MODIFICATIONS TO GIBBS ASCENDERS

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ABSTRACT

From the selection of mechanical prusiking devices available, the Gibbs ascender is about the cheapest and strongest, but also awkward and difficult to use.

The failure of the Gibbs to grip the rope at the top of each step has often been a problem. A small variation of the angle of the Gibbs cam relative to its shell can cause the ascender to grip the rope as desired, or slip.

Described and illustrated are a few methods of controlling the Gibbs to give smooth operation without slipping, and some other methods such as the 'Gibbs flick'. Part of the discussion is a non–mathematical analysis of the forces on the Gibbs in each case.

A collection of Gibbs modifications to improve the handling or to suit specific applications is presented, derived from the published works of various authors.

GIBBS OPERATION

The Gibbs ascender differs in a number of ways from the Jumar type. The standard Gibbs has no spring and there is only one obvious attachment point — the cam eye [Fig. 1]. The Gibbs ascender grips the rope by squeezing it between the U–shaped shell and the blunt teeth on the cam [Fig. 2]. The cam is a lever, providing a squeezing force that is slightly greater than the force applied to the cam eye by the load. Once the Gibbs is supporting a small load (even its own weight), increasing the load on the cam eye increases the gripping force on the rope. This is advantageous on slippery ropes where Jumar–style ascenders may require a helping thumb on the cam to prevent slippage as the ascender takes the load.

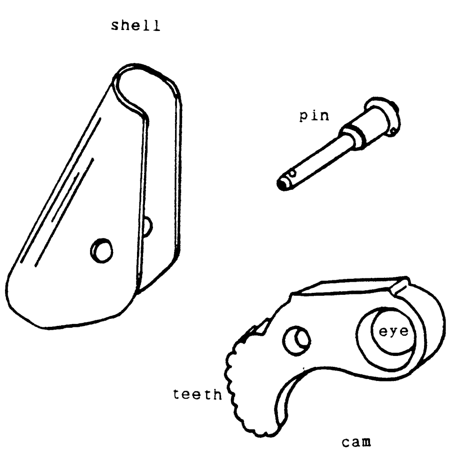


Figure 1: Parts of the Gibbs.

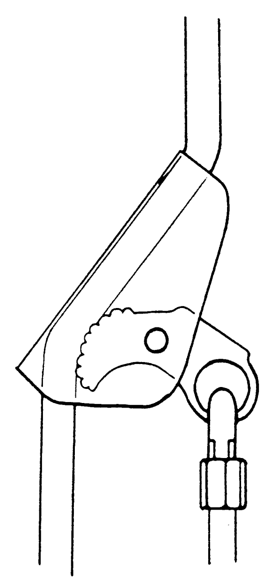


Figure 2: Gibbs supporting a load.

At the start of each step with a standard Gibbs there can be a problem. When it is lifted by the cam eye, the Gibbs trails freely up the rope. However, it can also freely slide down the rope when it is required to support a load. For the Gibbs to grip the rope the cam must be rotated relative to the shell so that the teeth press the rope into the shell. The rigging of the standard Gibbs with no spring can be arranged to provide the torque to cause the cam to grip the rope when required, as well as allowing a low resistance run up the rope to the next step when required. Some examples are included in the following.

METHODS

Gibbs Flick

The 'Gibbs Flick' is a term used to describe the quick jiggling, kicking motions used to make a loosely–rigged Gibbs grip the rope. The Gibbs flick applies a downwards force on the cam eye while the whole ascender maintains some momentum up the rope. The result is a force couple which acts to rotate the cam to grip the rope [Fig. 3(a)]. When there is moderate tension in the rope, pulling sideways and then downwards quickly can produce sufficient frictional drag on the shell to provide a similar force couple [fig. 3(b)].

Inverted Gibbs

A Gibbs hanging inverted in a hauling system has gravity providing the forces necessary for trouble–free operation [Fig. 4].

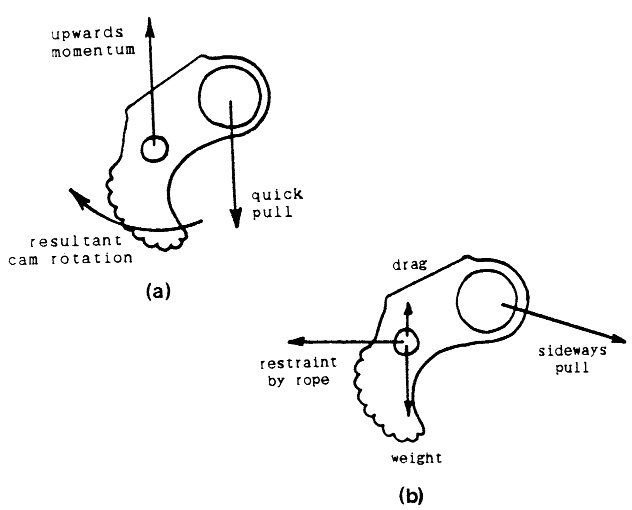


Figure 3: 'Gibbs Flick' forces acting on the cam

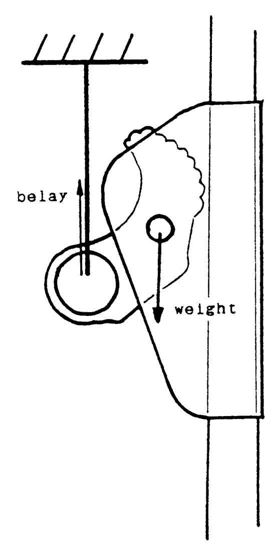
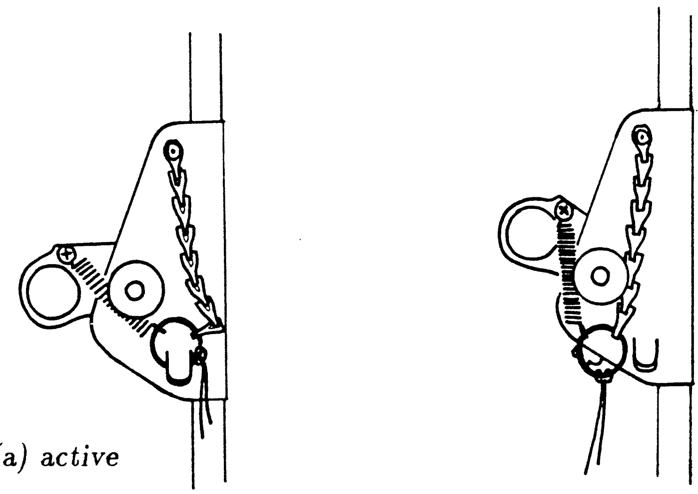


Figure 4: Inverted Gibbs (hauling system).

Spring Gibbs

The manufacturer offers a Gibbs with a strong spring. The spring can continuously apply the torque needed to start the cam teeth gripping the rope. Alternatively, the spring can be unhooked and then the ascender operates as a standard Gibbs [Fig. 5].



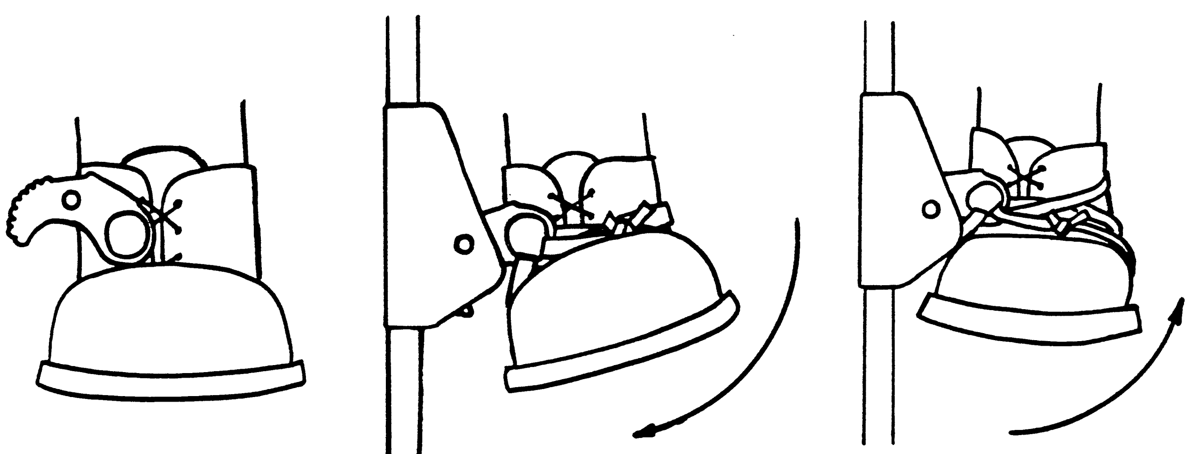
(a) active (b) released

Figure 5: Spring Gibbs with spring

The strong spring causes the cam teeth to rest heavily on the rope, causing significant drag when the spring Gibbs is moved up the rope. The spring can be replaced by shock cord (Hall 1979), and this allows the setting of any desired tension. The shock cord can also recover from overstretching abuse better than the spring.

Foot Gibbs

A Gibbs can be attached to the foot [Fig. 6(a)] and controlled to grip or run free as desired. If the Gibbs cam is attached to the caver's boot with sufficient friction (see below), then the cam can be rotated by twisting the foot while the shell remains aligned with the rope. To grip the rope, twist the boot sole towards the rope [Fig. 6(b)]. This rotates the cam, causing the teeth to lightly press the rope into the shell and grip the rope. Then body weight can be applied. which will increase the gripping force. When



(a) placement (b) gripping (c) release

Figure 6: Foot Gibbs.

there is room to take a moderate step, this apparently awkward boot twisting movement partially occurs just trying to get one's foot up high. (Go on, stand up and try it, moving the knee a little sideways). With a few metres of rope weight below, this foot Gibbs usually operates without any special attention; just step up.

To release (to step down), or to offer minimum resistance for the first few steps up, twist the boot sole away from the rope when the body weight is taken off that foot [Fig. 6(c)].

The cam must be attached to the boot with sufficient friction to prevent the cam from falling to rest on the boot. The author has used a knotted tape loop to stand in, with a tape chicken loop [Fig. 7]. It is a short struggle to fit, but without the shell and pin attached it is comfortable enough to wear throughout a caving trip.

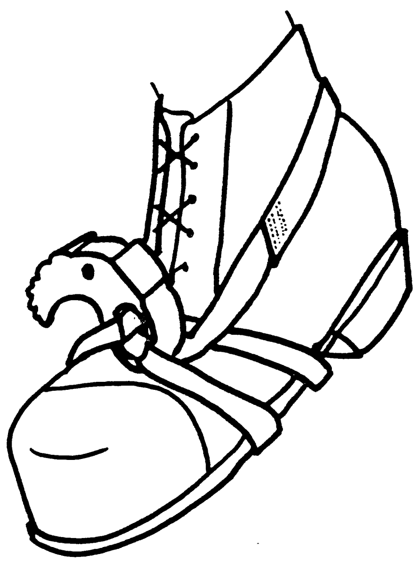


Figure 7: Cam attachment to boot.

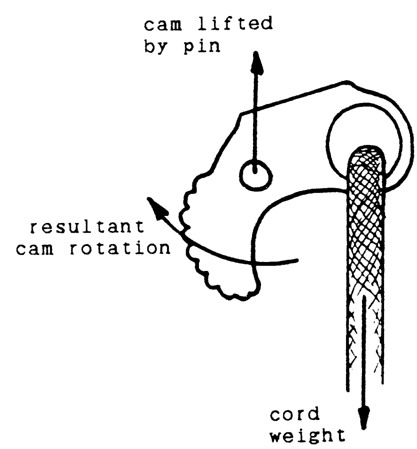


Figure 8: Forces on floating Gibbs.

Floating Gibbs

A reliable method of making the Gibbs grip the rope every time is to pull the shell up the rope. This lifts the cam by the pin [Fig. 8]. As the eye side is heavier, the teeth rest lightly on the rope. Any additional weight on the cam eye increases the Gibbs' grip on the rope.

Shock cord is generally used to provide the upwards pull. A simple method of attaching it to the Gibbs is to pass it through a hole drilled in the side of the shell. This hole should ideally be placed above the centre of gravity of the complete ascender and sling, so that the shell hangs in line with the main rope. Placing the hole approximately 35mm above the pin and close to the edge of the shell on the same side as the pin head gives satisfactory operation [Fig. 9(a)].

An alternative method of attaching the shock cord is to use a small plate under the head of the pin [Fig. 9(b)] (Montgomery 1977).

A third possibility is to attach the shock cord to the top of the cam. This allows operation as a spelean shunt as well as limited operation as a floating ascender (see spelean shunt section).

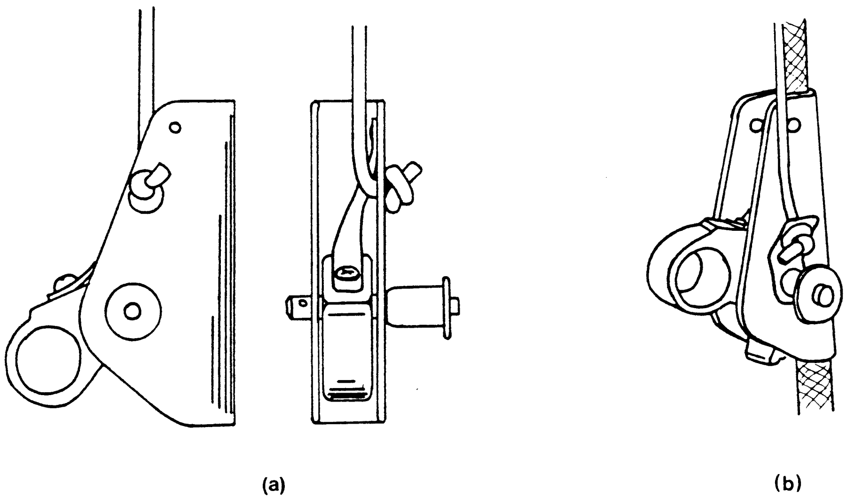


Figure 9: Shock cord attachment to (a) shell, and (b) pin.

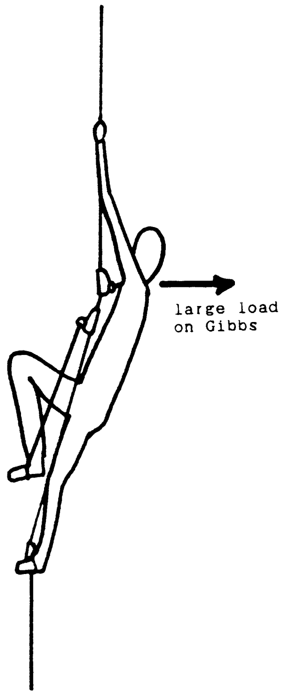
Shock cord tension and length

In ropewalking rigs shock cord tension is a compromise. The shock cord should be
- tight enough to lift the floating ascender as high as the attached foot requires;
- tight enough to overcome minor snagging of the floating ascender on the caver's body or rock face; but
- not so tight that it pulls uncomfortably on the caver's shoulder or chest harness; and
- not so tight that the floating cam teeth drag and wear excessively against the main rope

A short length of shock cord is too tight for comfort at the bottom of the step, and too weak at the top of the step to pull the floating ascender as high as is desirable. If the change in shock cord length is small compared with the total length, then the change in tension is small. Therefore make the shock cord as long as one can tolerate. For large–stepping ropewalking rigs, the added complication of running the shock cord over a small pulley on the shoulder and down to the other foot may be justifiable. The shock cord could be run through a carabiner on the chest harness, instead of a pulley, but wear on the shock cord is significant in this case.

Shoulder–level Gibbs

In ropewalking systems with a shoulder Gibbs, the force keeping the caver upright causes much friction and drag on the shoulder Gibbs [Fig. 10]. Small rollers can be added to the Gibbs to reduce friction [Fig. 11] (Isenhart 1974, Storrick 1979).
The author's solution is to use a separate open–sided pulley on the shoulder to hold the caver upright, with a Gibbs resting above the pulley. A cord connects the cam eye to the sit harness [Fig. 12(a) and (b)].



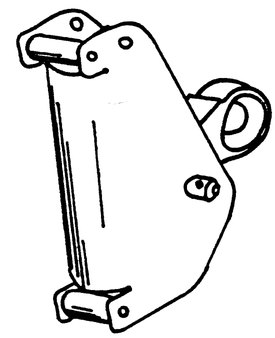
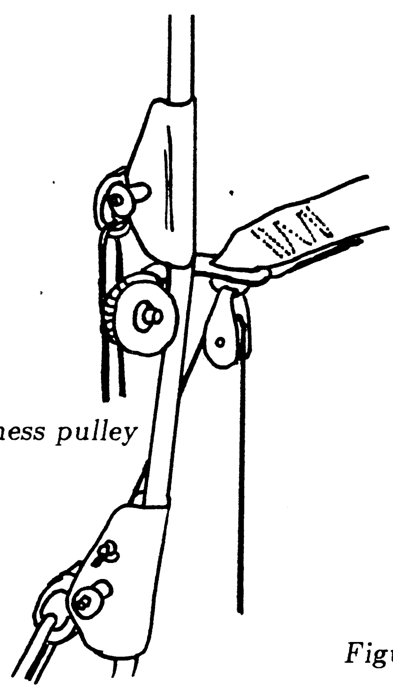
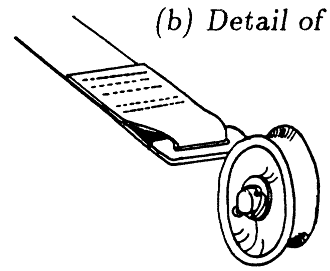


Figure 11: Gibbs with rollers added.

Figure 10: Shoulder Gibbs holds caver upright.



(a) shoulder harness pulley



(b) Detail of pulley

Figure 12

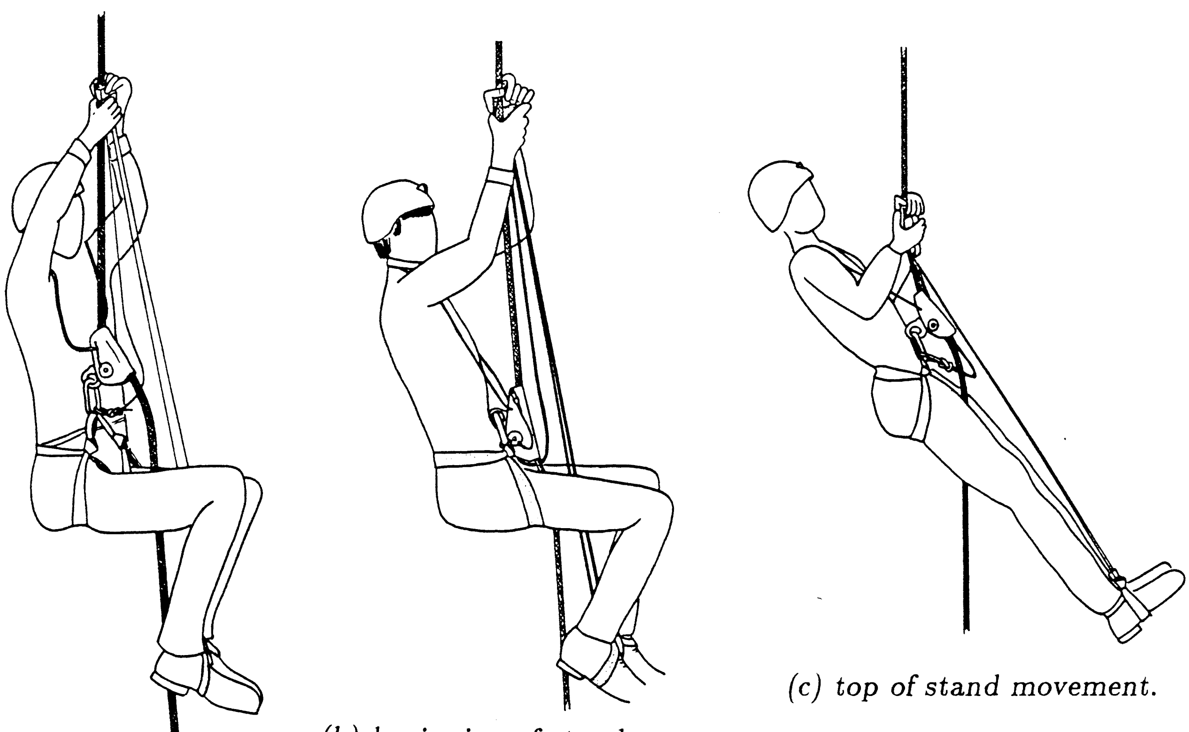
The pulley assembly pushes the shell of the Gibbs up the rope whenever the caver's body is raised. The Gibbs is always gripping the rope, but only weakly. When the caver sits down the Gibbs grips tightly and supports the caver by the sit harness, while the pulley runs down the main rope as the caver relaxes.

On inclined pitches or edges the pulley can be disengaged from the main rope, instead of slipping the body out of the shoulder strap of conventional three–Gibbs rigs.

Body ascender: For sit-stand prusik systems

The Gibbs is connected directly to the sit harness by a carabiner through the cam eye. The shock cord from the Gibbs shell is tied in a neck loop, or to a shoulder or chest harness [Fig. 13(a)]. The shock cord length is adjusted carefully so that at the beginning of the standing movement the Gibbs is hanging loosely on the carabiner [Fig. 13(b)]. Near the top of the stand movement the caver's back straightens, the distance from shoulder to seat carabiner increases, and the shock cord tightens. The cam teeth, which were clear of the main rope, contact and grip the rope when the cam is rotated by the tightening shock cord pulling the shell up [Fig. 13(c)].

If the sit harness is worn loosely, it may be necessary to connect a second, shorter. shock cord to the seat carabiner to prevent it sagging and causing the Gibbs to drag unnecessarily on the main rope.



(a) sitting *(b) beginning of stand movement* *(c) top of stand movement.*

Figure 13: Body ascender:

Shoulder harness

The author's shoulder harness is a tape from the shock cord near the collar bone, round the back of the neck, over the other collar bone, under the armpit, across the back and return to the shock cord.

Self belay

A Gibbs ascender can be used as a belay device on a fixed rope. The Gibbs can be allowed some positional freedom by connecting it to the sit harness with a short cord or tape loop. A length of shock cord (or even tape or normal cord) from the Gibbs' shell is connected to the caver near the shoulder [Fig. 14]. Care must be taken that the shock cord is not so long that the cord between the cam eye and sit harness holds the cam open.

The Gibbs is easily pulled up the belay rope by the cord to the shoulder, while always weakly gripping the rope. If the caver drops, the Gibbs remains stationary on the rope with its grip increasing as the caver's weight is transferred onto the cam eye.

Spelean shunt

A standard Gibbs can be used as a trailing ascender belay on descents, as shown by Toomer and Welsh (1977). Replacing the tape connecting the cam eye to the chest harness with a shock cord from the top of the cam to a chest or shoulder harness allows greater freedom of movement to the caver attached to the shunt. In addition, a shock cord–modified spelean shunt Gibbs can function as a body ascender in sit-stand prusik systems or as a self belay on a ladder or free climb.

Assembly

The Gibbs is assembled on the rope with a carabiner passing through the cam eye and encircling the shell with the solid (ungated) side of the carabiner resting on the head of the quick–release pin. A cord or tape loop connects the sit harness to the cam eye [Fig. 15]. This connecting loop must be slack when descending to allow the weight of the carabiner to hold the cam in the open position. The shock cord from the top of the cam

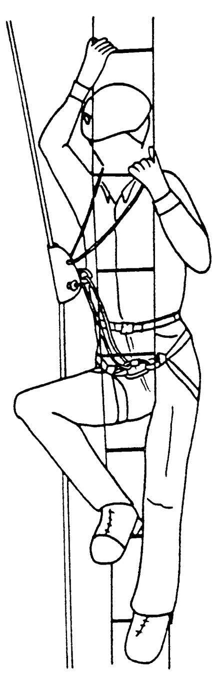


Figure 14: Gibbs as self belay.

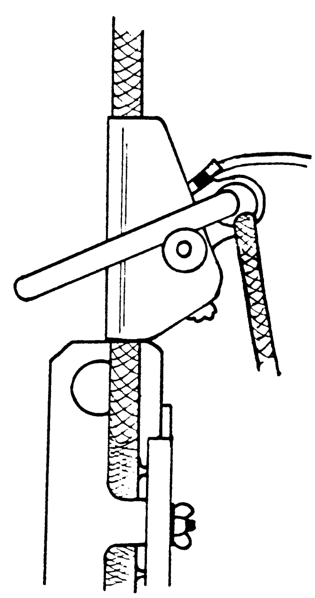


Figure 15: Spelean shunt.

to the shoulder or chest harness must be slack while descending normally. This allows the shunt to rest on the abseiling device without gripping the main rope.

Triggering

When the caver leans back, the shock cord pulls on the top of the cam. The shell is restrained horizontally by the loaded abseil rope. The resultant force couple rotates the cam onto the rope. While the triggered shunt remains stationary on the rope, the caver continues to abseil a short distance until the cord between the sit harness and Gibbs (cam eye) supports the caver.
The shunt can also be triggered without the use of a trigger cord. The caver descends with a gloved hand loosely clutching the main rope between the descending device and the shunt [fig. 16]. When the average caver fears a quick descent or panics, the gloved hand tightens on the main rope, and holds up the shunt. The caver continues down until the cord from the sit harness to the Gibbs (eye) tightens and rotates the cam against the weight of the carabiner, which was holding the Gibbs open. The Gibbs grips and supports the caver (J. Webb, pers. comm.).

Release

To release the shunt, pull down on the carabiner (much like doing a one–handed chin up). which levers the cam eye upwards, releasing the Gibbs grip on the rope [Fig. 17]. If it is too difficult by hand, attach a cord or tape loop to the carabiner and stand in the loop.

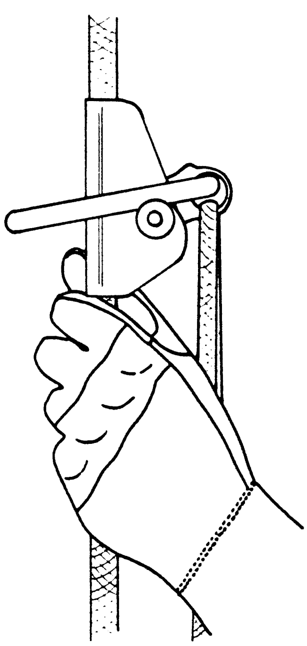


Figure 16: A panic grip triggers the shunt.

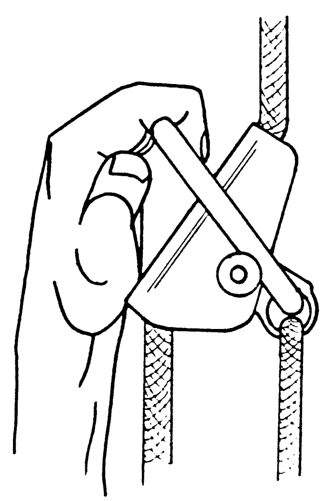


Figure 17: Releasing the shunt.

Spelean Shunt modifications

The basic shunt modification is to attach shock cord to the screw on top of the cam, along with the small tape connecting it to the shell [Fig. 18].
For reliable operation as a free–running self belay on ascents, it is important that the shock cord is free to move at the connection to the cam. The author used one link of the Gibbs chain under a longer self-tapping screw, with a wire ring about 10mm diameter attached. The shock cord passes through this ring, is doubled back, and is bound with whipping cord [Fig. 19]. The shock cord is connected to the body near the shoulder. The length is critical for good operation as a body ascender. For use as a self belay device, 300–400mm is satisfactory.
Note — Due to the poor reliability of this self belay in service, the author now (1985) prefers the shock cord connected to the shell of the Gibbs, which gives excellent self belay reliability at the expense of decreased shunt triggering sensitivity.

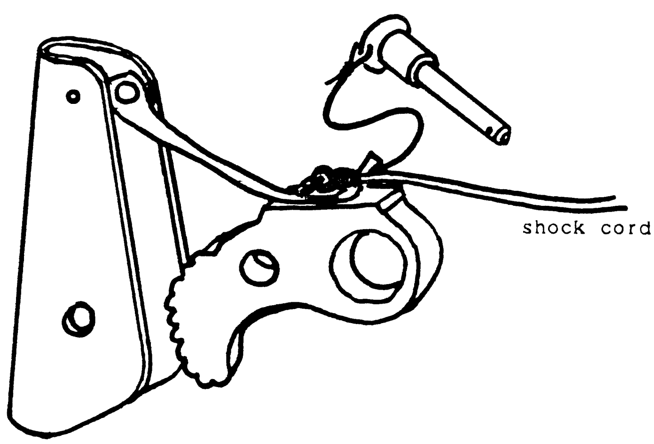


Figure 18

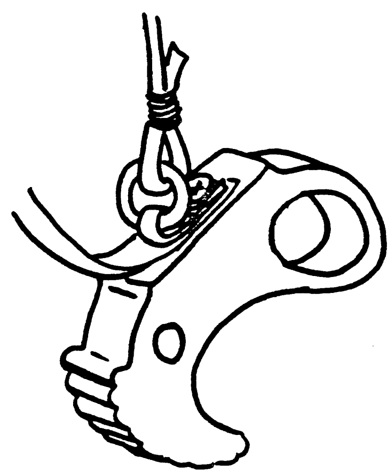


Figure 19: Dual purpose modification: spelean shunt/self belay.

The cam eye can be enlarged to accept both a carabiner and an 8mm cord simultaneously. The standard size eye only has enough room for a tape sling to the sit harness when the spelean shunt carabiner is in position. To use 8mm cord for this main safety sling, enlarge the cam eye to an egg shape [Fig. 20]. Although a Gibbs with this enlarged cam eye has not been tested to failure, if the original thin part around the eye is not reduced, the author does not expect any significant weakening of the cam.
Hang the quick release pin on a cord connected to the cam so that the pin can be inserted from either side, and the carabiner used for the spelean shunt can be removed from the Gibbs without removing the Gibbs from the rope (if there is little or no load in the main rope). Prise the chain off the rivet and flatten the rivet against the shell (it still secures the red tape to the cam). Whip a 3mm cord to the quick release pin and attach the other end to the shock cord connection on the cam [Fig. 18].

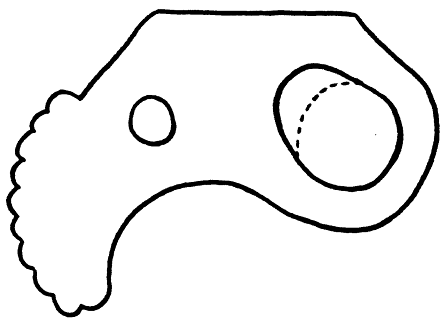


Figure 20: Enlarged cam eye.

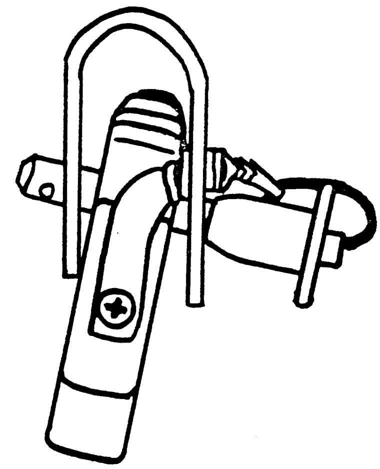


Figure 21: Bent shell.

Handling modification

The sharp edges left from the manufacture of the Gibbs need to be smoothed to prevent damage to the ascender cords and tapes. Even the laziest caver should smooth the inside of the cam eye.

Check that the cam moves freely in the shell. If the shell is bent, the cam could bind [Fig. 21].

The frustrations of assembling the three–piece Gibbs on the rope can be eased with experience, but also these minor modifications (below) can help.

Bevel the pin hole in the cam a little to make assembly a little easier [Fig. 22] (Storrick 1979). Some of the later Gibbs have this done in manufacture.

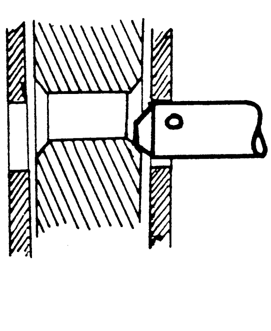


Figure 22: Bevel pin hole in cam.

Replace the chain with 3mm cord (Hall 1979). The chain is awkward. One twist and it is too short. About 100mm of 3mm cord allows the pin to be inserted from either side.

Cut the chain, leaving the first link riveted to the shell. Smooth the retaining hole in the pin. Whip the ends of the doubled–over cord [Fig. 23].
A different solution to the assembly fumbling is the homemade swing–open cam of Delbert Province (Davison 1974) [Fig. 24].

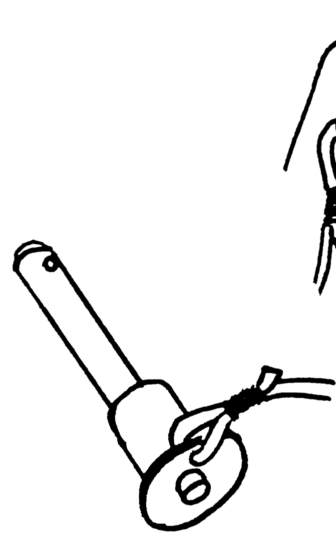


Figure 23: Replace the chain with 3mm cord.

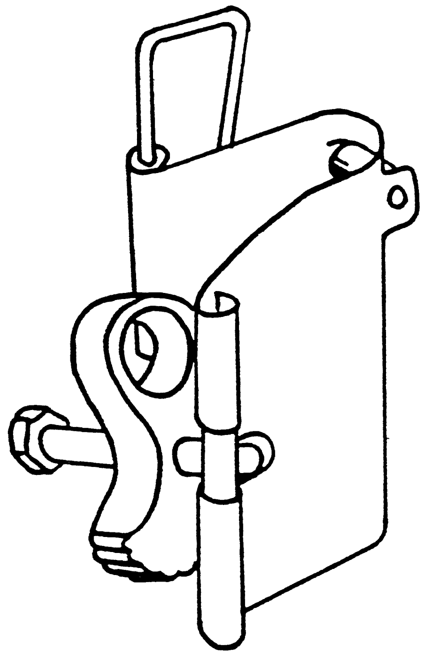


Figure 24: Swing–open cam.

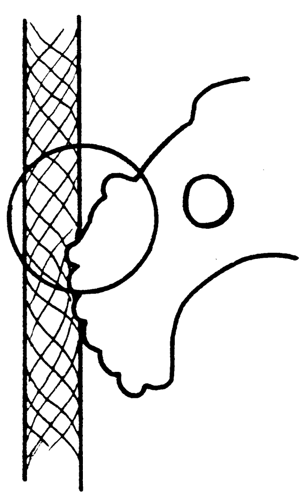


Figure 25: Channelling.

Channelling (Davison, 1974)

This is the removal of a portion of the cam teeth which hinders the release of the Gibbs in the transition from being loaded to being pulled up the rope. When the Gibbs is gripping, the rope is compressed between the shell and the cam teeth. When the load is removed the rope springs back to almost its original round shape and pushes against the cam teeth. As the Gibbs releases, the cam rotates. The one or two teeth immediately above the load–bearing teeth meet the rebounding rope and oppose the cam's rotation, hindering release.

On the lowest Gibbs, it is helpful to file a groove in the one or two teeth above the load–bearing teeth so that the rebounding rope does not push on the upper teeth. Then less force is needed to release the Gibbs and start it moving up the rope.

The groove to file is the same as that which eventually wears in a floating Gibbs.

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