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COLD ROLLED RIMMED STEEL SHEET AND STRIP HAVING PREFERRED
ORIENTATION ADAPTED FOR PRESS FORMING
AND PRODUCTION OF THE SAME
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FIG 1

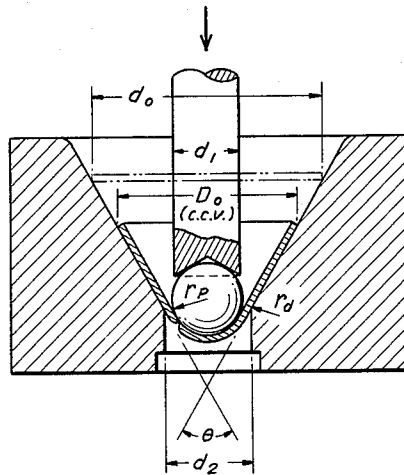


FIG 2



FIG 3

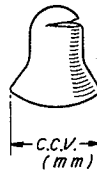
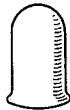


FIG 4



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COLD ROLLED RIMMED STEEL SHEET AND STRIP HAVING PREFERRED ORIENTATION ADAPTED FOR PRESS FORMING AND PRODUCTION OF THE SAME

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18 Claims. (Cl. 148—2)

The present invention relates to the cold rolled rimmed steel sheet and strip having a preferred orientation adapted for press forming and the production of the same.

Heretofore an aluminum stabilized steel has been widely employed as a deep drawing steel sheet and strip. The aluminum stabilized steel sheet or strip is produced by the steps of making a steel ingot which has been deoxidized to a high degree by aluminum in an ingot casting step followed by a hot rolling step and a cold rolling one, and annealing a steel sheet or strip to precipitate aluminum nitride, whereby an elongated grain structure is formed in it. In reference to the reason why the aluminum stabilized steel sheet or strip has a superior deep drawing property, it has heretofore been attributed to the fact that the elongated grain structure has caused the deformation resistance in a thickness direction to be greater than the deformation resistance in a plane so that the thinning in thickness has been reduced.

However, after an extensive study of the aluminum stabilized steel sheet or strip by means of the X-ray diffraction method, it has been found that the excellent deep drawing property of the aluminum stabilized steel sheet or strip is not attributed to the form of grains, but to the preferred orientation caused by the conditions of the steel sheet or strip making process.

Having our attention focused on the conditions of the steel sheet or strip production advantageous for the formation of the preferred orientation favorable to the deep drawing quality together with the effect of addition of minor elements, I, inventor, have completed the present invention.

The steel sheet or strip provided with the above quality in accordance with this invention has been accomplished by the process comprising the steps of adding one or more of the elements selected from the group consisting of antimony, bismuth and niobium into a molten steel produced by the open hearth furnace, the electric furnace and the converter in either a steel making or ingot casting step to obtain rimmed steel ingots containing one or more of said elements singly or combined in a total amount of 0.003–0.100% by weight, then subjecting said steel to hot and cold rolling, then annealing the cold rolled rimmed steel sheet or strip at a temperature of 500–750° C. in an atmosphere containing hydrogen and moisture to decarburize its carbon content less than 0.020% or decarburize and denitride its carbon content less than 0.020% and its nitrogen content less than 0.002%.

The decarburizing annealing step and the decarburizing and denitriding annealing one described in the present invention are achieved by subjecting the cold rolled rimmed steel sheet or strip to an anneal in an atmosphere containing hydrogen and moisture at the temperature of 500–750° C. for a predetermined period of time. The period of time required for the anneal depends upon the steel sheet thickness and the composition of the atmosphere. In reference to the behavior of carbon and nitrogen in the annealing process, the velocity of decarburiza-

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tion is relatively so fast that carbon is removed sufficiently at an early period of the anneal, but, on the other hand, the velocity of denitridation is so low even in an atmosphere, such as AX gas, containing a low nitrogen content that it will take a pretty long period of time until a desired low nitrogen content is attained in the steel sheet. However, denitridation is hardly effected even in the atmosphere containing a high nitrogen content.

In order to obtain the steel sheet or strip having a good drawability as well as non-aging property, it is effective to decrease the carbon and nitrogen contents thereof as low as possible by subjecting it to annealing in the atmosphere consisting of a major part of H₂ and a minor part of N₂ and H₂O.

From an economical point of view for the purpose of attaining a low cost production of a steel sheet having a good drawability with an inferior non-aging property, an annealing step in the atmosphere consisting of a major part of N₂ and a minor part of H₂ and H₂O, such as DX gas with appropriate moisture, for a relatively short period with a view to decarburizing only is relied upon to produce a cold rolled rimmed steel sheet or strip having a better drawability than that of the commercial one of prior art.

A preferred embodiment of this invention comprises making steel by the known basic open hearth furnace, adding bismuth to the thus obtained molten steel, and producing a rimmed steel ingot containing 0.060% carbon and 0.015% bismuth.

Then, a cold rolled strip coil of 0.8 mm. in thickness is produced by the known process of slabbing, hot rolling and cold rolling.

Subsequently, this strip coil is subjected to a decarburizing annealing in an open coil annealing furnace at about 700° C. for a period of 40 hours in DX atmosphere with moisture, and to known skin pass rolling, which results in the production of excellent deep drawing cold rolled steel sheet and having the following properties:

$\bar{R}$ 1.65, Er. 11.20 mm., C.C.V. 35.70 mm., T.S. 29.3 kg./mm.² and El. 50%

The chemical analysis and mechanical properties of the present steel sheet are listed as No. 23 data in Table 1.

Another preferred embodiment of this invention comprises making steel by the known basic open hearth furnace, adding antimony to the thus obtained molten steel, and producing a rimmed steel ingot containing 0.08% carbon and 0.025% antimony. Then, a cold rolled strip coil of 0.8 mm. in thickness is produced by the known process of slabbing, hot rolling and cold rolling. Subsequently, this strip coil is subjected to a decarburizing and denitriding annealing in an open coil annealing furnace at about 700° C. for a period of 40 hours in AX atmosphere with moisture, and to known skin pass rolling, which results in the production of excellent deep drawing cold rolled steel sheet and having the following properties: $\bar{R}$ 1.82, Er. 11.13, C.C.V. drawn-through, T.S. 29.0 kg./mm.², and El. 48%. The chemical analysis and mechanical properties of the present steel sheet are listed as No. 6 data in Table 1.

One of the features of this invention is to provide the formation of the preferred orientation favorable to the deep drawing process by the steps of adding a minor amount of one or more of antimony, bismuth and niobium to the steel and subjecting the thus produced steel to heat treatment. The steel sheet or strip of this invention can be produced from a relatively low cost rimmed steel, therefore it is less expensive than the aluminum stabilized steel or strip. Moreover, the steel sheet or strip of this invention is superior to any other steel sheet or strip in the deep drawing property. The excellent prop-

erties of the steel sheet or strip of this invention will now be described hereinbelow in the following description.

Table 1 shows the plastic strain ratio ($\bar{R}$), the conical cup value (C.C.V.), various mechanical properties and the intensity of (111) plane diffraction peak by the X-ray

inverse pole figure method, all of which have been determined on the commercial rimmed steel, the aluminum stabilized steel, and the steel sheet of this invention containing various amounts of antimony, bismuth and niobium.

TABLE 1

Specimen No.	Steel	Chemical Analysis (Percent)			
		C	Si	Mn	P
1	Com. rim. steel	0.055	Tr.	0.32	0.010
2	Com. rim. steel de-C. de-N. anneal	0.006	Tr.	0.33	0.010
3	Al stabilized steel	0.043	Tr.	0.30	0.008
4	Sb-cont. de-C. de-N. rim. steel	0.004	Tr.	0.32	0.010
5	do	0.006	Tr.	0.32	0.010
6	do	0.006	Tr.	0.32	0.010
7	do	0.005	Tr.	0.32	0.010
8	do	0.006	Tr.	0.32	0.010
9	Bi cont. de-C. de-N. rim. steel	0.007	Tr.	0.33	0.011
10	do	0.006	Tr.	0.32	0.010
11	do	0.007	Tr.	0.32	0.100
12	Nb cont. de-C. de-N. rim. steel	0.007	Tr.	0.33	0.011
13	do	0.004	Tr.	0.33	0.010
14	do	0.005	Tr.	0.32	0.010
15	do	0.009	Tr.	0.32	0.011
16	Sb-Bi cont. de-C. de-N. rim. steel	0.009	Tr.	0.34	0.015
17	do	0.007	Tr.	0.36	0.014
18	Sb-Nb cont. de-C. de-N. rim. steel	0.008	Tr.	0.38	0.013
19	do	0.008	Tr.	0.37	0.013
20	Bi-Nb cont. de-C. de-N. rim. steel	0.008	Tr.	0.34	0.014
21	do	0.007	Tr.	0.35	0.013
22	Sb cont. de-C. rim. steel	0.008	Tr.	0.34	0.012
23	Bi cont. de-C. rim. steel	0.009	Tr.	0.33	0.010
24	Nb cont. de-C. rim. steel	0.009	Tr.	0.34	0.010

Specimen No.	Chemical Analysis (percent)					
	S	Al	Sb	Bi	Nb	N
1	0.013	Tr.	Tr.	Tr.	Tr.	0.0025
2	0.014	Tr.	Tr.	Tr.	Tr.	0.0008
3	0.010	0.060	Tr.	Tr.	Tr.	0.0058
4	0.013	Tr.	0.005	Tr.	Tr.	0.0007
5	0.013	Tr.	0.013	Tr.	Tr.	0.0009
6	0.013	Tr.	0.025	Tr.	Tr.	0.0009
7	0.013	Tr.	0.050	Tr.	Tr.	0.0008
8	0.013	Tr.	0.084	Tr.	Tr.	0.0010
9	0.014	Tr.	Tr.	0.005	Tr.	0.0008
10	0.013	Tr.	Tr.	0.011	Tr.	0.0009
11	0.013	Tr.	Tr.	0.030	Tr.	0.0008
12	0.014	Tr.	Tr.	Tr.	0.005	0.0008
13	0.012	Tr.	Tr.	Tr.	0.013	0.0009
14	0.013	Tr.	Tr.	Tr.	0.028	0.0008
15	0.013	Tr.	Tr.	Tr.	0.048	0.0010
16	0.018	Tr.	0.005	0.005	Tr.	0.0013
17	0.017	Tr.	0.018	0.013	Tr.	0.0012
18	0.017	Tr.	0.005	Tr.	0.005	0.0009
19	0.016	Tr.	0.010	Tr.	0.019	0.0008
20	0.018	Tr.	Tr.	0.005	0.005	0.0009
21	0.017	Tr.	Tr.	0.012	0.015	0.0010
22	0.012	Tr.	0.024	Tr.	Tr.	0.0024
23	0.013	Tr.	Tr.	0.015	Tr.	0.0021
24	0.013	Tr.	Tr.	Tr.	0.014	0.0023

Specimen No.	Mechanical Properties							Intensity of (111) plane diffraction peak
	$\bar{R}$	C.C.V., mm.	El., percent	Er., mm.	T.S., kg./mm. ²	Y.P., kg./mm. ²	Y.E., percent	
1	1.07	38.20	45	10.20	32.8	26.5	3.0	3.5
2	1.40	37.25	51	10.84	28.3	18.0	0.5	8.0
3	1.55	37.30	47	10.40	30.5	-----	0.0	9.0
4	1.55	36.80	51	12.11	28.4	17.8	0.2	10.5
5	1.78	35.73	49	11.60	28.5	18.3	0.2	14.0
6	1.82	(¹)	48	11.13	29.0	-----	0.0	14.5
7	1.80	(¹)	47	10.55	31.3	-----	0.0	14.4
8	1.75	35.97	45	10.40	34.0	-----	0.0	13.8
9	1.52	37.19	51	11.90	28.2	18.5	0.2	9.2
10	1.72	35.41	50	11.35	28.5	18.1	0.2	10.6
11	1.81	(¹)	48	10.91	29.4	18.0	0.2	11.0
12	1.57	37.37	52	11.43	28.0	-----	0.0	9.8
13	1.08	26.50	52	11.67	28.3	-----	0.0	10.9
14	1.78	(¹)	52	11.54	28.4	-----	0.0	12.9
15	1.75	35.02	51	11.02	29.3	-----	0.0	11.0
16	1.74	36.50	49	11.20	28.5	18.4	0.5	9.6
17	1.80	35.80	48	10.52	29.0	19.0	0.2	10.5
18	1.65	36.53	50	11.00	28.6	-----	0.0	9.8
19	1.71	36.48	48	10.70	28.8	-----	0.0	10.4
20	1.58	36.80	51	11.05	28.2	-----	0.0	9.4
21	1.75	35.75	50	10.95	28.5	-----	0.0	11.0
22	1.75	35.90	47	10.90	29.2	18.5	1.2	12.8
23	1.65	35.70	50	11.20	29.3	17.5	1.0	10.2
24	1.70	36.36	50	11.50	29.0	17.0	0.7	11.0

¹ Drawn through.

NOTE.—El.=Elongation (test specimen: JIS No. 5, gauge length=50 mm.). Er.=Erichsen. Y.E.=Yield Point Elongation. T.S.=Tensile Strength. Y.P.=Yield Point.

TABLE 2

Steel	Chemical Analysis (Percent)							
	C	Si	Mn	P	S	Al	Sb	Bi
Com. rim. steel.....	0.055	Tr.	0.35	0.010	0.014	Tr.	Tr.	Tr.
Al stabilized steel.....	0.045	Tr.	0.30	0.008	0.010	0.055	Tr.	Tr.
De-C. de-N. rim. steel.....	0.006	Tr.	0.34	0.012	0.014	Tr.	Tr.	Tr.
Sb-cont. de-C. de-N. rim. steel.....	0.004	Tr.	0.33	0.010	0.014	Tr.	0.023	Tr.
Bi-cont. de-C. de-N. rim. steel.....	0.006	Tr.	0.34	0.012	0.010	Tr.	Tr.	0.012
Nb-cont. de-C. de-N. rim. steel.....	0.007	Tr.	0.35	0.010	0.014	Tr.	Tr.	Tr.

Steel	Chemical Analysis (percent)		Punch Shape					
			Round	Round	Round	Round	Flat	Flat
	Nb	N ₂	Blank dia., mm.					
			300	300	225	225	225	220
			Blank Holder Pressure (ton)					
			15	5	5	5	5	5
			Measurement					
			Stretch Depth, mm.	Stretch Depth, mm.	Stretch Depth, mm.	Flange Strain ratio, α percent	Flange Strain ratio, α percent	Flange Strain ratio, α percent
Com. rim. steel.....	Tr.	0.0022	44.5	50.0	61.5	4.78	3.93	9.45
Al stabilized steel.....	Tr.	0.0058	45.0	50.5	66.0	7.78	5.94	18.89
De-C. de-N. rim. steel.....	Tr.	0.0008	46.5	51.0	65.5	7.50	5.62	14.52
Sb-cont. de-C. de-N. rim. steel.....	Tr.	0.0008	46.5	51.0	68.0	8.91	6.59	(1)
Bi-cont. de-C. de-N. rim. steel.....	Tr.	0.0009	46.7	51.5	67.5	8.52	6.28	25.41
Nb-cont. de-C. de-N. rim. steel.....	0.010	0.0008	47.0	51.5	68.0	9.12	5.09	14.60

¹ Drawn through.

NOTE.—100-ton press test. Die and Punch in detail.

Punch shape:

(a) Round: Hemisphere.

(b) Flat: Profile radius. 10R.

Punch diameter.....

100 mm. ϕ .

Die diameter.....

102.4 mm. ϕ .

Die profile radius.....

5R.

Blank holder diameter.....

300 mm. ϕ .

The Japanese Industrial Standard Z-2249, relating to the method of conical cup test, has been recently published. In this conical cup test, it is possible to draw a steel sheet without forming wrinkles and without applying any blankholder pressure provided the correct blank diameter is selected with respect only to sheet thickness. The effect of bending and unbending, which is an important factor in a cylindrical cup-forming test, is also less important in the conical cup test. A hemispherically ended punch with a profile radius of approximately 5 to 10 times the thickness of the test blank is used. The rating of drawability is obtained from the average diameter of the rim of the conical cup when fracture occurs. Since the blank diameter is fixed only by the sheet thickness, the test is simple and quick.

The principle of the test is illustrated in FIG. 1. A circular blank is rested horizontally in the conical die, and drawn with the appropriate punch until the bottom of the cup fractures. The dimensional specifications are given in Table 3.

The die hole diameters specified are such that no ironing of the cup occurs as it enters the die hole. Blanks should be cleaned and then lubricated and the speed of drawing is virtually immaterial.

The conical cup-forming test of the Japanese Industrial Standard, X-2249, is performed in an arrangement of tools for a conical cup test shown in the accompanying drawing, in which:

FIG. 1 shows a sectional view of the arrangement of tools for the conical cup test.

FIG. 2 shows a perspective view of a shape of fractured cup as the result of test.

FIG. 3 shows a perspective view of another shape of fractured cup.

FIG. 4 shows a perspective view of a shape of a completely drawn cup with no fracture.

More particularly, the conical cup value (C.C.V.) is represented by the numerical value, mm., of the average diameter of the rim of the conical cup when fracture occurs as shown in FIGS. 2-3. The conical cup value shown in FIG. 3, which is less than that of FIG. 2, is obtained from the steel sheet having a better deep drawability than that of the one shown in FIG. 2. The shape of the completely drawn cup with no fracture shown in FIG. 4 is attained by the steel sheet of a very high deep drawability, and in this case, no value of conical cup test is obtained, but represented as "drawn through" in Table 1.

In order to obtain the conical cup value or C.C.V. of a steel sheet of a particular thickness, the particular tools specified by JIS Z-2249 as shown in Table 3 should be employed. C.C.V. of various steel sheet listed in Table 1 are the measurements conducted on the sheet of the thickness, 0.8 mm. by means of the die type 17 of Table 3. In Table 4, the minimum standard value for showing the drawability of each sheet of a particular thickness produced by the process of this invention is listed.

TABLE 3

Die Type-----	Blank thickness, mm.			
	Over 0.5 to 0.8, excl.	Over 0.8 to 1.0, excl.	Over 1.0 to 1.3, excl.	Over 1.3 to 1.6, incl.
	13	17	21	27
Blank dia., d_0 , mm-----	36	50	60	78
Conical half-angle of die, θ° -----	60	60	60	60
Die hole dia., d_2 , mm-----	14.60	19.95	24.40	32.0
Die profile radius r_d , mm-----	3.0	4.0	6.0	8.0
Ball radius, r_p , mm-----	$d_{1/2}$	$d_{1/2}$	$d_{1/2}$	$d_{1/2}$
Punch dia., d_1 , mm-----	12.70	17.46	20.64	26.99

TABLE 4

Sheet Thickness	Die Type, JIS	C.C.V. of the sheet of this invention
0.6 mm-----	13	26.40 or less.
0.7 mm-----	13	26.40 or less.
0.8 mm-----	17	37.30 or less.
0.9 mm-----	17	37.42 or less.
1.0 mm-----	21	44.82 or less.
1.2 mm-----	21	45.12 or less.

The plastic strain ratio, $\bar{R}$, is a value showing the deep drawing property and the preferred orientation suitable for the deep drawability of the steel sheet, and can be obtained from the following formula:

$$\bar{R} = \frac{\log W_0/W}{\log t_0/t}$$

where

W_0 =width of tensile test specimen before tension
 W =width of tensile test specimen after tension
 t_0 =thickness of tensile test specimen before tension
 t =thickness of tensile test specimen after tension

The greater the $\bar{R}$ value the less thinning in the thickness direction in the plastic deformation, and the more the deformation in the width direction.

It follows that the steel sheet material having a large R value is excellent in the deep drawing property, since the fracture in the deep drawing process is caused by the necking due to the decrease of sheet thickness. As matter of fact, in obtaining the $\bar{R}$ value, it is difficult to conduct an accurate determination of the thinning in the thickness direction. So we measured the elongation of gauge length of the tensile test specimen by means of the electronic strain meter and the mean width of the specimen. The $\bar{R}$ value obtained from the following formula, provided that the volume of the deformed test specimen being constant:

$$l_0 \cdot W_0 \cdot t_0 = l \cdot w \cdot t$$

where

l_0 =gauge length before tension.
 l =gauge length after tension.

$$\bar{R} = \frac{\log W_0/W}{\log l \cdot w/l_0 \cdot w_0}$$

By the above measurement, the test errors are very small. For this test specimen, a tensile test specimen (gauge length 50 mm.) of JIS (Japanese Industrial Standard) No. 5 is employed, and the R value in 15% extension is obtained. In general, as the R value depends on the direction from which the test specimen is taken, the measurement along the three directions, rolling direction (R_L), 45 degrees to the rolling direction, (R_{45}), and 90 degrees to the rolling direction (R_c), is made, and the

mean value $\bar{R}$ is obtained from the following formula:

$$\bar{R} = \frac{(R_L) + (R_c) + 2(R_{45})}{4}$$

As clearly shown in the $\bar{R}$ value and the X-ray intensity of (111) plane diffraction peak of Table 1, the crystallographic orientation of the rimmed steel sheet of this invention containing a small amount of antimony, bismuth and niobium is different from that of the known rimmed steel sheet which has been decarburized and denitrided. Thus, the X-ray intensity of (111) plane diffraction peak of the known rimmed steel is small while that of the steel sheet produced from the known rimmed steel which has been subjected to the decarburizing and denitrifying annealing is also relatively small. Compared to the above, the accumulation of the main crystallographic orientation (111) plane of the present decarburized and denitrided rimmed steel sheet containing antimony, bismuth and niobium is stronger.

The intensity of (111) plane diffraction peak of the aluminum stabilized steel is stronger than that of the known rimmed steel, but weaker than that of the present steel sheet. The above-mentioned relationship is made more distinct in the $\bar{R}$ value of Table 1. Thus, the $\bar{R}$ value of the commercial rimmed steel is the least of all, that of the decarburized and denitrided rimmed steel larger, and that of the aluminum stabilized steel the largest. The $\bar{R}$ value of the present decarburized and denitrided rimmed steel sheet containing antimony, bismuth and niobium is also equal to or larger than that of the aluminum stabilized steel.

In case (111) plane is parallel with the rolling surface, the fact that the $\bar{R}$ value is made large can be explained theoretically as follows: when the slip direction is only [111] direction while deformation, and when (111) plane is parallel with the rolling surface, it is explained by mathematical analysis that the strain in the sheet plane direction becomes larger than that in the thickness direction.

In Table 1, the conical cup value of the rimmed steel sheet containing an appropriate amount of antimony, bismuth and niobium is good, and particularly, the test specimen of the steel sheet containing 0.025% Sb and 0.030% Bi and 0.028% Nb is drawn through without fracture.

As described hereinabove, a favorable effect of antimony, bismuth and niobium on the deep drawing quality of the steel sheet is apparent. However, in the practical press forming process, the formation of miscellaneous complicated shapes is required so much that not only the high degree deep drawability but also the high stretch formability should be given to the steel sheet. In reference to the characteristic value for showing stretch formability, both elongation, El. and the Erichsen value, Er. are universally adopted.

As clearly illustrated in Table 1, the steel sheet containing a suitable amount of antimony, bismuth and niobium has a good conical cup value as well as good El. and Er. values, and the sheet containing niobium has a superior stretch formability.

Table 2 shows the results of various practical press forming tests conducted on various steel sheet. In each press forming test shown in Table 2, the stretch formability refers to the left side while the deep drawability to the right more emphatically than the other, respectively. In the press forming requirements, the greater the blank holder pressure, the larger the blank diameter, and the round punch rather than the flat one will all favor the stretch formability more emphatically in the press forming test. Three measurements in the left refer to the depth, mm., of penetration when fracture occurs. Three values in the right refer to the flange strain ratio α :

$$\alpha \text{ percent} = \frac{D_0 - D_1}{D_0} \times 100$$

where

D_0 =blank diameter before press forming

D_1 =mean diameter after press forming

As is evident from Table 2, the deep drawing property of the commercial rimmed steel sheet is considerably inferior to that of other steel sheet for the same purpose, but the stretch formability thereof is relatively good. The aluminum stabilized steel sheet shows the mean values both in the deep drawability and stretch formability.

Compared to the above, the decarburized and denitrified rimmed steel sheet or strip containing antimony, bismuth and niobium of the present invention has not only the excellent deep drawing property but also the good stretch formability. It will be appreciated, therefore, that this steel sheet or strip is well suited for all type of press forming.

As to the aging property of the present steel sheet, the aging velocity thereof is considerably slower than that of the commercial rimmed steel sheet of prior art, and if the carbon and nitrogen content can be reduced by the decarburizing and denitrifying annealing, the present steel will be given the non-aging property. However, from an industrial and economical point of view, it will be adequate if no stretcher-strains occur in press forming. The steel sheet or strip of the invention will have an adequate non-aging quality if the elements, carbon, nitrogen, antimony, bismuth and niobium are contained in the steel in the above-mentioned range.

I claim:

1. A method for producing cold rolled rimmed steel sheet and strip having good drawability and stretchability comprising the steps of adding at least one element selected from the group consisting of antimony, bismuth and niobium to molten steel to produce a rimmed steel containing 0.003–0.100% by weight of said additive, making a cold rolled rimmed steel sheet or strip by hot and cold rolling procedure, and subjecting said steel sheet or strip to a decarburizing anneal to decrease its carbon content to less than 0.020% by weight.

2. A method for producing cold rolled rimmed steel sheet and strip having good drawability and stretchability represented by a conical cup value determined by the conical cup test specified by the Japanese Industrial Standard Z-2249, said value being less than 37.30 for a sheet of the thickness of 0.8 mm. and dependent on a thickness selected from the range of 0.5 to 1.6 mm., comprising the steps of adding at least one element selected from the group consisting of antimony, bismuth and niobium to molten steel to produce a rimmed steel containing 0.003–0.100% by weight of said additive, making a cold rolled rimmed steel sheet or strip by hot and cold rolling procedure, and subjecting said steel sheet or strip to a decarburizing anneal to decrease its carbon content to less than 0.020% by weight.

3. The method as claimed in claim 1, in which at least two elements selected from the group consisting of antimony, bismuth and niobium are added.

4. The method as claimed in claim 2, in which at least two elements selected from the group consisting of antimony, bismuth and niobium are added.

5. A method for producing cold rolled rimmed steel sheet and strip having good drawability and stretchability comprising the steps of adding at least one element selected from the group consisting of antimony, bismuth and niobium to molten steel to produce a rimmed steel containing 0.003–0.100% by weight of said additive, making a cold rolled rimmed steel sheet or strip by hot and cold rolling procedure, and subjecting said steel sheet or strip to a decarburizing and denitrifying anneal to decrease its

carbon content to less than 0.020% and its nitrogen content to less than 0.002%.

6. A method for producing cold rolled rimmed steel sheet and strip having good drawability and stretchability represented by a conical cup value determined by the conical cup test specified by the Japanese Industrial Standard Z-2249, said value being less than 37.30 for a sheet of the thickness of 0.8 mm. and dependent on a thickness selected from the range of 0.5 to 1.6 mm., comprising the steps of adding at least one element selected from the group consisting of antimony, bismuth and niobium to molten steel to produce a rimmed steel containing 0.003–0.100% by weight of said additive, making a cold rolled rimmed steel sheet or strip by hot and cold rolling procedure, and subjecting said steel sheet or strip to a decarburizing and denitrifying anneal to decrease its carbon content to less than 0.020% and its nitrogen content to less than 0.002%.

7. The method as claimed in claim 5, in which at least two elements selected from the group consisting of antimony, bismuth and niobium are added.

8. The method as claimed in claim 6, in which at least two elements selected from the group consisting of antimony, bismuth and niobium are added.

9. The method according to claim 1 wherein the added element is antimony.

10. The method according to claim 1 wherein the added element is bismuth.

11. The method according to claim 1 wherein the added element is niobium.

12. The method according to claim 2 wherein the added element is antimony.

13. The method according to claim 2 wherein the added element is bismuth.

14. The method according to claim 2 wherein the added element is niobium.

15. A cold rolled decarburized rimmed steel sheet or strip having good drawability and stretchability, said steel consisting essentially of at least one element selected from the group consisting of antimony, bismuth and niobium, the total element percentage being 0.003–0.100% by weight, less than 0.020% carbon, 0.15–0.60% manganese, and the balance iron and incidental impurities.

16. The cold rolled steel sheet or strip according to claim 15 wherein at least two elements from the group consisting of antimony, bismuth and niobium are included in the steel.

17. The steel sheet or strip according to claim 15 wherein the nitrogen content of the steel is less than 0.002%.

18. The steel sheet or strip according to claim 16 wherein the nitrogen content of the steel is less than 0.002%.

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