July 30, 1957 R. B. COTTRELL **2,800,982**

BRAKE ROTOR

Filed July 22, 1950

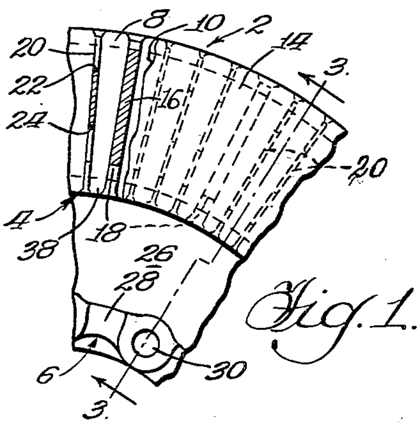

Fig. 1.

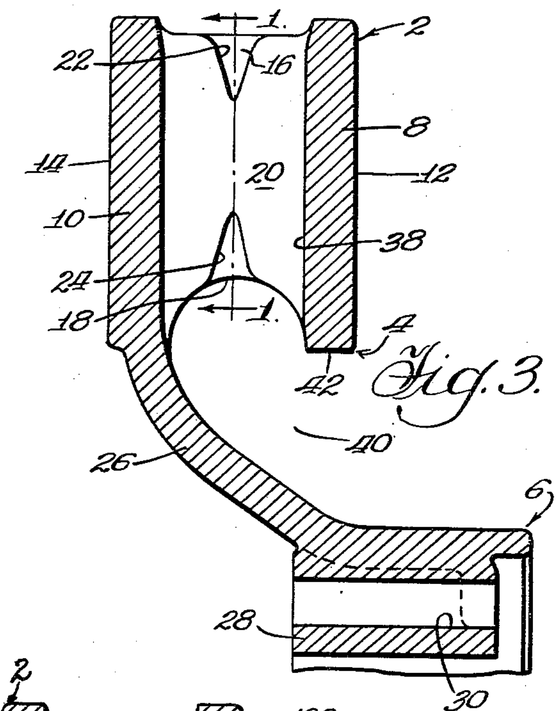

Fig. 3.

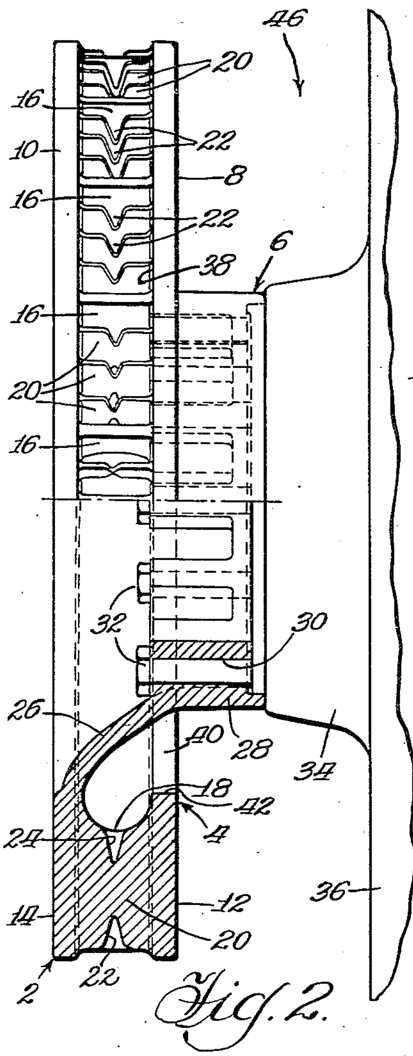

Fig. 2.

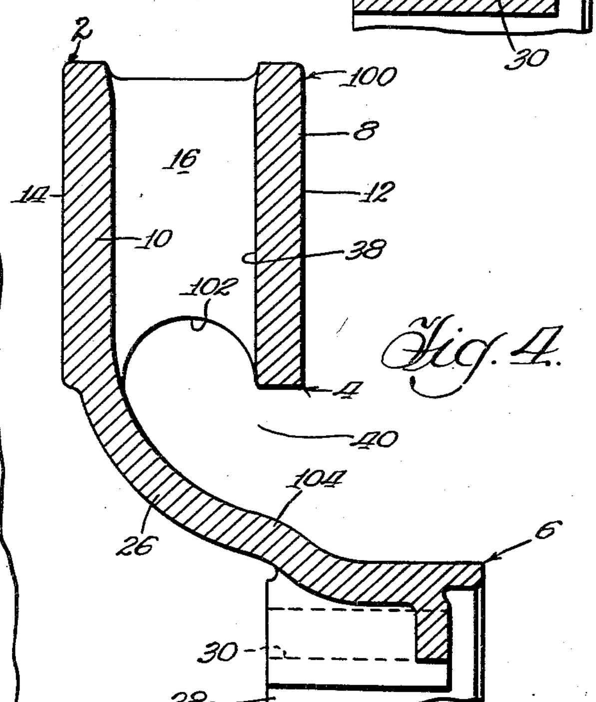

Fig. 4.

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BRAKE ROTOR

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3 Claims. (Cl. 188—218)

This invention relates to off-wheel brakes for railway rolling stock and more particularly to a novel brake rotor or disc.

The invention is embodied in a rotor comprising a two plate brake ring wherein one of the plates is formed integral with and as a continuation of a support hub for the rotor. Brake rotors of this type are relatively inexpensive and convenient to manufacture but have generally proved unsatisfactory in service in that they rapidly develop cracks and fractures and have a short life. In addition, it has been found that the shoes at opposite sides of this rotor wear unevenly which is undesirable in that it accelerates the frequency of maintenance.

In previous arrangements the connecting web between the brake ring and the support hub was formed either too small or, to increase the area, the web was made with sharp critical curves or corrugations which obtains a poor crystalline structure in the cast metal and develops planes of weakness which lead to early cracks. I have also found that as a rule the rotors heretofore made are thermally unbalanced at opposite sides. The plate directly connected to the hub is afforded a direct path for conducting heat into the hub which affords large heat radiating surfaces for rapidly dissipating the intense heat. This results in higher heat concentration in the free plate, that is the one which has less area in that it is not directly united with the hub. This causes more rapid wearing away of the engaging shoe. I have further discovered that thermal cracks on the plates result at least in part from nonuniform distribution of heat in various zones of the plates and that the plates are generally much hotter at their central zones than at their inner or outer zones. This is due to the fact that the heat developed on the central zones has had no special provision for escape inasmuch as the contiguous zones are also hot and conduction to these zones is thereby impeded. Also greatest heat concentrations develop at the center portions of the shoes engaging these central zones of the plates. It wil be understood that cognizance of these factors is important in view of the tremendous amount of energy developed in stopping a train and that the input into the rotor takes place in a few seconds.

A general object of the invention is to provide an inexpensive brake rotor which will perform efficiently and have long life in service.

A more specific object of the invention is to provide a two plate rotor of the type described wherein the parts are so arranged as to obtain a thermal balance at opposite sides of the rotor and across the entire extent of each plate and also arrange the connection between the hub and one of the plates in such a manner as to obtain a large web construction without resorting to critical shapes and convolutions such as would produce a poor crystalline structure.

More particularly, the invention utilizes a construction of a large connecting web between one plate of the brake ring and the hub and an arrangement of the connecting web in such manner that it merges at extremely flat or broad agles with the hub and the one plate of the friction ring. Thus favorable crystal formation of the metal is obtained. A large web construction of desirable cross-section is obtained by locating the hub outwardly of one side of the rotor and connecting it by the web to the plate at the opposite or far side of the rotor with respect to the hub. Thus, a large connecting web construction is gained without resorting to the corrugated construction. The greater length of metal in the connecting web also affords low stress thermal expansion and contraction.

By connecting the hub to the plate at the far side with respect to the wheel a further thermal balance is obtained. In operation the air is circulated between the outer side of the free plate, that is the one adjacent to the wheel, and the inner side of the wheel and the air is drawn through the brake ring by blades interconnecting the plates and across the inner side of the free plate. At the same time this air passes across the large external side of the connecting web of the support and internal side of the plate connected to the web. Thus a more efficient circulation of air is provided around the free plate to compensate for the increased capacity and heat radiating areas of the combined plate and web of the support.

The construction provides for certain vanes to interconnect the plates in such a manner as to obtain maximum heat radiation in the central zones of the plates and gradually decreased heat radiation as the inner and outer peripheries of the plates are approached. This is obtained by thin vanes which are provided with V notches in their inner and outer ends. The thin vanes thus become narrower and narrower as they approach the margins of the plates, whereas the intermediate portions extend across the entire space between the central zones of the two plates. Thus the greatest width of the thin blades is in axial alignment with the central zones of the plates, thus providing maximum heat radiating areas at the central zones of the plates, where most needed.

These and other objects of the invention will become more apparent from the specification and the drawings, wherein:

Figure 1 is a fragmentary reduced side elevational view of a brake rotor partly in section and embodying one form of the invention, the section being taken substantially on the lines 1—1 of Figure 3;

Figure 2 is an edge view of the rotor partly in axial cross-section and shown attached to an associated wheel, fragmentarily shown;

Figure 3 is an enlarged sectional view taken substantially on the line 3—3 of Figure 1; and

Figure 4 is a sectional view comparable to Figure 3 and illustrating a modification of the invention.

Describing the invention in detail and referring first to the embodiment shown in Figures 1 to 3, the brake rotor, generally indicated **2**, comprises a brake ring, generally indicated **4**, and a support structure, generally indicated **6**.

The brake ring comprises a pair of axially spaced generally parallel radially extending friction plates **8** and **10** which present substantially flat friction surfaces **12** and **14** on their remote sides. The plates **8** and **10** are interconnected on their adjacent sides by a plurality of relatively thick blades **16**, **16**, the blades **16** being substantially regularly spaced and extending lengthwise radially and widthwise axially of the rotor. The blades **16** extend from the radially inner peripheries of the plates to the radially outer peripheries of the plates and are formed substantially flat at their outer ends and have a semi-circular recess or cutout **18** at their inner ends.

The plates **8** and **10** are also interconnected on their inner or adjacent sides by a plurality of relatively thin blades or vanes 20, 20 which are spaced at regular intervals between the blades 16, 16. It will be understood that the blades 16 are provided to give the structure the necessary strength and that the vanes 20, 20 serve as auxiliary braces, however, their principal function is to provide extensive surfaces for radiating heat which is generated in the plates 8 and 10 and to implement the blower action of the rotor.

I have discovered as heretofore stated that to obtain constant thermal characteristics across the full extent of each friction plate from its inner periphery to its outer periphery it is necessary to provide auxiliary heat radiating surfaces in the central areas of each plate to compensate for the heat radiating surfaces which are presented at the inner and outer peripheries of each plate for the inner and outer zones of each plate and also due to the restriction in the transmission of heat in the intermediate portions to the outer portions inasmuch as the outer portions are also heated through engagement with the friction shoes. The temperature gradient increases from the minimum at the inner periphery of each plate to a maximum in an intermediate area of each plate substantially in alignment with the center of an associated shoe which frictionally cooperates with the same and then the gradient drops again to the minimum at the outer peripheries of the plates.

To compensate for this, there are provided V-shaped notches 22 and 24 in the radially outer and inner extremities of the vanes 20, 20. It will be seen that this arrangement provides a blade which widens gradually from the inner and outer peripheries of each plate to the center thereof. The apex of each notch 22 and 24 is terminated at a point approximately one third of the distance inwardly of the associated vane. Thus each vane 20 has its widest area in alignment with the central portions of the plates 8 and 10, thereby providing maximum heat radiating surfaces for these areas of shortest distance thereto.

The brake ring 4 is connected at the radially inner edge of the plate 10 at a flat angle to the radially outer edge of a bell-shaped member or web 26 which forms part of the support 6. The bell-shaped member extends through the brake ring 4 and merges at its radially inner end at a flat or broad angle into a hub 28 which extends outwardly of the brake ring on a side remote from the plate 10.

The hub is provided with a plurality of openings 30 through which extend bolts 32 which are threaded into a hub 34 of a wheel 36 which is positioned parallel to the brake ring, the inner side of the wheel facing the friction surface 12 of the friction plate 8.

It will be noted that the connection between the hub and the wheel is of conventional form, however, it will be observed that by connecting the hub 28 with the plate 10, which is on the far side of the brake ring with respect to the hub, the length of the member 26 is increased to the maximum and the web is a simple cross section extending generally diagonally from the outer periphery of the hub to the inner periphery of the plate 10 across the entire space in alignment with a fluid chamber 38 defined between plates 8 and 10. This increased length of metal in the member 26 over that which is conventional practice accommodates low stress expansion and contraction and provides an increased heat radiating area and permits the shallow angle of connection without resorting to critical shapes.

As heretofore noted the plate 10 is afforded a good heat conductance into the support 6 which would normally cause the shoe engaging plate 10 to wear longer than the shoe engaging plate 8. To balance the thermal characteristics of plates 8 and 10 the arrangement of the bell member 26 provides a fluid inlet passage 40 between the outer surface of the support 6 and the inner periphery 42 of plate 8, said inlet communicating with the chamber 38. It will be observed that the disposition of plate 8 adjacent to the inner surfaces of wheel 36 affords a channel at 46 between friction surface 12 and the inner side of the wheel through which the air passes into the inlet 40 across the outer surface of the support and impelled by blades 16 and the vanes 20 radially outwardly through the fluid chamber 38 defined between plates 8 and 10. Thus it will be seen that provision is made to afford an efficient heat radiation into the air for plate 8 by causing the air to circulate around plate 8 and an efficient transfer of heat by conduction is provided for plate 10 to the support 6.

Referring now to the embodiment shown in Figure 4 wherein parts identical with those shown in the previous embodiment are identified by corresponding reference numerals. The brake rotor 100 differs from that previously described in that all of the thick and thin blades are formed with a substantially semicircular recess or cutout 102 at their radially inner ends and are formed substantially flat at their outer ends. In addition the juncture between the inner edge of the member 26 and the hub 28 is offset in a gentle curve radially outwardly as at 104 in order to increase the radial thickness of the hub at said junction to provide increased thermal capacity in this area and to extend the web 26 slightly over that shown in the previous modification.

I claim:

1. A unitary brake rotor for a railway car truck having a wheel and axle assembly, a brake ring having two generally parallel friction plates, said friction plates defining the outermost limits of the ring in axial direction and having braking friction surfaces on their outer sides, blades interconnecting said plates on their adjacent sides, a support within the ring comprising a hub extending from one side of the ring and having means for attachment to said wheel, and an annular bell-shaped member connected at its inner periphery to the hub and at its outer periphery to the friction plate on the side farthest away from the hub, said friction plates defining a fluid chamber therebetween having an outlet at the outer periphery of the ring and having an uninterrupted annular inlet defined between the external side of said bell-shaped member and the inner periphery of the plate adjacent to said hub and said wheel, said inlet having air channeled thereto between said wheel and the outer side of said last mentioned plate, whereby the last mentioned plate is cooled on its external side as the air is drawn into the rotor and on the internal side by the air blowing through the chamber, and said plate remote from the hub being cooled by the air blowing along its interior side in the chamber and through conduction into the support, whereby substantially balanced thermal characteristics are established in both of said plates.

2. A unitary brake rotor comprising a brake ring including inner and outer spaced interconnected friction plates, said friction plates defining the outermost limits of the ring in axial direction and having braking friction surfaces on their outer sides, a support having a hub adjacent the inner friction plate, and an annular integrally formed bell-shaped web interconnecting the outer periphery of the hub with the inner periphery of the outer friction plate wherein the inner plate is cooled on its external side as the air is drawn into the rotor and on its internal side by the air passing between the plates of the rotor and whereby said outer plate is cooled on its interior side by the air blowing between the plates of the rotor and through conduction into the support whereby substantially balanced thermal characteristics are established in both of said plates.

3. A unitary brake rotor for a railway car truck having a wheel and axle assembly comprising a ring, an inner and an outer annular plate relative to the wheel and spaced apart in axial direction, said plates defining the outermost limits of the ring in axial direction and having braking friction surfaces on the outer sides, radial blades

interconnecting the plates on their inner sides, and a support for the ring including a hub adjacent the plane of the outer surface of the inner plate for securement to the wheel, and a web integrally connected with the hub and extending therefrom through the inner plate in diverging, bell-shape fashion and integrally connected with the radially inner periphery of the outer ring, the web forming a broad angle with the hub and with the outer plate, and there being a smooth and uninterrupted surface from the hub, across the outer surface of the web and onto the inner surface of the outer plate, the plates defining a fluid chamber therebetween having an uninterrupted outlet at the outer periphery of the ring and an uninterrupted annular inlet between the outer surface of the web and the inner periphery of the inner plate.

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