Stamped Steel Frame Parts...

One of the simplest ways to form a bicycle frame lug, fork crown, or bottom bracket shell is to stamp it out of a sheet of steel, press it around a form, and then weld the edges together. Frame parts made this way are called *stamped*, or *pressed*, or *welded*. We'll just call them stamped.

Stamping used to be a common way to make high quality frame parts, and manufacturers like Prugnat, Haden, and Eisho thrived. But now TIG-welded mountain bikes comprise most of the U.S. market, and most of the remaining high quality lugged bicycles are built with labor-saving investment castings. Good stamped lugs are becoming scarce.

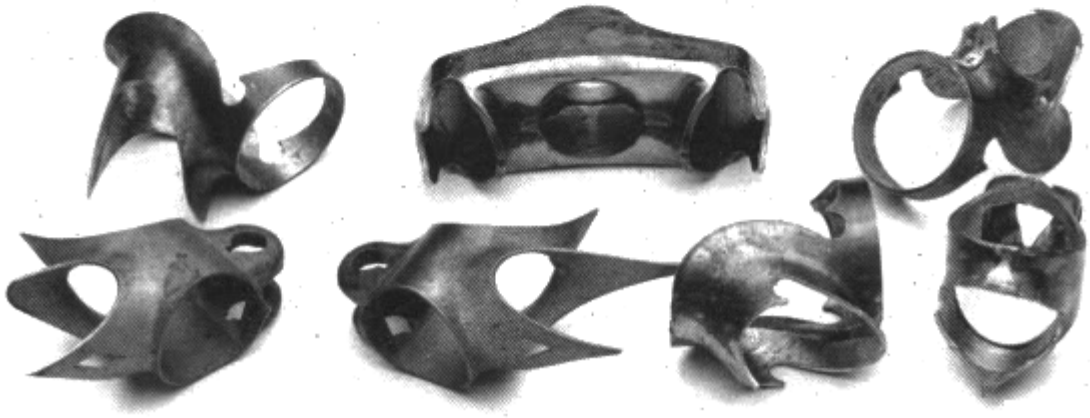
It takes a lot of hand labor — filing, mostly — to make a stamped fitting look really pretty, and the cost of labor more than offsets the low cost of the stamped piece.

Material

Most stamped lugs are made from high tensile steel, like that used in the frames of inexpensive bicycles. This steel is ideal for stamped fittings, since it is more formable than chrome-moly (it doesn't spring back as readily), and it bends without cracking. Unlike investment cast fittings, whose size and shape are restricted by the ability of the molten metal to fill in the nooks, corners, and points, stamped fittings can be as long and as ornate as you like — just make the braking punch (step #1) to suit.

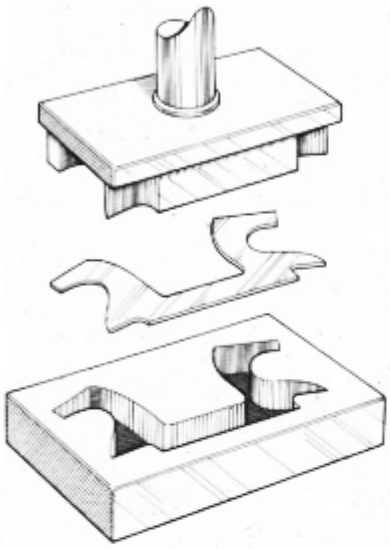
Where to find them

The most ornate lugged bicycles, such those made by the English builders Hetchins and Cottingham, are built with stamped lugs; and stamped fittings are still popular in Japan on low-end sport and utility bikes.



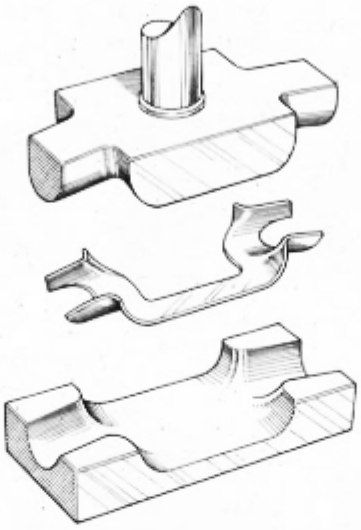
An assortment of stamped lugs from France, and an inexpensive stamped fork crown from Japan.

...and How to Make Them



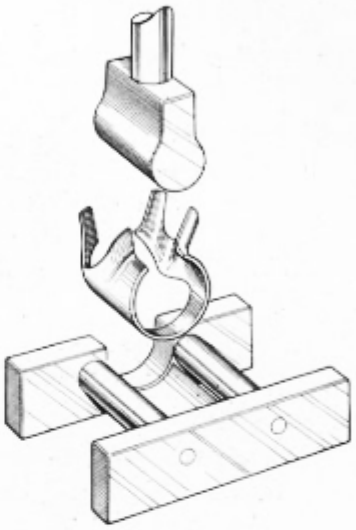
Stamp No. 1

Get a tool steel die and a flat sheet of steel between 1.2mm and 2.0mm thick. Stamp out your shape, using 30 to 80 tons of force.



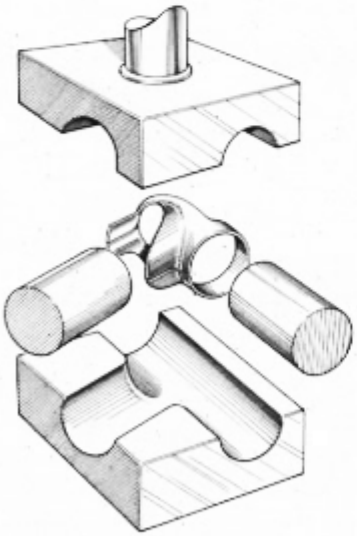
Punch No. 1

Then punch the sheet steel with another 30 to 50 tons, drawing it over an appropriate form, to prepare it for...



Punch No. 2

...your bending punch. This punch is coated with rubber to protect the metal. The edges are now closer together.



Punch No.3

Then slide in a solid bar to limit the deformation, and punch it once more with 30 tons of force. Now the edges should almost touch.

Welding

Butt-weld the edges together, being careful to leave no gaps. The bores should be round, so the frame tube fits well. This helps in brazing.

Finished.

File the weld.
The framebuilder should not have to do much work on this lug, but it's nice to leave a little extra metal there to work with.

INVESTMENT CASTING

"CASTING" — POURING LIQUID INTO A MOLD AND LETTING IT HARDEN — WAS DEVELOPED BY THE GREEKS 2,500 YEARS AGO (IN THE DAYS OF PERICLES, THE RENOWNED STATESMAN UNDER WHOSE TUTELAGE ATHENS REACHED ITS ZENITH!). INVESTMENT CASTING, OR "LOST WAX" CASTING, IS A VARIATION WHOSE FUNDAMENTAL DIFFERENCE IS ILLUSTRATED ON THE FACING PAGE. IT'S A POPULAR WAY TO MAKE JEWELRY AND EXPENSIVE BIKE FRAME FITTINGS, AMONG OTHER THINGS. ITS ADVANTAGES ARE:

1

ACCURACY

The casting will be as correct as your mold. With modern technology, creating an accurate mold is easy.

2

CONSISTENCY

With a good mold and good technique, you can pop out clone after clone, stabilizing quality.

3

EXPEDIENCY

The casting looks fine right out of the mold. After heat-treatment and minor machining, it's ready.

4

BRAZEABILITY

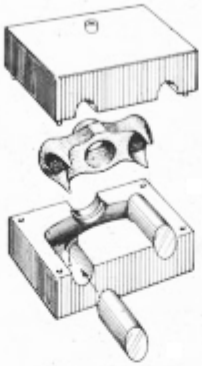
The close tolerances possible make brazing easier, particularly with low-temperature silver braze.

Castings are grainless, like a brick or a Presto log, so they tend to be brittle — although proper heat-treatment can restore some of the ductility. And some metals tend to "freeze up" in long, skinny sections; so investment castings tend to have simple low-risk designs.

Investment casting saves finishing labor, an attribute that helps offset the mold cost. But many craftspeople — in all fields — shun investment-castings; regarding them as affordable, imitation art for the masses.

Investment-castings do make nice bicycle frame parts, though.

INVESTMENT CASTING IN 8 EASY STEPS



STEP NO. 1

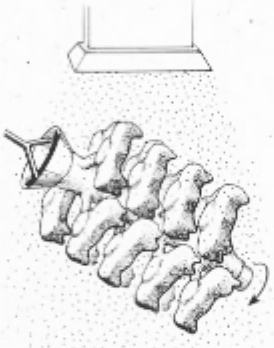
Make a metal mold, then pour wax into it to make replicas.

STEP NO. 2

Hang the wax fakes onto a "tree," so you can...

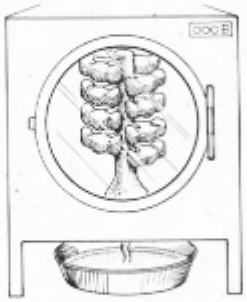
STEP NO. 3

...dip them all into a ceramic batter until...



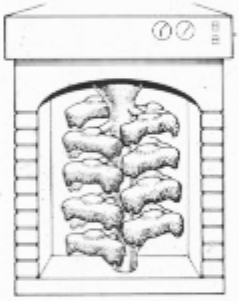
STEP NO. 4

...a porous, heat-resistant crust forms.



STEP NO. 5

Then heat the wax and let it drain out a hole.



STEP NO. 6

Turn the molds upside down (rightside-up?)...

STEP NO. 7

...and pour in the molten metal– CrMo, in the case of this fork crown. When it has set...

STEP NO. 8

...break off the crust and inspect your castings for voids, where the metal may not have flowed.

Remove the castings, heat treat to restore ductility (see *Heat-treatment at Home*, in next year's catalogue). Machine the new parts as necessary.

Sand Casting

FISCHER BOTTOM BRACKET SHELL (MASI STYLE, FROM 1973) READY FOR FILING

AFTER THREE AND A HALF HOURS OF HAND FILING, IT'S READY FOR BRAZING

THE GREEKS WERE SAND CASTING GOLD, copper, and bronze six and a half thousand years ago. Later in Mesopotamia the Babylonians, Assyrians, and the now-forgotten Chaldeons developed cast iron. The Chinese took this one step further and made the first commercial iron castings in the 6th century B.C. Sand-cast iron products, ornamental and functional alike, can now be found in abundance all over the world.

Some of the best bicycle frame fittings from the turn of the century through the mid '70s were sand cast. Some of the best were made by a Swiss foundry, Fischer, whose castings were favored by Masi, Cinelli, and other top builders. Sand castings still have a small but strong following among builders and riders, even though they are extremely labor-intensive to build with, and don't result in a better-riding or longer-lasting bicycle.

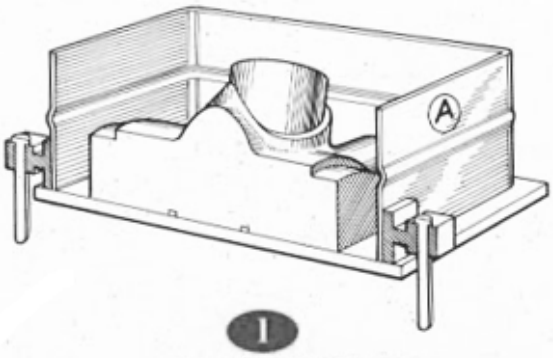
The appeal of sand castings is probably more romantic than it is practical, but it is not entirely unpractical: some builders insist that a cast-iron fitting is more malleable than a steel investment casting, and the malleability gives them more freedom to provide just the right angle.

Many riders and builders believe that Europe's golden age of framebuilding was in the late '60s through the mid '70s. Production quantities were smaller then, partly because the bikes used stamped steel and sand-cast fittings, which require more handwork. The surface of a fresh sand casting is as rough as the sand it was cooked in, and can take a single builder working with a hand file as much as four hours to make it pretty enough to build with. (By comparison, a modern, factory-built European racing frame made with investment cast fittings takes fewer than sixteen minutes to build.) If frame makers were to build with hand-filed sand-cast fittings, prices would skyrocket, production would plummet, and nobody would be happy except for the rare wealthy and sentimental enthusiast. Since most riders don't care how a frame is made, as long as it's made right, sand-cast lugs and bottom bracket shells have disappeared.

Whatever the case, few modern framebuilders have experience with sand-cast fittings, and among those that do, the number who pine over their demise is small. Sand castings are so much trouble that most are glad to be rid of them.

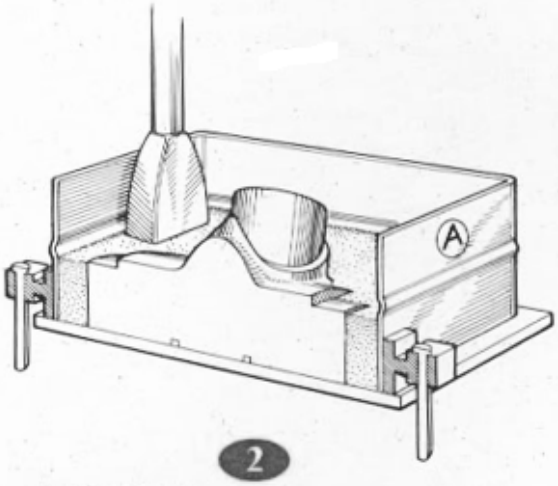
Sand Casting: Steps 1, 2, 3, & 4

THESE DRAWINGS SHOW HOW A SAND-CAST BOTTOM BRACKET SHELL IS MADE.



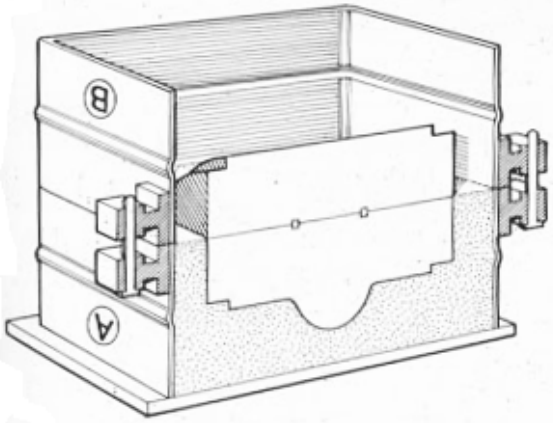
1

PLACE THE DRAG, OR BOTTOM HALF OF A MOLDING FLASK (A) UPSIDE DOWN ON A "RAM-UP" BOARD. NOTE THAT THE LOCATING PINS ON EACH END OF THE FLASK ARE POINTED DOWNWARD. THEN PLACE THE DRAG HALF OF THE BOTTOM BRACKET PATTERN ON THE RAM-UP BOARD. TOGETHER, THESE FORM BOTH THE OUTSIDE GEOMETRY OF THE CASTING AND THE VOIDS IN THE MOLD, WHICH SUPPORT THE CORE.



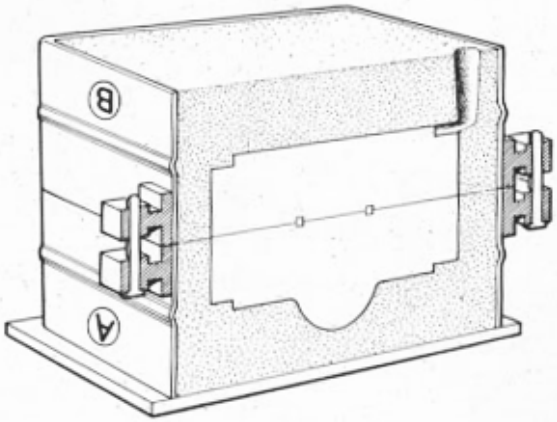
2

MIX SILICA SAND, AS YOU MIGHT FIND ON A BEACH OR A DESERT, WITH BENTONITE CLAY AND WATER (AS A BONDING AGENT). THEN ADD RICE HULLS TO AID IN TIGHT PACKING, AND FINE-GRAINED "SEA COAL" — LITERALLY COAL FROM THE OCEAN FLOOR — TO KEEP THE MOLTEN METAL FROM PENETRATING THE MOLD. PACK TIGHT AND FULL.



3

TURN THE DRAG RIGHT-SIDE UP, AND PLACE THE COPE (OR TOP) ONTO IT. NOTE THAT THE COPE HAS BUSHINGS AT EACH END WHICH SLIP OVER THE DRAG PINS. YOU MUST GET THE ALIGNMENT RIGHT.

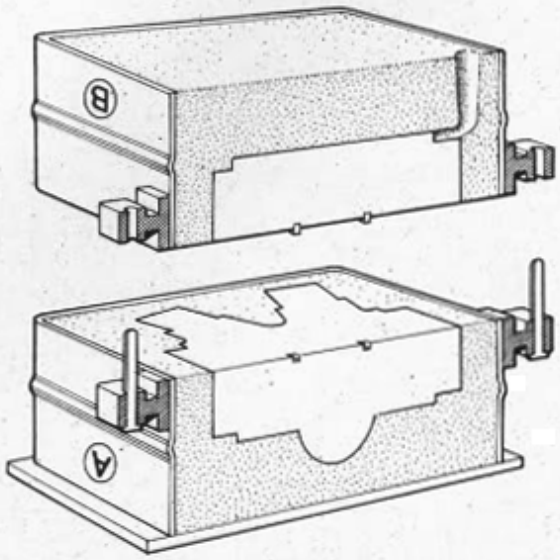


4

PACK THE COPE WITH SAND/BENTONITE CLAY/ RICE HULL/SEA COAL MIX. ALWAYS PACK FULL AND TIGHT. THIS CANNOT BE EMPHASIZED ENOUGH. *IF YOU CANNOT PACK IT FULL AND TIGHT, GIVE THE JOB TO SOMEBODY WHO CAN!*

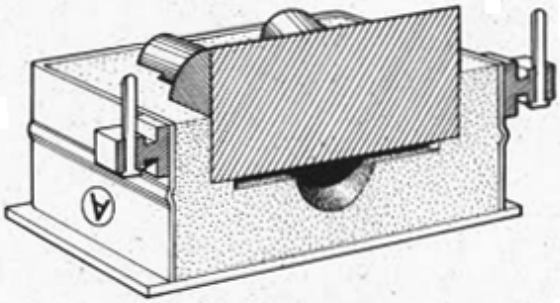
Sand Casting: Steps 5, 6, 7, & 8

Finish step 8, cast the other lugs, and you're ready to build your frame.



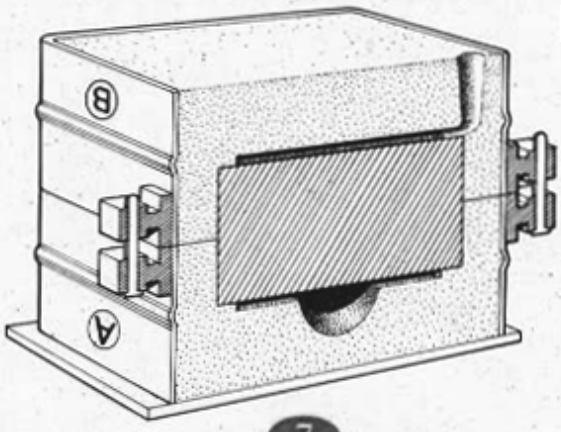
5

Remove the cope from the drag, then draw out the pattern halves, leaving voids in the sand.



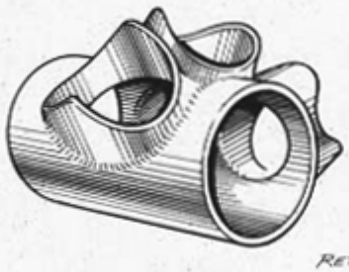
6

Place the sand core into the mold. This forms the void in the casting — the hollow portion for the bearings, cups, and axle.



7

Cut a funnel or "sprue" into the cope and set the cope onto the drag, lining up the pins and bushings. Now the void in the mold conforms to the shape of a bottom bracket. Pour in the molten metal.



8

After the metal has solidified, take the mold to a "shake-out" area and remove the casting from the sand. This is your bottom bracket shell. Machine the faces so they're perfectly parallel, cut the threads, grab a file, and have at it.