2 Sheets—Sheet 1.

W. LORENZ.

Hardening Hollow Steel Articles and Apparatus for the Same.

No. 241,680. **Patented May 17, 1881.**

Fig. 1.

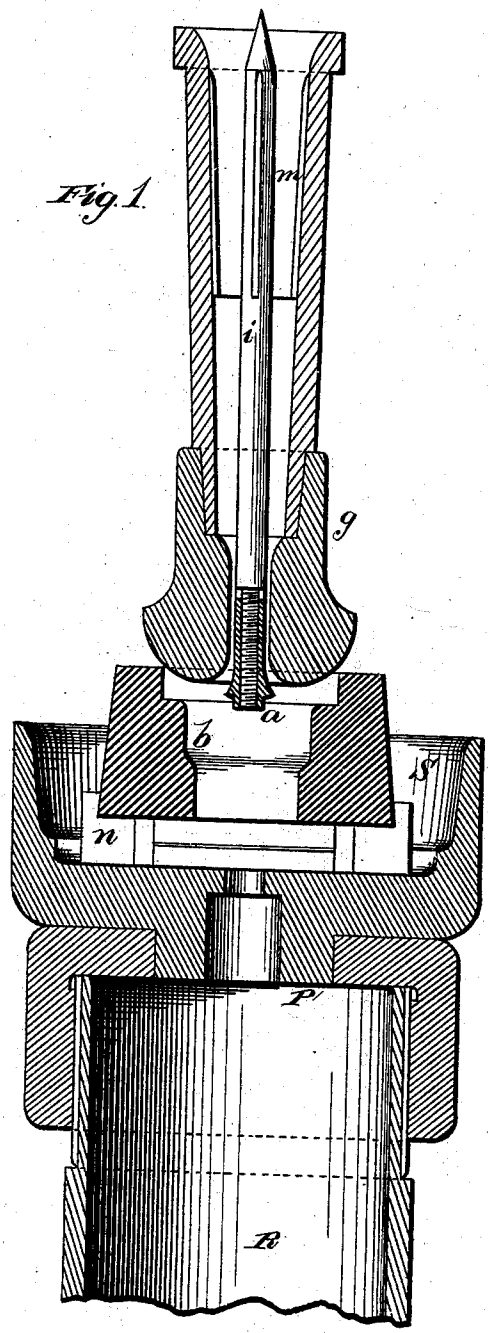
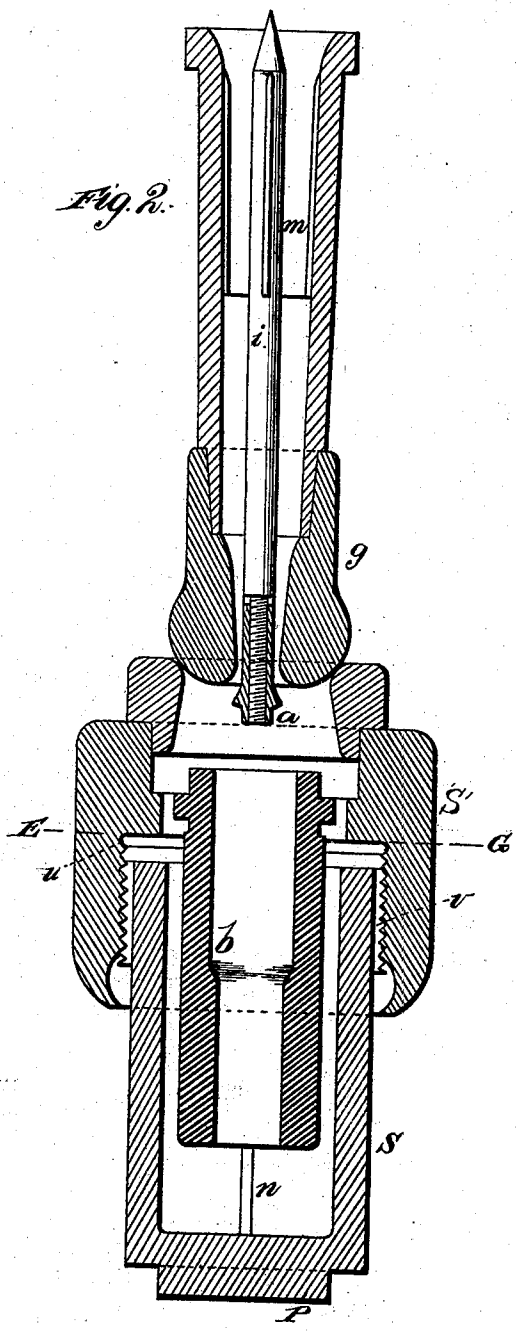


Fig. 2.



WITNESSES

Robert Ewalt

A. Clay Smith

William Lorenz, INVENTOR

by Thomas D. Stetson

ATTORNEY

N. PETERS, Photo-Lithographer, Washington, D. C.

2 Sheets—Sheet 2.

W. LORENZ.

Hardening Hollow Steel Articles and Apparatus for the Same.

No. 241,680. **Patented May 17, 1881.**

Fig. 3

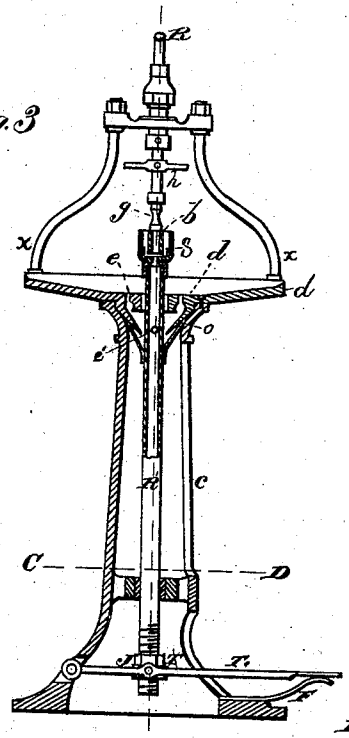


Fig. 4.

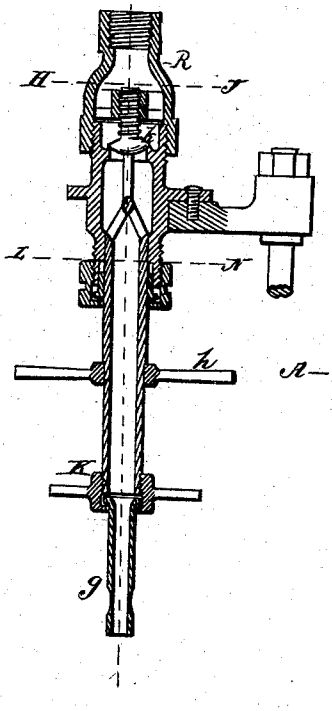


Fig. 5.

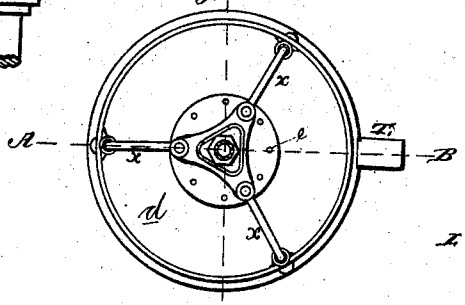


Fig. 6.

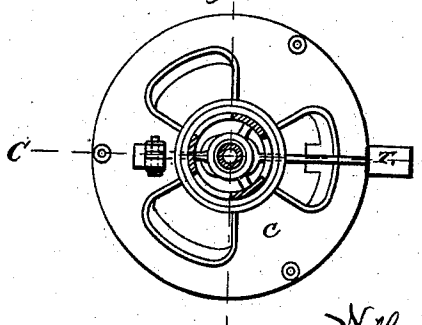


Fig. 9.

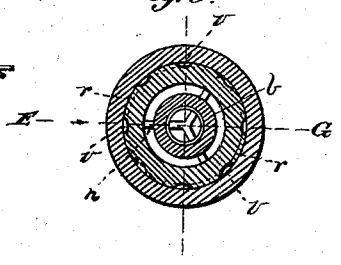


Fig. 8.

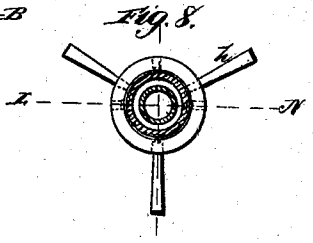
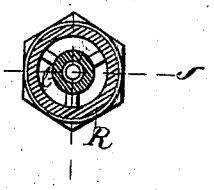


Fig. 7



WITNESSES

Robert Everett

O. Delay Shiretts

INVENTOR

William Lorenz

by Thomas D. Stetson

ATTORNEY

N. PETERS, Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

WILLIAM LORENZ, OF CARLSRUHE, BADEN, GERMANY.

HARDENING HOLLOW STEEL ARTICLES AND APPARATUS FOR THE SAME.

SPECIFICATION forming part of Letters Patent No. 241,680, dated May 17, 1881.

Application filed December 8, 1879.

To all whom it may concern:

Be it known that I, WILLIAM LORENZ, a citizen of the Grand Duchy of Baden, residing at Carlsruhe, Grand Duchy of Baden, Germany, have invented certain new and useful Improvements in Methods of and Apparatus for Hardening Hollow Steel Articles, of which the following is a specification.

The invention relates to a process and mechanical device by which it is carried out, whereby the cooling and hardening is effected inside and out of the hollow article in a very equable and efficient way, as will be explained.

In the ordinary process for hardening hollow steel articles, by which these when heated are cooled simultaneously and equally on their inner and outer surfaces, the contraction of the material cannot take place proportionately to the radially-decreasing sections in the direction from the outside to the inside, and unequal tensions are thus produced in the article, whereby, when the inner hardened surface once becomes worn, the article is rendered useless. By the use of the invention such tensions are prevented, so that a hollow steel tool or die can be rehardened many times without deterioration, the action being such that the tool or die at each hardening is caused to contract in proportion to the thickness of its sides, so that when the inner surface has become worn the inner space is brought to the proper dimensions again merely by the shrinkage caused by the act of hardening. For this purpose the water for cooling is applied partially to the inner surface and partially to the outer surface, and according to the thickness of the article. It is applied either simultaneously in regulated quantity to both the inner and outer surface, or first only to the outer surface and then quickly to the inner surface, or first to the inner and then to the outer surface, causing the same water that has acted on the one surface to act on the other. The hollow steel articles are for this purpose placed in specially-formed receptacles, in which they rest upon their supports, so that the water flowing down through the interior can find its way underneath the lower end, and up between the outer surface and sides of the receptacles.

The apparatus for carrying out the above-described process consists, first, of the above-mentioned receptacle, which may be in two or more parts, according to the form of the article to be hardened; secondly, of a discharge-pipe supporting the said receptacle, through which the water, after having done duty, is conducted away; thirdly, of a stand having a dish-shaped top for receiving any water that may overflow the sides of the receptacle, and that conducts it through channels into the said discharge-tube; fourthly, of a nozzle, carried by a bracket at the top of the stand, through which the requisite water is supplied.

The accompanying drawings form a part of this specification, and illustrate what I consider to be the best means of carrying out the invention.

Figure 1 is a vertical section of one form of the nozzle and receptacle in which the water first passes into the interior of the article being manipulated. Fig. 2 is a similar view of a form in which the water flows inside and outside of the article simultaneously. Fig. 3 is a vertical section of the complete apparatus, taken on line A B in Fig. 5. Fig. 4 is an enlarged vertical section of the supply-pipe and nozzle. Fig. 5 is a plan view of the device. Fig. 6 is a transverse section on line C D, Fig. 3. Fig. 7 is a transverse section on line E G, Fig. 2. Fig. 8 is a transverse section on line L N, Fig. 4. Fig. 9 is a transverse section on line H J, Fig. 4.

Similar letters of reference indicate like parts in all the figures.

R is the supply-pipe, through which the water is furnished to the nozzle. The supply through it is attained, regulated, or shut off by the valve *k*, which is operated by means of the screw *l* working in a threaded portion of the pipe R, turned by means of the handles *h*. The nozzle (marked *g*) is supported by the braces *x* attached to the dish *d*, which is sustained upon the column *c*. Beneath the nozzle is the receptacle S, into which the article *b* to be hardened is placed, and under this is the escape-pipe R′, through which the water, after being used in tempering, passes away. Any water overflowing the receptacle S is caught in the dish *d*, passing through the openings *e* into the funnel *o*, and through the perforation *e′* into the discharge-pipe, and thence out. The pipe R′, which bears the receptacle at the top, is supported by the spring-treadle T F, which forces the pipe and receptacle into the normal

position under the nozzle; but when an article for hardening is to be placed in the receptacle the treadle is depressed and the pipe and receptacle lowered, so that it is readily done, and on releasing the treadle the article is brought into proper position under the nozzle.

The nozzle in Figs. 3 and 4 is little more than an extension of the supply-pipe. This form will do for simple articles, but for more complicated objects the forms of nozzle and receptacle shown in Figs. 1 and 2 are preferable. Here the nozzle has within it the cylindrical rod *i*, held centrally by means of the ribs *m*, and having a conical piece, *a*, screwed on its lower end. By screwing this piece *a* upward or downward the width of the annular orifice is diminished or increased, and the stream of water is directed more to the outer surface or more to the interior of the article *b*, as may be required.

In Fig. 1 the steel article *b* is first cooled internally by the stream of water, which then partly flows underneath the bottom thereof and up over its outer surface, escaping over the edge of the receptacle, while the remainder passes directly through the hole in the bottom of the receptacle into the pipe R′. In Fig. 2 the water flows simultaneously through the interior and over the outer surface of the steel article. The receptacle S is in this case closed at the bottom, and fits with a projection, P, into the hole P′ in the top of the pipe R′. It is screwed into the piece S′, on which the nozzle bears and in which is formed a circular channel, *u*, that, together with the vertical channels *r* cut in the screw-thread, serve for the escape of the water, as shown more clearly in Fig. 9. Thin ribs or supports *n n* are provided in the receptacles S for the steel articles to rest on.

The supply and direction of the water may be so accurately controlled that the most delicate effects are produced, and all tensions and uneven cooling and tempering obviated.

Having thus described my invention, I desire to claim—

1. The process of hardening hollow steel articles, by causing a stream of water to pass first through the interior of the article and then over the outer surface thereof, substantially as described.

2. A receptacle for holding the article to be hardened, mounted upon a spring base, whereby it is lowered and caused to resume its place again automatically, in combination with a nozzle having an adjustably regulated and directed supply of water, as set forth.

3. In a hardening apparatus, the combination of the nozzle *g*, receptacle S, discharge-pipe R′, and dish *d*, as set forth.

4. The nozzle *g*, having a flaring mouth at its lower end, and provided with the rod *i*, screw-threaded at its lower end, in combination with the conical screw-piece A, adjustable up and down on the threaded end of the rod relatively to the flaring mouth of the nozzle, as set forth.

5. In combination with a water-supply nozzle, *g*, a receptacle, S, and escape-pipe R′, mounted on a spring-treadle, T F, for the purpose of allowing the easy introduction and proper placement of the article to be hardened, as set forth.

6. The combination, with the nozzle and receptacle, of the dish *d*, having holes *e*, pipe R′, having funnel *o*, and openings *e′*, as set forth.

WILLIAM LORENZ.

Witnesses:
C. GRONERT,
H. RASSBACH.