

UNITED STATES PATENT OFFICE.

ROBERT J. TILFORD AND HENRY M. REDEMANN, OF LOUISVILLE, KENTUCKY,
ASSIGNORS TO THE REDEMANN-TILFORD STEEL COMPANY, OF SAME
PLACE.

MANUFACTURE OF STEEL.

SPECIFICATION forming part of Letters Patent No. 397,477, dated February 5, 1889.

Original application filed July 25, 1888, Serial No. 281,018. Divided and this application filed November 13, 1888. Serial No. 290,737. (No specimens.)

To all whom it may concern:

Be it known that we, ROBERT J. TILFORD and HENRY M. REDEMANN, citizens of the United States, residing at Louisville, Jefferson county, Kentucky, have invented new and useful Improvements in the Manufacture of Steel, of which the following is a specification.

Our invention relates to certain new and useful improvements in the treatment of crude or low-grade steel to produce a refined or high-grade steel.

The most successful method of producing low-grade steel is that known as the "Bessemer" process, described in his patent of 1855; but this product, as is well known, is suitable chiefly for railways, axles, and like uses, and is totally unsuited for structures, machinery, and tool purposes, unless puddled, hammered, and rolled, for the reason that in its normal state it is too soft, and when hardened it becomes too hard and brittle for the purposes stated. It was the recognition of these inherent defects in the Bessemer and low and medium grade steel which led us to the investigation of the subject which has developed our present invention, the object of which is the production at slight cost and a minimum degree of labor of a higher grade and more refined steel by treating the Bessemer and other low and medium grade steel in such manner as to produce a molecular change from a coarse grain to a fine grain and silky fracture, to increase the tensile strength and elasticity, toughness, and ductility, and to greatly increase the carbon. We have found from experience that uniform results in all instances flow from the treatment of metals having like properties.

With these ends in view our invention consists in heating the metal to be treated to a white heat, and then submerging the same in a bath of glycerine and water in the proportion of three (3) ounces of glycerine to one-half ($\frac{1}{2}$) gallon water and allowing it to remain submerged until the change is effected, which should be until the metal is substantially cool, or until such reduction of heat in the metal is made that it will no longer take up the

gases generated by contact with the bath. We have found in some instances that better results and effects are obtained by the addition to the bath of glycerine and water of spirits of niter, aqua-ammonia, chloride of ammonium, sulphate of zinc, sulphate of alumina, and ammonia; but to this last-named addition we lay no claim herein, as the same forms the subject-matter of a second divisional application of our application, Serial No. 281,018, filed July 25, 1888, of which this application is the first division. Neither do we lay herein any claim to the broad idea of first heating low-grade steel to a degree of heat represented by white heat, and then subjecting the metal so heated to a liquid bath (in contradistinction to the dry or cementation process) in which hydrocarbon or similar gases are generated by contact with the heated metal and bath, as this last-named matter forms the subject of our original application referred to.

We of course do not wish to confine ourselves to the exact proportions named, as they may be varied within reasonable limits, and yet produce the same general results; but we have found from long experience and repeated tests and experiments that the proportions given produce the best results.

It will also be understood that we do not wish to confine ourselves to the exact degree of heat imparted to the metal, as that may be varied slightly, so long as the results desired are obtained.

We have of course been unable to analyze the gases resulting from the contact of the hot-metal body with the bath, but are led to believe that they constitute a hydrocarbon gas which has a strong affinity for the metal, and that the latter, being in a heated state, is in such a physical condition as to readily take up or absorb such gas; but as to the fact that the metal is highly improved we have no doubt whatever, as has been demonstrated by all the well-known scientific and mechanical tests.

It will be understood, of course, that when the treatment is applied adjacent to the furnaces where the low-grade steel is manufac-

5 tured the ingots may be treated without re-
heating, and thus the expense of such reheat-
ing is avoided. After the metal has been sub-
jected to the treatment in the bath of glycer-
ine and water it is allowed to cool in the or-
10 dinary manner, and it may afterward be sub-
jected to any ordinary hardening or temper-
ing process, and the temper may, if necessary,
be drawn and again restored without at all
affecting the other properties acquired from
the bath.

15 We are of course aware that the quality
of Bessemer and other low and medium grade
steel may be improved by what is known as
the "dry" or "cementation" process, which
requires a large expenditure of skilled labor
and great length of time, and that, too, with-
out always securing uniform and satisfactory
results.

20 We desire it to be distinctly understood
that we lay no claim to the broad idea of in-
creasing the quality of steel by subsequent
treatment, as that has been heretofore done,
especially by what is known as the "cementa-
25 tion process," which may be termed a "dry
process," our invention differing from such
process in the particular that it requires a
period of time amounting to a small percent-
age of the time required in the cementation
30 or dry process, and is in contradistinction to
such process essentially a liquid or wet pro-
cess, the former requiring many days, while
the latter involves only a few minutes.

35 As before stated, we wish it to be under-
stood that the chief feature of our process in-
volves the employment of a bath of glycerine
and water, for in the use of these two bodies
we accomplish desirable and improved re-
sults; but the addition to the glycerine and
40 water of spirits of niter, aqua-ammonia, chlo-
ride of ammonium, sulphate of zinc, and sul-
phate of alumina and ammonia produce bet-
ter and enhanced results; hence we do not
wish to confine ourselves to the use of a bath
45 embodying all the bodies named.

Our invention or process is distinguished

from processes for tempering steel in oil in
that by our process the nature and the physical
construction of the metal are completely
changed, whereas the tempering of steel in 50
oil, as practiced by some processes, simply
tempers the metal more slowly than is done
by tempering in water and other properties,
leaving the metal less hard, but somewhat
tougher than water-tempered material. The 55
changes caused by the oil-tempering process
are merely temporary, and do not change the
physical or granular construction of the metal,
and such changes as are caused thereby can
be readily neutralized by reheating and allow- 60
ing the metal to cool. The changes caused
by treatment by our process are permanent,
and cannot be removed by any known treat-
ment or process without entirely destroying
the steel properties of the metal by burning. 65

By our invention we greatly increase the
tensile strength and elasticity, and yet do not
destroy the percent. of reduction or ductility,
while with ordinary tempering the tensile
strength and elasticity are greatly increased, 70
but the per cent. of reduction and ductility
is very much impaired.

What we claim as new, and desire to secure
by Letters Patent, is—

The process herein described for convert- 75
ing lower-grade steel into refined or higher-
grade steel, which consists in heating the
metal to be treated to a white heat, and then
submerging the heated metal in a liquid bath
of glycerine and water in the proportion of 80
three (3) ounces of the former to one-half ($\frac{1}{2}$)
gallon of the latter, substantially as herein-
before set forth.

In testimony whereof we have hereunto set
our hands in the presence of two subscribing 85
witnesses.

ROBERT J. TILFORD.
HENRY M. REDEMANN.

Witnesses:

HENRY J. TILFORD,
DAVID BARKLEY.