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MANUFACTURE OF RAILWAY AND TRAMWAY RAILS

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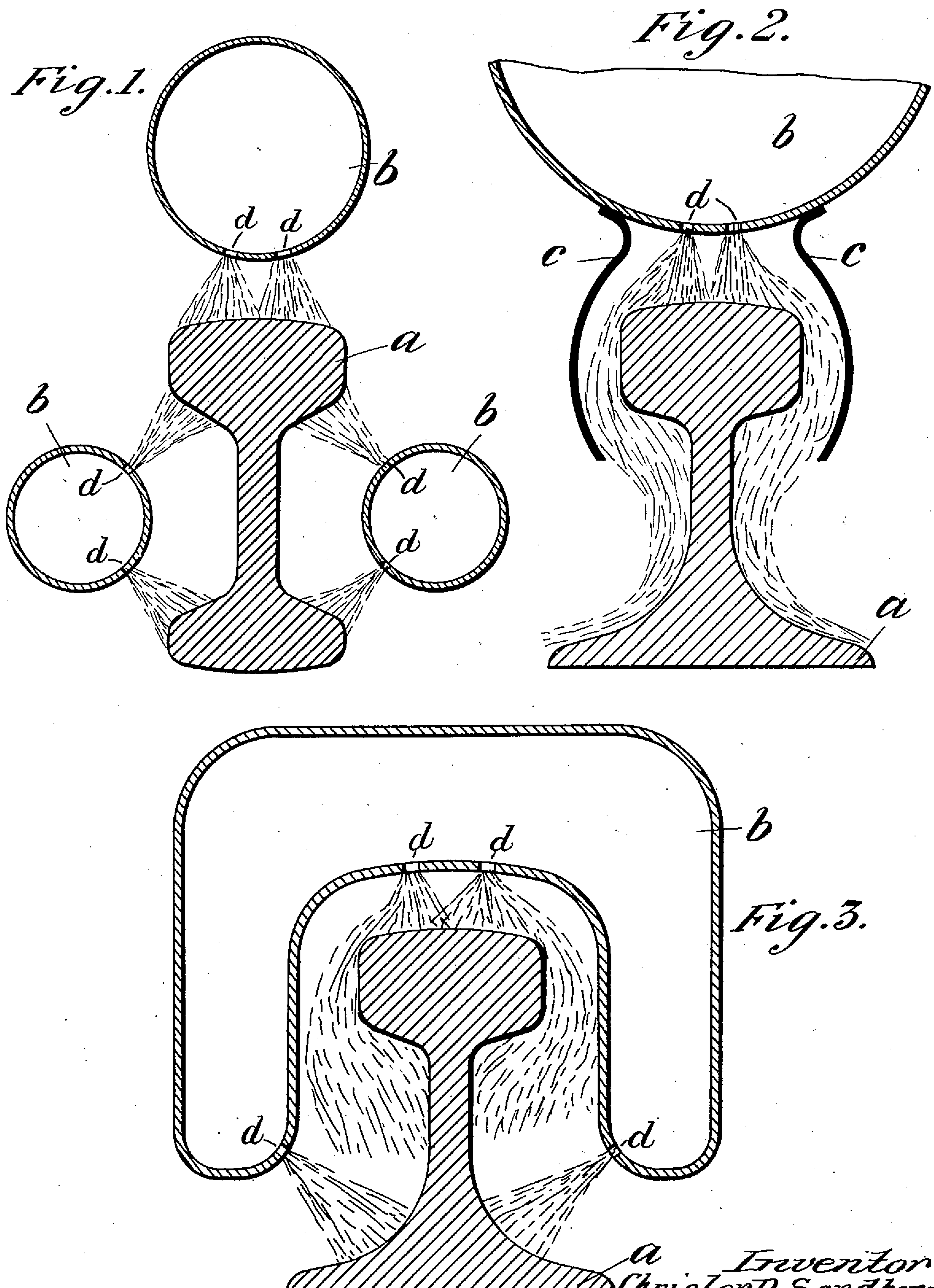

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MANUFACTURE OF RAILWAY AND TRAMWAY RAILS.

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To all whom it may concern:

Be it known that I, Christer Peter Sandberg, a subject of the King of Great Britain, residing in London, England, have invented certain new and useful Improvements Relating to the Manufacture of Railway and Tramway Rails, of which the following is a specification.

One object of this invention is the avoidance of the defects caused by "blue heat brittleness" in railway and tramway rails. These defects may be explained as follows:—

From atmospheric temperature up to a temperature of about 300° C., the strength of steel increases with rising temperature, but above this point there is a very sudden drop in strength which at first is not accompanied by a corresponding rise in toughness and ductility. Within the range of 300–450° C., especially under the action of long sustained stresses and with the presence of discontinuities in the structure such as are formed by non-metallic inclusions of a sharp or angular nature, the crystals in the steel may—without being distorted—be torn apart from one another. It is the formation of internal cracks during this range due to local tearing apart of the crystals which constitutes the "blue brittleness."

Another object of this invention is the avoidance of internal stresses during the cooling of a railway or tramway rail.

The section of a rail, whether of the "bull head" type or of the flange type is built up of portions of varying form having very varying relations between their areas and external surfaces. As a consequence the massive portions such as the head, and to a smaller extent the foot of a "bull head" rail, or the junction of flange and web on a flange rail, not only retain a higher temperature during the rolling operations but cool at a far slower rate than do the thinner portions such as the web or ends of the flange. All parts being of the same length when leaving the rolls it follows, therefore, that the subsequent thermal contractions during cooling must tend to distort the rail as it lies upon the hot bank. During the earlier stages of cooling the steel may be sufficiently plastic to avoid the setting up of large internal stresses, but during the later stages and especially when the thinner and more rapidly cooling parts, such as the web and flange, have cooled to about 300° C. and acquired their maximum strength, while the heavier and more slowly cooling parts, such as the head, are still some 150–200° C. above this temperature, very large internal stresses may be set up. To some extent these stresses are relieved by the bending of the rail, but such bending cannot relieve the greater proportion of them. In certain cases such cooling stresses undoubtedly lead to internal ruptures in the steel as it is passing through the "blue brittle" temperature which may subsequently develop during service, and lead to the failure of the rail in track.

Examination of new rails also has shown that when cold the interior of the head is occasionally shattered by a system of small internal cracks, which, on examination by metallographic methods, show evidence of having been formed when the steel was at a blue heat, and in the portions of the section which would be subjected to tensile stresses during cooling.

The invention consists in applying a gentle cooling agent, preferably a blast of air or air and an atomized fluid, to the portions of the hot rail which are of heavier section, in such a manner that these portions shall arrive at and pass through the range of temperature 450°–300° C., that is to say the range of blue brittleness and subsequent maximum strength, at approximately the same time as the portions of lighter section. For this purpose the rail may be taken from the mill and, with or without an intermediate period of natural cooling, be placed in an apparatus such as shown in diagrammatic cross section of Fig. 1 of the accompanying drawings, in which an elastic cooling fluid such as air is projected from a series of jets on to the surfaces of the portions of heavier section. The amount of fluid to be used is regulated partly by observing the relative loss of heat of the various portions as judged by their colour or by pyrometric measurement, and also by observing the tendency of the rail to camber. The cooling fluid is so applied as to reduce this cambering to a minimum. In this manner it is possible to ensure that the temperature of the whole section shall arrive at and pass through the "blue" range at the same time. If no cooling medium is applied until the whole of the rail has cooled to a temperature below that of the critical range, then no extra hardening of the steel will occur due to the accelerated cooling, but in any case the rate of cooling of the heavy portion of the section will be but little greater than normally occurs in the lighter portions of the section, which it is known does not lead to any marked increase in the hardness of these parts.

The invention is particularly applicable as an improvement of the process described in my British specification No. 18972 of 1914 whereby the cooling of the head of a rail whilst passing through the critical range is accelerated by means of blasts of an elastic fluid projected against its upper surface. In applying this process in this manner it has been found that in order that the desired increase in hardness in the head may be produced, the variations in temperature of the section may exceed those which would occur during normal cooling on the hot bank, with the consequent tendency to the formation of increased internal stresses. It has been found, however, that if, instead of applying the cooling fluid to the upper surface of the head only, a portion of its is also applied to other parts of the section, such augmentation of stresses may be avoided, and their magnitudes may be reduced to below those which would normally occur with natural cooling.

The most convenient method of distributing the cooling fluid to the various parts of the section is by projecting the main bulk of it on to the surface of the head, as described in the said specification, but, instead of letting it immediately escape, to confine and direct it by a series of guide plates so that it subsequently passes over the surfaces of the parts of lighter section. With certain sections of rail the extra cooling of the flange and web so obtained may be sufficient for the purpose, but with other sections additional jets of fluid impinging directly on the underside of the head, or upon the junction of web and flange may be necessary. The object of either guides or extra jets is in all cases the cooling of the section so that all parts of it may arrive at a temperature of about 450° C. and cool down from this temperature to about 300° C. at the same rate, this result being judged partly by temperature measurements either by eye or pyrometer, and partly by the tendency of the whole rail to camber during cooling from about 450–300° C.

The invention is illustrated in the accompanying diagrammatic drawings, in which:

Fig. 1 represents a cross-section of a rail being treated according to the invention, and

Figs. 2 and 3 are cross-sections similar to Fig. 1 illustrating modifications.

In Fig. 1 air is shown as being projected upon the surface of the head and web of a rail *a* from openings *d* in an air-pipe or chamber *b*. In Fig. 2 air is shown as being projected upon the surface of the head of a rail from openings *d* in the air pipe or chamber *b*, the air as it impinges upon the surface of the head of the rail being constrained by guide plates *c* to pass over the surface of the flange and web of the rail. In Fig. 3 the cross-sectional shape of the air chamber *b* is such that the portions of the air chamber *b* which overlie the head of the rail act in substantially the same manner as the guide plates shown in Fig. 2. In this case air is projected from openings *d* in the air chamber *b* not only upon the head of the rail *a* but also upon the junction of the web and the flange.

Having thus described the nature of the said invention and the best means I know of carrying the same into practical effect, I claim:—

1. An improvement in the manufacture of railway and tramway rails for the purpose herein set forth, which consists in applying a gentle cooling agent to the portions of the hot rail which are of heavier section, in such a manner that these portions shall arrive at and pass through the range of temperature 450–300° C. at approximately the same time as the portions of lighter section.

2. The modification of the improvement referred to in claim 1, wherein the rail is allowed to cool below the critical range before the gentle cooling agent is applied.

In testimony whereof I have signed my name to this specification.

CHRISTER PETER SANDBERG.