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SHELLING-RESISTANT RAIL

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This invention relates to a railroad or similar track rail and, in particular, to a rail having a greatly increased resistance to shelling.

Railroads carrying heavy traffic over hilly terrain have considerable difficulty in track maintenance because of the early failures of rails by shelling at the gauge corners of the rail head. Shelling is the flattening of the rail head, usually accompanied by longitudinal splitting, resulting from the cold-working of the metal under the heavy and repeated impact of the passage of car wheels. Attempts have been made to avoid this difficulty by using a special-analysis steel for the rolling of rails, e. g., 3% chromium steel, or by subjecting rails after rolling to a special heat treatment. Both these remedies increase the cost of making rails. It is accordingly the object of my invention to provide a rail composed of steel having only small additions of alloying elements which will, nevertheless, have the high hardness, yield point and tensile strength necessary to resist shelling, after normal cooling from the hot-rolling temperature and without any post-cooling heat treatment.

In a preferred embodiment and practice of the invention, I produce rails from a steel containing about the same percentage of carbon as conventional rail steel (.64–.82% carbon, .60–1.0% manganese and .10–.23% silicon) but higher in manganese and silicon and containing also a small percentage of chromium and a minute amount of vanadium. A rail produced from such steel by known methods has, when cooled in the usual manner from the hot-rolling temperature, a yield point in excess of 100,000 p. s. i., a tensile strength in excess of 160,000 p. s. i., an elongation in 2" of 8–10%, a reduction in area at the fracture of 15–26% and an average (center and surface) Brinell hardness number from 310 to 365. These properties make it much more highly resistant to shelling than rails of conventional rail steel.

More particularly, I provide a rail of aluminum-killed steel, having a fine-grained (pearlitic) micro-structure and a composition within the following ranges:

	Percent
Carbon	.55–0.85
Manganese	1.20–1.55
Silicon	.25–0.40
Chromium	.85–1.35
Vanadium	.08–0.20

and the balance iron except for:

	Percent
Phosphorus	0–.04
Sulphur	0–.04
Residuals:	
Copper	0–.10
Nickel	0–.10
Aluminum	0–.10

The preferred analysis is:

	Percent
Carbon	About .70
Manganese	About 1.30
Silicon	About .30
Chromium	About 1.00
Vanadium	About .12

and the balance iron with the same exceptions as given above.

A heat of such steel is made by the practice ordinarily followed in producing fine-grained steel in the open-hearth furnace. After tapping, the steel is killed by the addition of aluminum and teemed into ingot molds. The ingots are reduced to blooms and the blooms to rails by hot-rolling in the known manner. The blooms are preferably rolled at a starting temperature of from 2150–2250° F. and the rails are finished at from 1900–2000° F. The finished rails are cooled in air on a hot bed from 1900° F. to a temperature from 700–1000° F. and are then subjected to controlled cooling in an insulated container in the known manner, to 300° F. in a period of 10 or 12 hours or more.

When finally cooled, a rail produced as described above, from a steel within the composition ranges given, will have a fine-grained, pearlitic micro-structure and will exhibit a remarkably high resistance to shelling. The improvement in this respect is evident from the fact that, under test, the improved rail showed signs of shelling only after eight million contacts by a loaded wheel, compared to one million for a rail of conventional steel.

Table I below gives the analyses of several examples of steels suitable for producing rails in accordance with the invention.

Table I

Heat No.	C	Mn	Si	Cr	V	P	S	Cu	Ni	Al
D-249	.62	1.18	.24	.99	.10	.008	.024	.06	.08	.035
D-250	.76	1.52	.35	1.30	.13	.008	.024	.06	.04	.040
976186	.64	1.51	.41	1.11	.16	------	------	-----	-----	-----
996080	.69	1.38	.30	1.11	.13	------	------	-----	-----	-----
933883	.74	1.30	.25	.90	.12	------	------	-----	-----	-----
924146	.78	1.42	.27	.95	.13	------	------	-----	-----	-----

Table II below gives the physical properties of the steels listed in Table I.

Table II

Heat No.	Brinell Hardness	Yield Point, p. s. i.	Tensil Strength, p. s. i.	Percent Elong. in 2"	Percent Reduc. in Area
D-249	315	104,800	162,400	10	26
D-250	352	120,100	186,200	8	15
976186	341	118,000	177,000	11	19
996080	341	107,300	162,700	6	6.4
933883	341	118,400	171,800	7.5	11.6
924146	352	142,200	182 900	7.5	14

It will be apparent from the foregoing that the rail of my invention is quite hard so it endures wear well, but is also ductile so it is not subject to early breakdown under cold-working. Taken together, these properties afford a greatly increased resistance to shelling under heavy loads, as compared to the performance of ordinary carbon-steel rails. The prime advantage of my rail however, is that it attains its hardness by air cooling from the hot-rolling temperature to the intermediate temperature below which cooling is continued at a controlled slow rate. No special post-cooling heat treatment is needed. Finally, the amounts of alloying additions

(chromium and vanadium) are so small that they do not increase the cost very much. The improved rails, furthermore, may be made in existing mills as presently equipped.

Although I have disclosed herein the preferred embodiment of my invention, I intend to cover as well any change or modification therein which may be made without departing from the spirit and scope of the invention.

I claim:

1. A railroad rail of fine-grained alloy steel consisting essentially of from .55 to .85% carbon, from 1.1 to 1.55% manganese, from .25 to .40% silicon, from .85 to 1.35% chromium, from .08 to .20% vanadium and the balance substantially iron, said rail, in the hot-rolled condition after cooling to atmospheric temperature from the final rolling temperature, being highly resistant to shelling under repeated heavy impact and exhibiting an average Brinell hardness number of from 310 to 360 without heat treatment.

2. A railroad rail of fine-grained alloy steel consisting essentially of about .7% carbon, about 1.3% manganese, about .30% silicon, about 1.00% chromium, about .11% vanadium and the balance substantially iron, said rail, in the hot-rolled condition after cooling to atmospheric temperature from the final rolling temperature, being highly resistant to shelling under repeated heavy impact and exhibiting an average Brinell hardness number of from 310 to 360 without heat treatment.

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