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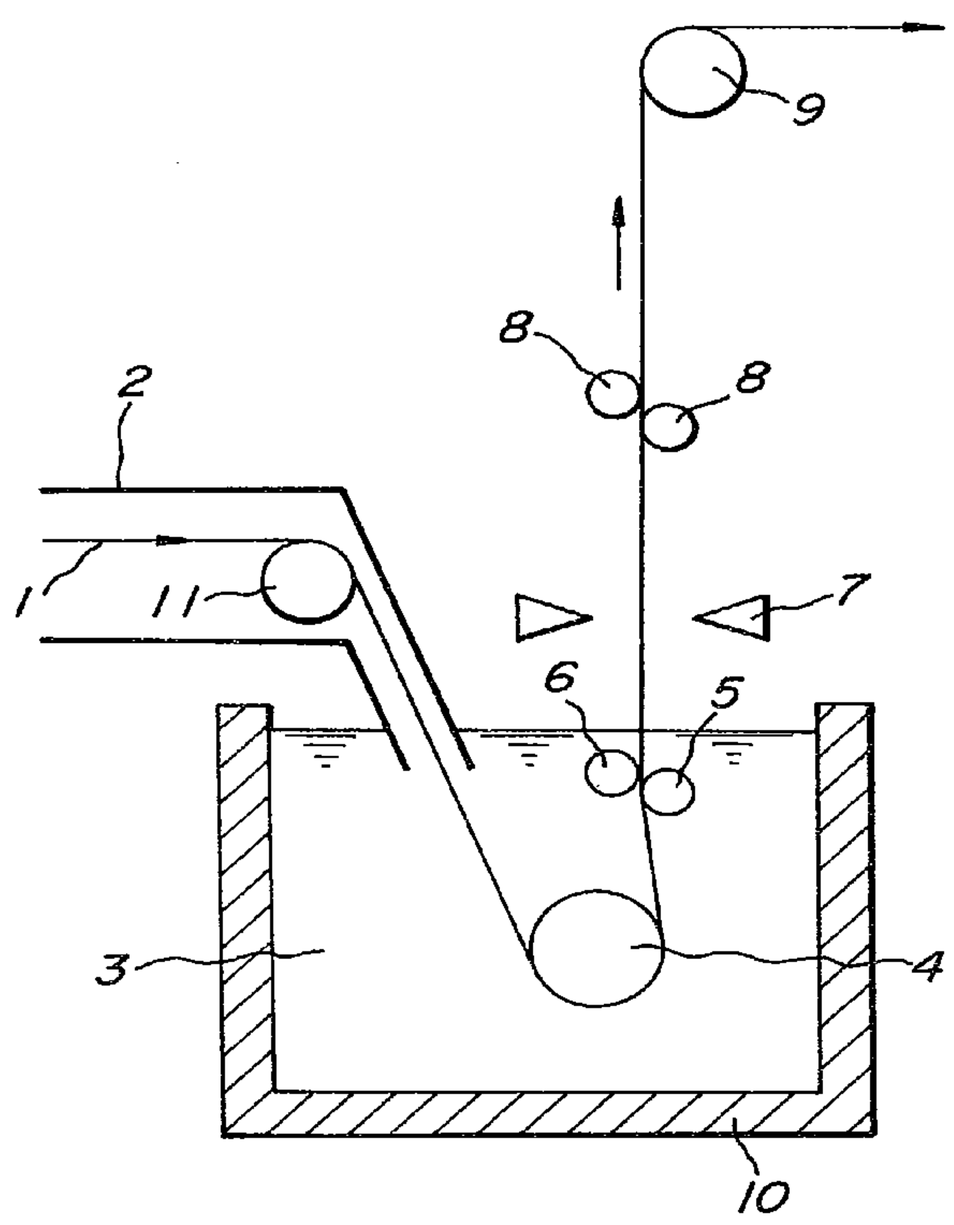
(54) **TAMBOUR A REVETEMENT APPLIQUE PAR PULVERISATION DESTINE A LA GALVANISATION EN CONTINU**

(54) **SPRAY-COATED ROLL FOR CONTINUOUS GALVANIZATION**



(57) A roll used for continuous galvanization is provided at its surface with a spray-coated layer made from a cermet spraying material consisting essentially of WC-Co. The spray-coated layer consists of WC, at least one specified intermetallic compound and at least one of amorphous W-C-Co compound and free C, but contains no free W and free Co.

Abstract of the Disclosure

A roll used for continuous galvanization is provided at its surface with a spray-coated layer made from a cermet spraying material consisting essentially of WC-Co. The spray-coated layer consists of WC, at least one specified intermetallic compound and at least one of amorphous W-C-Co compound and free C, but contains no free W and free Co.

SPRAY-COATED ROLL FOR CONTINUOUS GALVANIZATION

Background of the Invention

Field of the Invention

This invention relates to a spray-coated roll used in an apparatus for continuously galvanizing steel sheets, and more particularly to a surface coating structure of a roll such as sink roll, support roll, touch roll or the like immersing in a galvanizing bath.

Disclosure of the Related Art

The galvanized steel sheets (inclusive of zinc-aluminum hot dipped steel sheets) are used as an outer plate for vehicles, a corrosion resistant material for buildings or the like, and manufactured mainly by an apparatus as shown in Fig. 1.

That is, a steel sheet 1 to be galvanized is first annealed in a continuous annealing furnace, passed through a snout 2 maintained in a reducing atmosphere and then introduced into a galvanizing bath 3, where the steel sheet 1 is galvanized while passing through a sink roll 4, a front support roll 5 and a back support roll 6. Thereafter, the galvanized steel sheets is passed through wiping nozzles 7, a touch roll 8 and a top roll 9 to adjust a thickness of the resulting galvanized layer. Moreover, numeral 10 is a ceramic pot for the galvanizing bath, and numeral 11 a turn down

roll for guiding the steel sheet from the continuous annealing furnace to the galvanizing bath 3.

In general, the above rolls except the roll 11 are immersed in the galvanizing bath or contact with the high temperature galvanized steel sheet, so that they are required to satisfy the following conditions:

(1) The roll is hardly subjected to an erosion due to molten metal;

(2) The roll is hardly abraded by contacting with the passing steel sheet;

(3) When the roll is taken out from the galvanizing bath for maintenance and inspection, zinc easily peels off from the surface of the roll;

(4) The roll can be used over a long period of time; and

(5) The cost of the roll is low.

In order to provide rolls satisfying these conditions, i.e. rolls used for the galvanization, there have hitherto been proposed the following surface coating methods:

(a) A self-fluxing alloy is sprayed onto the surface of the roll as disclosed in Japanese Patent laid open No. 54-69529;

(b) A ceramic such as ZrO_2, Al_2O_3 or the like is sprayed onto the surface of the roll as disclosed in Japanese Patent laid open No. 61-37955 and No. 61-117260;

(c) A surface coating layer of 0.1-2.4mm in thickness consisting of at least one of WC, Cr_3C_2 and TiC and the reminder of hot corrosion-resistant metal or its alloy is formed as disclosed in Japanese Patent Application laid open No. 58-25468; and

(d) A spray-coated layer composed of WC-Co series cermet material containing 5-28 wt% of Co and having a porosity of not more than 1.8% is formed on the roll surface as disclosed in Japanese Patent laid open No. 1-225761.

Among these conventional coated layers, the cases (a) and (b) are good in the resistance to galvanization as compared with the non-treated steel roll, but the self-fluxing alloy layer or the oxide ceramic layer are locally peeled off from the surface of the roll in use over about 2 weeks, which is transferred onto the roll surface as a undesired pattern, and consequently the commercial value is considerably lowered.

In the case (c), the carbide such as WC, Cr_3C_2, TiC or the like shows an excellent resistance to erosion due to galvanization, but can not form the coated layer by spraying process alone. Therefore, the carbide is used together with a metal as a binder to form a so-called cermet coated layer. However, the cermet coated layer has a drawback that the performances are considerably lowered in accordance with the kind of

the metal used as a binder and can not be put into practical use. That is, when the carbide is mixed with Ni, Si or the like as a heat-resistant metal, the resulting coated layer is rapidly eroded by the galvanizing solution to loose the function of the coated layer.

Moreover, the coated layer made from a cermet material of the carbide containing Co is relatively durable to the galvanizing solution, and may be eroded thereby in a short time though the cause of erosion is not clear. The latter coated layer is required to have a thickness of not less than 0.1mm. If the thickness is less than 0.1mm, the effect is poor.

In the case (d), the inventors have proposed a method for improving the carbide-Co cermet coated layer. In this method, the porosity of the coated layer is restricted to not more than 1.8%, whereby the coated layer is sufficiently durable to the galvanizing solution even at a thickness of less than 0.1mm. However, the appearance becomes important rather than the improvement of the corrosion resistance as a performance required in the recent galvanized steel sheet. That is, a slight cloud of gloss generated in the galvanized surface, a linear transferred damage on the galvanized surface due to groove formed in the sink roll immersed in the galvanizing bath and the like, which have been ignored in the conventional technique,

recently become not acceptable.

In the spray-coated layer of WC-Co cermet system, it is often difficult to produce high quality galvanized steel sheets by defining only the amounts of both components used, and also if the resulting WC-Co cermet layer satisfies the requirements, it has a drawback that the life is relatively short.

Summary of the Invention

It is, therefore, an object of the invention to form a spray-coated layer having an excellent resistance to corrosion against molten zinc or Zn-Al molten alloy onto a surface of a roll for galvanization.

It is another object of the invention to provide a spray-coated roll effective for the formation of galvanized layer on steel sheet having improved galvanizing operation and high productivity.

It is the other object of the invention to provide galvanized steel sheets having an excellent quality.

The inventors have made various crystallographical studies of WC-Co spray-coated layer in order to develop a spray-coated layer for a sink roll in accordance with the above requirements on the quality of the galvanized steel sheet and found that an excellent resistance to erosion of the galvanizing solution is exhibited by selecting a coating composition

among various intermetallic compounds and decomposition compounds produced in the production of WC-Co series spray coating materials and through heat hysteresis in the spray coating as mentioned later.

According to the invention, there is the provision of a spray-coated roll for continuous galvanization comprising a roll drum and a spray-coated layer of a cermet material consisting essentially of WC-Co formed on an outer peripheral surface of the roll drum, the spray-coated layer containing at least one substance selected from the group consisting of intermetallic compounds, amorphous W-C-Co compounds and free carbon and having a structure that free W and free Co are hardly detected by an X-ray diffractometry, and the intermetallic compound being selected from W_2C, Co_3W_3C, Co_6W_6C, Co_2W_4C and $W_6C_{2.54}$.

In preferred embodiments of the invention, the spray-coated layer has a thickness of 0.04-1.85mm and a porosity of not more than 1.8%.

Brief Description of the Drawings

The invention will be described with reference to the accompanying drawings, wherein:

Fig. 1 is a schematic view showing an outline of a galvanization apparatus; and

Figs. 2a and 2b are a chart of X-ray diffraction pattern of spray-coated layer from WC-12%Co

material synthesized by sintered and crushed process.

Description of the Preferred Embodiments

In general, WC-Co spraying material is produced by the following processes:

(i) WC and Co are sintered at a high temperature of not lower than 1000°C in a hydrogen gas atmosphere having a very low oxygen partial pressure, which is mechanically crushed and sieved to particle size range suitable for the spraying (sintered and crushed process);

(ii) The surfaces of WC particles are subjected to Co plating (coated process);

(iii) WC particles and Co powder are mechanically mixed (agglomerated process);

(iv) Co is fused in an atmosphere containing no oxygen and WC particles are charged thereinto to react them and then the resulting reaction product is mechanically crushed and sieved (cast and crushed process); and

(v) The powder produced in anyone of the above processes (i)-(iv) is fused by plasma flame or laser, which is pulverized and sieved (plasma-densified or laser-densified process).

The inventors have confirmed that WC-Co spraying materials produced by the above processes are the same in the chemical composition but are largely

different in the crystalline state of components constituting the material. That is, in these spraying materials having a hysteresis exposed to a high temperature state as in the processes (i), (iv) and (v), WC reacts with Co to produce W_2C, Co_3W_3C, Co_6W_6C, Co_2W_4C and the like. On the other hand, in the spraying materials produced by the processes (ii) and (iii), WC and Co are existent at a freely mixed state.

As mentioned above, the crystalline structure of components constituting the WC-Co spraying material largely differs before and after the production the spraying material by the above processes. Furthermore, it has been found that these crystalline structures largely affect the resistance to galvanizing bath solution. That is, even when the chemical composition of these spraying materials are merely called as WC-Co series spraying material, it has been confirmed that all of these materials are not necessarily suitable as a coating layer on a roll for galvanization. In other words, in order to form the spray-coated layer according to the invention, it is necessary to use the spraying materials produced by the processes (i), (iv) and (v).

As a method of producing the coated layer by using the above spraying material, use may be made of (A) plasma coating method, (B) high-velocity oxygen/fuel method using combustion energy as a heat source (hereinafter referred to as HVOF method), (C) detonation

method using explosion energy of combustible gas and the like. Even in these methods, the spraying material is subjected to heat hysteresis, so that the crystalline structure is again changed.

In general, plasma flame produces a high temperature of several to twenty thousand centigrade degree, so that it can easily melt not only metal but also high melting point ceramics. However, when the WC-Co spraying material is subjected to plasma coating, WC is decarburized in plasma flame of high temperature, or WC reacts with Co and hence the chemical composition before coating largely changes. The decarburized product of WC is poor in the resistance to galvanizing bath solution and is unfavorable as a coating for the sink roll. For example, when the spraying material produced by the above sintered and crushed process (WC-12 wt% Co) is subjected to plasma coating in air, WC is decarburized according to the following reaction formulae:

$$2WC \rightarrow W_2C + C \quad .... (1)$$

$$W_2C + O_2 \rightarrow 2W + CO_2 \quad .... (2)$$

As a result, the resulting spray-coated layer becomes porous and hot zinc easily penetrates into the inside of the layer and the steel of the roll substrate is considerably eroded. Furthermore, W produced according to the reaction of the formula (2) reacts with hot zinc, so that the resistance to galvanizing bath solution in

the spray-coated layer itself is lowered.

The chemical change in the plasma flame as mentioned above differs in accordance with the production process of WC-Co spraying material (production hysteresis) as mentioned later. Further, this chemical change directly affects the resistance to galvanizing bath solution. Therefore, the spray-coated layer having excellent resistance to galvanizing bath solution can not be obtained even if only the chemical composition of the spraying material is defined or if only the spraying method is restricted.

In the spraying method using an energy of combustion gas such as propane, acetylene, propylene, hydrogen or the like as a heat source, the temperature of the heat source is low as compared with the plasma flame and is not higher than 3000°C. However, the WC-Co spraying material is decomposed or reacted even at this temperature, so that the resistance to galvanizing bath solution of the resulting spray-coated layer can not accurately be judged only by this spraying method or the chemical composition of the material.

Fig. 2 shows the X-ray diffraction patterns of the spray-coated layers produced by plasma coating method in air (Fig. 2a) and by HVOF coating method (propylene as a fuel)(Fig. 2b) using WC-12Co spraying material produced by the sintered and crushed process, respectively. As seen from Fig. 2, even when the same

spraying material is sprayed, strong peaks of WC, W_2C and W are identified in the spray-coated layer obtained by plasma coating method, and also the presence of free carbon can be observed. On the other hand, the spray-coated layer obtained by the HVOF coating method consists essentially of WC and contains W_2C and η -phase (Co_3W_3C) but does not contain free W and C.

The following Table 1 shows the results of X-ray diffraction patterns on the spray-coated layers obtained by the plasma coating method and the HVOF coating method from the WC-12%Co spraying materials produced by the above various processes.

Table 1

No	Manufacturing method of spraying Powder	Powder	Plasma Coating	HVOF Coating
1	Sintered and Crushed	<u>WC</u>, Co_3W_3C	<u>W</u>, W_2C, C, B	<u>WC</u>, W_2C, Co_3W_3C, $W_6C_{2.54}$
2	Cast-Crushed and Fused	<u>WC</u>, W_2C, Co_3W_3C, Co_6W_6C	<u>WC</u>, <u>W_2C</u>, Co_2W_4C, C	<u>WC</u>, W_2C, ※W, Co_2W_4C, C
3	Agglomerated	<u>WC</u>, Co	<u>WC</u>, W, W_2C, C, B	<u>WC</u>, W, W_2C, C, B
4	Coated	<u>WC</u>, Co	<u>WC</u>, W, W_2C	<u>WC</u>, C, W

Note:

B: Unknown broad peak in X-ray diffraction pattern.

Under line: Main peaks

※: Very small peak

As seen from Table 1, in the spraying materials produced by the agglomerated process and the coated process, WC and Co are identified at individual state, so that it is apparent that both the components are existent at a mixed state. When the spraying material of such a mixed state is sprayed by the plasma coating or the HVOF coating method, Co is not identified in the resulting coated layer and free W is inversely detected.

On the other hand, the spraying material produced by the sintered and coated process consists essentially of WC and Co_3W_3C as a reaction product between WC and Co before the coating, but when it is coated by the plasma coating method, W, W_2C, C and unidentifiable amorphous component (broad peak) are detected, while when it is coated by the HVOF coating method, WC, W_2C, Co_3W_3C and C are detected. Therefore, even when using the same material, if the coating method is different, the crystalline structure of the resulting spray-coated layer changes.

The phenomenon of changing the crystalline structure in the spraying material and the spray-coated layer as described above is common even in WC-5%Co, WC-17%Co, WC-28% Co materials in addition to the WC-12%Co material though the changing degree is somewhat different. That is, When the WC-5%Co material having a small Co content is coated by the plasma coating method,

W is strongly identified in the resulting spray-coated layer, while when the WC-28%Co material having a high Co content is coated by the HVOF coating method, unreacted Co is detected in the resulting spray-coated layer. These layers are poor in the resistance to galvanizing bath solution and unsuitable as a coated layer according to the invention.

As is generally known, the compounds capable of judging by X-ray diffractometry are restricted to have a crystallinity, while the amorphous substance and slight components of not more than 1% can not be detected. However, the inventors have found that the acceptance of the spraying material to be used in the invention and the spray-coated layer can be judged by the X-ray diffractometry, so that all judgements in the invention are based on this method.

Furthermore, the X-ray diffraction apparatus used in the invention is an apparatus of RAD #C model made by Rigaku Denki Kabushiki Kaisha using CuKα line at 40 KV and 40 mA.

Moreover, various WC-Co cermet materials used in the invention contains not more than 2% of impurities such as Fe, Ni, Cr, C, Si and the like when considering the incorporation of them from the starting material or the production step.

On the other hand, even if the spray-coated layer is excellent in the resistance to galvanizing bath

solution, when it contains many pores, hot zinc penetrates into the inside of the coated layer to erode the substrate
of the roll, whereby the coated layer is peeled off from the substrate, so that it is important to control the porosity of the coated layer. In this connection, the inventors have observed the appearance of the spray-coated layers after the WC-Co coated layers (thickness: 150μm) having different porosities were prepared on carbon steel (JIS G 3101 SS400) by the plasma coating process under atmospheric pressure and the HVOF coating process and then immersed in hot zinc at 480°C for 3 days.

The thus observed results are shown in Table 2, from which it is confirmed that the coated layer having a porosity of not more than 1.8% is not eroded by hot zinc and shows a sound state, while the coated layer having a porosity of more than 2.0% is locally peeled off from the substrate or the substrate is largely eroded by hot zinc.

Moreover, the coated layer having the porosity of not more than 1.2% can not be formed by the plasma coating process, while the more densified coated layer is obtained by the HVOF coating method.

The porosity of the coated layer is measured as follows:

At first, the section of the spray-coated

layer is photographed and recorded by means of an optical microscope and pore portions of the layer in the photograph are colored, which is analyzed by an image analyzing apparatus to measure an area ratio of colored portions to the recorded photograph.

Table 2

No	Porosity of coating (%)	Damaged area of coating (%)	
		Plasma coating	HVOF coating
1	< 0.5	—	< 0.01
2	0.8 ~ 1.0	—	< 0.01
3	1.2 ~ 1.5	—	< 0.01
4	1.6 ~ 1.8	< 0.05	< 0.01
5	2.0 ~ 2.3	3.6	2.5
6	2.5 ~ 3.5	38	32
7	> 3.8	45	46

Spraying powder : Sinter-Crushed WC - 12% Co.

Damaged area : Including the chipping, spalling by thermal shock and attacked area by molten Zn

In the spray-coated layer formed on the roll for galvanization, the thickness of the layer is an important factor in addition to the above crystalline structure of the components constituting the layer and porosity of the layer. When the coated roll is immersed in the galvanizing bath at a high temperature and taken up therefrom, internal stress based on the difference of

thermal expansion coefficient between the coated layer and the roll substrate is caused in accordance with the thermal change. As the difference of thermal expansion coefficient becomes large, the coated layer is apt to be peeled off from the roll substrate. Particularly, there is caused a phenomenon that a part of the coated layer is scattered off from the roll substrate or a so-called chipping phenomenon. Thus, when the thickness of the coated layer is too thick, it is easily peeled off from the roll substrate, while when the thickness is too thin, the pores are easily formed and hence hot zinc easily penetrates into the inside of the coated layer to lower the resistance to galvanizing bath solution.

As a result of the inventors' experiments, it has been confirmed that when using the spraying material according to the invention, the thickness of the resulting coated layer is preferably within a range of 0.04-1.85mm. When the thickness is outside the above range, the coated layer is easily peeled off, and also the cost thereof increases together with the rise of the spraying material cost.

The following examples are given in the illustration of the invention and are not intended as limitations thereof.

Example 1

In this example, a spray-coated layer having a

thickness of 0.15mm and a porosity of 1.2-1.6% was formed on each of a sink roll, a support roll, a touch roll and a top roll used in the continuous galvanizing apparatus of Fig. 1 (a material of each roll is JIS G3445(1983) STKM13A) through the HVOF coating method using a WC-12%Co spraying material
produced by the sintered and crushed process and agglomerate process. Then, a steel sheet of 900mm in width and 0.35mm in thickness was immersed in a galvanizing bath containing molten zinc (JIS H2107(1957) corresponding to special distilled zinc) at 470-480°C through these rolls to conduct a continuous galvanization treatment, during which the change of the spray-coated layer was measured.

For comparison, rolls having no coated layer made from STKM13A, SCS1 or SCS12 (corresponding to JIS G5121(1980)) were used in the continuous galvanization treatment. The chemical compositions of these roll materials are shown in Table 3.

Table 3

Sym-bol	Chemical composition (wt%)							
	C	Si	Mn	P	S	Ni	Cr	Re-marks
STKM 13A	0.18	0.28	0.45	0.021	0.019	-	-	
SCS 1	0.09	1.25	0.68	0.015	0.018	-	12.80	corre-spond-ing ASTM CA 15
SCS 12	0.14	1.33	1.41	0.017	0.015	9.01	19.25	corre-spond-ing ASTM CF 20

After one week of the galvanization, the roll surface was observed irrespective of the presence of the spray-coated layer to obtain results as shown in Table 4.

Table 4

No	Spraying Powder and roll material	Damaged area of coating [Zinc deposition area (%)]			
		Sink-Roll	Support Roll	Touch-Roll	Top-Roll
1	Powder by sintered and crushed process	< 0.01	< 0.01	< 0.01 [2.5]	< 0.01 [1.2]
2	Powder by Agglomer-ated process	39.5	29.8	2.5 [15.2]	1.8 [8.2]
3	STKM13A	Severe attack	Severe attak	[20.8]	[16.8]
4	SCS 1	Severe attack	Severe attack	[11.3]	[6.3]
5	SCS 12	attack	attack	[8.9]	[3.5]

Spraying Gun : HVOF

Thickness of Coating : 0.15mm

Porosity of coating : 1.2 ~ 1.6 %

As seen from these results, the surfaces of the rolls always contacting with the hot zinc and having no coated layer, particularly sink roll, support roll and the like were considerably eroded. the damage of about 3mm in thickness was observed even in the roll of austenitic SCS 12. The erosion was further conspicuous in the rolls of SCS1 and STMK13, which was not durable to next use. Furthermore, soft zinc was strongly adhered to a portion of the galvanization line contacting with the steel sheet after the passing through the galvanizing bath such as a top roll or the like (hot zinc was not sufficiently cooled and solidified), so that the damage due to zinc adhered to the roll surface was caused on the surface of the galvanized steel sheet and hence the quality of the sheet considerably lowered.

On the contrary, the roll substrate provided at its surface with the spray-coated layer showed a relatively sound state. In the spray-coated layer formed on the sink roll, support roll or the like by the agglomerate process, many peelings of about 20-50mm in diameter were caused and the total peeled area was 30-40% of the full spray-coated area. Further, the exposed portion of the roll substrate was eroded by hot zinc, but the eroded degree of the roll was relatively small as compared with the case of using the roll having no spray-coated layer.

In the spray-coated layer made from the spraying material through the sintered and crushed process, the

erosion of hot zinc was hardly observed, and also the peeling of the coated layer was only about 0.5-1.0mm in diameter and the total peeled area was not more than 0.01% of the full spray-coated area.

Moreover, in the rolls having the spray-coated layer, the influence of the roll material was not recognized, and the coated layer formed on the roll made from any material develops the excellent resistance to galvanizing bath solution.

In the spray-coated layer formed on the top roll and made from the spraying material through the sintered-crushed process, the adhesion of zinc was extremely small and the adhered zinc was easily peeled from the roll by lightly rubbing. On the other hand, zinc was strongly adhered to the coated layer made from the material through the agglomerated process, and also the adhered amount of zinc was larger than that of the former case.

As seen from the above, the spray-coated layer formed from WC-12%Co spraying material through the sintered and crushed process exhibits the excellent resistance to galvanizing bath solution and is small in the adhesion to zinc, and the galvanization apparatus using rolls each provided with this spray-coated layer is suitable for efficiently producing the galvanized steel sheet with an excellent quality.

Example 2

In the sink roll of the same continuous

galvanization apparatus as in Example 1 was formed a spray-coated layer having a thickness of 0.18mm and a porosity of 1.2-1.6% by the HVOF coating method using WC-12%Co spraying material produced by the sintered and crushed process, cast-crushed and fused process, agglomerated process or coated process. Then, a steel sheet of 900mm in width and 0.35mm in thickness was subjected to a continuous galvanization treatment by passing through a galvanizing bath at 470-480°C through the above rolls, during which the effect of the spray-coated layer was examined.

Moreover, the continuous galvanization was conducted for 1 week by adding 0.05 wt%, 0.10 wt%, 0.30 wt%, 3 wt% or 5 wt% of Al to the galvanizing bath.

The results are shown in Table 5.

Table 5

	Manufacturing process spraying powder	Damaged area of coating (%)				
		Al content (wt%)				
		0.05	0.10	0.30	3.0	5.0
Invention Example	Sintered and crushed	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
	Cast-crushed and Fused	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Comparative Example	Agglomerated	5.8	7.8	6.5	10.5	8.9
	Coated	8.5	7.8	11.5	15.6	20.2

As seen from Table 5, a phenomenon of slightly peeling an outermost layer portion due to thermal shock in the immersion into high temperature galvanizing bath was observed in the spray-coated layers made from the spraying materials produced by the sinter-crush process and the cast-crush and fused process according to the invention, but the total peeled area was not more than 0.01% of the full spray-coated area. Furthermore, the coated layer was remained beneath the slight peeled portion, so that the roll substrate was not subjected to erosion through hot zinc. Thus, the spray-coated layer according to the invention exhibited an excellent erosion resistance against the galvanizing bath containing 0.05-5 wt% of Al. On the other hand, the spray-coated layers made from the spraying materials produced by the agglomerated process and the coated process were considerably eroded likewise the pure galvanizing bath of Example 1, and not less than 50% of the coated layer was peeled off from the roll surface.

As mentioned above, according to the invention, the spray-coated layer consisting of WC, W_2C, $W_6C_{2.54}$, Co_2W_4C, Co_6W_6C, Co_3W_4C and C and containing no free W and Co unidentifiable by X-ray diffractometry is formed on a surface of a roll for the galvanization at a state having a porosity of not more than 1.8% and shows an excellent erosion resistance to hot zinc or a

galvanizing bath containing 0.05-5 wt% of Al. By using such a spray-coated layer can be ensured stable galvanizing operation, high productivity and improvement of quality in the galvanized steel sheet.

THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

1. A spray-coated roll for continuous galvanization comprising a roll drum and a spray-coated layer of a WC-Co cermet material containing no more than 2% of impurities formed on an outer peripheral surface of the roll drum, wherein the spray-coated layer has a porosity of not more than 2% and a thickness of 0.04-1.85 mm; wherein the spray-coated layer contains at least one substance selected from the group consisting of intermetallic compounds, amorphous W-C-Co compounds and free carbon and has such a structure that free W and free Co are hardly identified by an X-ray diffractometry; and wherein the intermetallic compound is selected from W_2C, Co_3W_3C, Co_6W_6C, Co_2W_4C and $W_6C_{2.54}$.

2. The roll according to claim 1, wherein the spray-coated layer has a porosity of not more than 1.8%.

3. The roll according to claim 1 or 2, wherein the cermet material to be spray-coated is obtained by sintering WC and Co at a temperature of not lower than 1000°C in a hydrogen gas atmosphere having a low partial oxygen pressure and crushing and sieving the resulting sintered product.

4. The roll according to claim 1 or 2, wherein the cermet material to be spray-coated is obtained by melting Co in an atmosphere containing no oxygen, charging WC particles into molten Co to react them and crushing and sieving the resulting reaction product.

5. The roll according to claim 1 or 2, wherein the cermet material to be spray-coated is obtained by sintering WC and Co at a temperature of not lower than 1000°C in a hydrogen gas atmosphere having a low partial oxygen pressure and crushing and sieving the resulting sintered product or melting Co in an atmosphere containing no oxygen, charging WC particles into molten Co to react them and crushing and sieving the resulting reaction product, and then melting the resulting sieved particles and pulverizing and sieving them.

6. The roll according to any one of claims 1 to 5, wherein the spray-coated layer is formed by spraying the cermet material through any one of plasma coating method, high-velocity oxygen/fuel coating method and detonation coating method.

7. The roll according to any one of claims 1 to 5, wherein the spray-coated layer is formed by spraying the cermet material by a high-velocity oxygen/fuel coating method.

8. The roll according to any one of claims 1 to 7, wherein the cermet material is WC-5%Co, WC-12%Co, WC-17%Co or WC-28%Co.

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FIG. 1

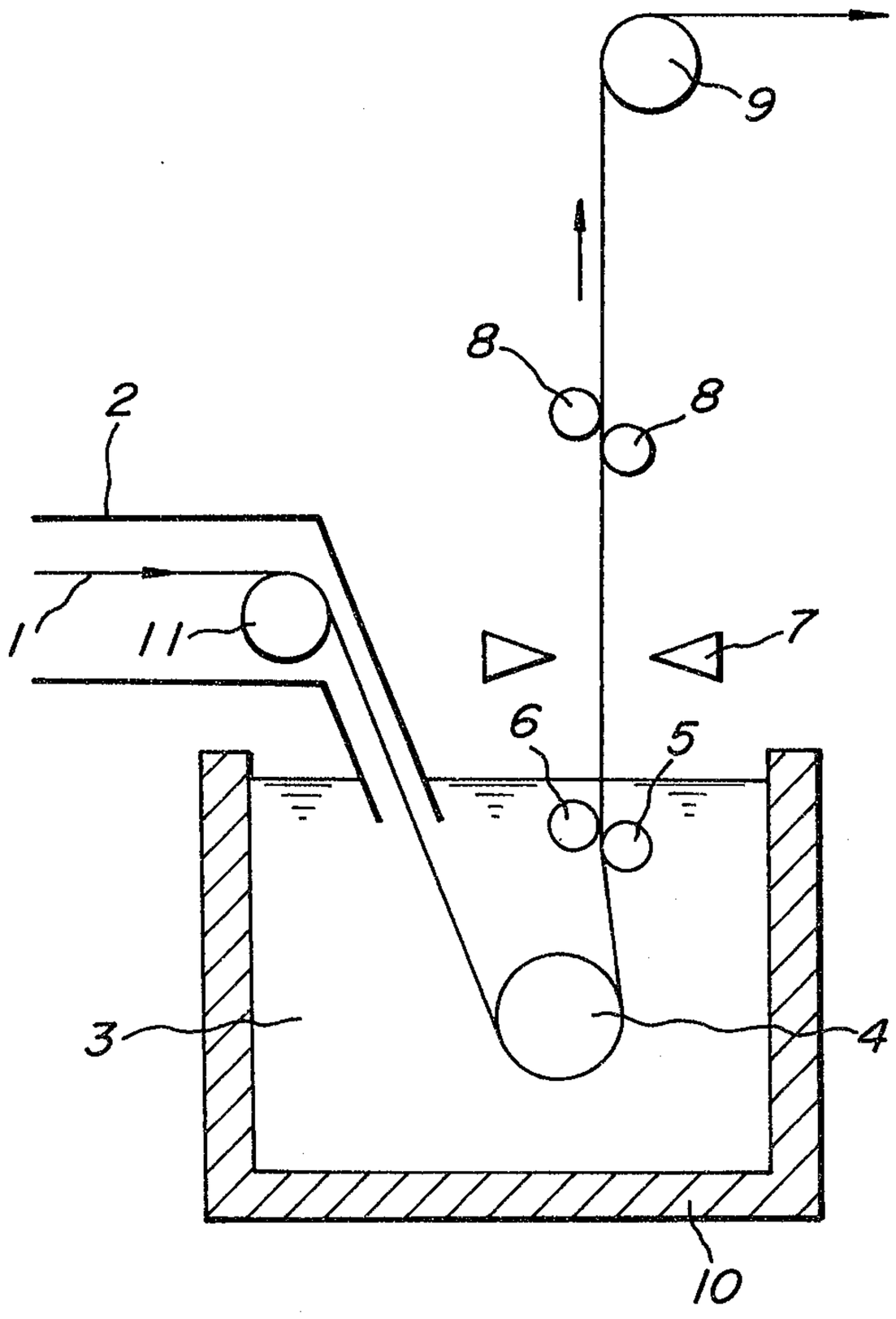

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FIG_2a

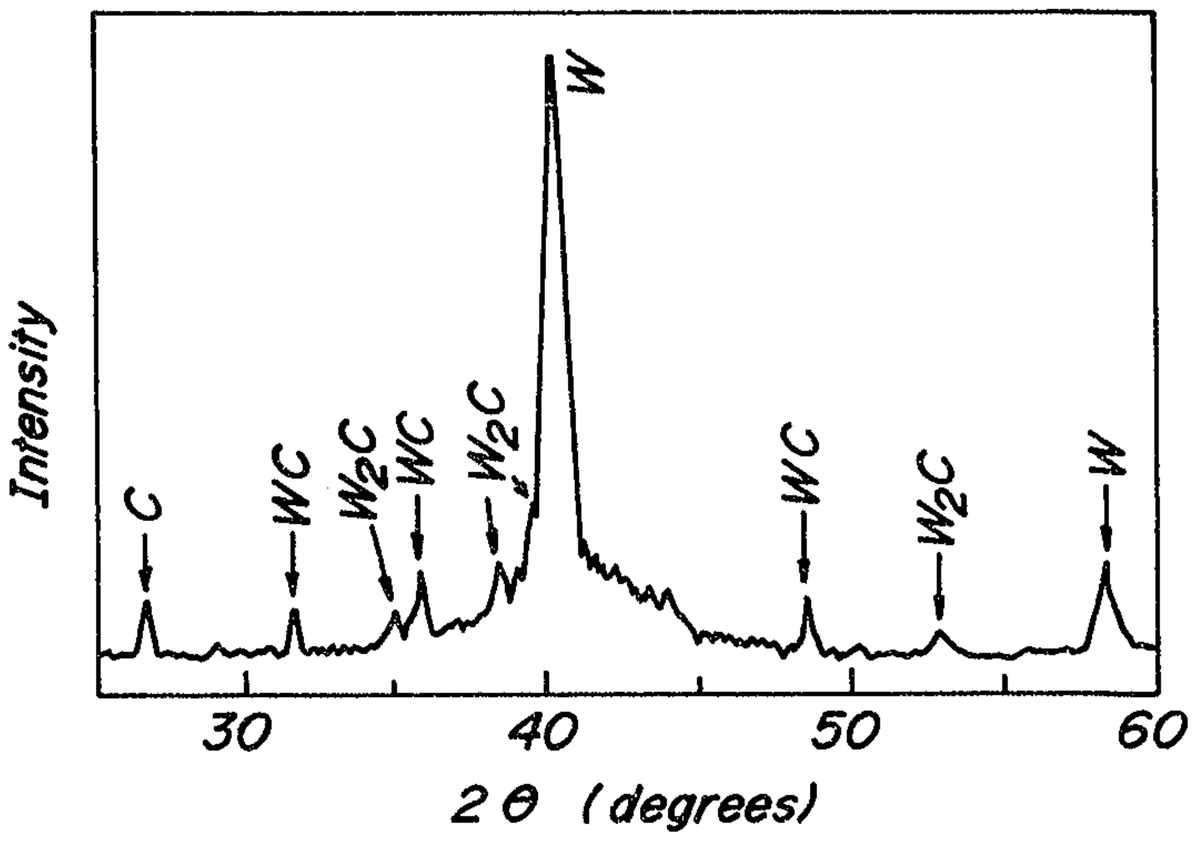
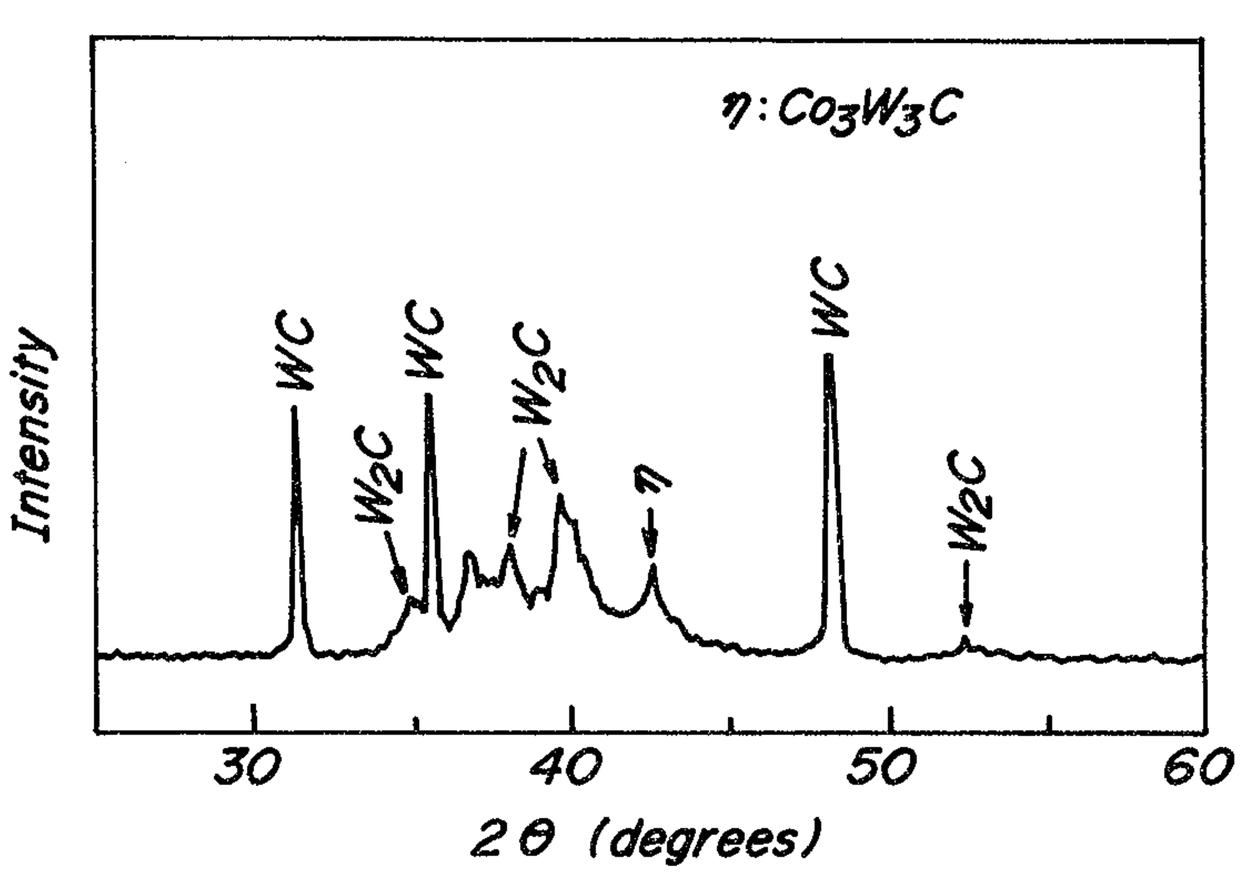


FIG_2b



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