

[54] **COMPOUND CAST-IRON FOR MAKING BRAKE SHOES**

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[58] **Field of Search**..... **75/123 D, 123 CB, 75/123 N, 123 J, 123 L, 123 M, 126 A, 126 E, 126 K, 126 L, 126 Q**

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[57] **ABSTRACT**

Cast-iron composition for making brake shoes which composition, after casting, consists essentially of C 2.7–3.5%, Si 1.0–2.0%, Mn 0.4–1.5%, P 1.0–3.0%, S<0.15% and Ti 0.3–0.7% and additionally includes either V 0.05–0.30% or Cr 0.10–1.25% or Mo 0.15–1.25%, the remaining proportion of the composition consisting of iron.

2 Claims, No Drawings

COMPOUND CAST-IRON FOR MAKING BRAKE SHOES

The present invention is related to a cast-iron composition for making brake shoes comprising C 2.7–3.5%, Si 1.0–2.0%, Mn 0.4–1.5%, P 1.0–3.0%, S<0.15% and Ti 0.3–0.7% and additionally include either V 0.05–0.30% or Cr 0.10–1.25% or Mo 0.15–1.25% and the remaining proportion of the composition being made up of iron. All of these percentages are of course based upon the weight of the composition.

The purpose of the present invention is to obtain a cast-iron for making brake shoes which has an excellent braking effect (i.e., a large coefficient of friction) and wear-resisting capacity as well as sufficient strength and tenacity.

It has hitherto been well-known that among cast-iron brake shoes for railway vehicles, those which contain phosphor have such advantages as a good wear-resisting capacity, a large coefficient of friction and accordingly a large braking effect. Their greatest disadvantage, however, is that due to the inclusion of phosphor, the brakes become stiff and fragile and also become weak in mechanical function and consequently break and fall off during their use. Therefore, high phosphor cast-iron brake shoes are not suitable for actual use unless they are reinforced in their mechanical strength by means of casting either a copper plate or a copper bar onto the back of their main body in order to make up for their weakening in mechanical function.

It is a publicly known fact that the so-called titanic cast-iron brake shoes which contain an increased amount of titanium have a large coefficient of friction and also have a good braking effect and mechanical function. However, a mere increase in the titanium content can not bring about as much wear-resisting capacity as that of the high phosphor cast-iron brake shoes and moreover it causes scratches on wheels due to the adhesion wear phenomenon. It is also a publicly known fact that the so-called globulous graphite cast-iron brake shoes, in which carbon has been made globular (for example, ductile brake shoes), have a good wear-resisting capacity and a good mechanical function. Their greatest disadvantage, however, is that they have a low coefficient of friction and a bad braking effect and consequently they are dangerous when they are used alone. The above three special types of cast-iron brake shoes are the main products which have hitherto been invented apart from ordinary cast-iron brake shoes. The high phosphor cast-iron brake shoes, the titanic cast-iron brake shoes and the ductile brake shoes have their own special advantages, but at the same time they each have the abovementioned disadvantages.

Therefore, if one could make up for those disadvantages by means of utilizing the excellent properties of each element effectively in the composition of the cast-iron and in the technique of controlling components, it would be possible to produce a new brake shoe which has excellent properties.

In the present invention, a cast-iron composition for making brake shoes is produced by means of making the main body cast-iron with a super high phosphor cast-iron which consists of such chemical components as C 2.7–3.5%, Si 1.0–2.0%, Mn 0.4–1.5% and

S<0.15%, to which Ti 0.3–0.7% is added and further either V 0.05–0.30% or Cr 0.10–1.25% or Mo 0.15–1.25% is added as a carbide formation stabilizing element, the remaining part of the main body being Fe.

In other words, the composition is so devised as to increase both the co-efficient of friction and the wear-resisting capacity further by means of defining the P content to 1.0–3.0% and educing steadite to a great extent. (Generally, high phosphor brake shoes contain P by 0.4–1.0%.) When the P content is less than 0.4%, the effect of P does not appear while, in the case of it being more than 0.4%, both the coefficient of friction and the wear-resisting capacity increase in accordance with the increase of the P content. But, when the P content exceeds 3.0%, the brake shoes become too hard due to many phosphatized iron crystals and consequently they may produce disadvantageous effects on wheels.

By means of adding Ti to the main body cast-iron by 0.3–0.7%, the latter becomes to have a very fine co-crystal graphite structure in which graphite educes as a mixed structure of a globular and a green caterpillar shape. The Ti containing cast-iron combines with oxygen and nitrogen in melting cast-iron so easily that it increases its mechanical capacity (i.e., tension-resisting force and break-resisting force) as the result of strong deoxidization and denitrification functions. When the Ti content is less than 0.3%, the deoxidization and denitrification are weak and the co-crystal graphite structure cannot be produced. When the Ti content exceeds 0.7%, the globular shaping of graphite progresses so much that the structure has a globulous graphite cast-iron and consequently it causes scratches on wheels by adhesion wear. The use of Ti together with either V 0.05–0.30% or Cr 0.10–1.25% or Mo 0.15–1.25% as a carbide formation stabilizing element further increases the mechanical capacity (tension-resisting force and break-resisting force) further. At the same time, by the function of V, Cr or Mo (since they are the elements which easily form a carbide and yet they prevent the carbide from dissolution during the cooling of the cast-iron), the Ti carbide and Ti nitride attain stabilized set-ups which are scattered in the cast-iron ground and thus it becomes possible to obtain the stability of coefficient of friction for high-speed running.

When the V content is less than 0.05%, no significant effects of V can be observed and when it exceeds 0.30%, there appears a tendency to chill so strongly that the cast-iron increases its hardness and thus causes scratches on the wheels. Similarly, in the case of Cr 0.10–1.25% or Mo 0.15–1.25%, the effect of Cr or Mo is not apparent when their contents are respectively less than 0.10% and 0.15%. While, when their contents exceed 1.25%, there is a strong tendency to chill such that the cast-iron increases its hardness and thus causes scratches on wheels.

In view of the abovementioned results, the chemical components after casting are defined as C 2.7–3.5%, Si 1.0–2.0%, Mn 0.4–1.5%, P 1.0–3.0%, S<0.15%, Ti 0.3–0.7%, V 0.05–0.30% or Cr 0.10–1.25% or Mo 0.15–1.25%, and the tension-resisting force is defined as 24–30kg/mm².

The following table shows the comparison of conventional ordinary cast-iron and high-phosphor brake shoes with the cast-iron shoes made according to the present invention.

Kind of brake shoe	Item	Chemical component (percent)						
		C	Si	Mn	P	S	Ti	V
Ordinary cast-iron brake shoes...		3.10	1.33	0.57	0.13	0.115		
High-phosphor brake shoes.....		2.90	1.25	.67	.65	.110		
Brake shoes made in accordance with the present invention.....		2.91	1.53	.56	1.90	.098	0.33	0.15
Do.....		3.01	1.51	.53	1.88	.101	.31	
Do.....		3.03	1.50	.59	1.31	.095	.80	

Mechanical capacity (based on Japan Industrial Standard)					
Cr	Mo	Fe	Tension resisting force (kg/mm ²)	Maximum load (kg)	Brinell hardness (HB)
		94.655	15.8	1980	6.1
		94.411	20.5	1870	4.5
		92.522	27.8	2420	6.5
0.39		92.269	24.6	2170	6.2
0.32		92.295	28.2	2240	6.3

Results of friction tests				
Amount of wear (gr)	Average coefficient of friction (km/h)			
	35	65	95	110
492	0.173	0.101	0.072	0.065
252	.298	.228	.112	.113
130	.324	.243	.141	.130
136	.317	.236	.137	.125
139	.312	.231	.131	.121

The results of friction tests in the above table have been obtained by means of testing with a full size testing machine under the conditions as follows.

Test conditions:

- 1. Full size testing machine.
- 2. Wheel diameter in 860 mm.
- 3. Weight of inertia is 6.36 tons.
- 4. Load (W) onto a brake shoe is 2.54 X 2 tons.
- 5. Braking velocities(Vo) are 35, 65, 95 & 110 km/h.
- 6. Number of tests is 5 per each speed.

Microscopic structure

By a microscopic observation of the structure of the cast-iron for making brake shoes in accordance with the present invention, it is found that the graphite structure is very fine and that graphite educes as a mixed structure of globular and green caterpillar shape. Further observation shows that the cast-iron ground has, in general, scattered steadite and that part of it is a pearlite structure. It can also be observed that small compounds of carbonized Ti and nitrified Ti are scattered throughout. Such structure as this can be said to be an ideal structure for producing brake shoes which have a metallurgically strong mechanical capacity and

a good wear-resisting capacity. Because, it can increase the coefficient of friction and the wear-resisting capacity by the steadite structure scattered in the cast-iron ground and because the carbonized Ti and nitrified Ti together with the strong cast-iron, this results in a product having a stable coefficient of friction. Further, the mechanical capacity of the castiron of the present invention is excellent due to the fact that the graphite structure is very fine and yet consists of graphite educing as a mixed structure of a globular and green caterpillar shape.

An example of the method of manufacturing the compound cast-iron of the present invention is as follows.

The chemical compounds in the cast-iron after casting have been defined as C 2.7-3.5%, Si 1.0-2.0%, Mn 0.4-1.5%, P 1.0-3.0%, S<0.15% and Ti 0.3-0.7%, to which either V 0.05-0.30% or Cr 0.10-1.25% or Mo 0.15-1.25% has been added. Then, the cast-iron thus prepared has been melted at a high temperature of 1,500°-1,600°C and the desired compound cast-iron for brake shoes has been obtained.

As clearly seen from the above description, the present invention has made it possible to produce the excellent cast-iron for manufacturing brake shoes. This cast-iron has excellent strength and tenacity and the amount of wear is so small that their wear-resisting capacity is about 3.8 times better than that of ordinary cast-iron brake shoes and about 2 times better than that of the high-phosphor brake shoes which are used at the present time. Further the coefficient of friction of the present brake shoes is high and yet stabilized enough to be used at high speeds.

What we claim is:

1. A cast-iron composition for making brake shoes which consists essentially of, after casting, carbon from 2.7 percent up to 3.5 percent by weight, silicon from 1.0 percent up to 2.0 percent by weight, manganese from 0.4 percent up to 1.5 percent by weight, phosphorus from 1.0 percent up to 3.0 percent by weight, sulfur less than 0.15 percent by weight, titanium from 0.3 percent up to 0.7 percent by weight, vanadium from 0.05 percent up to 0.30 percent by weight and the balance iron.

2. A cast-iron composition according to claim 1 wherein the phosphorous is present in an amount of 1.90 percent.

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