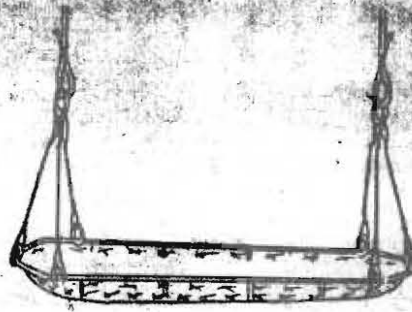
I. Anchors

- A. Natural Protection (trees, horns, flakes)
- B. Fixed Protection (bolts, fixed pins)
- C. Other Artificial Protection (chocks, camming devices)
- D. Self-Equalizing
 - 1. Direction of pull
 - 2. Use small angles - < 90 degrees
 - 3. Back-up anchors

II. High Angle Rescue Methods

A. Rocky Mountain Rescue Group / ASRC System

Fig 17.16 Rocky Mountain Rescue Group's spider. Each end of the spider has an eye splice in it.



- 1. Advantages: Stability while loading patient - when one spider is detached, other two stabilize
- 2. Disadvantages: Cannot adjust angle of stokes to rock or protect patient from rockfall, uses two independently controlled lowering ropes without joining at a common point, requires constant communication with two attendants, and it is more difficult to pass knots. *Cannot be used on all terrain*

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B. Yosemite System

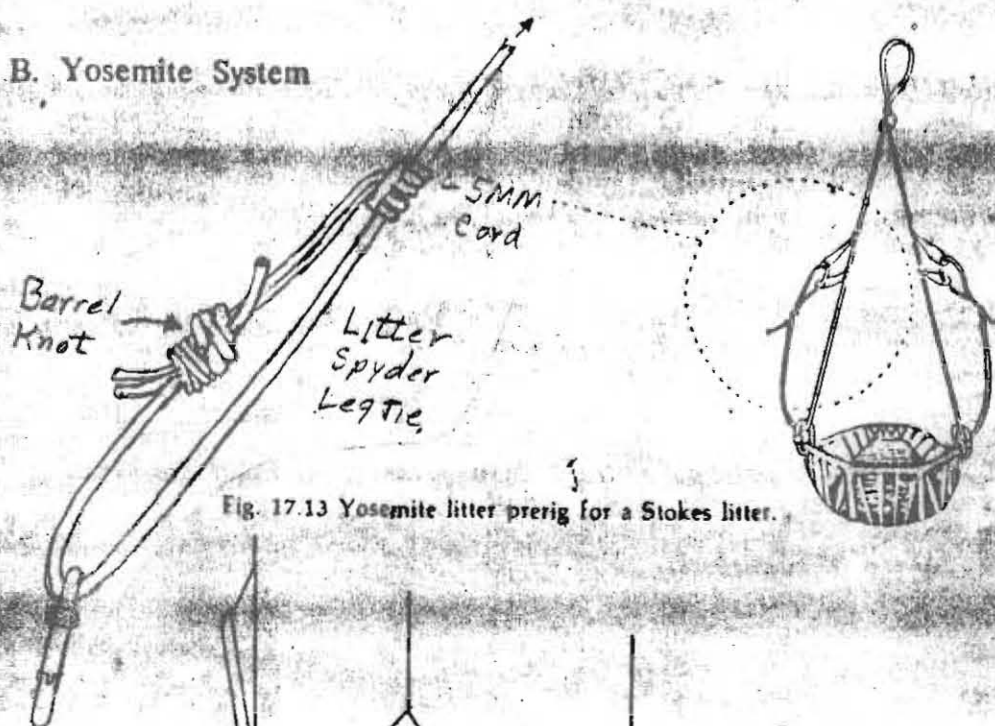


Fig. 17.13 Yosemite litter prerig for a Stokes litter.

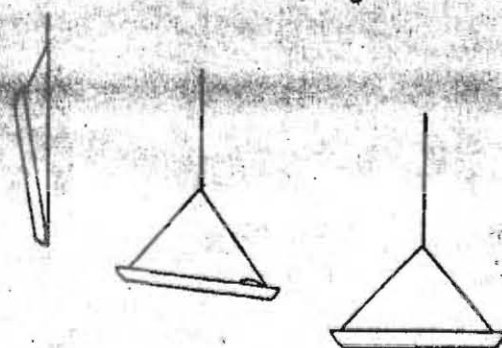


Fig. 17.14 Possible variations of litter positions using prerig: vertical (left), shock position (center), and horizontal (right).

Fig. 17.15 Side view of possible variations of litter as it is lowered down a rock wall.



1. Advantages: Litter can be set at many different angles, patient can be protected from falling rock, in high angle situations- it only requires one attendant, and it is easier to pass knots.
2. Disadvantages: Not as stable for loading.

III. ASRC Vertical Rescue

A. Equipment

1. Personal

- helmet, seat harness, fieldpack, gloves, prussiks, locking carabineers, figure-8

2. Group (minimum)

- 3-4 Static ropes, 1-2 dynamic ropes, 2-4 Gibbs ascenders, long slings, short slings, carabineers, pulleys, edge padding or rollers, radios, prussiks, spider rigging, rappel rack, rack of protection, straight stokes

B. Personnel Involved

2 - Attendants

1 - Brakeman

1 - Assistant Brakeman / Radio Operator

2 - Gibbs / prussiks monitors

1-2 - Belayers

1 - Rescue Specialist

Others may be employed in rope management, padding placement, and personnel to manage second lowering system for knot passing

8 - 12 People Minimum

C. The Lowering

V. Passing Knots

A. RMRG and ASRC System

B. Yosemite System

Sources:

Appalachian Search & Rescue Conference, Inc.

Fisher, Udo. "Search and Rescue Operations in Mountainous Terrain" *NASAR '85 Conference Papers*, National Association for Search and Rescue.

Setnicka, Tim J. *Wilderness Search and Rescue*. Appalachian Mountain Club: Boston, 1980.

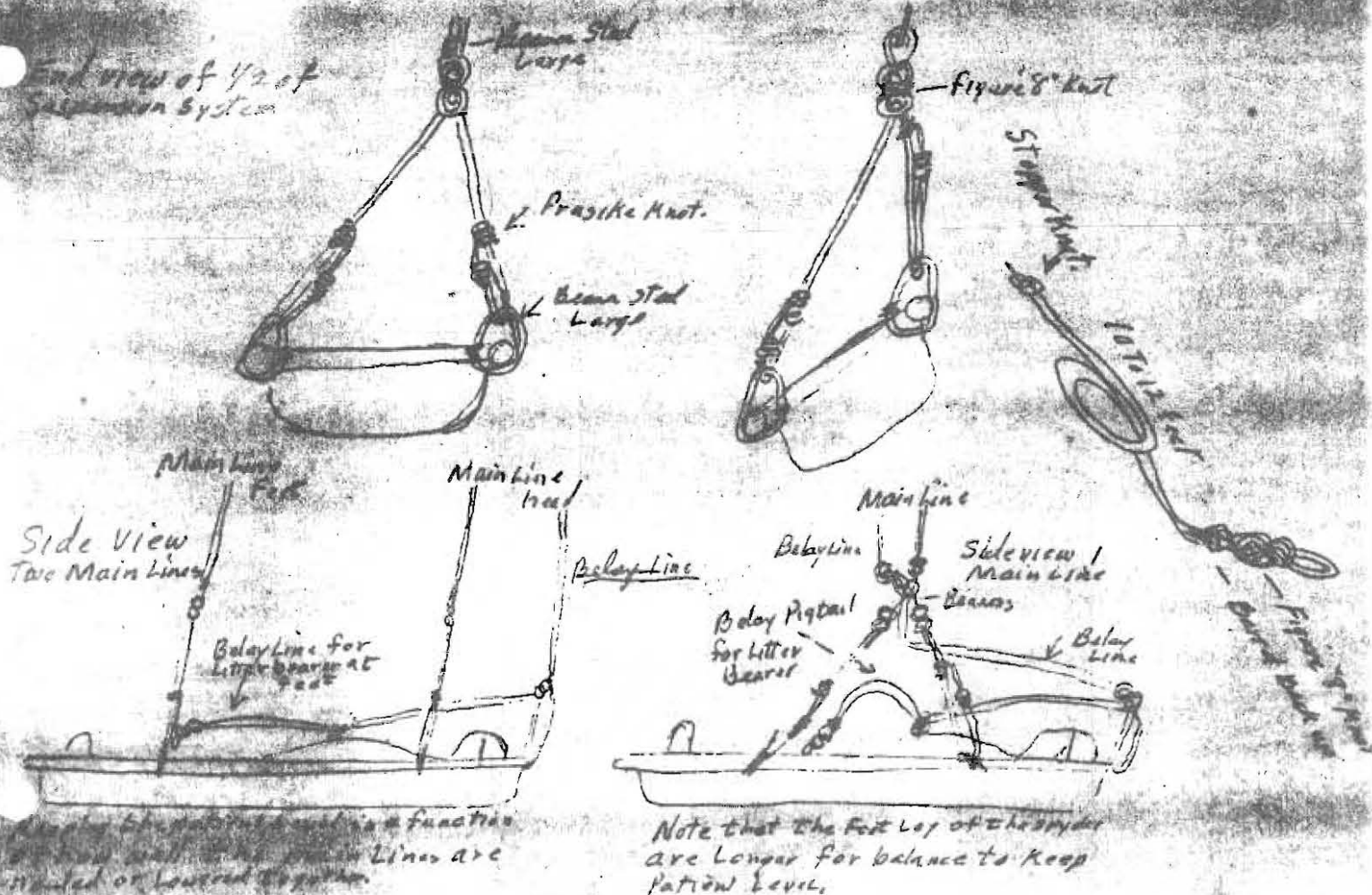
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movement but not the freedom of a separate line. Additional litter handlers at the edge of the cliff are used to assist the litter over the edge, up or down, and must be tied in.

HORIZONTAL HAULING AND LOWERING OF LITTERS

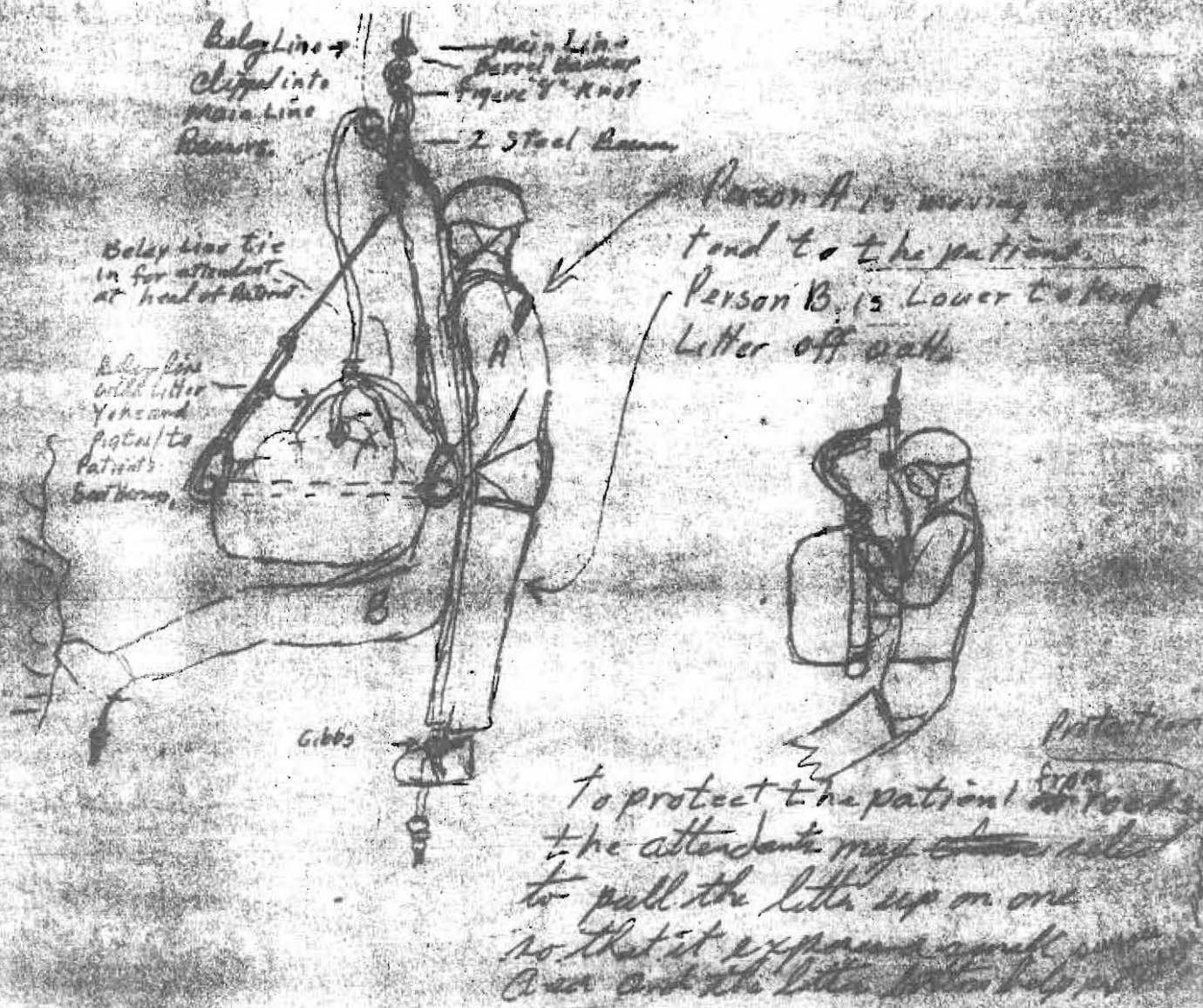
The most critical area to consider here is the suspension system used to keep the litter horizontal during hauling or lowering. The most common is a rope spider or litter bridge. This system should have the following capabilities:

1. Can be rigged for one or two main lines.
2. The length of the straps or ropes can be adjusted while under load by the medic or attendant.
3. The length of the legs can be adjusted to raise and lower opposite sides of the litter to a 45 degree angle to permit the medic to clear vomit or to protect the patient in rock falls.
4. The litter suspension system should have two pigtails of 10 to 12 feet in length. Each pigtail may have a litter attendant attached so that they may move freely about the litter, to help move it around obstacles and attend to the patient using ascenders.



Delay time does not occur when tension is on the rope as it is all the way out. Complete inspection and if possible pre-testing is required.

The following example of litter attendant and patient may help to visualize the rigging.



ONE MAIN LINE HAULING AND LOWERING

This method is preferred for most situations. It requires the least amount of equipment, rigging points and is easily modified for a traveling brake, discussed later, when communication between the litter attendant and lowering team are poor. The only drawback to this system is that the attitude of the litter cannot be changed from vertical to horizontal in route. Once rigged the entire traverse must be made in that mode. Here are some additional litter handling calls for hauling. The lowering calls were covered under Semi-technical.

Haul - called by litter attendant to have litter raised by

haul team. This also is the fastest speed that the haul team will use during the lift.

Haul slow - called by the litter attendant to reduce speed for difficult areas.

The only difference in the lowering calls is that the team that controls the main line lowering will respond to the belay calls under semi-technical. Any instructions intended for the belayer are prefixed by "Belay" then the command.

TWO MAIN LINE HAULING AND LOWERING

While the litter is now supported by two lines, a separate belay line should still be used. If the line to the head is lost, there is no way to right the litter in route. The major advantage to this system is that the attitude can be altered from horizontal to vertical and back to horizontal when the litter needs to pass through restrictions and the patient cannot be kept feet down the whole trip. There are some additional calls to consider during this phase of litter handling as two lines are in use. The attendant at the head should be the only person at the litter to give instructions to the haul team and belayer. As two main lines are in use, there are additional calls as follows:

Haul (feet or head) - called by the litter attendant at head to raise the head or feet so that the litter is level or to raise the head to pass through a restriction.

Down (feet or head) - called by the litter attendant at the head to lower the head or feet so that the litter is level or to lower the feet to pass through a restriction.

Any call made that is not qualified as feet or head refers to both main lines. If you call slack, both main lines are released to reduce tension. I hope you did not mean "Belay slack."

BELAY CONSIDERATIONS

During one and two main line hauling and lowering, the belayer plays a passive role and must feel the tension in the belay line and if possible be able to see the progress of the litter and act independently, if needed. The vigilance of the belayer cannot be understated here. The belayer should call stop if the line is tangled or a problem is seen by the belayer.

If the belayer cannot be positioned to see the progress, an independent observer for the belayer is very helpful.

TRAVELING OR FIXED BRAKE

The fixed brake is usually at the top of a drop and used as part of a lowering system. It may use a tree wrap or mechanical belay device and controlled by a person at the top. In general, this is the safest method to use as the litter attendants have their hands full getting the litter around obstacles and monitoring the patient. Once tied in, the medic need know nothing about the rope work and will not create a hazard for the patient.

The traveling brake has few justifications for use due to the danger to the patient. Here the litter attendant controls the descent of both the patient and attendant. The attendant must go over and around obstacles, monitor the patient and deal with controlling the rappell. The most commonly used reason for the traveling brake is poor communication, such as a waterfall or high winds when the litter attendant cannot communicate to the team above. The other reason is a shortage of personnel. One litter attendant and one person on belay above. Only the most urgent situation is justification for not waiting for additional personnel.

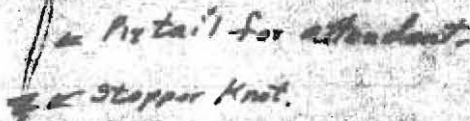
HIGH LINE OR TYROLEAN TRAVERSE

The Tyrolean can be a great time saver for the litter team in crossing rivers, canyons and break down piles. The primary consideration is, do you have the time to set it up without delaying the litter team and do you have the right equipment. The line used to support the litter will be stressed to several thousand pounds and the anchors need to be super strong. If a tree is used to gain elevation remember to tie the tree off to another tree from where the high line connects to the support tree to the base of another tree on line with the other anchor. There can be enough force to pull the tree over.

RIGGING THE LITTER FOR TRAVERSE

The litter is first rigged as if for two main lines with the following exception. One of the pigtails from the spyder is used to join the two supports of the spyder at the top, at the same distance as the litter attachment. Add a pulley or extra beener to the "figure 8" knot that will be attached to the forward

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The litter attendant may find it easier to ride on the rails of the litter than to hang below it.

need to support the weight of the patient and attendant.

As with each new technique there is a new call for the attendant.

On traverse - is used when both the patient and litter attendant are ready to start.

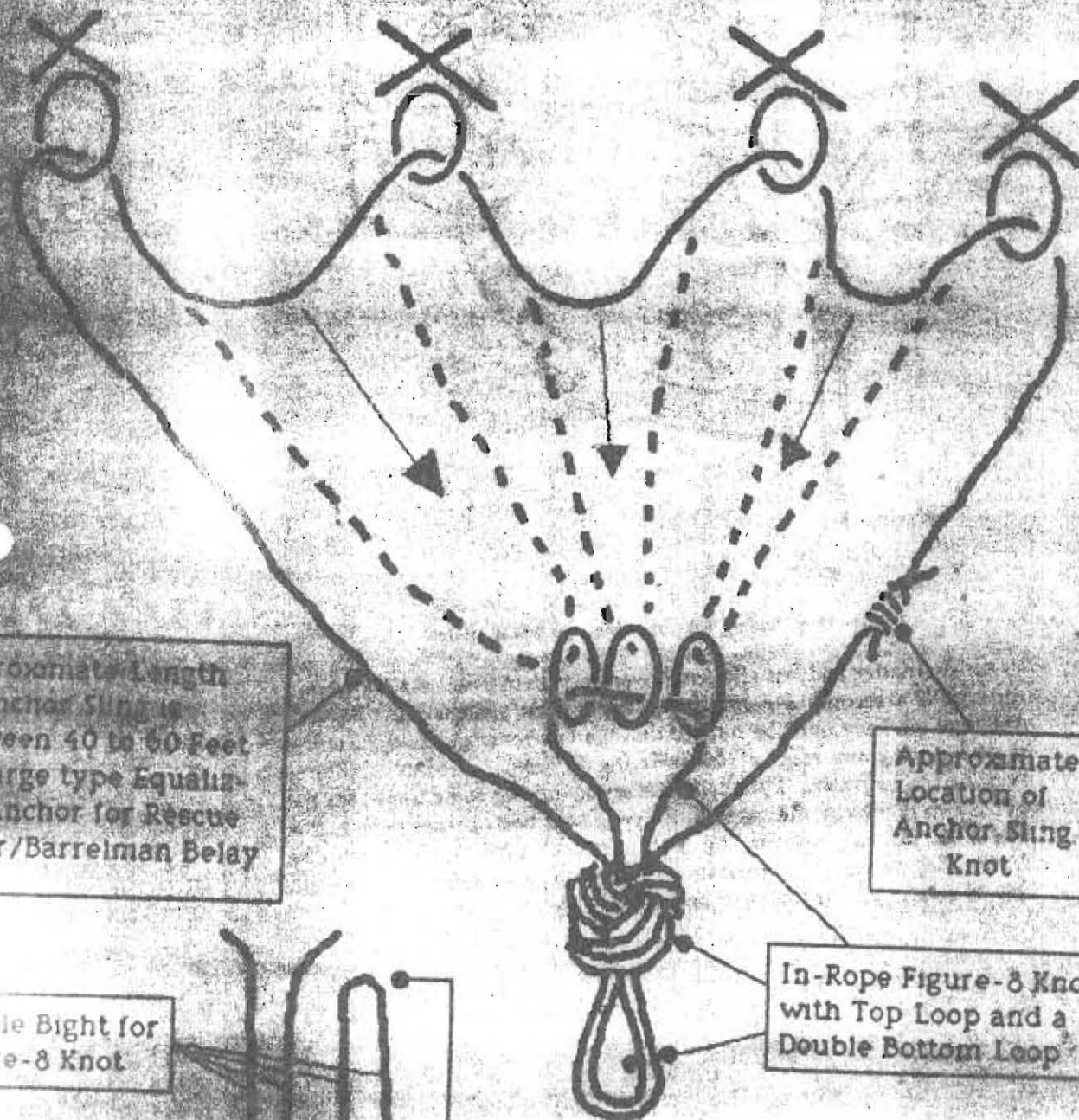
Off traverse - is used when completely OFF traverse.

These calls are ⁴made in the same manner as "On belay" and "Off belay."

The thing to do now is get good instruction, equipment and practice safely.

Equalizing Anchor System

(this is just one example)



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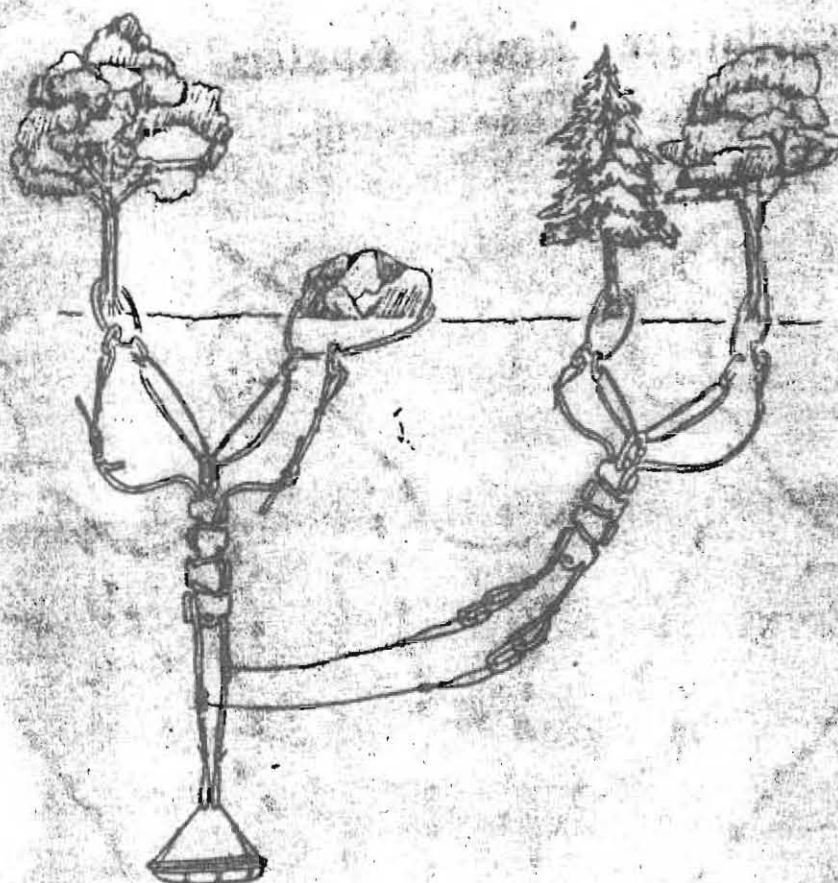


Fig. 18.6 Passing a knot using two brake plates.

An alternative and less efficient lowering system uses a main lowering rope with a second, separate belay rope. This system must be well designed, and one must be assured that the belayer could hold the entire system during any stage of the lowering in case a problem arose or a knot had to be passed. Usually a friction device has to be rigged for the belayer so that he or she can hold the weight of two or three people. It is probably just as easy to rig two identical systems, without discriminating between the functions of lowering and belaying. After all, this is an age of equality and androgyny, right?

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While this needs to be quantified on a testing machine, it seems logical. Therefore, in straightforward lowerings with no knots to pass and no obstacles to stop the lowering, say to bypass an obstacle on the way down, prusiks could be dispensed with, although this should be a very carefully chosen option.

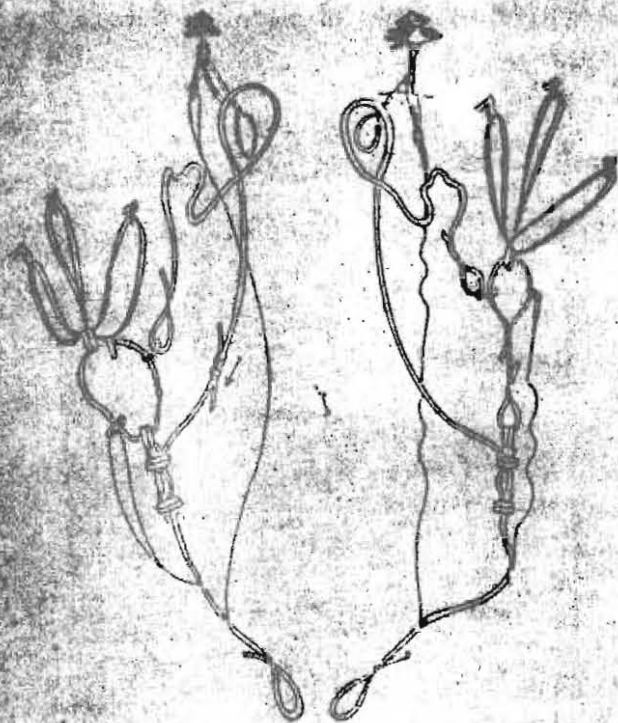


Fig. 12.3 Passing a knot during a lowering operation. As the knot on the left rope approaches the braking system, the right rope takes the load.

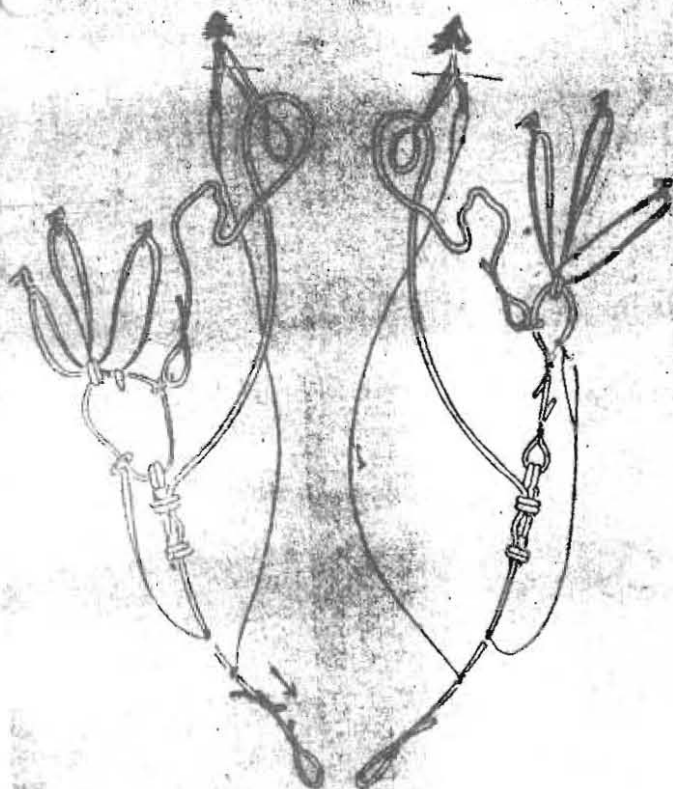


Fig. 12.5 The right rope continues to be lowered slowly and the knot is passed through the carabiner and the prusik one at a time. This way the system is still secured even if the right rope should suddenly break. During this process the prusiks are not set.

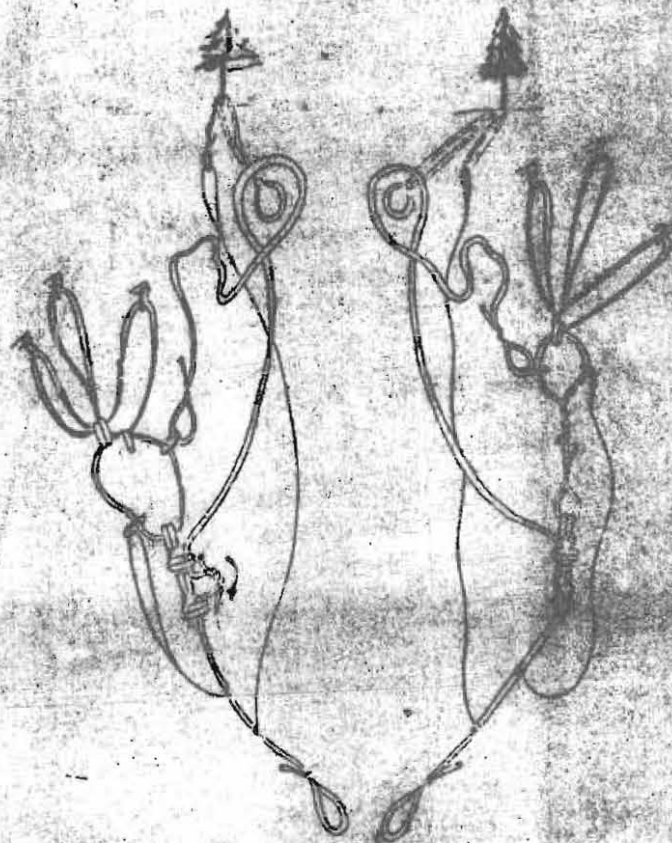


Fig. 12.4 After the right rope takes the load, the knot is clipped through one brake system at a time.

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Knot Passing

1. Tie Second Rope to Main Line
2. Call: STOP! Set (Safety set cam)
3. Attach Haul System just above Knot
4. Take rack out of System.
5. Take Tension on main Line with Haul System, Load and Check Knot.
6. Unlock Safety Cam, Lower Litter and Knot
7. Place Rack back in System, slack haul System, Load and Check Rack.
8. Continue Lowering until Knot is at Safety Cam. Lock rack and haul system and move Safety Cam above Knot.
9. Remove haul System and Continue Lowering.



Two Rope Systems

If two main Lines are used through one rack, the same method can be used by using an extra Cam on the haul system, to the two main Lines.

If two independent Lowering devices are used the Knot are Passed one at a time, starting with the feet to prevent the head from being Lower.

Knot Passing of Belay Line

1. Call: STOP, Belay off.
2. Move belay device above Knot
3. Call: Belay on.