Chapter 4

Lever caps, Cap-irons, Thumb screws, & Screw adjusters

There are very few sources for cast lever-caps of bronze or brass like those on old infills, but it is not a very difficult part to make. Brass is an easy metal to shape with hand tools and you can make a lever-cap that is every bit as elegant as the antiques. Thumbscrews are a little more challenging, but they too can be home-made to a very acceptable standard.

Lever-caps are far from essential, early infill makers used the tried & trusted wooden wedge, which does a perfectly satisfactory job, and although they are often found in poor condition on old planes, if treated with due respect a wedge *should* last the life of a plane. I have seen planes more than 100 years old with wedges in remarkably good condition. Fitting a wedge is simpler and easier than fitting a lever cap and if not fitting a screw adjuster, they are as convenient as a screwed lever cap. Metal "strike-buttons" were sometimes placed at the rear end of wedged planes, and sometimes on the top of the toe (a sharp rap on the top of the front bun is a very effective way to reduce set or loosen a wedge).

I don't know when wedges disappeared from infills, but through the latter part of the 1800s, catalogues increasingly showed lever-caps instead of wedges, well before Norris's screw adjuster appeared. (Though you could still 'special-order' a mitre plane with a wedge instead of a lever-cap into the early 20th C - some traditions die hard! Presumably they were seen as more convenient

than wedges or perhaps a good marketing point. But screwed lever-caps & screw adjusters are certainly complementary; loosening & tightening wedges in order to adjust blade depth would become very tedious and essentially negate any convenience the adjuster offered (which to be honest, is not all that much once you get used to hammer setting). This is recognised by Veritas who offer a sort of "wedge lever" with their small plane kits – the 'wedge' is tightened by a thumbscrew, making it easy to back off a little pressure before making depth adjustments.

On my first infill I used a ready-made bronze lever-cap. It was essentially a rough casting though it had been drilled & tapped for the thumbscrew (with a square thread) but it required a fair amount of filing & sanding to make it presentable, as well as trimming of the sides to fit in my plane. For my next plane, I decided to try making my own lever cap from a piece of brass bar & it turned out to be easier than I expected. Detailed instructions are given starting on page 62.

Lever-cap Screws

Potential thumbscrews for a small plane. From the left: brass screw with 0.5 inch knurled head & ¼ inch NC thread available from several sellers. Centre: Thumbscrew included with Veritas small plane kit. Right: "Found" screw.

Unless you have access to a metal lathe, thumbscrews can also be a problem for the backyard plane maker. You can buy *small* brass thumbscrews, with 6mm or ¼" NC threads and skinny ~13mm heads, but 6mm threads would be both inadequate & out of proportion on anything larger than a very small plane. The thin heads also provide little purchase for fingers & can be hard to tighten sufficiently.

Finding ready-made thumbscrews in larger diameters is difficult, I have seen some advertised on the internet at eye-watering prices, well above the cost of a suitable tap & die & some brass rod, which is all you need to make your own. You can make quite professional-looking thumbscrews without a lathe, you just have to be a bit more creative.

Three sizes of plane and 3 sizes of thumbscrew

Thumbscrews on old planes invariably had a coarse square thread, presumably because square threads are stronger & more efficient than pyramidal threads of similar pitch. But taps & dies for square threads are rare and expensive, so I would only consider that route if I wished to make a faithful replica of an old plane. The somewhat finer pitch of the typical bolt-thread sizes you would use for a thumbscrew makes up for any lower efficiency compared with square threads and the risk of stripping them in normal use is exceedingly remote.

The simplest approach is to find a bolt of the size you need, cut off the length of thread required, fit a suitable head, & you have your thumbscrew. You need a matching tapped hole in the lever-cap, but taps in the range of M6 to M12 are not expensive & readily available in most hardware stores, . These are usually high-carbon steel (HCS) which is not as durable as high speed steel (HSS) but will easily tap more brass lever-caps than you are ever likely to need. I turn many of the thumbscrews I use from solid brass rod, because it's easy, but for screws that need a long shaft like the wedge-retaining thumbscrews on shoulder planes it's more economical to make a separate head & use a stainless steel bolt for the shaft.

Match the thumbscrew thread size to the size of your plane. For very small planes ("thumb" or "palm" planes), M6 is appropriate; M8 suits block-plane sizes; M10 for typical smoothing planes, and M12 on larger models such as panel planes. If you want brass or stainless steel bolts in sizes above M8 you will probably need to go further than the local hardware store, but they are available from specialist suppliers. You can thread your own screws from a length of brass rod but be aware that most of the round brass bar sold by suppliers is made to Imperial sizes. The bars are accurately sized

& will accept Imperial dies (still readily available), but the only common sizes compatible with metric dies are 5/16" (= 8mm), & 5/8" (= 16mm), so make sure you have appropriate taps & dies for the size bar you choose.

There are many ways to go about making your thumbscrew. Derek Cohen, from W.A. has instructions on his blog for making a very serviceable thumbscrew head using parts from a half-inch brass hose-coupling to create a knurled head which he attached to a brass bolt using epoxy glue. Depending on the actual hose-fitting you select, you'll get a head about 22mm diameter, which is suitable for a large smoother or panel plane, but a little muscular for a small plane. Here is the link: (https://www.inthewoodshop.com/ShopMadeTools/Making%20Lever%20Caps%20and%20Lever%20Cap%20Screws%20in%20the%20Backyard.html).

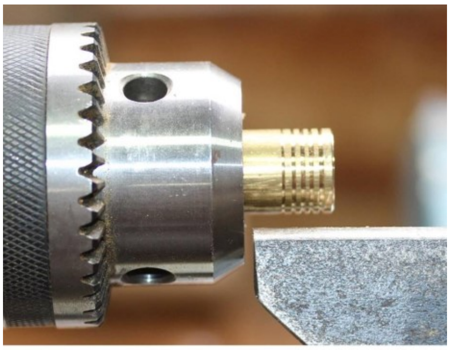
And here are some other low-tech alternatives for making up thumbscrews:

1. A *very* low-tech approach is to combine a small solid-brass knob and a bolt of suitable size. In the case illustrated at left & right, I used a 20mm knob and a 6mm bolt to make a thumbscrew for a small (110mm) plane.

All that is required is to enlarge the screw hole in the knob (which is typically ~4mm diameter), and re-tap it for the size bolt you wish to use. Cut the bolt to the required length & lock it in the knob using a metal glue such as "Loctite" or a 'superglue'. [*Note: most of the brass knobs you'll find in the chain hardware stores are hollow & quite thin-walled, and not suitable for drilling & tapping a hole larger than the one already in it. You may need to go to a place that sells 'antique' style brasses to find solid knobs*].

2. Make your own from a piece of brass bar. This is easier if you have a wood lathe & suitable chucks, but you can do it with a drill press, or even a battery drill - any method that will hold & turn the rod slowly. I've used 16mm rod for the following demonstration because it's the maximum diameter the Jacobs chuck for my wood lathe will accept, but I could have used a spiral chuck to hold a larger diameter rod. Use your ingenuity to adapt whatever gear is available to you.

Chuck a short length of rod, and at a very slow speed, clean & square the face with a file. Drill a hole for your tap in the centre, being careful to stop at least 2mm short of the length you wish to make your knob, then tap the hole. Use the tailstock chuck to hold the tap for a straight start, and needless to say, ***turn the lathe by hand***, don't be tempted to use power for this operation unless you have a proper tapping chuck. A hole 7-8mm deep in a knob 10mm long will work nicely for an M8 bolt, 3 or 4 turns of full thread will hold securely. For a thinner knob like those on many old infills, you will need to use a bottoming tap to get enough full threads in the shallow hole.



Shallow grooves turned on 16mm bras rod

Mark off the length you intend making the knob and divide that into evenly-spaced intervals. With the lathe turning very slowly, use either a fine-toothed blade in a hacksaw; a small, sharp-cornered triangular file; or a pointed cutting tool to make a well-defined groove at each of your marks. However you define your lines, you can accentuate & smooth them with a fine 3-cornered file applied lightly in the groove while the brass turns slowly.

Once satisfied with the circular grooves, score a series of evenly-spaced horizontal lines around the diameter. If you're lathe doesn't have indexed stops, cut a strip of paper as long as the diameter, divide it into the requisite number of spaces with ruler or dividers, & glue that around the head. To part-off the head squarely, use light strokes of a hacksaw with the brass turning very slowly. The rough surface left by the hacksaw is easily cleaned by rubbing the surface over sandpaper held flat on the bench or tablesaw top.

Thumbscrew made by hand-knurling compared with one made using a knurling tool

Screw in the bolt & hold it in a vise (with wood or aluminium jaws so you don't bruise the thread), and make a shallow cut on each of the longitudintal lines with a hacksaw.   If you're careful, this will make clean grooves, but some blades chatter & you may need to tidy the grooves with a fine file. Keep these cuts straight and even and your knob will look quite 'professional' and provide a comfortable finger grip.   Again, the screw can be secured in the head with 'Loctite' when finished. Brass or plain steel (but not SS) screws can be soldered in the head for a very sound permanent join .

16mm hand-knurled thumbscrew on 160mm smoothing plane

The (M8) screw I made for the above demonstration is a good fit for the small (160mm) plane at right.

You can let your creative juices flow & vary the groove pattern, file a waist or add other decorative flourishes to create your own unique style – there is a wide range of possibilities. Make the screw long enough to have a couple of full turns of thread in reserve when the lever-cap is tightened, but otherwise keep it short so it isn't in the way of shavings or fingers.

[*Note: while you have the screw in a chuck file a rounded point on the that will bear on the blade/cap-iron (as on both screws illustrated above. The sharper the point the less the tendency to slew the blade as it's tightened, but a sharp point will make indents in the cap-iron, which is likely to interfere with smooth blade adjustment, so it needs to be a rounded "point" that won't mar the surface of your cap-iron (see examples below)*].

Those are just a couple of ideas to get you started, there are other ways of making thumbscrew heads and an internet search will no doubt turn up other ideas.

Home-made thumbscrews. L to R: large TS made from a brass hose fitting ; two made from stainless steel bolts and heads of hand-knurled brass rod; TS made from brass cupboard knob and M6 brass bolt.

Lever-Caps

Materials such as brass, bronze & stainless all polish up well & have good corrosion resistance. Aluminium is another soft & easily-worked metal, which does the job (Veritas planes have aluminium alloy LCs), but it can actually be more difficult to file than brass because of its propensity to clog ordinary files. Files made specifically for soft-metals clog less, but that means buying yet more files, at considerable expense.

I start by making a cardboard template of the LC shape to determine the length, width & shape & where the axle point will be placed. I then make a wooden mock-up if there are any complicating issues (for example, a skewed blade). There is no need to fully shape the mock-up because you only need to check the key points like axle position & how the toe sits on the blade or cap-iron, but rasping it to something close to finished shape will give you a good idea of how the real thing will look. You can even drill & tap the thumb-screw hole in the mock-up (taps for metal work quite well in wood across the grain), & by adding the thumbscrew, get a clear idea of how the LC fits.

My first attempt at a LC (left) was unlikely to win a beauty contest. The chunky lines were only a cosmetic flaw, but I made the nose curve too blunt, and it blocked smooth exit of shavings. So I had a second go at it, cut & filed more distinct shoulders and gave the nose a more shallow curve (right).

That got rid of the blocking problem but it still looks a bit clunky, so for my next LC I didn't hold back & cut & filed more flowing lines (right). A finer neck really improves appearance. If you use 380 brass, as is most likely, it has high tensile strength and I think you would have to make the neck absurdly thin for it to flex or bend under thumbscrew pressure.

Lever cap with cove under toe and shaping of neck

The shallow cove under the toe serves two purposes; one is to create a narrow shelf behind the toe edge which can be more easily filed & adjusted to sit evenly on the blade or cap-iron. The second reason is that if the LC is set close to the blade bed, the cove is usually necessary to allow the blade/cap-iron assembly to be inserted & withdrawn, particularly if it needs to be manoeuvred over an adjuster before it can sit down flat on the blade bed.

The lever cap should fit snugly without large gaps at the sides where shavings may lodge and interfere with smooth egress of further shavings.

Where to pivot the lever cap?

I have not come across any rules of thumb for the relative dimensions of lever caps so I've just made it up as I went along. Obviously, the longer you make the section above the fulcrum point (the axle or cross-pin), the more leverage the thumbscrew gains & the greater the pressure you can apply to the toe end of the blade. However, it is usually easy to generate more than enough pressure with a thumbscrew, given that the screw itself adds mechanical advantage, so I have come to the conclusion that the ratio of top to bottom sections is not very critical. In practice, we tend to make the neck section a little longer, to ensure the thumbscrew stands clear of the body, and any ratio of 50/50 or more works. A longer neck on the LC is also more aesthetically pleasing, so about the only feature you have to worry about is placing the axle point so it isn't too close to the edge of the sides.

[*In fact, it requires less pressure to hold the blade securely than you may expect. I think we all have a tendency to over-tighten screwed lever-caps. Moving the blade under a screwed LC with an adjuster requires excessive force unless the thumbscrew is slackened a little. You're probably thinking, "But the blade is easy to adjust on Bailey type planes without slackening the LC?" This is perfectly true but that's partly because the Bailey adjuster has greater mechanical advantage (screw <u>plus</u> lever-action of the yoke) than the 'direct drive' of Norris type adjusters, and partly because the LC cam pressure can be easily adjusted so it holds the blade firmly enough without impeding adjustment*.]

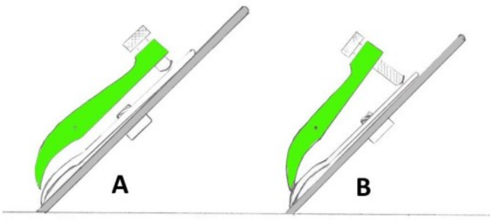
I have included drawings for lever caps with the plane plans in chapter 6. These are intended only as a general guide, and if you modify the plans you may need to adjust the length of your LC accordingly. The only 'critical' requirement is that the toe applies pressure on the blade as far down as it can without blocking the throat & causing choking. The actual design of your plane and the materials you have at hand and your own aesthetic will decide final shape.

Mounting a lever cap

Ideally, the lever cap should be mounted so it sits roughly parallel with the blade assembly when the thumbscrew is tightened. This keeps the thumbscrew perpendicular to the blade surface and (assisted by the rounded point mentioned above), minimises the slewing effect on the blade as the thumbscrew is tightened. Blade slewing can be a real annoyance when trying to make very fine adjustments!

If using a single-iron blade you can set the LC quite close to the blade because there are no obstacles like the cap-iron screw or the raised toe of the cap-iron to interfere with insertion & removal of the blade, but if using a cap-iron, you will obviously need a bit more clearance. In the diagram at right, "A" represents the ideal situation with the LC parallel with the blade bed and the thumbscrew perpendicular to the blade when tightened. "B" shows how having the LC pivot point further from the blade causes the screw to be off-perpendicular when tightened. In practice, you often end up with the thumbscrew slightly angled, but as long as it's only a little, it won't cause you any trouble.

The lever cap works best if roughly parallel with the blade, as in A, but allow sufficient room for easy blade insertion. Having the LC at too great an angle as in B looks awkward & the thumbscrew is more likely to slew the blade when tightened.



If fitting a screw adjuster, you need to be especially careful and make sure there is enough room to manoeuvre the blade assembly over the adjuster mechanism and far enough under the LC until the cap-iron screw head or holes in the blade (depending on the adjuster system), can engage and allow the blade to sit flat on the bed (this is where a wooden mock-up can be very helpful).

For neatness & maximum strength, the pivot point should end up around the centre of the arc of the hump in the sides, which should have been settled when you made your initial drawing.

Making the lever-cap

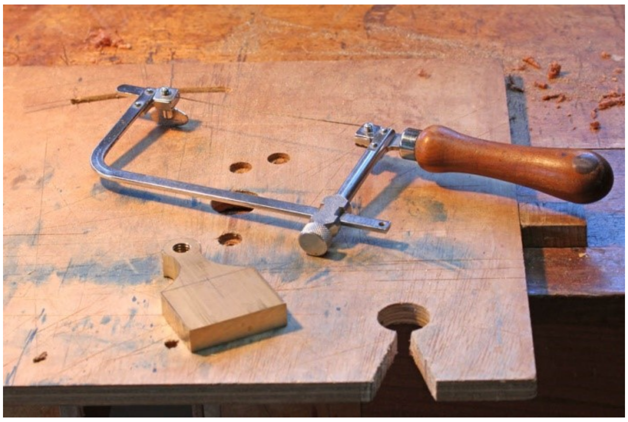
Choose a thickness of brass for the LC that will allow a decent amount of shaping. A large plane like a panel plane requires material 16-19mm (5/8-3/4") thick; for a medium-sized plane, 13mm (½") is sufficient; 8mm (3/8") is plenty for a small plane & I've even used 6.2mm (¼") thick bar for tiny ones.

Trace the shape of your template on the brass blank, and carefully mark the centre of the thumbscrew hole with a centre punch. Drill & tap for the thumbscrew while the brass is still square & easy to set up accurately in the drill press. It's also easier to drill & tap for the pivot screws (or through-rivet, if you wish to be traditional) while all surfaces are still square.

A steel washer bolted to the blank makes a good guide for cutting & smoothing the top of the LC

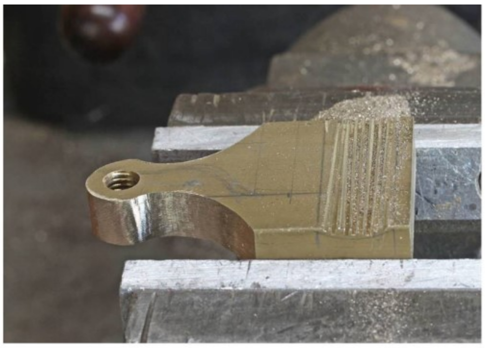
A steel washer clamped over the thumbscrew hole by a short screw is a handy guide for sawing & smoothing a neat top. Of course it doesn't have to be round, you may prefer a different shape – some old planes had heart-shaped tops or were shaped like the "spade" on playing cards. It's quite easy & fun to file different shapes.

A coarse blade in a jewellers' saw will cut 13mm thick brass quite well and with a good-quality blade it does not take very long to cut out the basic shape.

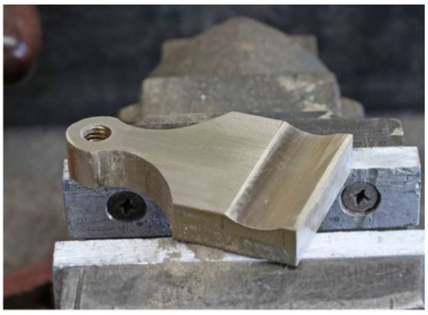


Smooth off the saw-cuts to the layout lines with files and "finger-gauge" some guidelines to help with the shaping. I use a hacksaw to remove bulk waste but even a 32 tpi hacksaw blade leaves a rough surface, so stay well clear of all layout lines - better to put up with a bit more filing than ruin an expensive piece of brass.

The cove under the toe is optional if using a single-iron blade, but I think it's still worth including because it makes it easier to refine the leading edge for a good fit across the blade. The cove should begin 2-3mm from the toe & extend as far back as possible without significantly reducing thickness around the fulcrum point. You can make a side template for the cove shape, but I work mostly by eye, the cove just needs to look straight and even, it doesn't have to be precise. With the hacksaw, make a series of cuts as close together as you can, to just above the depth of the cove. Beginning from the shallow outer cut, lean the blade over over & remove the slivers of metal. This will leave a rough cove which can be cleaned up quickly with a coarse half-round file but if you don't have a suitable file, use 60 or 80 grit paper wrapped round a dowel that roughly fits the curve. That will work almost as well as a file on the brass.



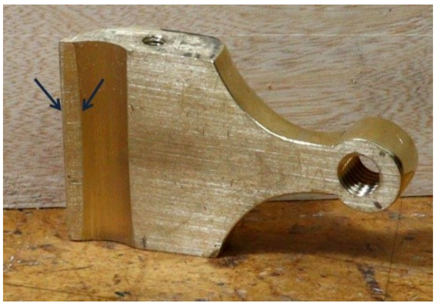
Shaping he cove underneath the LC. Make a series of cuts down to the line, then remove most of the waste by turning the hacksaw sideways.



Cove refined with a coarse half-round file and sandpaper wrapped round a suitably-sized dowel

With the cove formed, proceed to refine the top & shape the neck & nose to your taste using coarse & fine files, and/or abrasive paper wrapped around sticks & dowels. Once the shape is formed to my satisfaction I use various grades of 'wet & dry' paper wrapped over a hard flat block for smoothing the flat curve of the toe. Cloth-backed paper is good for smoothing the neck area. You can sand to 1500 grit for a nice satin sheen, or polish to a high shine as you wish.

Lever cap polished & ready to install

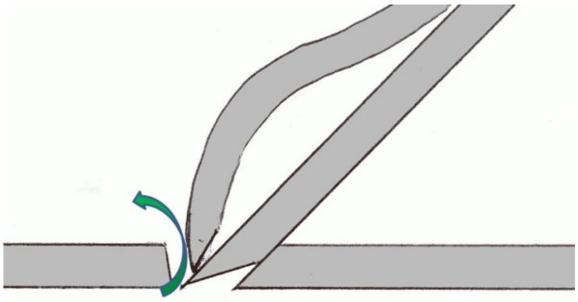


To get a clean, straight, mating surface at the toe, I first file a back-bevel on the underside of the leading edge to obtain a distinct lip (arrowed at left) with enough relief that only a narrow strip 1-2 mm wide actually contacts the blade or cap-iron. File carefully to avoid forming a curve, which is all too easy to do. The lip can be further flattened by carefully stroking it over a sheet of tightly-stretched sandpaper until it is perfectly straight.

Cap-Irons.

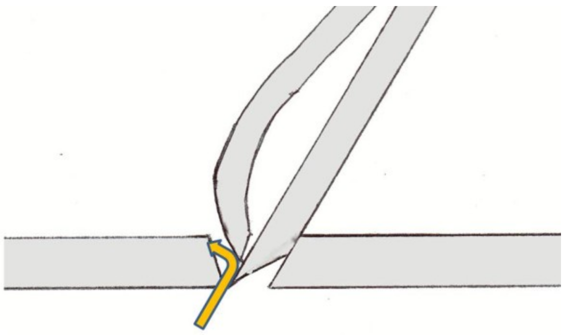
Some after-market plane blades can be purchased with a matching cap-iron, but many of the blades you may wish to use do not. For example, the blade that comes with the Veritas small plane kit is "borrowed" from one of their production block planes. Metal block planes, of course, have 'bevel-up' blades and don't use cap-irons. Veritas's intention is that the kits will be used to make simple, single-iron planes & so they neither include a cap-iron nor offer one as an optional extra. As far as I know, there are no readily-available cap-irons suitable for these blades (Hock may make a custom one for you, but it wouldn't be cheap!) so if you do want to add a cap-iron with these kits, or any "non-standard" blade, you will need to either find something you can modify, or make one. Fortunately, making a cap-iron is not too difficult.

Firstly, we should consider the geometry of cap-irons. Current wisdom is that for a plane with a standard bed angle of 45^0 or thereabouts, the tip of the cap-iron should meet the surface of the blade at a tangent of roughly 45^0, which puts it at 90^0 to the work surface (diagram E, left).



E: Cap iron & standard pitch: If CI meets top of blade at 45 degrees, it forms an angle of 90 degrees to the surface of the work & promotes smooth exit of shavings.

Raising the bed angle without altering the cap iron increases the angle of the CI relative to the work surface. On a 60^0 bed, the tip of the cap-iron will now be 105^0 to the work surface and turning the shaving very abruptly, which may force them into the 'wear of the mouth (right), causing impaction. This can be alleviated to a large extent by sloping the front of the mouth more, but if the mouth is relatively fine, a high-angle plane with a cap-iron is always more prone to choking.



F: A 60^0 blade with cap-iron meeting it at the typical 45 degrees. The angle is increased by 15^0 relative to the surface of the work if & set close to the cutting edge, it turns the shavings into the wall of the mouth, increasing liklihood of choking.

In any case, the value of a cap-iron becomes debatable at bed angles higher than around 55^0. The front of the blade itself begins to turn the shaving abruptly enough to fracture the fibres and reduce tear-out. A solid cap-iron certainly adds mass & stiffness to a thin blade, but in my own 'experiments' with a 60^0 pitch, I could not prove to my satisfaction that it adds significantly to tear-out control. In fact, if the cap-iron can become too obstructive and increase a tendency to choke. Worse, shavings seem to be able to work their way under the CI more easily, especially with our hard, short-fibred woods. Based on my experience to date, I'd suggest that a thick blade is a better investment than a cap-iron at 60^0 pitch and I think HNT Gordon's planes support that philosophy.

A cap-iron does need to be made accurately, if it doesn't fit snugly against the back edge of the blade, shavings will be easily forced under it and that causes a very rapid drop in performance. The fit against the lever cap must also be accurate so it transfers pressure evenly to the blade. It's all quite do-able, it just takes a bit of care.

I like to use stainless-steel but ordinary mild steel (which is used for the majority of cap-irons on factory-made planes), is perfectly satisfactory. Besides its corrosion resistance, an advantage of SS is that it is easy to obtain in small pieces that are a handy size for making cap-irons. Various internet sites advertise sheets 2-3mm thick & 100mm square for around $10-15, which will make at least one cap-iron & two if your blades are less than 50mm wide. You might also score small offcuts free or for very little from metal fabricators who use stainless steel if there are any convenient to where you live. Common 304 SS is a little harder on files & hacksaw blades (& taps) than mild steel, but it's no harder to bend than mild steel.

Modern after-market cap-irons tend to be moderately thick (~3 mm), though not as thick as cap-irons on old infills & wooden-bodied planes which were 4-5mm thick. The thicker the material, the more difficult it is to bend neatly with an improvised bending setup. A thick cap-iron adds to stiffness & mass of the blade assembly and gives more turns of thread in the screw hole, allowing a good purchase for the coupling screw. Old cap-irons had a thick brass boss pressed into them for the screw hole, which seems like overkill. The Stanley/Record cap-irons are about 1.75mm thick & take about one and a half full turns of thread, which is a bit skimpy, but I have only come across a single example with a stripped thread, so anything thicker than 2mm should be safe. My choice is 2.5mm thick material, which gives two full turns of thread for an M8 screw (pitch =1.25mm) and is easy to bend, but if you have 3.2mm it's still manageable and makes a very solid CI.

The main challenge in making a cap-iron is getting an accurate curve on the end. One way is to hammer the bend into it over a length of steel bar and smooth it with files & sandpaper. Another alternative is to clamp the blank in a vise against a bit of steel bar about 20mm diameter, and using a piece of wood to support the metal & keep it flat behind the bend, push it over the bar. That , will make a neater bend than hammering .

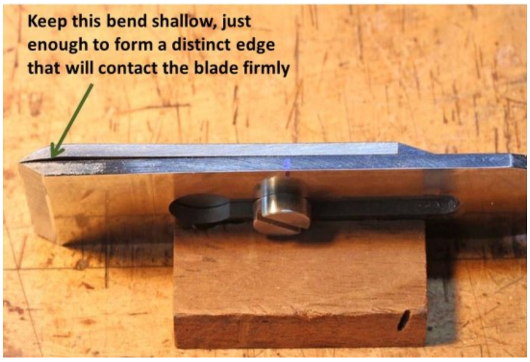
Jig for bending cap-irons

To make the arched bend used on Stanley cap-irons, I made a crude bending form from two bits of 19mm rod welded to a piece of 9.5mm thick steel bar, which made the process a bit more controllable.

Bending end of cap-iron

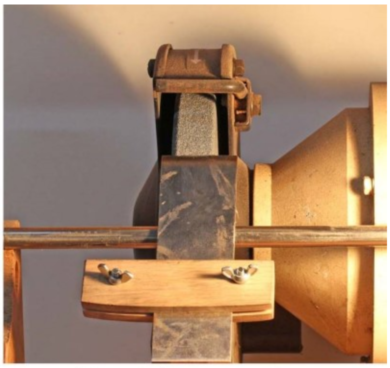
The blank is placed on the form & a bar of suitable diameter set on it between the two bars on the jig (duct tape is handy to hold the bits in place). Then slowly squeeze the bar into the cap-iron to create the desired bend. Watch the bend forming & stop when you think it looks right. It may spring back a little and need an extra squeeze but the good thing about this method is it's easy to control. As the bend is formed, the free part of the iron leans forward (see pic above). You can then use a piece of wood against the top part and push it back over the top rod to form the full arc or leave it with a single bend if you want that style. With careful setting up you can get very accurate bends.

For a "single bend", as on most current after-market cap-irons, keep the bend shallow, you only need enough to form the chip-deflecting curve and a straight, clean edge that can be pulled firmly against the top of the blade. If you make the curve too pronounced it may obstruct the throat and noticeably flex thin blades when tightened down so they don't sit flat on the bed. The latter may not necessarily affect performance, but depending on the lever-cap geometry and exactly where pressure is applied by the lever-cap, you *could* promote a 'springy' blade prone to chatter, so I think it's always safer to have the blade as flat & straight as possible. The old wooden planes & infills had very thick, single bend cap-irons, but they also had very thick blades (of the order of 6mm) which resisted flexing.



The arched cap-iron, as found on Stanleys & Records is designed to suit modern thin blades. Most of its length sits flat on the blade, and the arch acts as a spring which holds the end against the back of the blade. With either type, the lever cap does the main job of pressing the cap-iron against the blade. .

If you have a 6 inch (150mm) grinder you can use a simple jig to straighten & form the edge of the toe (200mm wheels tend to be too big to fit the inner curve well). Otherwise, careful filing and wiping across a hard stone will do the job.


Jig used for grinding a smooth curve under bend in cap-iron

Cap-irons made for skewed blades obviously require a skewed arc, and this can be accomplished by off-setting the blank in the bending jig. Setup is a bit fiddly - use duct tape to keep things in position while you get it set up for squeezing. Make sure you set the angle the correct way, it's too easy to set it the wrong way when working from the back side, as I discovered!


Cap iron blank with double bend

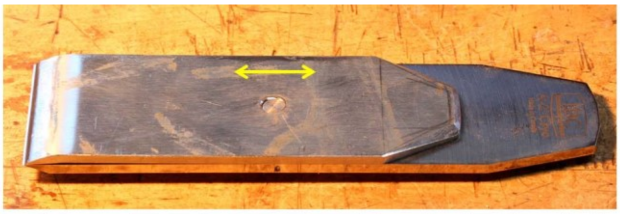
Here is an arched cap-iron of 3.2mm thick stainless steel screwed to a thin Stanley blade. Most of the CI & blade remain flat while the toe edge is pressed firmly against the blade. There is little or no flexing of the blade.


Cap-iron with double bend screwed to a thin blade. Most of the cap-iron sits flat on the blade, causing no bowing of the blade.

Positioning the cap-iron screw

Give some thought to where you place the screw on your cap-iron. If using a factory blade you may not have much choice, but consider the following: a) The cap-iron has to move back as the blade is ground successively shorter over time. This is no problem with blades made for cap-irons, which typically have a long 'keyhole' slot, but block plane blades like the one in the Veritas kit have a single large hole for the lever cap screw. The hole in the blade is just long enough to get a reasonable amount of wear out of the blade when used in its intended plane body, provided you place the screw as close as possible to the 'bottom' of the slot. You could cut a longer slot if you wish, but modern blades are hardened throughout so that won't be easy. For the planes I've made using block-plane blades I decided it's not worth the trouble to extend the slot in order to get an extra mm or two wear from the blade.

b) If you are making a plane with an adjuster mechanism that engages the screw head , this will dictate the position for the screw. You will ned to do some careful measuring and place the screw so the blade can be fully retracted when new and extended sufficiently to use up the useful blade.



Make sure the cap-iron screw is positioned so it will not foul the lever-cap screw at any point in the range of adjustment

Norris adjuster: note cup or 'banjo' which receives the cap-iron screw. These adjusters require a large excavation in the blade bed.

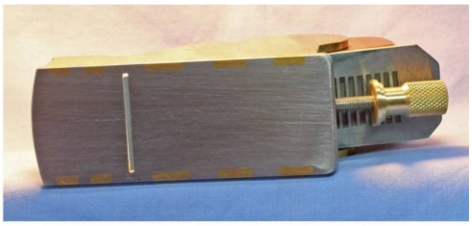
c) For a slotted blade in an adjuster-less plane, the screw may be placed wherever convenient, just make sure it isn't directly under the lever-cap thumbscrew, which would affect smooth blade adjustment.

For a cap-iron screw, you can use an M8 cup-head bolt which is threaded right to the head (shorter bolts usually are). File a flat on the head until it is no more than 3-4mm deep so it won't need such a deep channel in the blade bed to accommodate it. Or you can round the head of a hex-head bolt by chucking it in a drill and filing it round as it spins (slowly!). Use a hacksaw to make a screwdriver slot, which you can widen with a needle file if you want the traditional wide slot.

The Veritas adjuster requires very careful placement. It does not engage the cap-iron screw but uses a travelling spigot that engages a hole in the blade itself. This means the hole moves towards the plane's mouth as the blade wears and the adjuster has to be mounted at a specific point of the bed so that the limited range of adjuster travel is enough to keep extending the blade as it wears until the next spigot hole can be engaged. The critical dimensions are given in the instructions that come with their plane kit, and are also available on the Lee Valley website.

Screw Adjusters

The simplest type of screw adjuster is what I call the "direct drive" type, variations of which are fitted to many block planes. This consists of a thumbwheel running on a stud placed parallel to the bed, which either engages slots under the blade directly, or via an L-shaped plate that is captured on the thumbwheel. Unless an extremely fine thread is used, thi system is rather coarse, but acceptable on low-angle planes. Similar adjusters (usually with a screw on each side of the blade, have been fitted to spokeshaves & certain "economy" bevel-down planes, but the coarseness of the adjustment is even more noticeable on higher-angle blades. If you have the ability to make the necessary thumbwheel, you can easily fit this type of adjuster as long as your plane has a suitably thick back to take the stud (I fit a 6mm back on planes if I intend fitting an adjuster).



Simple home-made adjuster incorporating a disc that engages slots under the blade

If you don't have a lathe, the easiest option is to use the Veritas system. Either use the full kit, which comes with an adjuster or purchase the adjuster and a suitable blade separately. Veritas now sell a fine-thread replacement for their original coarse-thread adjusters, and the price is very reasonable compared with any other off-the-shelf adjuster I've seen. The holes in the Veritas blades go right through the blade so they can be used with the adjuster bevel-up or bevel-down without modification. The Veritas adjuster has a short shaft which is unsuitable for use with a tote/handle and so are really only practical for a plane with a rear bun. They can be modified by extending the shaft or making a longer one, but that is not easy to do without a metal lathe.

[*Note: When fitting a Veritas adjuster, be careful to follow the dimensions of the blade bed given in the kit instructions with respect to the setting out of the recess for what they call the "adjustment cup". This is an aluminium cup that is inserted in a recess in the blade bed to receive the pivoting cylinder of the adjuster. The cup needs to be centred at 3 5/16" (84.14mm) from the bottom of the sole (this distance is the same whatever the blade-bed angle). The distance is calculated to match the holes in the blade & allows for sufficient travel to keep advancing the blade as it wears down, then move to the next hole in the blade if the blade has been ground back to the point it can no longer be extended sufficiently from the first hole. Veritas have calculated things pretty finely all round with their adjuster and the height they suggest for the rear bun is just enough to contain the 'adjustment cup' on a 45^0 bed. The bun can't be any lower or the cup hole won't fit, nor higher because the short shaft would cause the thumbwheel to foul the top of the bun & obstruct both depth & lateral adjustment. The bun can be as long as you like, of course, that obviously doesn't affect the adjuster function.*

If you buy an adjuster without buying the full kit, the kit instructions containing the dimensions are available on line: http://www.veritastools.com/Content/Assets/ProductInfo/EN/05P4041EN.pdf.]

Making your own blade

An alternative to using a Veritas or any other commercial blade is to make your own, which will give you greater flexibility. Making your own blades is not difficult but heat-treating can be a bit tricky so you may not be keen to try for your first plane or two, but it may be something you might like to pursue eventually.

To get consistent results you will need some sort of small 'forge'. This can be a simple affair (google "coffee can furnace" for various instructions). One popular choice is 'gauge plate', an oil-hardening (O1) steel. Gauge plate is clean & accurately ground to its nominal thickness, which adds considerably to the price, but makes preparation of your blade easier. I've had very good results with 1084 steel, another oil-hardening alloy, sold by suppliers of knife-making material and not at all expensive. These "simple" steels are easy to heat-treat compared with the more "fancy" steels and with a bit of care (& a bit of luck), you can harden & temper them to make excellent blades (the highly respected Hock blades are O1 steel).

Both O1 & 1084 are sold annealed & are easy to work with a hacksaw, files, & regular high speed steel drill bits. The latter is sold as rolled bar which is not as accurate as gauge plate, but quite adequate for the purpose and far less expensive (around $6-8 for a typical blade 3.2mm thick), so you can afford to mess up a blade or two learning the ropes. If your blade cups slightly when quenched, it can take a lot of effort to flatten it but if you follow instructions when heat-treating you should not get significant warping. I have had only one blade warp & that was because I accidentally dropped it sideways in the quenching oil instead of dunking it vertically.

After hardening, the blade needs to be tempered back to a more practical hardness. If left quench-hard most steels are too brittle & liable to chip easily. Tempering can be done in an ordinary oven (it's your responsibility to negotiate this with your domestic overseer). The time & temperature required vary depending on the actual steel alloy, so follow the supplier's instructions.

Making Your Own Screw Adjusters

If you have access to a metal lathe, you may wish to try making your own adjusters. I've made several in the Veritas style, to extend the shaft length & also in an attempt to slow down the too-rapid feed rate of the original. The Veritas adjuster is an adaptation of the adjuster Norris used on his bevel-up planes, which works through a pivoting nut in the blade bed to provide both depth & lateral adjustment. A travelling spigot engages holes in the blade. Like the original Veritas use a left & right hand thread combination so that each full turn of the shaft advances or retracts the traveller by the <u>sum</u> of the pitches of the two threads. The Norris version has the secondary thread inside the main shaft, to make it more compact, while Veritas has a single solid shaft (see illustration). The Veritas has a more limited range of travel and requires two or more holes in the blade to get full use as it wears. Norris used extremely fine threads, which slow things down compared with the more coarsely-threaded early Veritas adjusters (Norris started with 35tpi on the main shaft & 40 on the secondary shaft, but later versions used even finer pitches to slow it down more). The principal is the same for both adjusters, but Veritas's version is less compact & the coarser threads make fine adjustments a very delicate affair, particularly if used in a standard pitch plane.

Modified version of a Veritas adjuster (rear), with RH primary and secondary threads , The Veritas original (front) has a LH secondary thread. The threaded length of the modified shaft is 52mm vs 38mm on the Veritas shaft.

I tried a different approach & used two right hand threads of different pitches. This means that the traveller actually moves backwards when the adjuster is screwed "in" but by using a finer secondary thread than the main thread, the net movement is in the desired direction. Each turn of the main shaft moves the traveller in the same direction by the difference in pitch of the two threads.

For example, I used ¼"x20 tpi for the main thread (pitch = 1.25mm), and 3/16" 32 tpi on the secondary thread (pitch = 0.8mm). The reason for using Imperial threads was to maximise the difference in pitch of the two threads and Imperial threads gave me the coarsest (BSW) & finest

Both adjusters fully retracted

Both adjusters fully extended. The total range of travel in the modified version is about 7mm vs 13mm for the original

(BSF) threads in the taps & dies I had in suitable sizes. So for each full turn of the shaft, the net movement of the spigot is 1.25mm – 0.8mm or 0.45mm per turn. By comparison, on the (older) Veritas adjuster with 28tpi on the main thread and 32tpi for the secondary, the spigot moves 0.9 + 0.8 = 1.7mm per turn – approximately 4 times as much as my version.

While the subtractive thread arrangement certainly improves fine control, it comes at the expense of compactness. There is 52mm of combined thread on my shaft giving just 7mm of spigot travel, whereas the Veritas original gets 13mm of travel using 38mm of combined thread.

Crude mock-up for determining mounting position of adjuster

The modified shaft was for a small handled plane. It took some very careful measuring of the distance between spigot holes & blade edge, the distance between the holes on the blade, and the amount of usable blade to arrive at the right place for the pivoting nut. A mock-up was made to confirm my calculations & I was able to confirm the spigot won't run out of travel before it can move to the next hole on the blade (just!).

Checking that the blade has sufficient travel & the shaft matches proposed handle shape

The mechanism could be made more compact by having the secondary shaft screw into the main shaft like the Norris, but tapping the long inside thread in the shaft that would be necessary is beyond my simple gear. Typical taps of the thread size required can only cut ~15mm of usable thread, which would not provide sufficient travel of the spigot with sufficient reserve inside the primary shaft for strength & to ensure it doesn't fall out when fully extended.

Large channel in blade bed needed to accommodate the longer adjuster shaft

As you can see in the illustration of the plane under construction at left, it required a substantial excavation of the blade bed to accommodate the mechanism.

With the modified adjuster the plane is quite easy to set for 0.025mm shavings compared with a Veritas adjuster.

The modified adjuster does make fine adjustments easier compared with the original Veritas version, and it allowed me to use the short blade from the original kit in a handled plane (as you can see, it would be very awkward to adjust the blade with a hammer!). It still suffers from the blade-slewing effect inherent in this all-in-one design, but you learn to live with that. The plane is not the prettiest, it looks a bit long & thin with its narrow body & 41mm blade, but it's well-balanced & performs very well.

In summary, the 'improved' (finer thread) Veritas adjuster is a reasonable option if you want to include a screw adjuster on a rear-bun design, but it is too short to use on a handled plane. If you have access to a lathe, it is quite easy to make the longer-shaft, subtractive-thread version described, which gives you better control over depth setting.

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