

(No Model.)

H. WILISCH.
APPARATUS FOR HARDENING STEEL.

No. 501,393.

Patented July 11, 1893.

Fig. 1

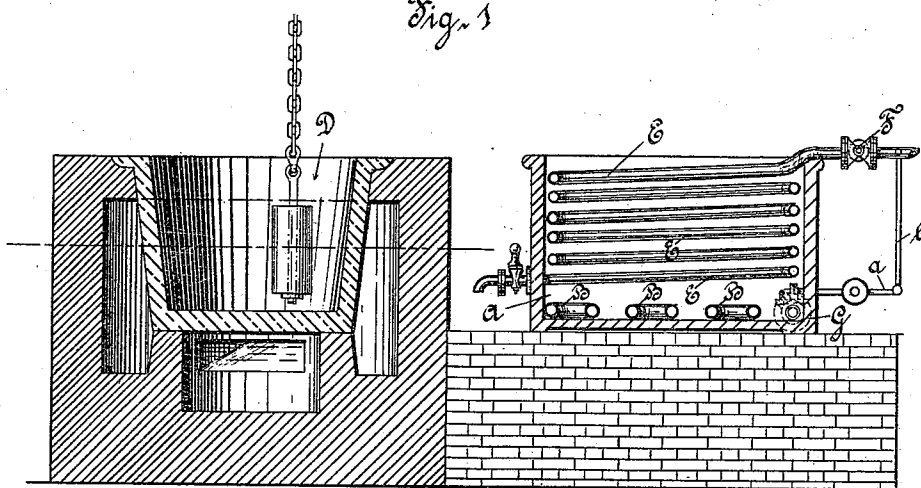
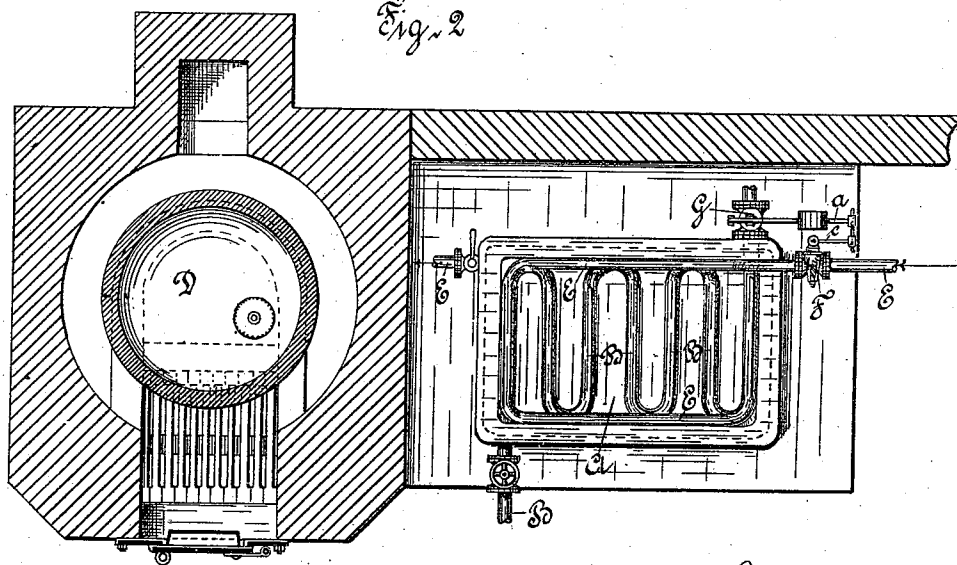


Fig. 2



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UNITED STATES PATENT OFFICE.

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APPARATUS FOR HARDENING STEEL.

SPECIFICATION forming part of Letters Patent No. 501,393, dated July 11, 1893.

Application filed August 26, 1892. Serial No. 444,212. (No model.) Patented in Germany June 26, 1891, No. 65,082, and in England July 18, 1892, No. 13,148.

To all whom it may concern:

Be it known that I, HUGO WILISCH, manufacturer, of Homberg-on-the-Rhine, in the Kingdom of Prussia, German Empire, have
5 invented a new and useful Improvement in an Apparatus for Hardening Steel, (for which I have obtained a patent in Great Britain, No. 13,148, bearing date July 18, 1892, and a
10 patent in Germany, No. 65,082, bearing date June 26, 1891,) of which the following is a specification, reference being had therein to the accompanying drawings.

This invention relates to hardening articles of steel or other metal, and to apparatus for
15 carrying out the process; its objects being to accomplish a thorough and uniform hardening to avoid warping or twisting, and to effect economy.

In the accompanying diagrams, Figure 1 is
20 a view partly in longitudinal section and partly in side elevation of apparatus adapted for use in carrying out my invention; Fig. 2 being a corresponding view partly in horizontal section and partly in plan.

The ordinary process of hardening large articles of steel or other metal by first heating them and thereupon cooling the same in a bath of water, oil or sand is generally unsatisfactory, having the drawback that only a
30 momentary cooling of the surface is effected; the article, owing to the heat retained in the body thereof, not being cooled enough to produce a thorough hardening. With water and oil especially, the vapors which are formed
35 and do not escape check the necessary abstraction of heat. This is also the case when the hardening is attempted in quicksilver, which is very soon caused to boil by large heated articles, and consequently is only suitable for hardening small and delicate steel
40 goods. Further, quicksilver cannot be employed for large articles on account of its cost and owing to the fact that the vapors it gives off are detrimental to health. The other metals which have been proposed for hardening
45 purposes, such as tin, lead and zinc are of no practical value, because each, when heated to its melting point, yields a bath too hot for hardening.

50 By the present invention, a thorough hardening of the articles is effected in a bath con-

sisting, not of pure metal, but of an alloy having a low melting point; the bath being so constructed that in one part the alloy is melted to form the liquid metallic bath, and
55 in another part the additional heat absorbed by the bath on large metallic articles being introduced is abstracted. Plates, cylinders, dies and similar articles of steel or other metal are first of all heated to a uniform tempera-
60 ture throughout, which is best effected in a metallic bath wherein a clear red heat, such as is required for instance for steel, can be produced quickly and economically. The red
65 hot articles are then brought into the hardening bath, which is composed of an alloy having a low melting point. This alloy is preferably made of tin and lead. If it be desired that the temperature of the bath should not
70 fall for instance below 358° Fahrenheit, the following alloy is suitable: ten parts of tin, and six parts of lead. The melting points of the alloys used can be altered, according to requirements, by the addition of other metals. The admixture of bismuth or cadmium with
75 the lead and tin would lower the melting point. For example, an alloy consisting of two parts of bismuth, one part of tin, and one part of lead is suitable for a bath in which the melting point should not fall below a temperature of
80 from 203° to 209° Fahrenheit.

Obviously any other metallic alloy can be employed in the place of those given above provided that its melting point is the one necessary for the particular operation. The point
85 whereat the alloy melts is important, because it has been established as essential that for certain technical purposes the temperature employed should be identical with that at which the alloy passes from the solid into
90 the liquid condition, because at that temperature a definite amount of fluidity is possessed by the bath, and this has an influence on the hardening. Consequently, it is always advisable to select an alloy the melting point
95 whereof corresponds with the desired temperature, and not to use an alloy the melting point of which is lower than the temperature to the bath.

In order to conveniently effect the melting
100 of the alloy, and to keep the same in a liquid condition, the tank containing the alloy is

provided with a heating tube. For the purpose of rapidly withdrawing heat imparted to the metallic bath by large articles introduced for the purpose of being hardened, so that the hardening operation may not be interfered with, the tank is provided with a second tube through which a cooling liquid is allowed to flow.

It is hardly necessary to add that the heating and cooling tubes may be replaced by any other suitable means for heating and cooling, so long as the nature of the apparatus is not materially altered.

A is the tank for containing the bath of melted alloy. This tank is provided with a bent heating tube B connected with the steam space of a boiler. If, for instance, steam at thirty pounds pressure, and consequently at 250° Fahrenheit, fills the tube, the alloy placed in the tank A melts; the temperature of the metallic bath being about the same as that of the steam. The articles to be hardened, after a preliminary heating, which is best effected in a tank D containing a correspondingly hot liquid metal or alloy, are introduced into the bath in the tank A, and retained therein until they have cooled down to its temperature.

For the purpose of conveying heavy articles from one bath to another, a traveling crane, to the chain of which the articles are connected, as indicated in Fig. 1, may be conveniently employed. The temperature of the hardening bath would, however, be raised by the metallic articles immersed as they give off their heat, and, if the bath be not made of unusual dimensions, it would, with continued working, reach too high a temperature to enable the hardening operation to be any longer effected. The tank A is consequently provided with a second pipe E, through which a cooling liquid is permitted to flow when it is desired to quickly cool the bath. As soon as the temperature of the bath in the tank A has sunk again to about 250° Fahrenheit that is, to its normal temperature, the flow of cooling liquid is cut off by means of the cock F. When the temperature of the bath is higher than 250° Fahrenheit, the steam contained in the pipe B exerts a pressure of more than thirty pounds, and this is indicated by the weighted safety valve G, which allows it to escape.

By regulating the flow of the cooling liquid,

the particular temperature in the bath necessary for the desired degree of hardening can be easily attained.

To automatically control the regulation of the temperature, the safety-valve G and the cock F may be united by a lever *b* and connecting rods in such a way that, when the safety valve G blows off, a corresponding movement of the cock F takes place.

The advantages of the above described process for hardening metallic articles in a tempering bath consisting of an alloy having a low melting point, the temperature of the bath being suitably regulated during the hardening process, are, first, that the cooling is uniform, so that the articles acquire a uniform hardness, and are not liable to warp or spring during the operation, and, secondly, that the hardening takes place throughout the substance, whereas in the processes hitherto known, the hardening is mostly confined to the surface, and, owing to the want of means for regulating the temperature of the liquid bath, each article is not hardened so uniformly as desired.

What I claim, and desire to secure by Letters Patent of the United States, is—

1. The herein described apparatus for use in hardening articles of steel or other metal, consisting of a tank A adapted to receive the alloy, and provided with a heating device B, passing through said tank for keeping the alloy in a melted condition, and a cooler C also passing through the tank for regulating the temperature of the bath, substantially as described.

2. The herein described apparatus for use in hardening articles of steel or other metal, consisting of a tank A adapted to receive the alloy, and provided with a steam heating pipe B passing through said tank, a weighted valve for automatically controlling the pressure of steam in the pipe, a cold water pipe also passing through the tank, a valve for regulating the flow of liquid through said pipe, and a connection between said steam valve and cooling valve, for regulating the temperature of the bath, substantially as described.

In witness whereof I hereunto set my hand in presence of two witnesses.

HUGO WILISCH.

Witnesses:

D. J. PARTELLO,
R. ELSHORST.