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(71) Applicant
Automotive Products
Limited, Tachbrook Road,
Leamington Spa,
Warwickshire, CV31 3ER
(72) Inventors
Richard Arnold Bass,
Peter Simpson Kirkwood
Grossart
(74) Agent
L. H. Street

(54) Brake Discs

(57) A ventilated brake disc has two aligned spaced annular parts 11 and 12, the opposed back faces 20 of which have projecting integral circumferentially spaced webs 13 and 14 housed within the annular envelope. The webs 13 and 14 are arranged so that the inner set of webs 14 are each inclined or have a portion inclined to a radius of the disc and act as an impeller drawing air into the interior of the disc, and the air then flows over the outer set of webs 13 to cool the disc and the inner and outer webs 13 and 14 are staggered so that the inner webs 14 guide air to the spaces between the outer webs.

The webs 14 from opposed faces 20 are joined—the webs 13 may be joined or may not meet. The webs 13, 14 may carry fins 51 in each corner to assist cooling.

Various web arrangements are illustrated in sections A, B, C, D of Figure 2.

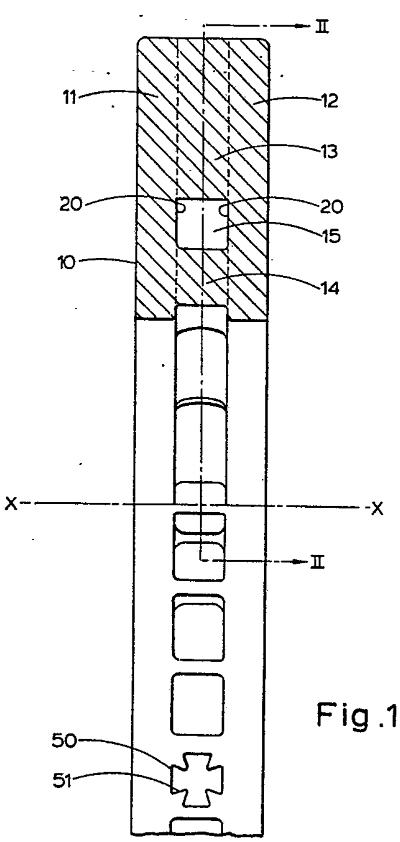

Fig.1

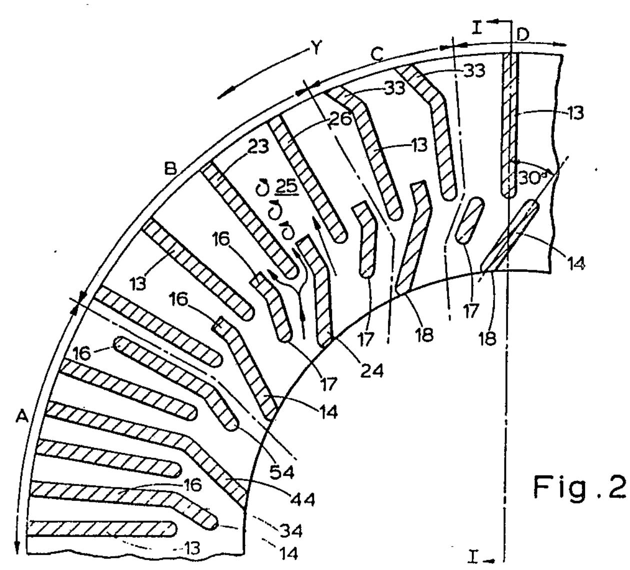

Fig.2

GB 2 024 966 A

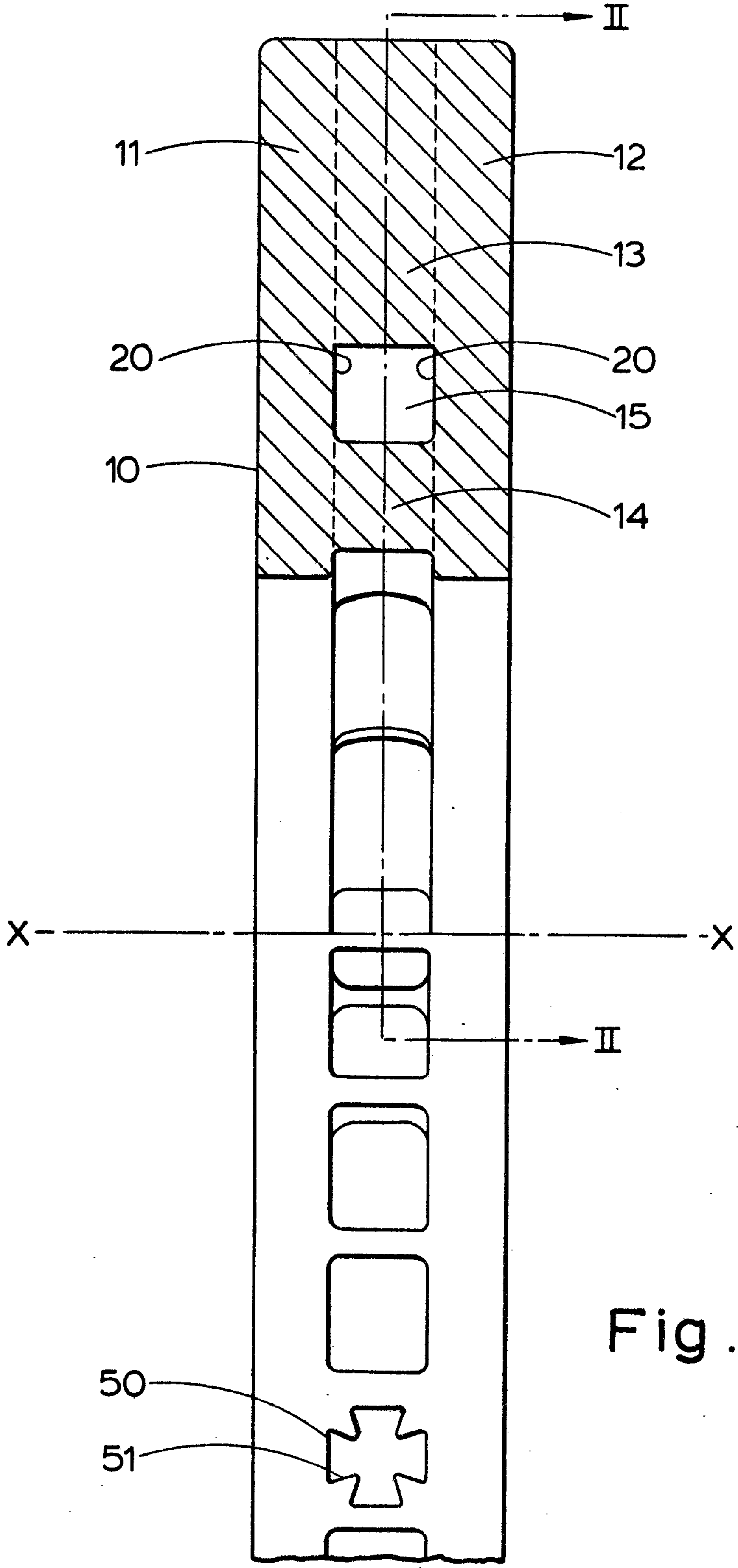

Fig.1

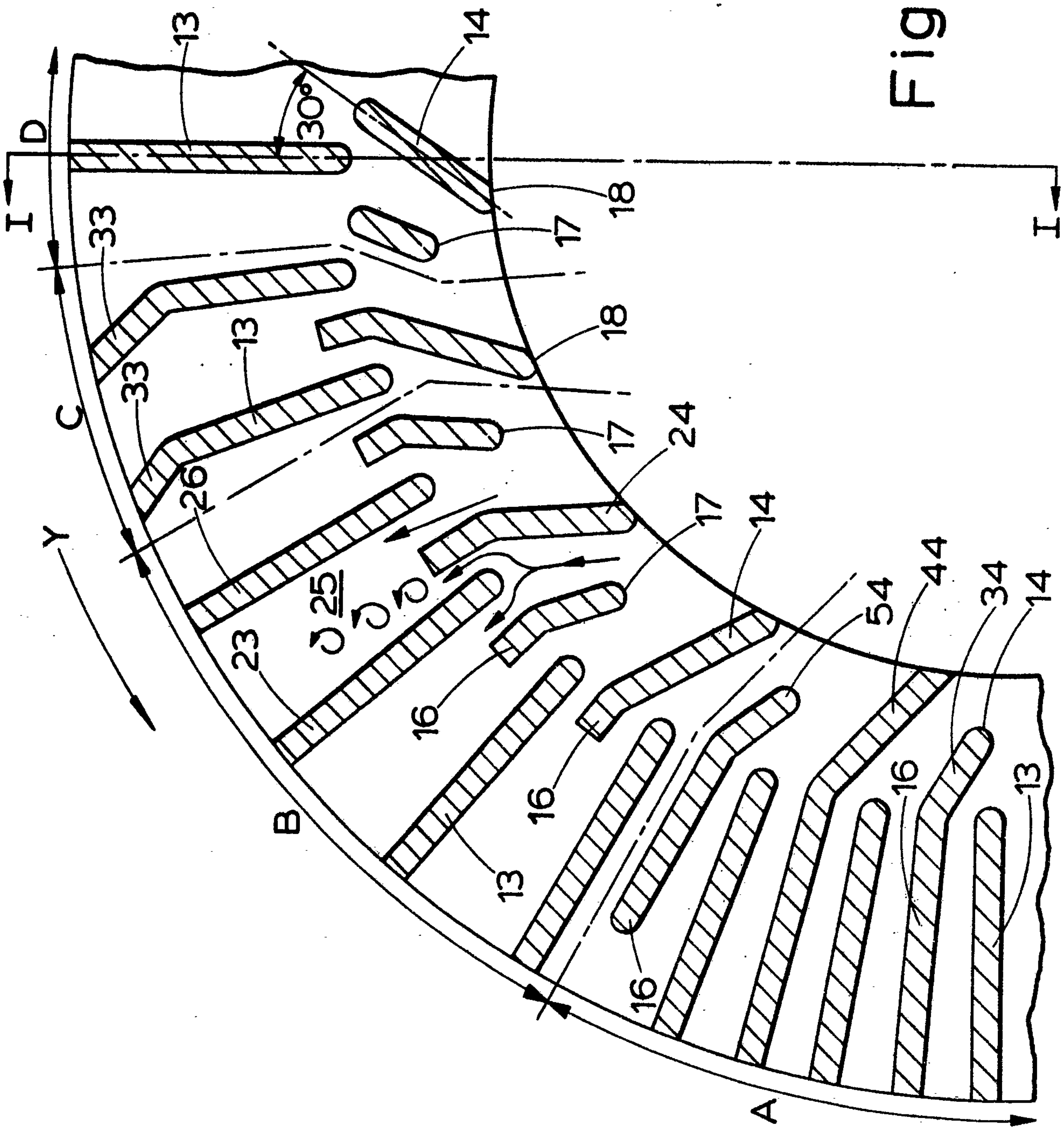
13
14
30°
D
I
18
17
33
13
18
C
33
17
24
26
Y
14
17
25
23
16
44
54
34
14
B
16
13
16
16
13
A

Fig. 2

SPECIFICATION
Brake Discs

This invention relates to ventilated brake discs for, but not exclusively for, heavy duty disc brakes for racing cars.

A major problem with heavy duty brakes is the amount of heat that is generated when the brakes are applied. The brake discs tend to act as heat reservoirs for this generated heat and in some cases approach red heat.

The high temperature of the brake disc, which is in contact with the brake friction pads during the braking operation, causes the break down of the resin binder utilised in the manufacture of the friction pads and the pads therefore wear more quickly.

With racing cars it therefore is desirable to reduce the rate of pad wear and hence the number of pit stops a racing car may have to make for new pads.

A known method of reducing the temperature of the brake disc is to provide radial or helical ventilation passageways through the disc.

An example of the type of disc is shown in British Patent No. 1,079,081. However, a disadvantage of this type of disc is that amount of cooling air that can be passed through the ventilation passageways tends to maximise out.

The object of the present invention is to provide an improved ventilated brake disc.

According to this invention there is provided a ventilated brake disc having two aligned spaced annular parts having oppositely directed friction surfaces, the opposed back faces of said parts being joined together by integral circumferentially spaced webs housed within the annular envelope, said webs comprising a set of radially inner webs and a set of radially outer webs, each inner web being inclined to a radius of the disc so that the inner set of webs acts as an impeller drawing air into the space between said annular parts and the air passes over the outer webs, said inner and outer webs being staggered such that the inner webs guide air to the spaces between the outer webs.

Preferably the inner set of webs overlaps radially with the outer set of webs and conveniently there are equal numbers of inner and outer webs and the two sets of webs are interdigitated such that each inner web is located between and guides air to a space between a pair of adjacent outer webs.

Conveniently alternate inner webs are shortened away from the inner periphery of the friction surfaces relative to the other inner webs so that the influx of air between said other inner webs is facilitated.

An embodiment of the invention will be described by way of example and with reference to the following drawings in which:—

Fig. 1 shows below the line X—X an elevation of a brake disc according to this invention and above the line X—X shows a section of the brake disc taken on the line I—I of Fig. 2; and

Fig. 2 shows an arc of a section on the line II—II of Fig. 1 and also shows different web constructions in the sectors A, B, C and D.

With reference to Fig. 1 and Fig. 2, the brake disc is manufactured as a single casting from cast iron. The disc comprises two aligned spaced annular parts 11 and 12 having oppositely directed friction surfaces 10 which in use engage with a pair of friction pads (not shown).

The opposed back faces 20 of the annular parts 11 and 12 are joined by integral webs 13 and 14. There are equal number of outer webs 13 and inner webs 14 and these are formed as respective sets of circumferentially spaced radially outer webs 13 and a circumferentially spaced radially inner webs 14. The spaced outer webs 13 are radially aligned relatively to the disc and each outer web extends from the outer periphery of the disc towards the inner periphery for between 50% and 75% of the radial width of the parts. The outer webs 13 conduct heat away from the friction surfaces 10 to the interior space 15 of the disc.

Each of the spaced inner webs 14 is inclined to 30 degrees to a radius of the disc, see sector D, Fig. 2, and extends from the inner margin of the disc radially inwards so that its radially outer end portion is located between a pair of outer webs 13. The inclined inner webs act as an impellor drawing air into the space 15 between the two back faces 20 and then guiding the air to between the outer webs. These inner webs 14 also conduct heat from the friction surfaces 10 of the parts 11 and 12 into the interior space 15 of the disc, and hence the webs 13 and 14 are cooled by the flow of air passing over them, thus reducing the temperature at the friction surfaces of the disc.

As is shown in sectors A, B and C of Fig. 2 the inner set of webs 14 can radially overlap with the outer webs 13 and one convenient method of accommodating this overlap is for the overlapping portion 16 of each inner web to be bent out of alignment with the remainder of said inner web such that the overlapping portion 16 is radially aligned relative to the disc.

The amount of overlap between the two sets of webs can be varied so as to obtain the desired rate of cooling and this alters the type of air flow taking place over the surfaces of the outer webs 13.

In sector B and C of Fig. 2 the overlap is approximately 10%—15% of the radially width of the disc. With the disc rotating anticlockwise in the direction of arrow Y then air on the leading edge of each inner web for example, web 24 is directed around both sides of the outer web 23. The air passing behind the trailing edge of the web 23 is caused to flow in a turbulent manner by the short bent portion 16 of the inner web 24. Also the sudden expansion of air into the space 25 between adjacent outer webs 23 and 26 causes a depression drawing air in from behind the web 24. Thus the web 24 is cooled on both sides and the webs 23 and 26 are subject to cooling on their trailing and leading faces respectively. The other sides of the webs 23 and 26 are cooled by air flow from other inner webs 14.

Alternatively as is shown in sector A, the overlap can be such that each inner web 34 and 44 can ultimately be taken out to the outer periphery of the disc to give an overlap of approximately 60%—65% of the radial width of the disc. In this case the air is only pumped through the spaces between the outer webs and whilst some air will also be thrown through by centrifugal forces there will be no air drawn in by the depression effect. This type of flow through these interdigitated webs is thought to be laminer flow. Further, shown in sector A is an inner web 54 having an overlap with the outer webs 13 which is intermediate the overlap shown by the inner webs 34 and 44, and that overlap shown by the webs 24 in sectors B and C. This web 54 has an effect intermediate the other two types shown.

The inner webs 14 are arranged such that circumferentially alternate inner webs 17 are fore-shortened away from the radially inner periphery of the disc relative to other inner webs 18. This is because the crowding of the inner webs 14 on the inner periphery would tend to choke the flow of air into the space 15. By fore-shortening alternate webs 17 away from the inner periphery the choking effect is reduced.

Also, but not shown in the drawings, with the inner webs 34 and 44 extended to the outer periphery of the disc, the outer webs 13 in Sector A can be arranged so that they do not extend between the opposed back faces 20, but the opposed outer webs 13 only project from their respective back face without meeting in the middle. This gives an air gap between the opposed outer webs and thereby gives an increased surface area over the same webs extending fully between the two back surfaces.

Furthermore in Sector C an alternate construction is shown for the outer webs 13. In Sector C each of which have a radially outer portion 33 that is inclined, away from the radially aligned remainder of the web, towards the direction of rotation.

An alternative form of web is indicated at 50 on Fig. 1. The webs, both inner and outer 14 and 13 respectively, carry fins 51 in each corner which project into the spaces between the webs. These fins 51 increase the surface area for heat transfer between the webs and the cooling air.

Claims

1. A ventilated brake disc having two aligned spaced annular parts having oppositely directed friction surfaces the opposed back faces of said parts being joined together by integral circumferentially spaced webs housed within the annular envelope, said webs comprising a set of radially inner webs and a set of radially outer webs, each inner web being inclined to a radius of the disc so that the inner set of webs acts as an impeller drawing air into the space between said annular parts and the air passes over the outer webs, said inner and outer webs being staggered such that the inner webs guide air to the spaces between the outer webs.

2. A brake disc as claimed in Claim 1, wherein each web of the outer set of webs is radially aligned relative to the disc.

3. A brake disc as claimed in Claim 1 or Claim 2, wherein both the inner and outer sets of webs have the same number of webs and each inner web guides air to the space between a pair of adjacent outer webs.

4. A brake disc as claimed in any one of Claims 1 to 3, wherein the inner set of webs overlaps radially with the outer set of webs.

5. A brake disc as claimed in Claim 4, wherein that portion of each inner web that overlaps with the outer webs is bent out of alignment with the remainder of said inner web such that the overlapping portion is radially aligned relative to the disc.

6. A brake disc as claimed in Claim 5, wherein the overlap between the inner and outer webs is equivalent to between 10% and 65% of the radial width of the annular friction faces.

7. A brake disc as claimed in any one of Claims 3 to 6, wherein each alternate inner web is shortened relative to the other inner webs away from the radially inner periphery of the faces.

8. A brake disc as claimed in Claim 7, wherein the said other inner webs intersect the inner periphery of the disc and said alternate webs are set back from the inner periphery by approximately 15% of the radial width of the friction faces.

9. A brake disc as claimed in any proceeding claim, wherein the disc is produced from a single casting.

10. A brake disc as claimed in any proceeding claim, wherein the angle of inclination of the inner webs is 30 degrees to the radius of the disc.

11. A brake disc as claimed in Claim 5, wherein the overlap between the inner and outer webs is such that the inner webs extend to the outer periphery of the disc and the outer webs do not extend between the opposed back faces but project therefrom such that the opposed outer webs on each back face do not meet but have an air gap therebetween.

12. A brake disc substantially as described herein and as shown in the accompanying drawings.

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