UNITED STATES PATENT OFFICE.

FRANZ FISCHER, OF BERLIN, GERMANY.

PROCESS FOR THE MANUFACTURE OF DUCTILE ELECTROLYTIC IRON.

992,951.

No Drawing.

Specification of Letters Patent. Patented May 23, 1911.

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To all whom it may concern:

Be it known that I, FRANZ FISCHER, chemist, a subject of the German Emperor, residing at 1 Hessischestrasse, Berlin, Germany, have invented certain new and useful Improvements in Processes for the Manufacture of Ductile Electrolytic Iron; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention refers to the electrolytic production of iron and comprises a specific manner of manufacturing objects consisting of such iron, such as sheets, rods or wires.

The iron produced by electrolysis from aqueous solutions is generally of such hardness and brittleness that it can only be used for certain purposes in which ductility is not essential. These inferior qualities of electrolytic iron produced according to processes hitherto known are due to the presence of hydrogen in the iron. Various methods have been suggested for the electrolytical production of an iron which is poorer in hydrogen and therefore more ductile. Maximowitsch (*Zeitschrift für Elektrochemie*, Vol. 11, fol. 52, 1905) produces such an iron from a solution of ferrous bicarbonate employing very low current densities (not exceeding .5 amperes per square decimeter) and working at ordinary temperatures.

According to the German Patent No. 126839 an electrolytic iron is obtained from a hot solution of ferrous chlorid at a temperature approaching 70° C. by constant stirring of the electrolyte or agitating the cathode, at somewhat higher current densities, that is from 3 to 4 amperes per square decimeter. But it is explicitly pointed out in this patent that the process can only be carried out successfully, if the ferrous chlorid is used without any foreign additions. I have now found that the quality of the electrolytic iron obtained from a solution of pure ferrous chlorid is greatly improved by raising the temperature. But this raising of the temperature is not without detriment to the solution, the latter being changed in the same ratio, as the temperature is raised. These changes consist in an oxidation of the solution by the oxygen of the air and in an increasing evaporation, so that it is practically impossible to work at atmospheric pressure at temperatures exceeding 90° C. According to my invention these disadvantages are overcome by means of adding certain ingredients to the electrolyte which prevent its being disintegrated. I use as such suitable additions very hygroscopic salts, such as chlorid of calcium, of magnesium, of aluminium etc. and I find that the said additions, especially at temperatures exceeding 70° C., and without stirring the electrolyte or agitating the cathode, have not only no detrimental effect, but, on the contrary, very materially improve the ductility of the deposit. This effect could not be inferred from German Patent No. 126839, in which it is explicitly stated that good results are only obtained with a pure solution of ferrous chlorid.

By adding substances such as the above mentioned I produce an electrolyte from which perfectly ductile iron is obtained at temperatures varying between 100° and 120° C., and at high current densities of more than 20 amperes per square decimeter.

In order to carry out my process I may proceed as follows. I dissolve 450 units weight of ferrous chlorid and 500 units of chlorid of calcium, in 750 units of water. I then subject the solution thus obtained to electrolysis at a temperature of about 110° C. and a current density which may, if desired, exceed 20 amperes per square decimeter. As regards the current density, however, it should be noted that although the improved process makes it possible to employ current densities of the value indicated, the process can be carried out successfully with currents of much lower density. By this process I obtain an electrolytic iron of excellent chemical and physical properties which in consequence of the high current densities and the very low voltages applied is produced in a time sufficiently short to enable me to manufacture on a large scale and with great economy. The electrolytic iron thus produced is found useful for divers industrial purposes. Besides the well-known steeling of the surface of engraved plates all other processes may be carried out and objects manufactured by employing electrolytic iron of any thickness in a very short time, for which purposes other metals, such as copper, have hitherto been used.

The electrolytic iron obtained by my process is specially adapted for use in elec-

tromagnetic apparatus, since I find that it far surpasses all kinds of iron hitherto known in magnetic permeability. In some cases, as when sheet iron or wire is wanted, I find it more economical instead of producing directly by electrolysis such sheets or wires in the desired thickness, rather to produce thicker blocks or plates, which are then stretched to the desired shape and thickness by the ordinary processes of forging, rolling or drawing.

As already stated above, I have found that the ductility of the product increases with the temperature of the electrolyte. Thus, if it is desired to produce directly by electrolysis iron of the highest quality as to ductility and magnetic permeability, the temperature of the electrolyte should not be allowed to descend below 90° C. If lower temperatures are employed the product cannot be used with advantage for purposes in which high ductility and magnetic permeability are essential. But I find that, if iron produced according to my present invention at temperatures between 70° and 90° C., is subsequently rolled or forged, it thereby acquires the desired qualities of high ductility and magnetic permeability in almost the same degree as with iron directly produced by electrolysis at higher temperatures. In cases of this nature therefore one manner of carrying out my invention consists in electrolyzing the above mentioned solutions at temperatures between 70° and 90° C., thus producing comparatively thick blocks or plates and subsequently reducing said blocks or plates to the desired thickness and shape by any well known process of forging, rolling or drawing.

What I claim is:

1. A process of producing electrolytic iron, which consists in subjecting a solution of iron salts to electrolysis at a temperature exceeding 70° C., with the addition of a hygroscopic salt.

2. A process of producing electrolytic iron, which consists in subjecting a solution of ferrous salts, with the addition of a hygroscopic salt, to electrolysis at a temperature substantially above 70° C.

3. A process of producing electrolytic iron, which consists in adding a hygroscopic salt to a solution of ferrous chlorid and then subjecting the solution to electrolysis at a temperature substantially above 70° C.

4. A process of producing electrolytic iron, which consists in adding calcium chlorid to a solution of ferrous chlorid, and then electrolyzing the solution at a high temperature.

5. A process of producing electrolytic iron, which consists in electrolyzing iron salts, with the addition of a hygroscopic substance, at a temperature substantially above 70° C. and with a current of relatively high density, as described.

6. A process of producing electrolytic iron, which consists in subjecting a solution of ferrous chlorid with an addition of highly hygroscopic substances to electrolysis at temperatures exceeding 70° C. and current densities of approximately 20 amperes per square decimeter.

7. A process of producing electrolytic iron, which consists in subjecting a solution of ferrous chlorid with an addition of chlorid of calcium to electrolysis at temperatures exceeding 70° C. and current densities of approximately 20 amperes per square decimeter.

8. A process of producing electrolytic iron, which consists in subjecting a solution of 450 weight units of ferrous chlorid, 500 weight units of chlorid of calcium in 750 weight units of water to electrolysis at temperatures between 100° and 120° C. and current densities of approximately 20 amperes per square decimeter.

9. A process of manufacturing objects of electrolytic iron, which consists of producing said products by precipitating iron from an electrolyte composed of iron salts, with an addition of hygroscopic substances, at temperatures exceeding 90° C.

In testimony whereof I have affixed my signature, in presence of two witnesses.

FRANZ FISCHER.

Witnesses:

HENRY HASPER,

WOLDEMAR HAUPT.