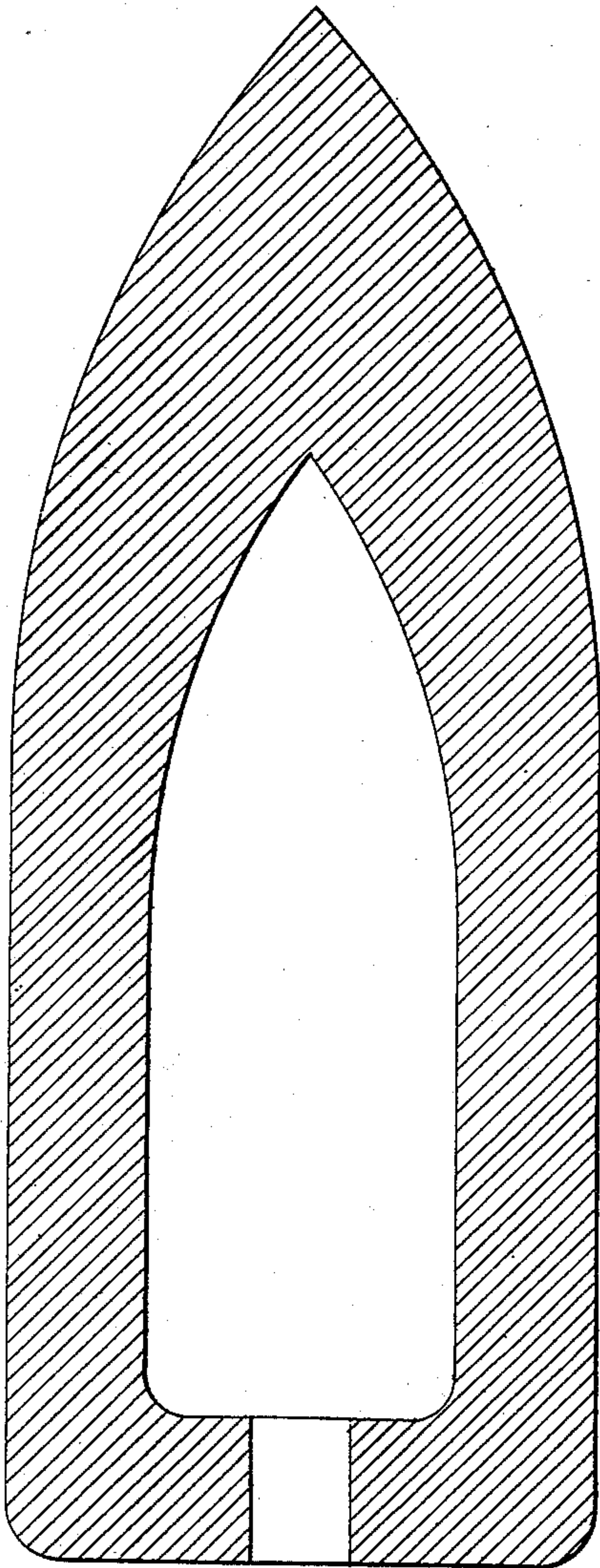


R. HADFIELD.
Projectile for Heavy Guns.

No. 199,973.

Patented Feb. 5, 1878.



WITNESSES

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UNITED STATES PATENT OFFICE.

ROBERT HADFIELD, OF SHEFFIELD, ENGLAND.

IMPROVEMENT IN PROJECTILES FOR HEAVY GUNS.

Specification forming part of Letters Patent No. **199,973**, dated February 5, 1878; application filed October 15, 1877.

To all whom it may concern:

Be it known that I, ROBERT HADFIELD, of Sheffield, in the county of York, England, a subject of the Queen of Great Britain, have invented or discovered new and useful Improvements in the Manufacture of Steel Shells for Projectiles for Ordnance; and I, the said ROBERT HADFIELD, do hereby declare the nature of the said invention, and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement thereof—that is to say:

This invention relates to improvements in hollow cast-steel shells of a conical or any other suitable form, as circumstances may require; and in order to carry out my invention I proceed as follows:

I take either molten crucible, Bessemer, Siemens-Martin, or any other cast-steel the temper and quality of which render it suitable for the purpose, and pour such molten metal either into a suitable metallic mold or molds or into a sand or other suitable composition mold or molds. I cast such shells hollow, and with a suitable plug-hole formed in the bottom of each shell, for the purpose of charging the same, thereby dispensing with all necessity for fitting or attaching the end thereto, as is now practiced with forged-steel shells, and avoiding the labor and expense consequent thereon. When so cast such steel shells are of an extremely brittle and crystalline character, and of uniform temper throughout. They are therefore too brittle for the purpose of piercing armor-plates and other similar defenses. Now, to obviate this disadvantage I subject such shells to an annealing process, which, by reducing the carbon contained therein to any desired ratio, modifies and alters the material by causing a more perfect cohesion of the particles, and consolidating the atoms or molecules into a dense, close, fine-grained steel, and, by eliminating all brittleness therefrom, greatly increases the strength and density of the shell. I then, by any well-known method, harden and temper the point or apex of each

shell as far as the shoulder, or even farther, if desirable.

By this improved process of manufacturing hollow steel shells I obtain an extremely tough and thoroughly homogeneous cast-steel shell, having an exceedingly hard point or apex, the penetrating power of which is almost irresistible when employed against armor-plates and other similar defenses.

One of the principal advantages possessed by projectiles so manufactured is that the steel is not subjected either to hammering, forging, rolling, or any other mechanical treatment as hitherto practiced, thus effecting a considerable economy in the time and labor necessary for their manufacture.

Another essential feature of my invention is that the hardening or tempering of the steel may be regulated and controlled at will, and by this means a projectile is produced the apex of which not only possesses an intensely penetrating power, but its rear or after part also possesses the peculiarly tough and thoroughly homogeneous characteristics I have before mentioned.

Grooves or steps or other conveniently-formed external recesses or projections, either radial or circumferential, may be, and, by preference, are, although not shown in the drawing, cast in the base ends of such shells, in order to admit of suitable metal gas-checks being either pressed in or otherwise fastened and fitted thereto, for the purpose of rotating the shell automatically and facilitating its transit, as by this simple method of casting such recesses or projections therein or thereon much difficult machine-labor is saved, and the necessity of cutting the same out by costly machinery, as is now practiced in forged-steel shells, is entirely dispensed with, resulting in a very great economy in time, labor, and expense.

If desired, however, such shells may be cast, as shown, without having such external grooves or projections formed in the base ends thereof.

Having now particularly described and as-

certained the nature of my said invention, and the manner of carrying the same into effect, I would have it understood that what I claim is—

The hereinbefore-described method of manufacturing steel projectiles, which consists in casting the projectiles, annealing them to give them a tough and homogeneous character, and

then hardening the points to adapt them for increased penetration.

ROBERT HADFIELD.

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