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(54) **ALUMINUM ALLOY AND METHOD OF MANUFACTURING EXTRUSION USING SAME**

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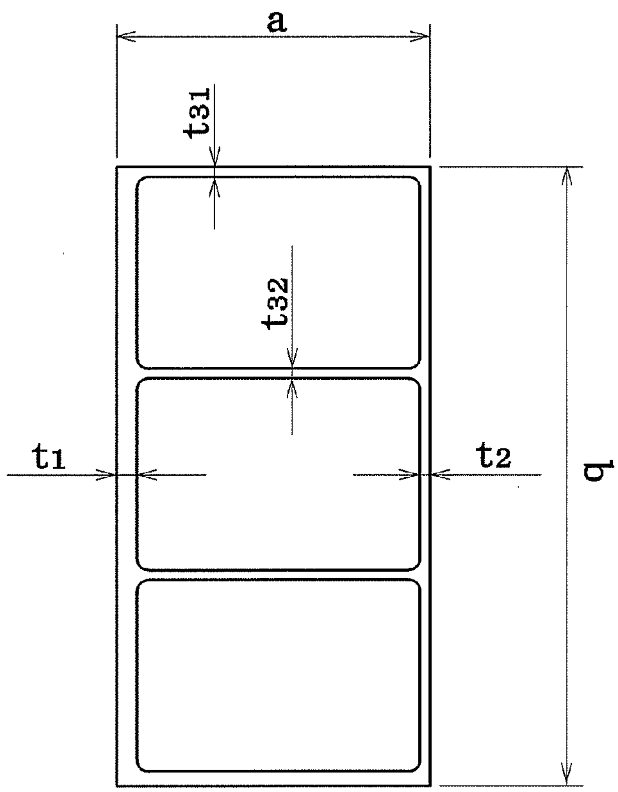
(57) **ABSTRACT**

A high-strength aluminum alloy exhibiting excellent stress corrosion cracking resistance and excellent extrudability, and a method for producing an extruded shape using the same are disclosed. The aluminum alloy includes 1.6 to 2.6 mass % of Mg, 6.0 to 7.0 mass % of Zn, 0.5 mass % or less of Cu, and 0.01 to 0.05 mass % of Ti, with the balance being Al and unavoidable impurities.



When 40mm<a≦75mm
- b≦120mm
- 3≦t_1≦8
- 1≦t_2≦6
- 1≦t_3≦6

FIG. 1

	No	Chemical component(%)										
		Si	Fe	Cu	Mn	Mg	Cr	Zn	Zr	Mn+Cr+Zr in total	Ti	Al
Example	1	0.06	0.17	0.25	0.00	2.01	0.00	6.69	0.19	0.19	0.02	Balance
	2	0.05	0.09	0.25	0.00	2.60	0.00	6.72	0.19	0.19	0.03	Balance
	3	0.05	0.17	0.25	0.20	1.70	0.00	6.64	0.19	0.39	0.02	Balance
	4	0.05	0.17	0.25	0.00	1.70	0.10	6.64	0.19	0.29	0.02	Balance
	5	0.06	0.16	0.20	0.20	1.59	0.01	6.39	0.17	0.38	0.02	Balance
	6	0.06	0.16	0.32	0.29	1.91	0.01	7.02	0.21	0.51	0.02	Balance
	7	0.05	0.18	0.19	0.18	1.91	0.00	7.01	0.16	0.34	0.02	Balance
	8	0.05	0.17	0.25	0.25	1.71	0.00	6.69	0.21	0.46	0.02	Balance
	9	0.05	0.17	0.25	0.25	1.71	0.00	6.69	0.21	0.46	0.02	Balance
	10	0.05	0.17	0.28	0.19	1.79	0.00	6.92	0.17	0.36	0.02	Balance
	11	0.05	0.16	0.29	0.19	1.60	0.00	6.37	0.17	0.36	0.02	Balance
	12	0.05	0.17	0.19	0.19	1.99	0.00	6.41	0.17	0.36	0.02	Balance
	13	0.05	0.17	0.20	0.19	1.78	0.00	6.01	0.17	0.36	0.02	Balance

FIG. 2

	No	Chemical component(%)										
		Si	Fe	Cu	Mn	Mg	Cr	Zn	Zr	Mn+Cr+Zr in total	Ti	Al
Comparative Example	1	0.05	0.17	0.25	0.10	1.70	0.00	6.64	0.19	0.29	0.02	Balance
	2	0.05	0.09	0.25	0.20	1.70	0.00	6.64	0.19	0.39	0.02	Balance
	3	0.06	0.16	0.25	0.01	1.35	0.01	7.00	0.18	0.20	0.02	Balance
	4	0.05	0.15	0.41	0.03	1.58	0.02	7.23	0.20	0.25	0.01	Balance
	5	0.05	0.17	0.24	0.00	1.15	0.00	7.92	0.15	0.15	0.02	Balance
	6	0.05	0.18	0.25	0.00	1.17	0.00	8.89	0.15	0.15	0.02	Balance
	7	0.05	0.09	0.25	0.00	2.50	0.00	5.24	0.19	0.19	0.03	Balance
	8	0.05	0.17	0.25	0.00	1.22	0.00	6.71	0.19	0.19	0.02	Balance
	9	0.06	0.17	0.25	0.02	1.35	0.01	6.53	0.19	0.22	0.02	Balance
	10	0.05	0.16	0.11	0.02	1.07	0.02	5.95	0.11	0.15	0.01	Balance
	11	0.05	0.17	0.25	0.02	1.15	0.01	6.80	0.20	0.23	0.02	Balance
	12	0.06	0.17	0.25	0.01	1.05	0.01	6.40	0.19	0.21	0.02	Balance
	13	0.06	0.16	0.25	0.01	1.25	0.02	7.00	0.19	0.22	0.02	Balance
	14	0.06	0.16	0.25	0.02	1.02	0.01	6.75	0.20	0.23	0.02	Balance
	15	0.05	0.17	0.08	0.00	0.95	0.00	5.81	0.05	0.05	0.02	Balance
	16	0.05	0.17	0.42	0.08	1.73	0.05	7.50	0.21	0.34	0.02	Balance
	17	0.06	0.17	0.25	0.02	1.35	0.01	6.53	0.19	0.22	0.02	Balance
	18	0.06	0.17	0.25	0.02	1.35	0.01	6.53	0.19	0.22	0.02	Balance
	19	0.06	0.17	0.25	0.02	1.35	0.01	6.53	0.19	0.22	0.02	Balance
	20	0.15	0.29	0.25	0.02	1.32	0.01	6.47	0.19	0.22	0.02	Balance
	21	0.06	0.17	0.25	0.00	1.38	0.00	6.49	0.05	0.05	0.02	Balance
	22	0.06	0.17	0.25	0.02	1.35	0.01	6.53	0.19	0.22	0.02	Balance
	23	0.06	0.17	0.25	0.02	1.35	0.01	6.53	0.19	0.22	0.02	Balance
	24	0.06	0.17	0.25	0.02	1.35	0.01	6.53	0.19	0.22	0.02	Balance
	25	0.05	0.17	0.25	0.01	1.80	0.01	7.50	0.19	0.21	0.02	Balance
	26	0.06	0.17	0.25	0.01	1.01	0.01	7.19	0.19	0.21	0.02	Balance
	27	0.05	0.17	0.43	0.01	1.15	0.01	6.71	0.01	0.03	0.02	Balance
	28	0.06	0.18	0.01	0.01	1.16	0.01	6.74	0.10	0.12	0.02	Balance

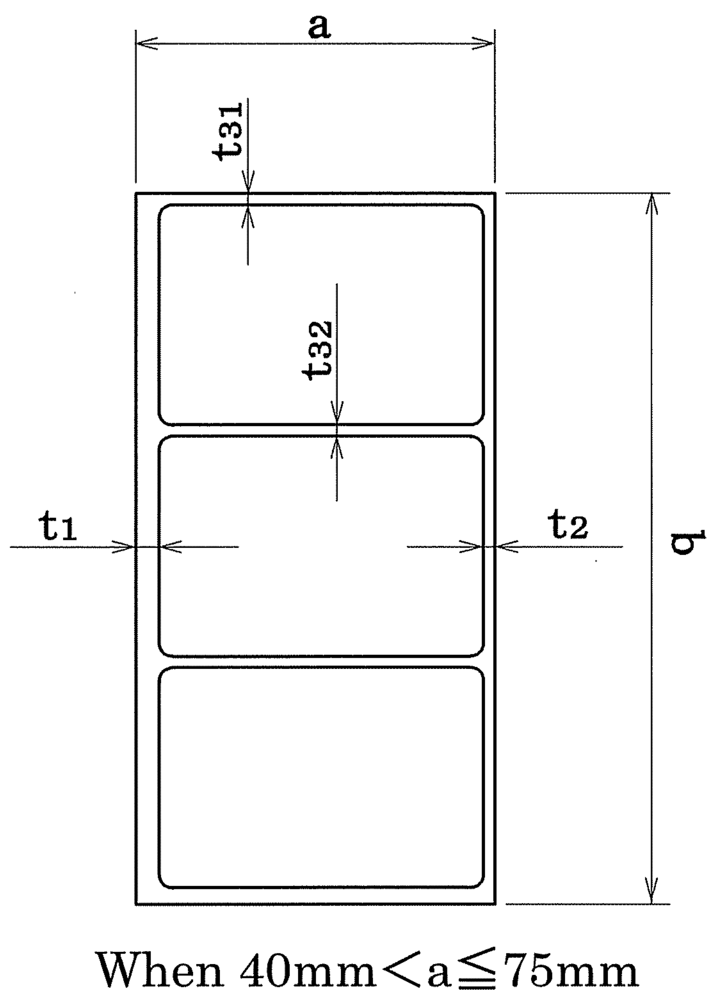
FIG. 3

	No	HOMO temperature	Extrusion conditions			Mechanical properties				SCC		Microstructure		Extrudability	Overall evaluation
			Billet temperature	Temperature of extruded shape	Cooling rate after extrusion	σ_B (N/mm^2)	$\sigma_{0.2}$ (N/mm^2)		δ (%)	cyc		Recrystal-lization ratio(%)		Surface properties	
		500 ~ 560	400°C or more	500 to 585°C	50 to 500 °C/min or less		470 or more	Evaluation		720 or more	Evaluation	15 or less	Evaluation	—	
Example	1	520	510	531	62	529	487	○	16	756	○	2	○	Normal	○
	2	520	510	529	139	512	482	○	15	882	○	2	○	Normal	○
	3	500	400	533	141	535	503	○	14	882	○	2	○	Normal	○
	4	500	400	531	141	536	497	○	14	962	○	1	○	Normal	○
	5	500	400	527	140	511	574	○	15	776	○	5	○	Normal	○
	6	510	400	531	140	567	516	○	14	821	○	1	○	Normal	○
	7	500	400	530	139	561	511	○	15	735	○	7	○	Normal	○
	8	500	400	525	141	537	503	○	14	910	○	1	○	Normal	○
	9	540	400	531	137	536	505	○	14	886	○	2	○	Normal	○
	10	500	400	527	136	544	515	○	14	925	○	4	○	Normal	○
	11	500	400	532	139	512	479	○	15	879	○	2	○	Normal	○
	12	500	400	530	140	519	488	○	14	931	○	5	○	Normal	○
	13	500	400	529	142	507	476	○	14	870	○	1	○	Normal	○

FIG. 4

	No	HOMO temperature	Extrusion conditions: Billet temperature	Extrusion conditions: Temperature of extruded shape	Extrusion conditions: Cooling rate after extrusion	Mechanical properties: σ_B (N/mm^2)	Mechanical properties: $\sigma_{0.2}$ (N/mm^2)	Evaluation	Mechanical properties: δ (%)	SCC: cyc	Evaluation	Microstructure: Recrystallization ratio(%)	Evaluation	Extrudability: Surface properties	Overall evaluation
		500 ~ 560	400°C or more	500 to 585°C	50 to 500 °C/min or less		470 or more			720 or more		15 or less		–	
Comparative Example	1	565	400	537	140	535	497	○	14	36	×	32	×	Normal	×
	2	565	400	533	141	532	495	○	14	40	×	24	×	Normal	×
	3	520	510	529	62	490	451	×	17	1440 or more	○	2	○	Normal	×
	4	520	510	534	62	503	473	○	16	693	×	1	○	Normal	×
	5	520	510	541	68	506	466	×	16	63	×	21	×	Normal	×
	6	520	510	540	62	529	479	○	16	42	×	19	×	Normal	×
	7	520	510	532	137	486	449	×	16	1008	○	2	○	Normal	×
	8	520	510	535	69	463	421	×	17	1440 or more	○	2	○	Normal	×
	9	520	510	536	31	454	419	×	18	1440 or more	○	2	○	Normal	×
	10	520	510	528	62	418	371	×	14	819	○	18	×	Normal	×
	11	520	510	533	62	449	413	×	16	1440 or more	○	2	○	Normal	×
	12	520	510	539	62	414	374	×	16	1440 or more	○	2	○	Normal	×
	13	520	510	531	62	477	437	×	17	1440 or more	○	2	○	Normal	×
	14	520	510	534	62	427	391	×	17	1440 or more	○	2	○	Normal	×
	15	520	510	533	63	386	341	×	13	441	×	46	×	Normal	×
	16	520	510	532	142	531	492	○	14	84	×	2	○	Normal	×
	17	480	510	530	62	458	412	×	18	1440 or more	○	2	○	Normal	×
	18	565	Local melting occurred during homogenization												×
	19	520	510	529	25	409	368	×	15	1440 or more	○	3	○	Normal	×
	20	520	510	530	62	436	391	×	12	1440 or more	○	3	○	Normal	×
	21	520	510	539	62	438	410	×	11	84	×	100	×	Normal	×
	22	520	510	537	750	476	441	×	16	252	×	3	○	Normal	×
	23	520	530	585	62	–	–	–	–	–	–	–	–	Tear	×
	24	520	540	590	62	–	–	–	–	–	–	–	–	Pickup	×
	25	520	510	531	62	572	542	○	17	252	×	2	○	Normal	×
	26	520	510	536	62	443	402	×	17	504	×	2	○	Normal	×
	27	520	510	532	62	445	403	×	17	252	×	100	×	Normal	×
	28	520	510	538	62	439	404	×	17	504	×	17	×	Normal	×

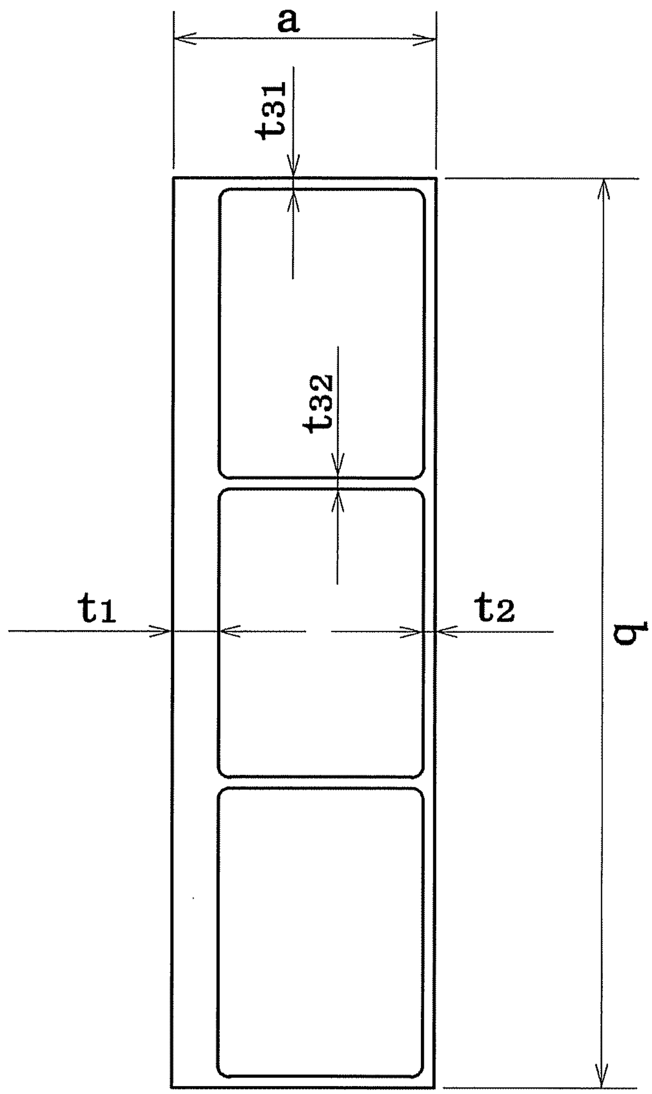
FIG. 5



When $40\text{mm} < a \leqq 75\text{mm}$

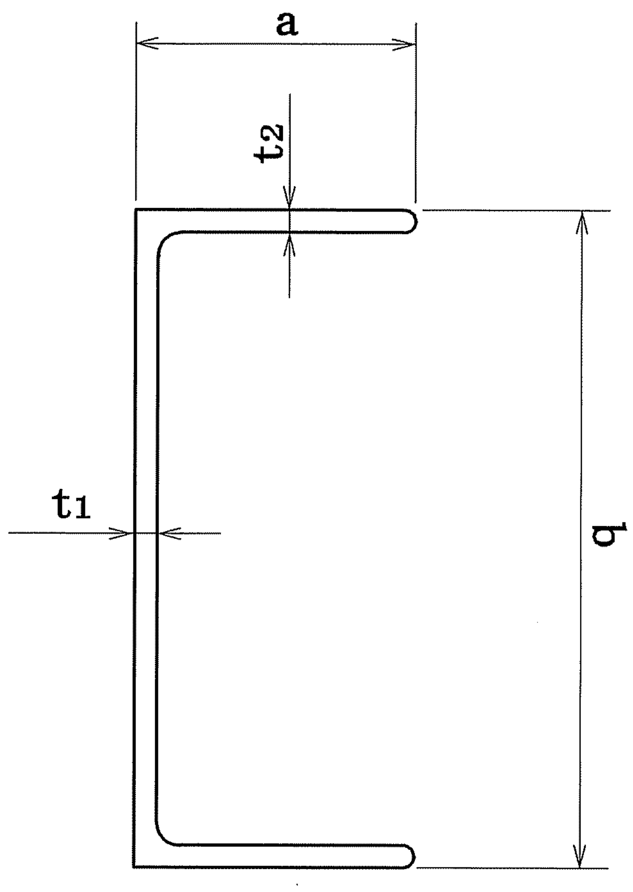
- $b \leqq 120\text{mm}$
- $3 \leqq t_1 \leqq 8$
- $1 \leqq t_2 \leqq 6$
- $1 \leqq t_3 \leqq 6$

FIG. 6



When a≦40mm
- b≦140mm
- 3≦t_1≦8
- 1≦t_2≦6
- 1≦t_3≦6

FIG. 7



- $a \leqq 170$ mm
- $b \leqq 140$ mm
- $1 \leqq t_1 \leqq 8$
- $1 \leqq t_2 \leqq 8$

ALUMINUM ALLOY AND METHOD OF MANUFACTURING EXTRUSION USING SAME

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application is a U.S. National Stage Application of International Application No. PCT/JP2012/060949 filed on Apr. 24, 2012, and published in Japanese as WO 2012/165086 A1 on Dec. 6, 2012. This application claims priority to Japanese Application No. 201 1-1 24276 filed on Jun. 2, 2011. The disclosures of the above applications are incorporated herein by reference.

TECHNICAL FIELD

[0002] The invention relates to a high-strength aluminum alloy exhibiting excellent stress corrosion cracking resistance and ensuring high productivity, and a method for producing an extruded shape using the same.

BACKGROUND ART

[0003] A high-strength aluminum material has been strongly desired for a vehicular structural member (e.g., side member) and a vehicular energy-absorbing member (e.g., bumper reinforcement and side door beam) in order to reduce fuel consumption through a reduction in weight.

[0004] However, when the content of Mg, Zn, Cu, and the like in a JIS 7000 series aluminum alloy is increased in order to improve the strength of the material, a decrease in toughness that has a trade-off relationship with the strength may occur. Moreover, since $MgZn_2$ precipitates having a potential lower than that of aluminum may be produced at the crystal grain boundaries, a deterioration in stress corrosion cracking resistance and a significant deterioration in extrudability may occur.

[0005] The applicant of the present application proposed a high-strength aluminum alloy obtained by quenching an aluminum alloy that includes 1.5 to 2.0% of Mg, 7.0 to 9.0% of Zn, 0.2 to 0.4% of Cu, and the like after extrusion at a cooling rate of 1000° C./min or more (see Japanese Patent No. 3735407).

[0006] The aluminum material disclosed in Japanese Patent No. 3735407 exhibits high strength and excellent toughness. However, it is necessary to perform water quenching in order to achieve a cooling rate of 1000° C./min or more.

[0007] Since the extruded shape may become brittle due to incorporation of hydrogen during water quenching, there has been room for a further improvement in stress corrosion cracking resistance.

[0008] As an aluminum alloy that is characterized by the content of Mg, Zn, and Cu, Japanese Patent No. 3834076 discloses an aluminum alloy that is used to produce an automotive constituent member, and includes 0.9 to 1.3% of Mg, 8.0 to 10.0% of Zn, and 0.45 to 0.55% of Cu, and Japanese Patent No. 2928445 discloses a high-strength aluminum alloy that includes 1.0 to 1.5% of Mg, 5.0 to 7.0% of Zn, and 0.1 to 0.3% of Cu. However, since the Mg content in these aluminum alloys is 1.3% or less or 1.5% or less, it is difficult to obtain a 0.2% proof stress of 470 MPa or more.

[0009] In Japanese Patent No. 3834076, since the Zn content is as high as 8% or more, a deterioration in stress corrosion cracking resistance may occur.

[0010] Japanese Patent No. 4498180 discloses an aluminum alloy that includes 1.9 to 2.6% of Mg, 5.7 to 6.7% of Zn, and 2.0 to 2.6% of Cu. However, since the Cu content is 2.0% or more, it is expected that the extrudability significantly deteriorates. Therefore, the aluminum alloy disclosed in Japanese Patent No. 4498180 is not suitable for producing an extruded shape having a hollow cross-sectional shape (e.g., bumper reinforcement).

SUMMARY OF THE INVENTION

Technical Problem

[0011] An object of the invention is to provide a high-strength aluminum alloy exhibiting excellent stress corrosion cracking resistance and excellent extrudability, and a method for producing an extruded shape using the same.

Solution to Problem

[0012] According to one aspect of the invention, an aluminum alloy includes 1.6 to 2.6 mass % of Mg, 6.0 to 7.0 mass % of Zn, 0.5 mass % or less of Cu, and 0.01 to 0.05 mass % of Ti, with the balance being Al and unavoidable impurities. Note that the unit "mass %" may be hereinafter referred to as "%".

[0013] The aluminum alloy that includes the above chemical components ensures that a high-strength extruded shape that exhibits a 0.2% proof stress of 470 MPa or more is obtained by performing air quenching without performing water quenching immediately after extrusion, or performing heating and water quenching after extrusion.

[0014] Since water quenching is unnecessary, incorporation of hydrogen that may cause stress corrosion cracking does not occur, and the stress corrosion cracking resistance is improved.

[0015] The aluminum alloy may further include 0.15 to 0.6% of one element or two or more elements in total among Mn, Cr, and Zr in order to suppress formation of recrystallized grains on the surface of the extruded shape during extrusion.

[0016] The stress corrosion cracking resistance is further improved by thus suppressing formation of recrystallized grains on the surface of the extruded shape.

[0017] According to another aspect of the invention, a method for producing an aluminum alloy extruded shape includes casting a billet using the aluminum alloy, homogenizing the billet at 500 to 560° C., and extruding the homogenized billet to obtain an extruded shape, the extruded shape being cooled by fan cooling at a cooling rate of 50 to 500° C./min immediately after the extrusion. According to the above configuration, the stress corrosion cracking resistance can be improved while ensuring high strength since water quenching is unnecessary.

[0018] The reasons for selection of the chemical components (mass %) and the production conditions are described below.

[0019] If the Mg content is less than 1.6%, it may be difficult to achieve a high strength necessary for achieving a reduction in weight of the resulting product. If the Mg content exceeds 2.6%, a deterioration in extrudability may occur.

[0020] Therefore, the Mg content is set to 1.6 to 2.6%.

[0021] If the Zn content is less than 6.0%, it may be difficult to achieve a high strength that is necessary for achieving a reduction in weight of the resulting product. If the Zn content exceeds 7.0%, a deterioration in stress corrosion cracking resistance may occur.

[0022] Therefore, the Zn content is set to 6.0 to 7.0%.

[0023] Cu contributes to an increase in strength. However, if the Cu content exceeds 0.5%, a deterioration in extrudability may occur.

[0024] Therefore, the Cu content is set to 0.5% or less. The Cu content is preferably set to 0.1 to 0.5% from the viewpoint of obtaining the effect of addition of Cu.

[0025] The Cu content is more preferably set to 0.15 to 0.4%.

[0026] Mn, Cr, and Zr suppress formation of coarse recrystallized grains on the surface of the extruded shape, and suppress propagation of cracks, thereby contributing to an improvement in stress corrosion cracking resistance. If the total content of Mn, Cr, and Zr is less than 0.15%, the above effects may not be obtained. If the total content of Mn, Cr, and Zr exceeds 0.6%, the quench sensitivity may become high, and the desired strength may not be obtained.

[0027] When adding only one element among Mn, Cr, and Zr, the content of that element is preferably set to 0.10 to 0.30%.

[0028] Although Zr can sufficiently suppress formation of recrystallized grains when added alone, it is preferable to add Zr together with Mn and/or Cr in order to stabilize the fiber structure.

[0029] Ti refines the crystal grains when casting a molten metal of the aluminum alloy into a billet. Ti is normally added within the range of 0.01 to 0.05%.

[0030] Fe and Si are generally mixed as impurities during aluminum refinement and casting.

[0031] A 7000 series high-strength aluminum alloy may show a deterioration in toughness when the amount of Fe and Si mixed therein is large. The Fe content is set to 0.3% or less, and preferably 0.2% or less.

[0032] The Si content is preferably set to 0.1% or less.

[0033] It is preferable to limit the total content of impurities excluding Fe and Si to 0.1% or less.

[0034] The billet homogenization conditions and the extrusion conditions are described below.

[0035] If the billet is homogenized at a temperature of less than 500° C., the solute elements may not be sufficiently dissolved, and the desired strength may not be obtained. If the billet is homogenized at a temperature of more than 560° C., the billet may be locally melted. Even if the billet is locally melted to only a small extent, and can be extruded, the amount of precipitates produced during homogenization is small, and recrystallization of the extruded shape may not be suppressed. As a result, a deterioration in stress corrosion cracking resistance may occur.

[0036] Therefore, the billet homogenization temperature is set to 500 to 560° C.

[0037] If the billet is not heated at a temperature of 400° C. or more during extrusion, the temperature of the extruded shape may be less than 500° C., and a supersaturated solid solution may not be formed by fan press quenching after extrusion. As a result, the desired strength may not be obtained.

[0038] If the temperature of the extruded shape exceeds 585° C., defects (e.g., pickup or tearing) may occur on the surface of the extruded shape.

[0039] Therefore, it is preferable to set the billet preheating temperature to 400° C. or more, and control the temperature of the extruded shape immediately after extrusion to 500 to 585° C.

[0040] If the cooling rate after extrusion is less than 50° C./min, the desired strength may not be obtained. It is difficult to achieve a cooling rate of 500° C./min or more by fan cooling due to an insufficient cooling capability. If a cooling rate of 500° C./min or more is achieved by water cooling (die edge T6) immediately after extrusion, the material may become brittle due to incorporation of hydrogen, and a deterioration in stress corrosion cracking resistance may occur.

[0041] Therefore, it is preferable to control the cooling rate to 50 to 500° C./min by means of fan cooling without using water cooling.

Advantageous Effects of the Invention

[0042] The aluminum alloy according to the aspect of the invention ensures that a high-strength extruded shape that exhibits a proof stress of 470 MPa or more is obtained by fan cooling without performing water quenching after extrusion as a result of optimizing the combination of the Mg content, the Zn content, and the Cu content, and exhibits excellent extrudability as a result of limiting the Cu content to 0.5% or less.

[0043] Therefore, it is possible to produce an extruded shape having a solid cross section (see FIG. **7**) and an extruded shape having a hollow cross section (triple-hollow cross section) (see FIGS. **5** and **6**).

[0044] Since high strength can be obtained without performing water quenching, it is possible to prevent a deterioration in stress corrosion cracking resistance due to incorporation of hydrogen.

BRIEF DESCRIPTION OF DRAWINGS

[0045] FIG. **1** shows the chemical components of the aluminum alloys of the examples.

[0046] FIG. **2** shows the chemical components of the aluminum alloys of the comparative examples.

[0047] FIG. **3** shows the extrusion conditions and the evaluation results when using the aluminum alloys of the examples.

[0048] FIG. **4** shows the extrusion conditions and the evaluation results when using the aluminum alloys of the comparative examples.

[0049] FIG. **5** illustrates an example of the cross-sectional shape of an extruded shape.

[0050] FIG. **6** illustrates an example of the cross-sectional shape of an extruded shape.

[0051] FIG. **7** illustrates an example of the cross-sectional shape of an extruded shape.

DESCRIPTION OF EMBODIMENTS

[0052] A molten metal of each aluminum alloy shown in FIG. **1** (Examples 1 to 13) and a molten metal of each aluminum alloy shown in FIG. **2** (Comparative Examples 1 to 28) were prepared, and cast into a billet.

[0053] Note that the content (mass %) of each component shown in FIGS. **1** and **2** indicates the analytical value after casting.

[0054] Each cast billet (diameter: 8 inches) was extruded.

[0055] FIGS. **3** and **4** show the billet homogenization temperature (HOMO temperature), the extrusion conditions, and the evaluation results.

[0056] FIGS. **3** and **4** show the optimum ranges of the HOMO temperature and the extrusion conditions, and each data indicates the measured value.

[0057] In FIGS. **3** and **4**, the billet temperature refers to the billet preheating temperature before extrusion, and the temperature of the extruded shape refers to the surface temperature of the extruded shape measured immediately after extrusion.

[0058] The cooling rate after extrusion refers to the cooling rate until the temperature of the extruded shape reached 200° C. or less when air was blown against the extruded shape using a fan immediately after extrusion.

[0059] SCC refers to the stress corrosion cracking resistance. The stress corrosion cracking resistance was evaluated as described below.

[0060] Specifically, an accelerated test was performed by immersing a sample (to which a stress equal to 80% of the proof stress was applied) in a 3.5% NaCl aqueous solution at 25° C. for 10 minutes, and allowing the sample to dry at a temperature of 25° C. (room temperature) and a humidity of 40% for 50 minutes (=1 cycle). When stress corrosion cracking was not observed after 720 cycles, it was determined that the sample had stress corrosion cracking resistance sufficient for a structural material (e.g., bumper reinforcement).

[0061] In FIGS. **3** and **4**, σ_B refers to tensile strength, $\sigma_{0.2}$ refers to proof stress, and δ refers to elongation. These mechanical properties were measured using a JIS Z 2241 No. 5 specimen that was cut from the extruded shape.

[0062] The recrystallization ratio in the microstructure was determined by observing the cross section orthogonal to the extrusion direction using a microscope, and calculating the area ratio of the recrystallization area.

[0063] The extrudability was determined to be normal when a surface defect having a depth of 0.5 mm or more was not observed when an extruded shape having the cross-sectional shape illustrated in FIGS. **5** to **7** was extruded, and the presence or absence of a surface defect (tearing or pickup) having a depth of 0.5 mm or more was evaluated.

Discussion

[0064] In Examples 1 to 13, a proof stress of 470 MPa or more that is necessary for achieving a reduction in weight of a bumper reinforcement and the like was obtained, and excellent stress corrosion cracking resistance was achieved.

[0065] In Comparative Examples 1 and 2 in which the HOMO temperature was more than 560° C., the billet was locally melted to only a small extent, and could be extruded. However, since the amount of precipitates produced during homogenization was small, and recrystallization of the extruded shape could not be suppressed, the stress corrosion cracking resistance deteriorated.

[0066] In Comparative Examples 3, 5, 8, 10 to 15, and 20, since the Mg content was less than 1.6%, a proof stress of 470 MPa or more could not be obtained.

[0067] In Comparative Examples 16 and 25, since the Zn content was more than 7.0%, the stress corrosion cracking resistance deteriorated.

[0068] In Comparative Examples 4 and 6 in which the Mg content was less than 1.6%, and the Zn content was more than 7.0%, the desired strength was obtained, but the stress corrosion cracking resistance deteriorated.

[0069] In Comparative Example 7, since the Zn content was less than 6.0%, the desired strength could not be obtained.

[0070] In Comparative Example 9, since the cooling rate after extrusion was less than 50° C./min, the desired strength could not be obtained.

[0071] In Comparative Examples 17 and 18 in which the HOMO temperature did not fall within the optimum range, the desired strength could not be obtained when the HOMO temperature was lower than the optimum range, and the billet was locally melted, and could not be extruded when the HOMO temperature was higher than the optimum range.

[0072] In Comparative Example 19, since the Mg content was less than 1.6%, and the cooling rate after extrusion was less than 50° C./min, the desired strength could not be obtained.

[0073] In Comparative Example 21, since the Mg content was less than 1.6%, the desired strength could not be obtained. Moreover, since the total content of Mn, Cr, and Zr was less than 0.15%, recrystallization of the extruded shape could not be suppressed, and the stress corrosion cracking resistance deteriorated.

[0074] In Comparative Example 22, since the Mg content was less than 1.6%, the desired strength could not be obtained. Moreover, since water cooling was performed after extrusion, the cooling rate exceeded 500° C./min, and the material became brittle due to incorporation of hydrogen. As a result, the stress corrosion cracking resistance deteriorated.

[0075] In Comparative Examples 23 and 24, since the temperature of the extruded shape was higher than 585° C., pickup or tear occurred on the surface of the extruded profile.

[0076] In Comparative Example 26, since the Mg content was less than 1.6%, the desired strength could not be obtained. Moreover, since the Zn content was more than 7.0%, sufficient stress corrosion cracking resistance could not be obtained.

[0077] In Comparative Examples 27 and 28, since the Mg content was less than 1.6%, the desired strength could not be obtained. Moreover, since the total content of Mn, Cr, and Zn was less than 0.15%, recrystallization of the extruded shape could not be suppressed, and the stress corrosion cracking resistance deteriorated.

[0078] The aluminum alloy according to the embodiments of the invention exhibits excellent extrudability, and makes it possible to produce an extruded shape having the cross-sectional shape illustrated in FIGS. **5** to **7**.

[0079] FIG. **5** illustrates an example of an extruded shape having a triple-hollow cross-sectional shape that is used for a bumper reinforcement and the like. When the dimension a is more than 40 mm and 75 mm or less, and the dimension b is 120 mm or less, it is possible to produce an extruded shape wherein $3 \le t_1 \le 8$, $1 \le t_2 \le 6$, $1 \le t_3(t_{31}, t_{32}, \ldots) \le 6$.

[0080] The extrudable dimensional range is similarly shown in FIGS. **6** and **7**.

INDUSTRIAL APPLICABILITY

[0081] A high-strength extruded shape exhibiting excellent stress corrosion cracking resistance can be obtained using the aluminum alloy according to the embodiments of the invention. The extruded shape may be applied to a vehicular structural member and the like.

1. An aluminum alloy comprising 1.6 to 2.6 mass % of Mg, 6.0 to 7.0 mass % of Zn, 0.5 mass % or less of Cu, and 0.01 to 0.05 mass % of Ti, with the balance being Al and unavoidable impurities.

2. An aluminum alloy comprising 1.6 to 2.6 mass % of Mg, 6.0 to 7.0 mass % of Zn, 0.1 to 0.5 mass % of Cu, 0.01 to 0.05 mass % of Ti, and 0.15 to 0.6 mass % of one element or two or more elements in total among Mn, Cr, and Zr, with the balance being Al and unavoidable impurities.

3. The method for producing an aluminum alloy extruded shape comprising casting a billet using the aluminum alloy as defined in claim **1**, homogenizing the billet at 500 to 560° C., and extruding the homogenized billet to obtain an extruded shape, the extruded shape being cooled at a cooling rate of 50 to 500° C./min immediately after the extrusion.

4. The method for producing an aluminum alloy extruded shape comprising casting a billet using the aluminum alloy as defined in claim **2**, homogenizing the billet at 500 to 560° C., and extruding the homogenized billet to obtain an extruded shape, the extruded shape being cooled at a cooling rate of 50 to 500° C./min immediately after the extrusion.

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