

Jan. 14, 1941.

J. MacQUAID

2,228,836

RUST-PROOFING PROCESS

Filed May 25, 1936

2 Sheets-Sheet 1

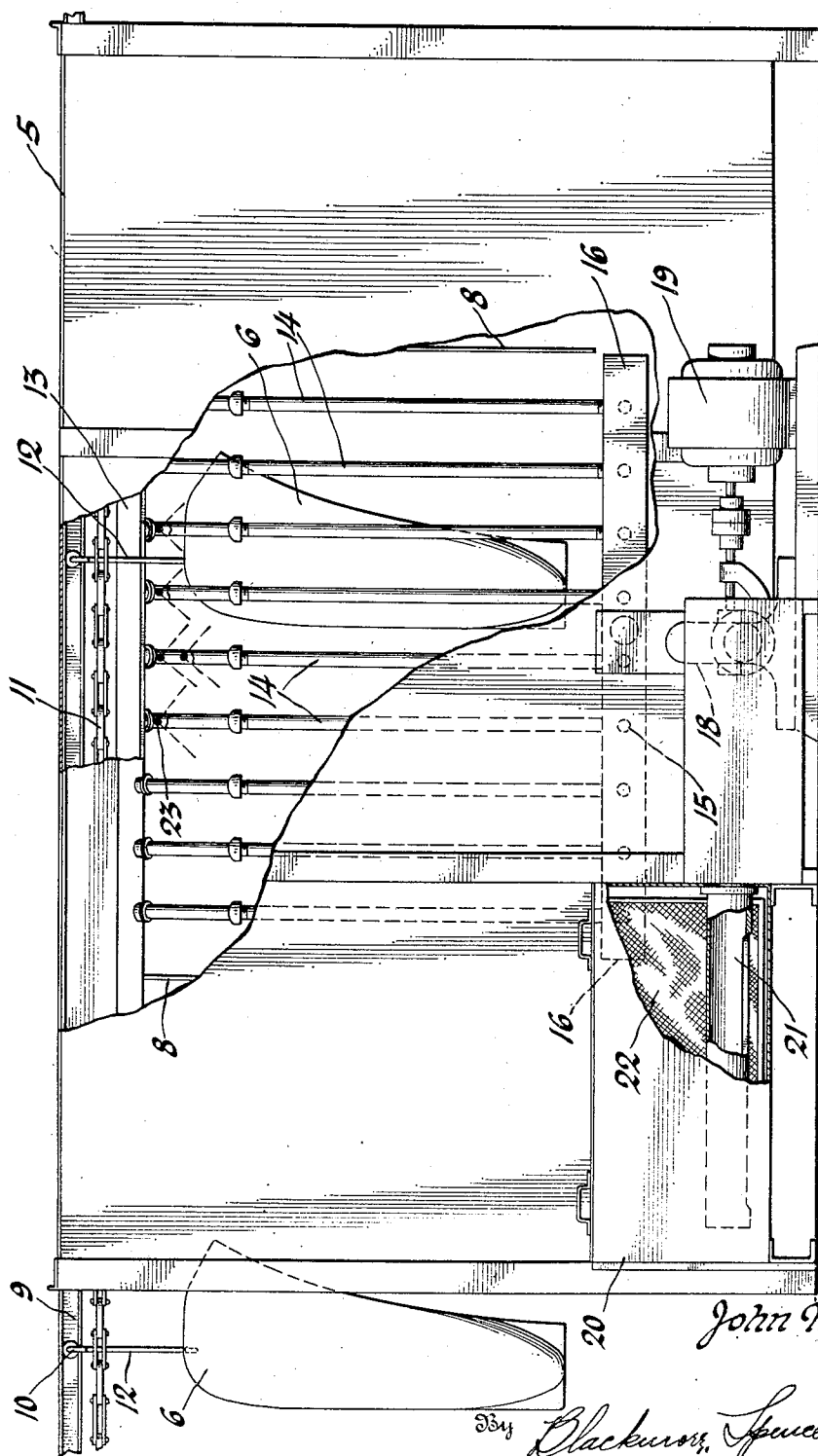


Fig. 1

Inventor

John MacQuaid

By

Blackburn, Spencer & Flint
Attorneys

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2 Sheets-Sheet 2

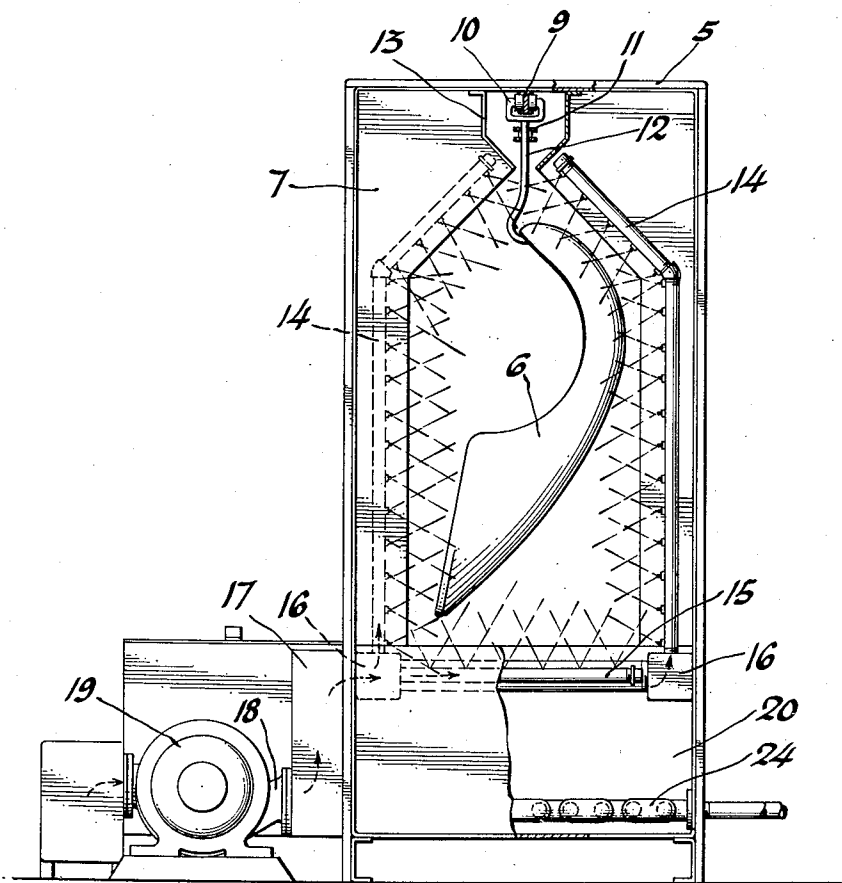


Fig. 2

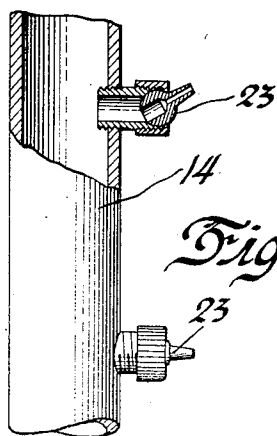


Fig. 3

Inventor
John MacQuaid

By *Blackmore, Spencer & Flint*
Attorneys

UNITED STATES PATENT OFFICE

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RUST-PROOFING PROCESS

John MacQuaid, Detroit, Mich., assignor to General Motors Corporation, Detroit, Mich., a corporation of Delaware

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4 Claims. (Cl. 148—6.5)

The invention relates to processes of applying rust-proofing solutions to articles, more particularly those having a ferrous metal surface, to produce thereon a coating tending to protect the iron or steel against corrosion or rust and adapted to retain other coatings, e. g., paint or enamel.

Methods of producing such "rust-proof" coatings by treatment of the article with solutions adapted to deposit phosphates, chromates, oxalates, etc., have been known for many years, the use of zinc and iron phosphates with phosphoric acid being disclosed, for example, in patents to Coslett 870,930 and 1,007,069, and oxalic acid in Gravell 1,315,017. The action of these baths was very slow and attempts were made to expedite the process by addition of activating agents, one of the most used being manganese compounds, as manganese dioxide. The time required, however, was still excessive, "thirty to ninety minutes," "one to three hours" or "several hours" being specified in patents dealing with such processes.

More recently there have come into general use other activating agents that still further expedite the reaction of rust-proofing chemicals with the metal, such as chlorides, nitrates, nitrites, etc. The action of these addition agents is variously explained, but the net effect as to time required for treatment has been such that, in more recent practice, satisfactory coatings have been obtained by immersion in hot baths for periods as short as three to ten minutes, depending somewhat upon temperature and concentration of the bath and the amount of coating desired.

I have discovered that, irrespective of the type of rust-proofing bath employed or of time-reducing chemical used, a further remarkable increase in activity of bath or reaction velocity can be attained by a novel method of applying the solution to the surfaces to be treated. In the practice of this process, which may be properly described as the surface scouring process, I apply the solution in continuous sheets or streams to substantially all areas of the surface to be coated while the article is suspended in the air. This is accomplished in general by directing the solution in a large number of jets, preferably substantially at right angles to the surfaces to be treated, in sufficient quantity and at sufficiently high velocity to cause energetic washing or scouring action upon the surfaces. This application of the solution by what may be termed a "blast" of solution and air is continued throughout the

treatment period and not merely to wet the surface.

The powerful washing or scouring action may be appreciated from the fact that, in applying the process for example to an ordinary automobile fender, solution is delivered at the rate of from four or five hundred gallons per minute up to twenty five hundred gallons or more per minute into a treating area of approximately eight feet in length under a pump pressure running as high as twenty pounds per square inch.

Typical rust-proofing solutions which I have employed in this process include, for example, a solution adapted to produce a coating of chromate or chromates of iron upon ferrous metal surfaces and containing as its essential constituents chromic acid and an activating agent of the halogen type, as sodium chloride. The proportions may vary widely but a typical commercial bath may contain about two ounces of a mixture of chromic acid (CrO_3) and sodium chloride (NaCl) per gallon of water. Another bath that may be employed consists initially of a water solution of a dihydrogen phosphate of zinc, iron or manganese or mixtures thereof with an activating agent of the nitrate type, e. g. copper or sodium nitrate. Still another suitable bath contains initially zinc dihydrogen phosphate activated with a nitrite or nitrous acid. It will be understood that the above are given merely as examples of suitable rust-proofing baths and are not intended as limiting my invention to use therewith since the invention contemplates the use of any chemical composition adapted to produce a rust-proof or corrosion-retarding coating upon metal surfaces such as iron, zinc, magnesium, aluminum, etc., by reaction of the treating chemicals with the metal of the surface.

In the prior use of rust-proofing solutions it has been the universal practice commercially, so far as I am aware, to immerse the articles to be treated in hot baths of the treating material. Some patents state that the solution may be applied by brushing or spraying or immersion. The time required for treatment, however, and the small quantity of solution that could be made to remain on the surface by merely brushing or spraying the solution on the surface rendered such methods of application ineffective for practical use. Various expedients were suggested for retaining on the surface sufficient solution for sufficient time to produce the desired coating, for example, by thickening the solution with colloidal materials such as gelatine or clay.

These processes also were ineffective and, to my knowledge, have had no commercial success.

One of the principal difficulties in producing rapidly a sufficient coating of rust-resistant salts is the difficulty of removing from the vicinity of the reacting agencies or from the sphere of chemical activity the undesired or waste products of the reaction. The velocity of the reaction in all these "contact" rust-proofing processes is subject to the law of mass action, in accordance with which the extent of chemical change is proportional to the active masses of the interacting substances. The velocity of the reaction, therefore, is increased by increasing the rate of destruction of the chemical equilibrium toward which the reaction tends. To effect such result the waste products of the reaction should be removed as rapidly as possible from the metal surface, which is the point at which the chemical action takes place. In other words, the reaction takes place only at the actual surface of the metal or in the ionic layer contacting such surface. The reaction velocity tends instantly to decrease in such layer in accordance with the law of mass action. I therefore maintain a high reaction velocity by forcibly removing the mobile reaction products in the solution so as to renew rapidly the chemical unbalance upon which the reaction depends.

Among the reaction products hydrogen is usually an important factor. It tends to form a sort of blanket on the metal surface which, in the immersion process, is removed only by formation of bubbles and escapes from the bath by mere gravitational influences. Other products are soluble or insoluble residues resulting from interaction of the metal and the acidic content of the bath but which do not enter into the coating process. The effect may be explained, in part, by stating that the surface of the metal becomes polarized and that further chemical or electrochemical action must await depolarization by removal, chemically or mechanically, of the polarizing agents. All of these products are forcibly removed by my process and a fresh supply of chemicals is constantly brought to the reaction sphere. It may be pointed out that the purpose of "spraying" as hitherto suggested in the art was merely to get the solution on the surface, whereas the basic idea in the present process is to get the solution off the surface and replenish the supply as rapidly as possible.

In practical application of the invention, I utilize apparatus one form of which is illustrated in the accompanying drawings in which

Figure 1 is a side view, partly broken away, showing a treatment chamber and mechanism associated therewith.

Figure 2 is an end view of the same.

Figure 3 is a detail view of a nozzle structure that may be employed.

Referring to the drawings, 5 indicates a compartment which may be formed with walls of sheet metal and of suitable dimensions to permit the passage therethrough of an article to be treated, for example a vehicle fender 6. End walls 7 and partitions 8 may be provided to hinder escape of treating liquid and to define within the compartment a treating chamber, these walls and partitions being apertured to allow the articles to pass through them. At the top of the compartment is shown a conveyer track or rail 9 on which trolleys 10 may travel, which trolleys are connected and moved by a chain 11. Hooks 12 are carried by the trolleys

10 from which may be suspended the articles to be treated. Shields 13 are arranged on both sides of the conveyer chain and track to protect them from the treating chemicals.

Within the treating chamber defined by the partitions 8 are arranged pipes 14, nine sets of which are shown. These are positioned upon both sides of the path through which the articles 6 travel and, together with cross-headers 15, almost completely surround the said path. These pipes and headers may be connected in any suitable manner, as by side-headers 16, to a riser 17, fed by the outlet of pump 18, driven by motor 19. Treating liquid contained in reservoir 20 may be supplied to the pump through pipe 21 the entrance to which is screened by suitable filtering means 22.

Pipes 14 and 15 are provided with a large number of outlets arranged to direct jets of the treating liquid into the path of the article 6. These outlets are preferably so constituted as to permit of adjusting the direction of the jets, e. g., by universally adjustable nozzles 23, so as to enable the operator to obtain proper distribution of the rust-proofing solution. In practice, with an article such as is illustrated, it has been found necessary to direct the nozzles, some forwardly, some rearwardly, and some to concentrate the jets toward the inner curved surfaces. The arrangement should be such that during at least the major portion of the travel of the article through the treating chamber, continuous blasts of liquid and the air necessarily admixed therewith will be directed toward all parts of the surface, thus maintaining a continuous scouring and impact effect over the entire surface.

The solution in the reservoir 20 may be maintained at any desired temperature by suitable heat-transfer medium in coils 24, a temperature of approximately 180° F. being desirable for the rust-proofing solutions in general use.

The length of the treating chamber and the rate of travel of the conveyer must, of course, be so coordinated as to effect the desired result.

In other portions of compartment 5 outside the rust-proofing chamber or in adjoining compartments may be arranged means for preliminarily cleaning the metal surfaces and final washing. Apparatus of conventional character may be used to apply the cleaning and washing solutions. It is highly desirable, however, that the washing step should follow immediately after the rust-proofing treatment and before the surfaces dry, in order to remove at once the rust-proofing solution and prevent spotting.

It will be noted that the effect of the application of high-pressure streams of solution to the metal surface will be to constantly wash from the surface the portions of the solution in which the active chemicals have become partially depleted, in fact, a most energetic scouring and cleaning action is produced. At the same time, by using the solution itself to effect the scouring action, the initial concentration of active chemicals is constantly being restored, and with such impact as to promote by the actual pressure itself a most intimate contact of the chemical agents with the reacting metal and cause the reaction to extend even into the pores. Furthermore, by reason of the tremendous turbulence produced in the solution itself and the forcible admixture of air with the bath liquid, oxidation, e. g., of ferrous salts, and other reactions beneficially affecting the solution or its "balance" are facilitated to an otherwise unattainable degree.

As a result of the effects above mentioned and possibly other factors which have not yet been recognized or the nature and influence of which have not been understood, it has been found possible to greatly reduce the time necessary for producing a satisfactory coating. In actual commercial practice, chromate coatings are now produced in as little as fifty seconds as compared with several minutes in the best immersion procedure. With some of the more active solutions the time has been reduced to as low as twenty-five seconds for standard procedure.

Further advantages of my process are found in the prevention of gas pockets and the avoidance of variations in chemical concentration or distribution.

By proper arrangement and adjustment of the nozzles the liquid may be so distributed and its impact and scouring effect upon the surfaces so determined as to substantially eliminate non-uniformity of coating and the "thin spots" which have hitherto occurred in rust-proofing articles of irregular shapes. The reduction in time of treatment and in amount of bath also enables the process to be applied in commercial installations and particularly in automatic conveyer systems with a minimum of space, equipment and tankage.

I claim:

1. The surface scouring process of rapidly producing a substantially uniform corrosion-resisting coating upon a metal surface comprising suspending the article to be treated in the air, moving such article through a treatment chamber, directing upon the article continuously while in such chamber blasts of liquid and air at high velocity, such liquid containing chemicals reacting with the metal to produce upon the surface a corrosion-resisting coating and containing ferrous salts, and so adjusting the blasts as to effect a substantially uniform coating upon the entire surface of the article.

2. Apparatus for rapidly producing a substantially uniformly corrosion-resisting coating upon the surface of a metal article comprising a treatment chamber, means for supporting an article

in the air, means for moving the article through the chamber, means for maintaining a supply of corrosion-resisting solution under high pressure, said solution containing ferrous salts and adapted to react with the metal surface to form a corrosion-resisting coating thereon, and means for directing upon the article while in said chamber blasts of corrosion-resisting solution and air at high velocity to thereby vigorously scour the surface of the article and rapidly form a substantially uniform corrosion-resisting coating thereon.

3. Apparatus for rapidly producing a substantially uniform corrosion-resisting coating on the surface of a metal article comprising a substantially closed treatment chamber having an entrance and an exit, means for suspending the metal article to be treated in the air, means for moving said article through the treatment chamber, means for maintaining a supply of corrosion-resisting solution under a pressure of approximately twenty pounds per square inch, said solution containing ferrous salts and containing chemicals adapted to react with the metal surface to form a corrosion-resisting coating thereon, and means for directing upon the article while in said chamber blasts of corrosion-resisting solution and air at high velocity whereby the surface of the article is vigorously scoured and a substantially uniform corrosion-resisting coating rapidly formed on the article.

4. The surface scouring process of rapidly producing a substantially uniform corrosion-resisting coating upon the surface of a ferrous metal article comprising supporting the article in the air, continuously directing upon the surface of the article while supported in the air a high velocity blast of rust-proofing solution admixed with air, said solution adapted to react with the ferrous metal surface to produce a corrosion-resisting coating thereon and containing ferrous salts, and continuously washing away the mobile products of reaction by the high velocity blast of rust-proofing solution and air.

JOHN MacQUAID.