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(54) GRAPHITE FRICTION LININGS FOR DISC BRAKES PARTICULARLY FOR AIRCRAFT

(71) We, MESSIER-HISPANO-BUGATTI, a body corporate organised and existing under the laws of France, of 5, rue Louis Lejeune, 92120 Montrouge, France,

do hereby declare the invention, for which we pray that a Patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:-

The invention relates to graphite friction linings for disc brakes, particularly for aircraft.

Such disc brakes may be multiple disc brakes wherein the friction linings provided on the elements, some of which (the rotors) rotate while the other (the stators) are stationary, produce a braking force by frictional engagement with one another.

In the aircraft industry in which wide use is made of disc brakes, technical progress has been mainly concerned with effecting a progressive reduction in weight and a progressive increase in permissible temperature in the disc brake generally, and in particular in the heat sink constituted by the lining and the bodies formed by the rotors and stators.

For this purpose it has been proposed to use rotating and/or non-rotating discs made of carbon, graphite for example, because of the intrinsic advantages of these materials as regards both weight and the remarkably high permissible temperature.

However, a major difficulty involved in the use of graphite in such a case lies in the fact that the mechanical properties of this material are poor.

With a view to overcoming this drawback it has been proposed, in the specification of our Application No. 3681/76 (Serial No. 1553973) to use structural graphite for the friction linings or friction shoes secured to one of the rotating body (rotor) and or to the non-rotating body (stator), with the linings or shoes secured to the other of the two bodies made of a different material, for example another graphite such as polycrystalline graphite.

The expression "structural graphite" has to be construed as meaning any graphite containing a substantial proportion of filaments or fabrics, these filaments or fabrics being arranged in superposed and preferably crossed layers which are interconnected either by gas-diffusion (using the method known as "carbon varpour deposition" or CVD) or by successive impregnation of the filaments or fabrics by means of polymerized substances or resins which are then carbonized and, if required, graphitized, the coated fabrics from which the structural graphite is formed imparting thereto suitable mechanical properties.

It is also proposed in the earlier specification, that the rotating and/or non-rotating bodies carrying the linings of structural graphite may themselves be made of structural graphite.

In this case, a particularly simple and economical way of producing such a brake comprises producing one-piece elements made of this structural graphite which form both the body and the linings carried by the body.

The structural graphites hitherto used, known in the U.S.A. as "carbon-carbon" materials, are obtained by coating rayon filaments which posses the advantage of having a good co-efficient of friction.

However rayon is an expensive product which has a low density and the mechanical

properties of which are only average. For this reason, when a particular mechanical strength is required, the shoes and linings have to be unduly large.

According to the present invention there is provided a friction lining or friction shoe of structural graphite for a disc brake, in which the lining or the shoe has a core comprising a structural graphite, obtained by coating polyacrylonitrile filaments, and at least one facing defining the friction surface and comprising a structural graphite, obtained by coating rayon filaments.

Since the polyacrylonitrile filaments are more dense and more solid than those made of rayon, the linings or shoes in accordance with the present invention can thus possess the advantage of occupying less space for a given mechanical strength, or of being stronger for a given amount of space occupied.

Also, polyacrylonitrile filaments are less costly than rayon filaments so that substantial savings will be effected by using such linings.

Finally, since the friction behaviour of structural graphite obtained by coating rayon filaments is better than that of structural graphite comprising polyacrylonitrile filaments, the provision of a facing of structural graphite of the first kind and defining the friction surface and having a thickness corresponding to the wear thickness, will allow linings and shoes in accordance with the invention to exhibit frictional behaviour similar to that of the previously proposed products.

For the purpose of forming the above-defined structural graphites, the rayon and polyacrylonitrile filaments can be woven, using for example a satin-stitch or taffeta-stitch weave, or they can be knitted.

The present invention also relates to single-piece elements of structural graphite which form both a rotating or a non-rotating body as well as the friction lining carried by this body which can be fitted on a disc brake such as is described in detail in our above-mentioned specification. These one-piece elements each have a core made of structural graphite obtained by coating polyacrylonitrile filaments, and two facings each defining a friction face and having a thickness corresponding to the wear thickness and made of a structural graphite obtained by coating rayon filaments.

The invention is diagrammatically illustrated by way of example with reference to the accompanying drawing, in which:-

Figure 1 is a radial half-section through the stator of a disc brake of previously proposed kind, in which stator are formed recesses each of which accommodates a friction shoe according to the invention; and

Figure 2 is a radial half-section through a single-piece rotor in accordance with the invention, which rotor can be fitted on a disc brake such as is described in our above-mentioned specification.

Referring to Figure 1, a brake comprises a frame 1 carrying means for applying compressive forces. A heat sink comprises stators 2 (only one of which is shown) between which are arranged rotors, (not shown).

Each stator 2 is provided with shoes 3 made of structural graphite, each of which is fitted in a recess in the body 4 of the stator 2, which body may be made of steel. Each of the shoes 3 comprises a core 5 made of a structural graphite obtained by coating polyacrylonitrile filaments, and a facing 6 made of a structural graphite obtained by coating rayon filaments. The thickness of the facing 6 corresponds to the wear thickness of the shoe 3 which bears on the body 4 of the stator 2 at the lateral surface of the core 5 and perpendicularly to the friction surface 7, that is to say at that of its portions having the better mechanical properties. The shoes are secured in their recesses by any suitable method, for example by bonding, by welding, by means of a previously applied layer which metallizes the graphite, or by means of a graphite having transitional properties or by means of any suitable mechanical securing means such as a rivet.

Referring to Figure 2, the one-piece rotor 8, which can be provided in the brake described in our above-mentioned specification, takes the form of an annular rim of structural graphite which forms both the body and the linings of the rotor. In the conventional manner the rotor has, on its outer circumference, notches 9 which are formed in the block of structural graphite and which impart thereto the appearance of a crown rim and in which slide drive pins carried by the moving part that is to be braked.

The annular rim 8 comprises a core 10 made of a structural graphite based on polyacrylonitrile filaments, and two facings 11 each having a thickness corresponding to the wear thickness and defining friction surfaces 12 and made of a structural graphite based on rayon filaments.

These embodiments are given merely by way of non-limiting examples; the shape of the shoes fitted in the recesses in the stators and/or rotors of disc brakes can be varied, and the grooves 9 can be formed on the inside circumference of the single-piece elements that may constitute the rotors or stators of disc brakes.

Also, any kind of weave of the polyacrylonitrile filaments of the core can be combined with any kind of weave of the rayon filaments of the facing or facings without thereby departing from the scope of the

invention.

WHAT WE CLAIM IS:-

1. A friction lining or friction shoe of structural graphite for a disc brake, in which the lining or the shoe has a core comprising a structural graphite obtained by coating polyacrylonitrile filaments, and at least one facing defining the friction surface and comprising a structural graphite obtained by coating rayon filaments.

2. A friction lining or friction shoe according to claim 1, in which the polyacrylonitrile filaments and/or the rayon filaments are woven or knitted.

3. A one-piece element of structural graphite forming both the rotating or non-rotating body and the friction lining carried by the respective body and provided in a disc brake, in which the element comprises a core comprising a structural graphite obtained by coating polyacrylonitrile filaments, and two facings, each of which defines a respective friction surface, the facings comprising a structural graphite obtained by coating rayon filaments.

4. A friction lining or friction shoe of structural graphite for a disc brake substantially as hereinbefore described and illustrated with reference to Figure 1 or Figure 2 of the accompanying drawing.

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1572535 COMPLETE SPECIFICATION
1 SHEET *This drawing is a reproduction of the Original on a reduced scale*

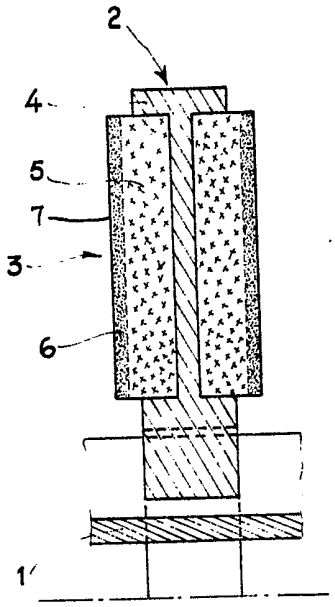

FIG. 1

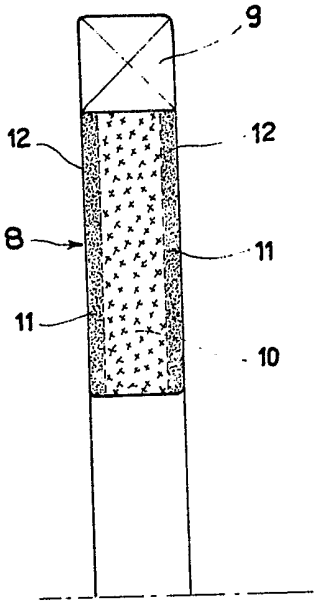

FIG. 2