

LIGHTWEIGHT COMBAT AXE WITH A CUTTING EDGE

INSERT IN A UNITARY TITANIUM BODY

FIELD

The present invention is a composite combat axe in which a single unitary titanium alloy body forms the head and handle, and receives a separate hardened tool-steel cutting-edge insert that is held in place by prongs on the back of the insert indexing into matching holes in the body, together with screws that pass through the body into the back of the insert, and in which the handle is optionally further lightened by a skeletonized truss geometry between the head and the pommel.

BACKGROUND

A combat axe is normally forged from a single piece of medium- to high-carbon steel and heat-treated to a hardness suitable for holding a cutting edge. Monolithic steel axes are unreasonably heavy, which fatigues the user over extended operations, transmits significant shock to the wrist and elbow, and slows the rapidity with which follow-up strikes may be delivered. Attempts to reduce weight by using aluminum or polymer for the head fail entirely, because neither material can hold a combat-grade cutting edge: aluminum rolls and yields under sustained cutting loads, and polymer cannot be heat-treated to retain a cutting geometry at all. Additionally, having a Titanium-only axe is impracticable because the Titanium does not hold a proper edge. Composite construction, in which a hardened steel cutting edge is combined with a lighter structural body, is desirable in principle, but has historically been limited by the practical difficulty of retaining a hardened insert on a softer body under repeated shock loading. Simple bolted retention, in which the fasteners alone transmit cutting-direction shear from the insert to the body, causes the fasteners to fatigue and loosen rapidly under typical combat-axe loading.

The Stiletto hammer, described in US6536308B1 (Thorne, et al.) and US6435059B1 (Martinez), addresses the analogous weight problem in framing hammers by attaching a hardened steel strike face to a titanium-alloy body. However, that teaching is confined to a striking tool with a flat steel working surface on a planar head face, and it does not address retention of a cutting insert against the large in-plane shear loads that a cutting tool sees, nor does it address further mass reduction in the handle itself. Thus, a lightweight composite combat axe with professional cutting performance was unrealized until the present invention.

SUMMARY

The present invention solves the above-indicated problems by providing a unitary titanium alloy body that forms the full head and handle, and a separate hardened tool-steel insert that forms the cutting edge. The insert is flat and straight-backed with two rearward prongs, and slides into a recessed pocket in the body so that the prongs fully seat in two matching blind holes. The edge assembly is captured by two screws that pass through the body and thread into tapped holes in the back of the insert. Of key note, the invention separates the two load paths that would normally compete in a bolted composite axe: the prongs react the cutting-direction shear loads on the insert, and the screws carry only axial load, so the fasteners never see cyclic shear fatigue and can be kept small. The handle itself is optionally further lightened by a skeletonized truss geometry, in which the handle material between the head and the pommel is reduced to a continuous zigzag of angled titanium struts, so that a direct load path remains from the head to the user's hand while the bulk of the handle mass is removed. As such, a composite combat axe with professional cutting performance is now within reach of the sophisticated armorer, without requiring a forging facility, and the end user has a handmade combat axe that is substantially lighter than a monolithic steel equivalent, transmits less shock to the user, and whose cutting

edge is field-replaceable in an ordinary workshop in a few minutes with commonly available tooling. Additionally, the present invention greatly increases the speed of striking the target, with multiple follow-up strikes that do not fatigue the user.

BRIEF DESCRIPTION OF THE DRAWINGS

Figures 1 through 5 show orthographic and isometric views of the assembled axe, the titanium head with its pocket and receiver holes, the hardened steel cutting-edge insert with its two rearward prongs, and the optional skeletonized truss handle, as embodied in a combat axe called the Advanced Combat Axe, which is one embodiment of the present invention.

DETAILED DESCRIPTION

The first embodiment of the disclosed method is illustrated in Figures 1 through 5, which show the arrangement discovered through iterative prototyping as applied to a combat axe called the Advanced Combat Axe. Figures 1 and 2 show orthographic and isometric views of the assembled tool, with the hardened steel cutting edge visible at the bit and the titanium body and handle forming the rest of the axe. Figure 3 shows the titanium head on its own, including the recessed pocket along the leading portion of the head and the two blind receiver holes machined into the pocket, sized to accept the two prongs on the cutting-edge insert. Figure 4 shows the cutting-edge insert on its own, a flat straight-backed hardened tool-steel piece with two rearward prongs. Figure 5 shows the optional skeletonized truss handle, in which the titanium material between the head and the pommel is reduced to a continuous zigzag of angled struts to further reduce mass while preserving a direct load path from the head to the user's hand. The titanium body is machined from a single piece of titanium to produce the full axe profile, including the head, the pocket, the receiver holes, and the skeletonized truss handle. The cutting-edge insert is separately formed from hardened tool steel to the profile shown in Figure 4. The insert is then

slid prongs-first into the pocket so that the prongs bottom in the two receiver holes, and two screws are installed through clearance holes in the body and tightened into tapped holes in the back of the insert. The prongs react the cutting-direction shear on the insert, while the screws carry only axial load, so the fasteners do not fatigue under repeated cutting. The result is a composite combat axe substantially lighter than a monolithic steel equivalent, further lightened by the skeletonized truss handle, with the single wear component field-replaceable in an ordinary armorer's shop by removing the two screws and sliding a fresh insert into the pocket. The challenge solved in this method is how to hold a combat-grade hardened cutting edge on a lightweight, shock-dampened, skeletonized axe body under repeated shock loading without the fasteners carrying cutting shear. The discovery of this two-prong shear-reacting retention together with the skeletonized titanium body enables the handmade manufacture of a professional composite combat axe in an ordinary machine shop, which is novel.

CLAIMS

1. A composite combat axe composed of a unitary titanium alloy body having a recessed pocket with blind receiver holes, a hardened tool-steel cutting-edge insert with rearward prongs seating in the receiver holes, and fasteners that pass through the body and thread into holes in the back of the insert, that realizes a lightweight composite combat axe whose cutting edge is field-replaceable without damage to the titanium body.
2. The process and method for creating the composite axe described in claim 1.
3. The process and method of claim 1 wherein the titanium body is further lightened by an optional skeletonized truss handle, in which the handle material between the head and the pommel is reduced to a continuous zigzag of angled titanium struts.

REFERENCES CITED

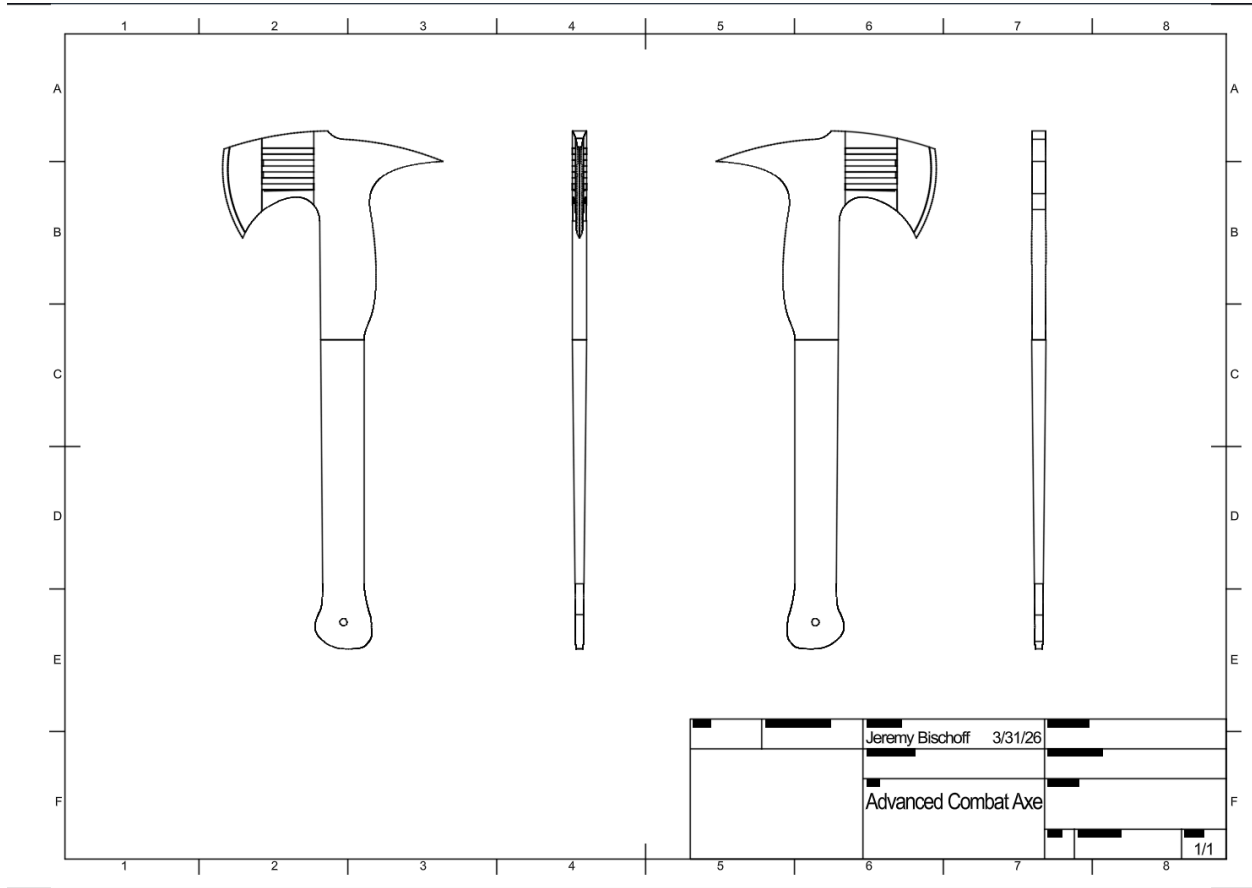
US6536308B1 3/2003 Thorne, et al.

US6435059B1 8/2002 Martinez

ABSTRACT

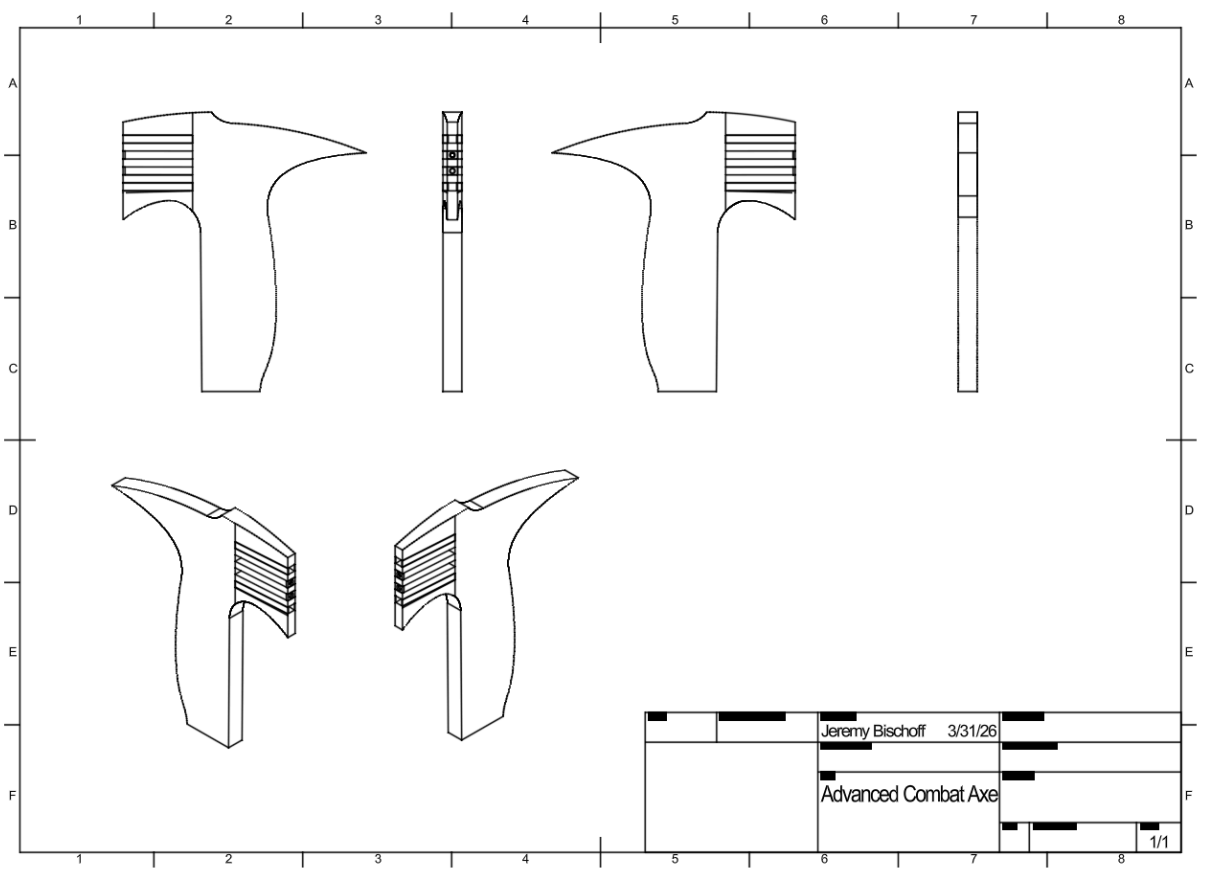
A lightweight composite combat axe is described, in which a unitary titanium alloy body receives a separate hardened tool-steel cutting-edge insert whose rearward prongs seat into matching holes in the body, and which is retained by fasteners passing through the body into the back of the insert, and in which the handle is further optionally lightened by a skeletonized truss geometry between the head and the pommel. The disclosed invention also allows for convenient application of the construction in an ordinary machine shop with commonly available tooling, as opposed to a heavy industrial forging facility or requiring specialty tools.

Figure 1



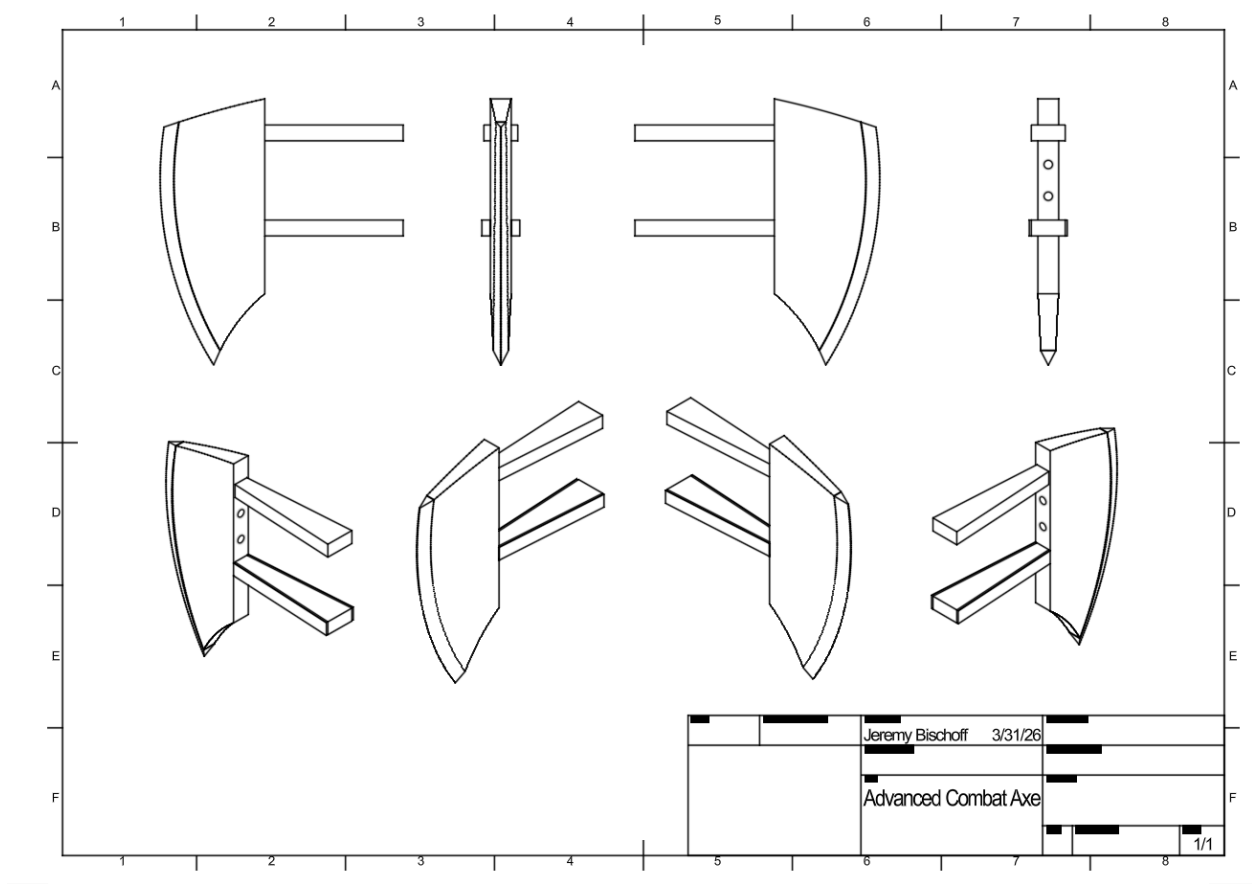
Orthographic views of the assembled Advanced Combat Axe.

Figure 3



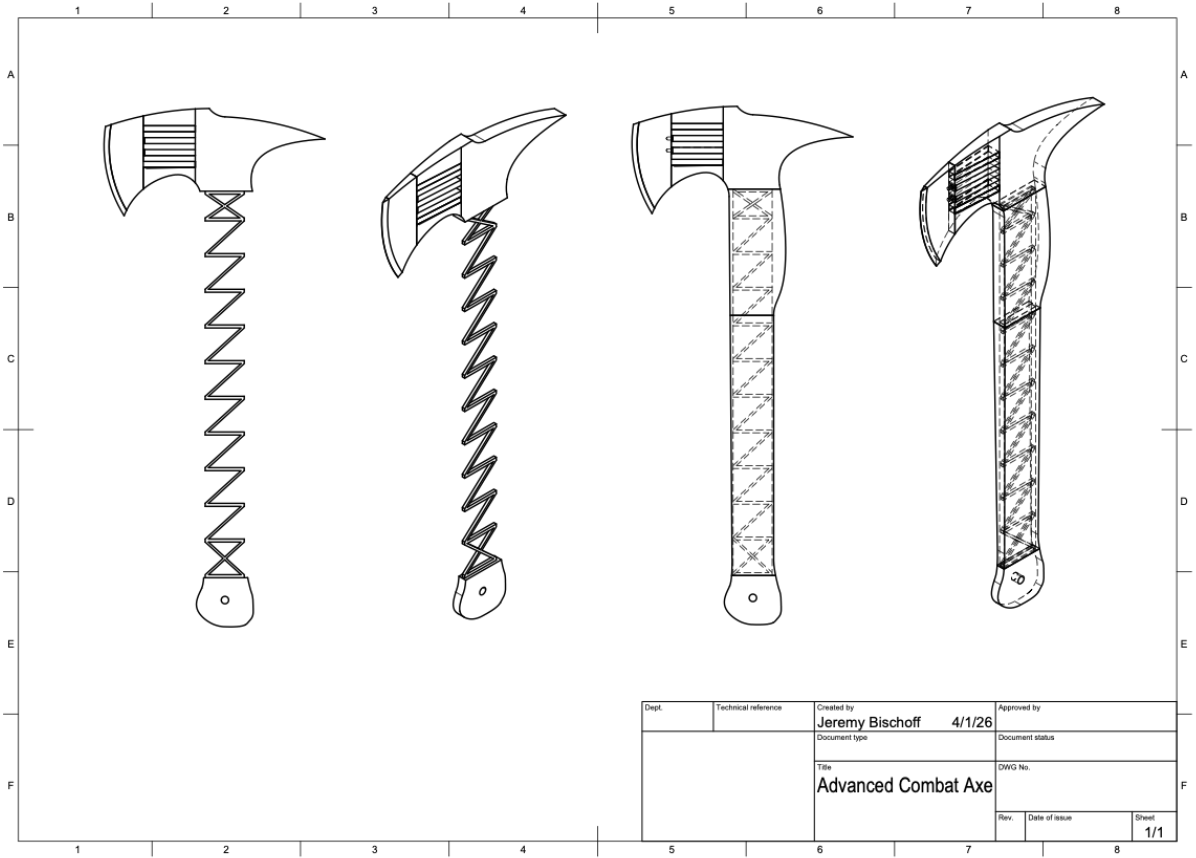
Titanium head shown on its own, with the recessed pocket and the two blind receiver holes that accept the prongs of the cutting-edge insert.

Figure 4



Hardened tool-steel cutting-edge insert shown on its own, with the two rearward prongs.

Figure 5



Skeletonized truss handle, showing the continuous zigzag of angled titanium struts between the head and the pommel.