

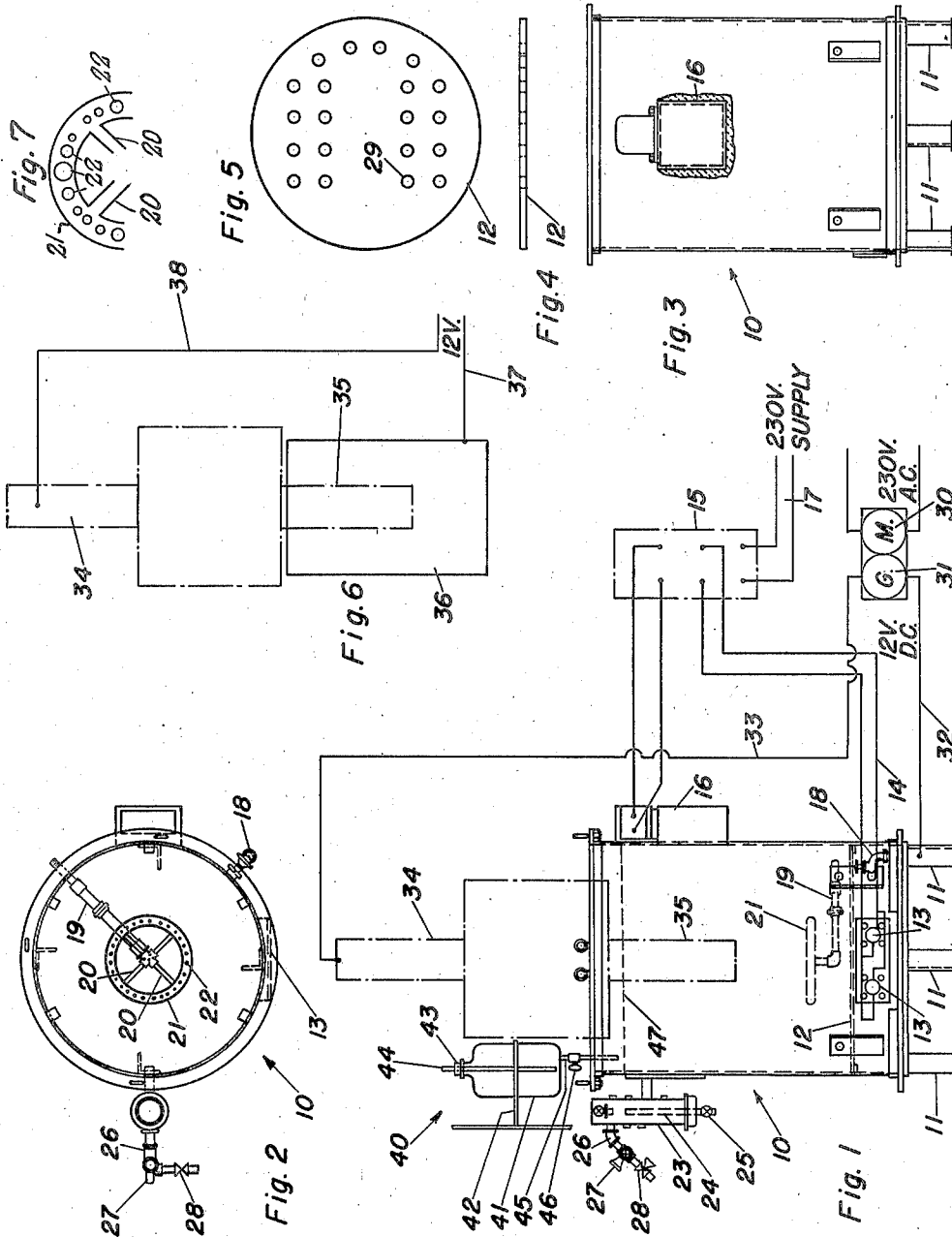
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IRON PLATING FOR SHAFTING

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IRON PLATING FOR SHAFTING

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This invention relates to a method and apparatus for building up worn steel shafts by electrodeposition of iron.

A further object of this invention is to provide a method of building up worn steel shafting by a practical sufficiently cold process that it cannot develop any heating strains or warping in the shafts, as compared with attempting to accomplish the same result either by welding or by hot metal spraying.

A further object of this invention is to provide a method and apparatus for iron plating of shafts which is of general application but is especially useful for plating shafting wherein the shaft may be of substantial size, as for instance, the shaft of a motor armature, and which may be applied without the necessity of disassembling the armature from the shaft, even though the assembled armature and shaft may weigh several tons.

A further object of this invention is to provide a method and apparatus for plating an iron shafting wherein the resulting plate will have qualities desirable for the purpose intended.

A still further object of this invention is to provide a method and apparatus for keeping the plating solution in proper control and of a proper purity and for keeping the pH (hydrogen ion concentration) of the plating solution under proper control within the maximum and minimum limits necessary to provide a plate having the desired quality.

With the foregoing and other objects in view, the invention consists in the construction, combination and arrangement of parts hereinafter described and illustrated in the drawing, in which:

Fig. 1 is a front elevational, partly X-ray view of the plating tank of this invention, with the electrical leads shown diagrammatically.

Fig. 2 is a top plan view of Fig. 1.

Fig. 3 is a side elevational view of Fig. 1.

Fig. 4 is an edge view of a false bottom.

Fig. 5 is a plan view of the false bottom of Fig. 4.

Fig. 6 is a diagrammatic elevational view of the pickling tank.

Fig. 7 is a fragmentary enlarged view of a portion of the gas outlet ring.

There is shown at 10 the plating tank of this invention supported on legs 11 and provided with a removable false steel bottom 12 to shield two 5000 watt immersion heaters 13 placed immediately below the false bottom 12, the immersion heaters 13 being provided with leads 14 connected thereto through the side of the tank and leading

to a switch control panel 15, through a thermostat control box 16 on the side of the tank, and through the leads 17 to a suitable source of electrical current, preferably of 230 volts.

Likewise extending through the side of the tank 10 is a tap 18 for draining off the solution when necessary. Also extending through the side of the tank is an air pipe 19 leading to a pair of cross pipes 20 at the end of which is supported a perforated preferably non-metallic ring 21 provided with a plurality of air or gas outlet apertures 22 on the top thereof. These apertures 22 are graduated in size, being smallest adjacent the points where the cross pipes 20 are joined to the ring 21 and largest at the points furthest from such junction so that the stream of air or other gas used escaping therefrom may be equalized throughout the circumference of the ring.

On one side of the tank near the top thereof is located a solution level control box 23 provided with an overflow pipe 24 having a control valve 25 and provided with an inlet pipe 26 having control valves 27 and 28. A 230 volt motor 30 may operate a 12 volt direct current generator 31 for supplying a plating current, a lead 32 being connected to the tank 10 through its leg 11 to act as the anode, while another lead 33 is connected to the work 34 whereby the shaft 35 being replated acts as the cathode.

There is also provided a pickling tank 36 which is connected to a suitable source of the direct current of 12 volts by means of a lead 37 to the lead lined wooden pickling tank 36, using the lead lining of the tank 36 as the anode, while the other lead 38 is connected to the work 34, making the shaft 35 again the cathode.

Another piece of apparatus provided is an ammonia dropping funnel 40, consisting of a glass bottle 41 suitably supported by a bracket 42 and having a rubber stopper 43 through which extends a glass tube 44 to the bottom thereof to decrease the evaporation, and a bottom outlet 45 with control stop-cock ends above the solution level 47 in the tank 10.

In operation, in preparation for a job, the worn, scored area of the shaft to be plated is cut down in a lathe to an even surface of good metal, preferably by means of a "diamond-pointed" tool, so as to get a properly roughened surface. The area is then blanked off with paper, the windings of the armature are protected with rubber sheet and paper, and the lower part of the shaft which will necessarily be immersed in the plating solution, but is not to be plated, is sprayed with a prime coat of insulating compound which is not effected

by the plating solution. A commercial insulating compound which works very well is on the market as General Electric "Glyptal." Cotton tape is wrapped around the primed surface while it is still soft. As soon as the primed surface is dry, a heavy cellulose lacquer, such as Dupont "Mt. Ash Scarlet," is then sprayed on, extreme care being taken that all corners and projections are properly covered. After the lacquer is dry the paper is removed from the area to be plated and a "rusting solution" composed of 10% hydrochloric acid, 10% alcohol and 80% water is lightly swabbed on and allowed to act over-night.

In the morning the plating is begun by dipping the rusted shaft 35 into the pickling tank 36, making the work the cathode with a minimum current density of about 600 amperes per square foot of area to be plated. The area to be plated should come from this pickling with a slightly matted, silvery surface, as left by the rusting solution. The pickling solution in the pickling tank 36 consists of 30% sulphuric acid, technical grade. Any carbon deposit on the area to be plated must be scratch-brushed off. The shaft 35 is then rinsed and immediately lowered into the plating bath in tank 10, the work 34 being connected as the cathode to the lead 33, while the tank 10 is connected as the anode to the lead 32 to the generator 31 supplying 12 volt direct current.

The plating solution consists of technical, crystal, ferrous sulphate in the proportion of 2 to 2½ pounds per gallon of water, and ammonium sulphate in the proportion of one pound per gallon when the solution is new, tap water being added to fill the tank to the level 47. The preferred current density used is 80 amperes per square foot of plating area, while the temperature of the solution is kept around 150° Fah. by means of the heaters 13 and the thermostat control box 16. A higher current rate or too low a temperature tends to produce rough metal or "whiskers." A lower current area can be used to advantage in slow building up of a film, unusually thick, such as one of 0.100 inch or cover.

The work 34 is suspended in position by means of a chain fall or crane so that it may be rotated a quarter turn every half hour or so by the operator to equalize any discrepancies in plating rate on different sides. Before the current is turned on the shaft is centered and the air supply from the pipe 19 through the perforated ring 21 is adjusted to give a turbulent flow over the entire surface of the area to be plated.

The chemical control of the plating solution is maintained by thirty minute tests of pH, as well as daily analyses of the ferrous sulphate. The pH must be kept above 6, preferably from 6 to 6.4, equivalent to a greenish yellow in brom thymol blue, as tested in any standard block colorimeter. Any other means of measuring pH may be used. The pH can be raised by increasing the rate of addition of ammonia from the dipping funnel 40, the normal rate being one pound of ammonium hydroxide per hour, the stop-cock 46 being adjusted to control the rate as desired. The pH can be lowered by increasing the air flow from the ring 21.

The operator must watch the temperature to maintain it around 150° Fah., as too low a temperature tends to embrittle the metal. He must also watch the water level, plating current, and adjust the ammonia intake to maintain a steady pH.

The build-up of metal on the shaft 34 will ap-

proximate 0.002 to 0.003 inch per hour on the radius or twice that on the diameter. A 12 hour run should build up 0.060 inch on the diameter of the thinnest spot, making full allowances. An excess over the finished size of at least 0.010 inch should be allowed for machining and the plating should be continued without stopping until the job is finished, except that the shaft can be lifted a few inches near the conclusion of the run long enough for calipers to be applied to the top of the wet, newly plated surface, allowance being made, of course, for contraction upon cooling.

After one end of the shaft is finished in this way the other end of the shaft may be similarly treated. The finished shaft is then placed into a lathe and turned to exact size. The plated metal thus provided on a shaft is suitable for taking ball-bearing assemblies. The plated metal has ductility and hardness resembling that of freshly cast unannealed soft steel, and because of its purity resists rust better than soft steel. It has a radial grain at right angles to the plane of wear in the shaft, thereby increasing its resistance to wear in the same way that wooden paving blocks set upright in a floor resist wear better than the same blocks set side ways. A tool cut in the lathe removes fine shavings with a tendency to curl, and considerable hammering is required in order to knock the plating loose from the shaft, much more than the shaft would be likely to receive in service.

As the plating is carried on the ammonium sulphate concentration gradually increases, while the ferrous sulphate content gradually decreases by loss to the cathode and by oxidation by air and must be renewed at the approximate rate of 40 pounds for every 12 hour run. The sludge thus created drops through the solution through the holes 29 in the false bottom 12 to the bottom of tank 10, whence it may be removed from time to time.

Other modifications and changes in the proportions and arrangements of the parts may be made by those skilled in the art without departing from the nature of the invention, within the scope of what is hereinafter claimed.

The invention described herein may be manufactured and/or used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

Having thus set forth and disclosed the nature of this invention, what is claimed is:

1. A method of restoring full diameter to a shaft comprising the steps of cutting the worn shaft to an even surface of good metal, applying a rusting solution to the shaft and allowing it to remain over night, pickling the shaft in a solution of approximately 30% sulphuric acid with the shaft as the cathode at a minimum current density of about 600 amperes per square foot for from two to four minutes, rinsing the shaft, then making the shaft the cathode in a plating bath of ferrous sulphate and ammonium sulphate with a current density of about 80 amperes per square foot of plating area and a temperature of about 150° Fah., and maintaining the pH at above 6 and not over 6.4, the maintaining of the pH being controlled by adding ammonia and stirring the plating bath by a gas flow therethrough, the pH being increased by increasing the rate of ammonia addition, the pH being decreased by increasing the rate of gas flow.

2. A method of restoring full diameter to a shaft comprising the steps of cutting the worn

shaft to an even surface of good metal, applying a rusting solution of one part hydrochloric acid, one part of alcohol and eight parts water and allowing it to remain over night to provide a slightly matted surface, pickling the shaft in a solution of approximately 30% sulphuric acid with the shaft as the cathode at a minimum current density of about 600 amperes per square foot for from two to four minutes, scratch brushing off any carbon deposit, rinsing the shaft, immediately making the shaft the cathode in a plating bath of ferrous sulphate and ammonium sulphate with a current density of about 80 amperes per square foot of area and a maintained temperature of not less than 150° Fah., adding ferrous sulphate periodically as needed to maintain the solution, adding ammonium hydroxide continuously to maintain the ammonium sulphate in the solution, stirring the plating bath by a continuous gas flow therethrough, maintaining the pH at above 6 and not over 6.4 by increasing the rate of ammonium hydroxide addition to increase the pH, and increasing the rate of gas flow to decrease the pH.

3. In a method of restoring full diameter to a shaft comprising the steps of preparing the worm shaft for the plating operation which comprises making the shaft the cathode in a plating bath of ferrous sulphate and ammonium sulphate with a current density of about 80 amperes per square foot of area and a maintained temperature of not less than 150° Fah., adding ferrous sulphate periodically as needed to maintain the solution, adding ammonium hydroxide continuously to maintain the ammonium sulphate in the solution, stirring the plating bath by a continuous gas flow therethrough, maintaining the pH at above 6 and

not over 6.4 by increasing the rate of ammonium hydroxide addition to increase the pH, and increasing the rate of gas flow to decrease the pH.

4. In an apparatus for plating a heavy shafting comprising an open tank, a false bottom in said tank, immersion heaters in said tank below said false bottom, a gas outlet ring in said tank above said false bottom, said gas outlet ring having gas outlet openings graduated in size in proportion to their distance from the gas supply, whereby to supply an evenly dispersed quantity of gas, thermostat control means for maintaining a desired temperature of the solution within said tank, and means for maintaining the solution at a desired level.

5. In an apparatus for plating a heavy shafting comprising an open tank, a false bottom in said tank, immersion heaters in said tank below said false bottom, a gas outlet ring in said tank above said false bottom, said gas outlet ring comprising a hollow gas ring supporting spider, a gas feeding arm supporting said spider, and a gas dispersing ring supported on said spider, said gas dispersing ring having a plurality of gas outlet openings therein, said gas outlet openings being graduated in size according to their distance from the gas feeding spider, the openings at the maximum distance being of the maximum size, thermostat control means for maintaining a desired temperature of the solution within said tank, means for maintaining the solution at a desired level, and means above said tank for adding an ingredient to said solution at an adjustable rate.

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