

# UNITED STATES PATENT OFFICE.

ADAM TINDEL, OF PHILADELPHIA, PENNSYLVANIA.

## PROCESS OF MANUFACTURING STEEL FORGINGS AND CASTINGS.

SPECIFICATION forming part of Letters Patent No. 324,433, dated August 18, 1885.

Application filed April 11, 1885. (No specimens.)

*To all whom it may concern:*

Be it known that I, ADAM TINDEL, a citizen of the United States, residing in the city and county of Philadelphia, and State of Pennsylvania, have invented a new and useful Improvement in the Process of Manufacturing Steel Forgings and Castings, of which the following is a specification.

The object of my invention is to produce steel forgings or castings possessing a high degree of elasticity and tensile strength, and great capacity for elongation or minimum brittleness.

In the manufacture of steel forgings or castings as heretofore practiced it is well known that the elasticity and tensile strength of the steel are in direct ratio, while its capacity for elongation is in inverse ratio to its carbon contents. In other words, it is well known that with an increase of carbon contents the tensile strength of forgings and castings and their elasticity are increased, while their capacity for elongation is diminished and their brittleness increased, with the result that only certain degrees of elasticity and tensile strength could be obtained within the limits of safety by the processes heretofore in use. Heretofore, therefore, it has been necessary in the manufacture of steel forgings and castings possessing high tensile strength and a high limit of elasticity to sacrifice their capacity for elongation, and to thus render the product too brittle to be used where the metal was required to resist severe strains and sudden shocks.

I have discovered that steel forgings and castings containing from substantially .20 to .35 of one per cent. of carbon may be greatly increased in tensile strength and in elasticity without a material decrease of their limit of elongation, or without materially increasing their brittleness, by treating them at a certain heat in a bath of oil, as hereinafter described.

The steel forgings or castings to be treated by my process should, previous to such treatment, be rendered homogeneous and their atoms freed from unequal tension, caused by forging or casting, so that their atoms shall have assumed a natural and unstrained position with regard to each other, and a more or less amorphous structure have been pro-

duced. This result may be accomplished by subjecting the cold forging or casting to heat in a furnace in which the heat is very slowly brought up to a temperature of about 1,800° Fahrenheit, this temperature being maintained until the heat has thoroughly and evenly permeated the entire body of the forging or casting, and by then dumping the fire and allowing the furnace and its contents to slowly cool.

To produce steel forgings or castings by my process I subject homogeneous steel forgings or castings of the character above described to heat in a furnace wherein the temperature is gradually raised to and maintained at about 1,800° Fahrenheit until the body of the metal has become thoroughly heated throughout. The heated steel is then withdrawn from the furnace, plunged quickly into a bath of oil, and is therein and as rapidly as possible cooled, whereupon the process is completed by the withdrawal of the steel from the bath. The product will be found to be steel of a fine dense and granular formation, possessing tensile strength and elasticity of unusually high degree, its capacity for elongation not having been materially diminished and brittleness not having been produced. In other words, the product of my process will be found to possess a much higher tensile strength and a much greater limit of elasticity than has been possessed by steel forgings or castings as heretofore made, without having been substantially varied as to the limit of elongation which corresponds with the maximum elasticity and tensile strength possessed by steel forgings or castings produced by methods heretofore in use. Thus by my process is produced a steel capable of greater resistance to severe strains and sudden shocks than it has heretofore been possible by the processes in use to obtain. This product is particularly suitable for railroad and other axles, crank-pins, pistons, connecting and parallel rods for locomotive and other engines, and for many other articles.

Various oils may be employed in the practice of my process. They should, however, be such as will neither disassociate by heat nor congeal and adhere to the steel. Cottonseed oil I have found especially adapted to the purpose.

An oil bath of sufficient quantity to prevent



material increase of its temperature by the heated metal should be employed, and the temperature of the bath should not materially exceed 100° Fahrenheit.

5 I am aware that some kinds of steel heated to a cherry-red have been annealed in oil; but I am not aware that steel such as is herein described has been annealed in oil in the manner and under the conditions above described.

10 Having thus described my invention, I claim—

1. In the manufacture of steel forgings and castings, the process of subjecting steel forgings or castings containing substantially .20 to  
15 .35 of one per cent. of carbon to heat at a temperature of substantially 1,800° Fahrenheit, and in then treating said heated steel in a bath of oil, substantially as and for the purposes set forth.

20 2. In the manufacture of steel forgings or castings, the process which consists, first, in subjecting steel forgings or castings containing substantially .20 to .35 of one per cent.

of carbon to heat at a temperature of about 1,800° Fahrenheit; second, in again sub- 25  
jecting said steel after it has become cold to heat at a temperature of about 1,800° Fahrenheit; and, third, in treating said heated steel in a bath of oil, substantially as and for the purposes set forth.

3. In the manufacture of steel forgings or castings, the process which consists in subject- 30  
ing steel forgings or castings containing substantially .20 to .35 of one per cent. of carbon, and which have been heated to a temper- 35  
ature of about 1,800° Fahrenheit and cooled to heat at a temperature of about 1,800° Fahrenheit, and in then treating said heated steel in a bath of oil, substantially as and for the purposes set forth.

40 In testimony whereof I have hereunto signed my name this 6th day of April, A. D. 1885.

ADAM TINDEL.

In presence of—

WM. C. STRAWBRIDGE,  
J. BONSAILL TAYLOR.