

July 11, 1961

L. P. GOTSCH ET AL

2,991,544

BRIGHT SURFACED METAL SHEETS AND METHOD OF PRODUCING SAME

Filed May 7, 1957

Fig. 1.

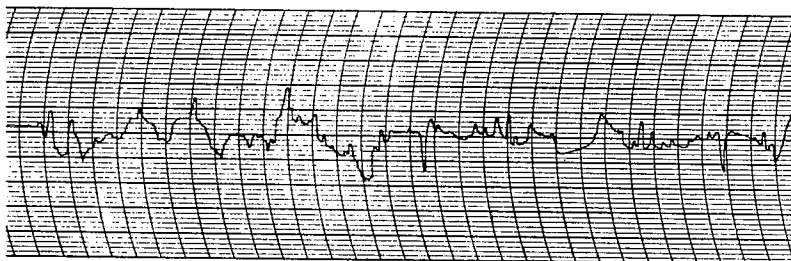


Fig. 2.

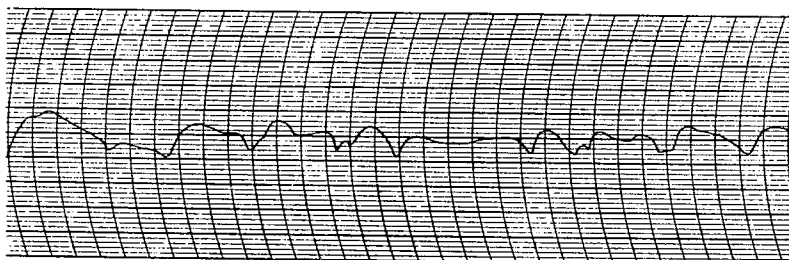


Fig. 3.

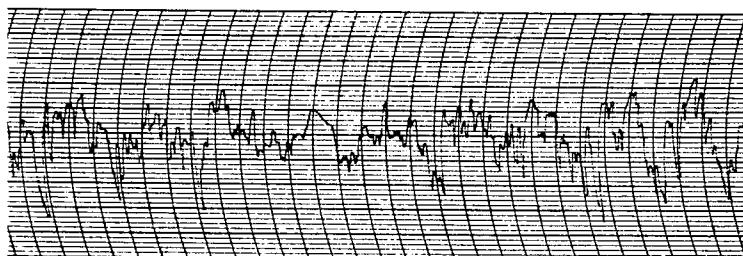
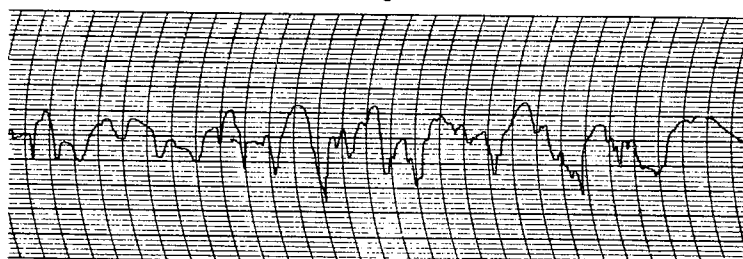


Fig. 4.



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1

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Filed May 7, 1957, Ser. No. 657,551

2 Claims. (Cl. 29—183.5)

The present invention pertains to a metal sheet, having a bright, reflective surface and a method of producing such bright surfaced metal sheet. More specifically, the invention pertains to a metal sheet having a particular type of surface smoothness producing the bright appearance and the method of producing this particular type of smoothness.

By the terms coarse roughness and fine roughness as used herein are meant surface ridges having an amplitude, when measured from base to crest, of about from 15 to 200 microinches, and surface ridges having an amplitude of less than 15 and usually less than 5 microinches respectively.

The invention will be described hereinafter with relation to low carbon steel known as black iron. However, it must be understood that the instant invention has application to other metals produced by rolling wherein their surface characteristics of fine and coarse roughness determine their specular reflection properties. Examples of such other metals are stainless steel, aluminum, copper, etc.

Black plate, the low carbon, sheet steel made from black iron, is produced in the steel mills by the well-known procedure of passing a steel billet successively between rollers whereby the thickness of the billet is successively reduced until a sheet of desired thickness is produced, and thereafter annealed and temper rolled to produce a surface finish. However, black plate so produced is dull in appearance and does not compare favorably with the bright shiny appearance of tin plate. This dull appearance of black plate is a serious drawback to its commercial acceptance as a can making material.

During experimentation to improve the surface appearance of black plate, it was determined that microscopic ridges on the plate surface scattered incident light thereby giving the surface a high diffuse reflectance value and consequently its dull, lacklustre appearance. Investigation of the plate surface showed it to have relatively widely spaced ridges or coarse roughness and, on the surface of the coarse roughness, relatively closely spaced ridges or fine roughness. Further investigation indicated that the surface of the temper rollers used to finish the black plate also exhibits this same pattern of coarse and fine roughness; that this pattern is imparted to the black plate surface by the rollers during the rolling operation; that the fine roughness on the black plate surface scatters the light and is responsible for the high diffuse reflectance value and dull appearance of black plate; and that the coarse roughness on the roller surface is necessary to give the roller sufficient "tooth" or "bite" into the steel sheet to enable the roller to frictionally engage and propel the sheet along and through the rolling operation.

It is therefore an object of the present invention to provide a metal sheet, primarily a black iron sheet, having a low value of diffuse reflectance.

A further object of the invention is to provide a bright-surfaced, light-reflective black plate comparable in appearance to tin plate.

Another object is to provide black plate of the character described which is substantially free of dulling, light-scattering microscopic ridges.

2

Yet another object is to provide a method of rolling black plate of the character described, which method is rapid and efficient, and which requires very little change in conventional equipment for rolling black plate.

Numerous other objects and advantages of the invention will be apparent as it is better understood from the following description, which, taken in connection with the accompanying drawings, discloses a preferred embodiment thereof.

Referring to the illustrations:

FIGURES 1 and 2 are reproductions of surface tracings of a sheet metal panel, the scale being 1 small division=5 microinches; and

FIGURES 3 and 4 are reproductions of surface tracings of a hardened steel, temper roller, the scale being 1 small division=5 microinches.

It has been discovered that the above objects are obtained by providing black plate with a surface having coarse roughness but having little or no fine roughness. Conventional polishing, i.e. gradually reducing the surface roughness of the black plate by polishing with successively finer abrasives, either by hand or by machine, does not produce the desired surface characteristics on the black plate. Aside from the fact that conventional polishing would be too time consuming to be economically feasible, such polishing reduces both the coarse and fine roughness substantially equally producing a very smooth, low friction surface. Black plate having this type of surface is difficult to handle or to perform subsequent operations on because of its low friction or "slippery" surface.

Lapping a black plate surface, which has received no previous polishing, using a very fine abrasive produces a surface having the desired coarse roughness but which is essentially free of fine roughness. However, a further discovery was made that obviates this time consuming lapping operation. This discovery comprises rolling the unpolished black plate with one or more hardened temper or finishing rollers, the surfaces of which have been lapped with a very fine abrasive whereby the fine roughness on the surface of the rollers is substantially reduced, but the coarse roughness thereon is, in large measure, retained. Finishing rollers so polished have sufficient "tooth" to frictionally engage and propel the sheet steel along a path of travel, but impart no dulling fine roughness to the sheet whereby black plate having high specular reflectance or brightness can be produced directly from the rolling operation without resorting to subsequent or additional treatment of the plate.

The following example will serve to explain the invention more precisely but is not to be considered limiting the invention in any way.

A panel of commercial CMQ (Can Maker's Quality black plate as received in a commercial lot from the steel mill) having received no preliminary grinding or polishing was lapped with an aqueous suspension of aluminum oxide carried on a polishing cloth which was backed with a metal surface. As shown in FIG. 1, before lapping this CMQ panel had considerable fine roughness having an amplitude of less than 15 microinches. However, as shown in FIG. 2, this fine roughness has been substantially completely removed; whereas the coarse roughness, although somewhat reduced, is still present and apparent. Before lapping, the panel had a diffuse reflectance measurement of 15.7%; whereas after lapping, the diffuse reflection was reduced to 3.2%, nearly a five fold reduction in diffuse reflectance.

FIGS. 3 and 4 respectively depict the surface of a hardened steel temper or finishing roller before and after having been wet lapped with levigated magnesium oxide. Although the amplitude of the ridges forming the coarse

3

and fine roughness is greater than that shown in FIGS. 1 and 2, the relationships between the two types of roughnesses is substantially the same on the finishing roller as on the CMQ panel. It can be seen in FIG. 4 that after having been lapped, the coarse roughness is still very apparent; whereas the fine roughness has been materially reduced.

By the method of the present invention, highly reflective or bright surfaced black plate may be produced directly from a conventional sheet rolling operation, i.e. successive rollings of a steel billet to reduce the thickness and increase the width thereof to form a sheet. This may be accomplished by adding one or more temper or finishing rollers polished in the manner specified above to the end of a temper rolling line or by substituting one or more of the polished temper or finishing rollers for the last conventional finishing rollers in a temper rolling line.

It is thought that the invention and many of its attendant advantages will be understood from the foregoing description, and it will be apparent that various changes may be made in the form, construction and arrangement of the parts and that changes may be made in the steps of the method described and their order of accomplishment without departing from the spirit and scope of the invention or sacrificing all of its material advantages, the form hereinbefore described being merely a preferred embodiment thereof.

We claim:

1. A metal sheet the surface of which is composed essentially of coarse roughness ridges having an amplitude when measured from base to crest of at least 15 microinches, the surface of said coarse roughness ridges being essentially free of fine roughness ridges having an amplitude when measured from base to crest of less than

4

15 microinches, whereby said sheet surface has sufficient frictional resistance to be easily handled and rolled and at the same time has a bright, shiny appearance.

2. A black iron sheet the surface of which is composed essentially of coarse roughness ridges having an amplitude when measured from base to crest of about from 15 to 200 microinches, the surface of said coarse roughness ridges being essentially free of fine roughness ridges having an amplitude when measured from base to crest of less than 15 microinches, whereby said sheet surface has sufficient frictional resistance to be easily handled and rolled and at the same time has a bright, shiny appearance.

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