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COATED SHEET AND METHOD OF PRODUCING SAME

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My invention relates to a novel form of metal sheet having a protective coating thereon, and to a method for its production. In particular, the invention contemplates a steel sheet coated with zinc, and a method of imparting to such product desirable characteristics not heretofore obtained.

According to present practice in the manufacture of steel sheets having a protective coating, the sheets having been rolled to the proper gauge, are passed through a galvanizing bath of molten zinc covered by a flux layer. During such treatment, the zinc forms an alloy with the iron in the surface of the sheets. This alloy has a density greater than that of the zinc bath and tends to drop off the sheet and accumulate at the bottom of the galvanizing tank, because of the solution pressure of the iron with respect to the zinc. In the usual process, however, the submersion of the sheet is not continued for a period long enough to cause the loss of a substantial amount of iron from the sheet surface. The sheet is drawn from the bath between finishing rollers partially submerged therein, which tend to remove excess zinc from the sheet. Investigation shows, however, that the finished sheet is coated with a composite protective sheath consisting of a series of zinc-iron alloys next the steel base, and a layer of substantially pure metallic zinc on top of the alloy.

As the sheets emerge from the bath, they are cooled in the air and the outer zinc layer acquires a smooth, bright, spangled surface, characteristic of the white metals. The spangles appear to result from the fact that, in cooling, the crystallization of the zinc progresses simultaneously about a number of widely spaced centers of crystal growth. The grains are therefore of large size. The planes of the different crystal groups are not parallel, and light rays falling on the sheet are reflected at different angles, giving the spangled effect.

Sheets produced by the process outlined above are unsatisfactory for numerous reasons. The surface of the sheets is so smooth that paint will not adhere thereto. A more serious objection is the fact that the alloy and zinc layers in the coating tend to crack and flake on bending such as is encountered in forming and deep-drawing processes. This effect appears to be due to the coarse crystalline structure of the spangled coat since the failure of the latter commences along the lines between spangles. The easily corrodible base metal is thus exposed and the advantage gained by the galvanizing is largely lost. Another disadvantage of the product is that some of the flux which floats on top of the galvanizing bath, clings to the sheets as they are drawn therefrom. This flux is a molten salt (usually ammonium chloride) and has a deleterious effect on the product which may not be apparent until after storage for a considerable period. In spite of this effect, no satisfactory method of removing the flux has been devised.

Because of the foregoing objections to the bright-finished sheets made by the present process, a considerable demand has arisen for a sheet which would stand up under bending and drawing operations, without fracture of the coating and having a dull or mat finish, to which paint would adhere readily.

Although it has been previously proposed to make a galvanized sheet having a dull finish, as far as I am aware there has been no desirable process brought forth for this purpose. It is well known that sherardizing produces a dull-finished coating of zinc but the practical difficulties of coating sheets by this process rapidly, continuously and at low cost, eliminate it from consideration. The product, furthermore, is characterized by the above mentioned objections to spangled sheets. According to another process, galvanized sheets on emerging from the bath are conducted through a furnace chamber where they are maintained at a high temperature for a considerable period. The product is a dull-finished sheet but its adaptability for forming and drawing is not materially improved over that of the spangled sheet. A serious objection to this process is that frequently, the sheets are badly discolored and must be scrapped or sold as seconds. The cost of production, furthermore, is considerably higher than that of spangled sheets. I believe that the extended period of heating out of contact with an excess of zinc permits the alloying process to continue so that substantially the entire coating consists of a zinc-iron alloy with substantially no free zinc. The heat treatment appears to permit crystal growth to take place at a slow rate around a large number of centers so that the grain structure of the coating is considerably smaller than that of the coating of spangled sheets which are cooled so rapidly as to favor the formation of larger grains. The latter condition, I believe is responsible for the poor characteristics of spangled sheets for forming and drawing.

I have invented a process for the manufacture of dull-finished galvanized sheets which is characterized by numerous advantages over known

processes. The resulting product, furthermore, is a distinct improvement over such sheets as now marketed.

In accordance with the invention, I subject sheets having a protective coating such as zinc, to a blast of abrasive particles. I prefer to employ an air blast and the abrasive may be sand or other material. The treatment is applied uniformly to the surfaces of the sheets. One surface may be treated at a time, or both surfaces simultaneously. The blasting produces a high grade of dull-finished sheet having a uniform surface condition characterized by slight pits or irregularities which makes it highly desirable for receiving a coat of paint. The paint adheres well to the sheet surface and may be applied so as to obtain a good area of coverage. The sheet, furthermore, is free from discolorations such as are frequently met with in sheets produced by the process mentioned above. The spangles of the original sheet are entirely obliterated. By eliminating the losses resulting from the scrapping of discolored sheets or the lowering of the grade thereof, my process effects marked economies in the manufacture of galvanized sheets. The cost of carrying out the invention is also less than that of known processes.

An important feature of the product, in addition to the foregoing, is the fact that the blasting of the sheet surface produces a state of compression in the coating layers. This condition will be clearly apparent if only one side of a sheet is treated at a time. The result of blasting one side of a sheet only, is to cause the sheet to assume a convex curvature on the side treated. The effect of the blasting seems to be similar to that of forging. The abrasive particles, that is, exert a plurality of forging blows on the surface of the sheet and tend to cause a lateral and longitudinal extension of the surface. The untreated surface retains its original dimensions and the compression between the grains of the treated surface causes the sheet to assume a camber. When the untreated side of the sheet is blasted, the sheet returns to its normal flat condition, showing that the compression between grains and the dimensions of the surface layer have been equalized on both sides of the sheet.

The product is characterized by greatly increased resistance to fracture of the coating on bending and forming of the sheet. I find that articles requiring deeper drafts and more severe bends than can be formed from spangled sheets, can be made from blasted sheets without any apparent fracture or weakening of the coating. I attribute this property of the product to the fact that both surfaces of the sheet are in a compressed condition and that the coarse crystalline structure of the coating is destroyed and replaced by a fine, close-grained structure. These conditions, added to the fact that the surface layers of the coating are roughened by the blasting, seem to make it possible to stretch the coating, as in bending and forming, without fracturing it, to a degree impossible with spangled sheets.

A further advantageous result due to the process described is that the traces of flux which cling to the spangled sheets are entirely removed by the blasting. Although this result is incidental to the provision of the desired surface condition of the sheets, its importance will be realized when it is stated that there is no known process for removing the flux, of which the cost is not entirely prohibitive.

A still further advantage is that the process may be utilized to remove excess zinc from the coating on the sheet. It is known that too much zinc may defeat the purpose of coating. It is obvious that abrasive blasting will tend to remove any zinc not alloyed with the steel base. The durability of the coating will be increased thereby, because the corrosion-resistant zinc-iron alloy will be exposed. The zinc removed by the abrasive may, of course, be reclaimed by suitable processes. If this is desirable, it will be best to use an abrasive which does not powder as sand does. After the removal of excess zinc, the coating appears to comprise substantially a layer of zinc-iron alloy exclusively, the alloy layer having a dull or mat finish. This coating has high resistance to fracture and removal as well as to corrosive influences. By cold-rolling a blasted sheet, I am able to produce a high-grade product having a uniform, dull-gray appearance, which is very much superior in ductility, durability and paint-receiving qualities, to the bright, spangled sheet as now produced.

Different degrees of surface roughening may be obtained by using different grades of abrasive.

From the foregoing description of the process and product of my invention, it will be apparent that the process has advantages of low cost and simplicity compared to known processes for producing dull sheets and that the product resulting has highly desirable characteristics not possessed by dull-finished sheets now on the market.

Although I have described but one modification of the invention, it is obvious that it may be practiced by methods other than that described and for that reason I do not wish to be limited specifically to the details disclosed. Any changes or alterations within the scope of the appended claims may be made without departing from the spirit of the invention.

I claim:

1. In a method of producing coated metal sheets, the steps including passing sheets through a galvanizing bath and a flux bath, cooling the galvanized sheets and subjecting them to a plurality of light forging blows by means of a stream of abrasive particles while carrying adherent flux from the bath, to improve the adherence and the drawing quality of the coating.

2. A method of improving the drawing quality of galvanized sheets, including the steps of subjecting the sheets when cooled after the galvanizing operation to a plurality of light forging blows by means of a stream of abrasive particles while carrying adherent flux from the bath, in substantially continuous sequence with said galvanizing operation.

3. The method defined by claim 1, further characterized by the cold rolling of the sheets after subjecting them to the effect of said abrasive particles.

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