

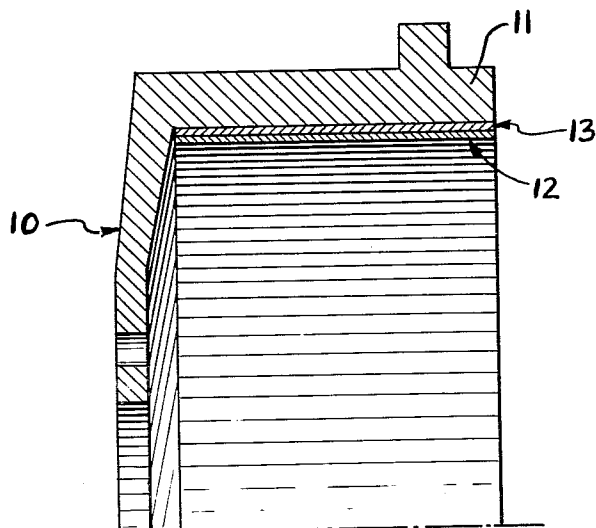
June 4, 1963

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3,092,214

FRICTION DEVICES

Filed Jan. 9, 1961



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3,092,214

FRICTION DEVICES

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Filed Jan. 9, 1961, Ser. No. 81,454
8 Claims. (Cl. 188—218)

This invention relates to improvements in friction devices, and particularly brake drums adapted to be rotatably associated with wheels of vehicles such as passenger cars, trucks, busses, and aircraft. It is a particular object of the present invention to provide aluminum brake drums of the class aforesaid of improved wear properties.

In view of the desire to reduce unsprung weight and to provide air-coolable brake drums having heat conductivity greater than that of the conventional cast-iron drums, the use of aluminum has been the object of research for many years.

Initially, attempts were made to employ aluminum or the conventional alloys of it, but these have been found to be impracticable due to the fact that they scuff and score badly, and these defects rapidly increase on application of increasingly higher energies.

In order to overcome such inherent defects, further attempts have been made to employ sprayed metal friction tracks over aluminum, using various grades of steel, but with indifferent results; high wear and scuffing remaining of serious order.

More recent tests have pertained to the use of high silicon-aluminum alloys, and while these are harder than conventional aluminum alloys, the melting point is still close to that of aluminum, and under high loading the surface of the friction tracks melts and the molten metal serves as a lubricant, causing fading and metal sloughing. Such usage has been further found to be detrimental on the friction composition materials used in the brake shoes because of the high abrasion tendency of the aluminum.

On further attempts to provide the aluminum brake drum with a wear track of chromium directly plated thereto, for example in a thickness range of .004 inch, it was found that when severity of brake application was increased beyond the standard tests, the aluminum melted beneath the chromium, resulting in spalling and cracking of the chromium plated surface.

As distinguished from the foregoing and in accordance with the present invention, we have found that all the advantages of light weight and moderate heat conductivity of aluminum brake drums may be retained, and a wear or friction track composed of metal having a higher melting point, greater hardness, lower thermal conductivity and lower coefficient of thermal expansion than said aluminum brake drum could be employed if we interposed and integrally bonded therebetween high heat conductive metal having a melting point and thermal conductivity greater than that of the aluminum brake drum, such as silver, copper, and alloys thereof, the previously encountered defects of using the aluminum and aluminum alloys alone or a mere overplating of relatively high melting point metal, such as one melting above 2000° F., could be overcome.

Examples of such high melting point metals are chromium, nickel, and molybdenum.

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The accompanying drawing diagrammatically illustrates a fragmentary section of a brake drum formed in accordance with the present invention.

Referring to the drawing, the reference numeral 10 indicates a conventional aluminum brake drum having a cylindrical flange portion 11, a high melting point wear track layer 12 thereover, and a relatively high heat conductivity metal buffer zone layer 13 disposed between the aluminum brake flange 11 and the high melting point wear track layer metal 12. The thickness of the wear track layer 12 can be on an average of about .002 to about .008 inch and the buffer zone metal can be on an average of from about .003 to about .030 inch in thickness. These layers are bonded to each other and to the aluminum flange 11 by means of spraying or plating to provide an integral bond, the metal of the intermediate layer 13 serving as a mutual bonding agent.

As an example of the present invention, the cylindrical flange of an aluminum brake drum was internally plated with a layer of copper in the thickness of .020 inch and then further plated with a layer of chromium in a thickness range of .004 to .006 inch. No difficulty was encountered in running conventional dynamometer tests on this surface, in contrast to iron or a plain aluminum surface which failed almost immediately in the same test.

As another example, the cylindrical flange on an aluminum drum was sprayed to a thickness of .030 inch of copper and then machined to a relatively uniform surface of .020 inch in thickness of the sprayed copper. This was then plated with .003-.006 inch of chromium on top of the copper plate, and the previous test repeated. It was found that with the buffer zone of high conductive copper and with its melting point of 1980° F. no melting of the aluminum beneath the copper and chromium layers occurred as when using chromium alone over aluminum, and the results of the test were superior to the use of chrome plate alone.

Similar results were obtained in a further test wherein the copper was plated to a thickness of .030 inch, machined to an average of .020 inch thickness, and plated with chromium of .003-.006 inch.

As to reduction in weight, the aluminum drums tested weighed 7½ pounds in contrast to 15 pounds for a conventional cast-iron drum of the same size and configuration. In employing the dual coated aluminum flanges in accordance with the present invention, wading and spalling of the metal was absent.

The primary requisite of the friction or surface contact metal is that it be relatively hard and heat resistant with fairly good heat conductivity and have a lower coefficient of expansion than aluminum. This lower coefficient of expansion on the wear surface brings the metal components in something approaching a thermal balance as far as expansion is concerned, since the heat in the friction track is far higher than the underlying metal even at so short a distance as .020 inch below the surface.

Although we have indicated our preferred limits of the layers 12 and 13, it will be understood by those skilled in the art that this is to some extent dependent upon the particular metal or alloys employed, and that these further should be in proportion to the heat generated or to be generated during the brake operation and of adequate volume to provide a temporary heat-sink

or thermal dashpot and to permit the heat generated in the braking operation at the interfaces of the metal member and the relatively stationary brake shoes to more gradually pass into the aluminum drum.

It will be understood that in accordance with the present invention, brake shoes lined with conventional friction composition materials such as asbestos fiber-reinforced, hardened organic binder-containing friction material compositions may be employed. Further, although the drawing shows a brake drum adapted for use in combination with conventional internally disposed expanding types of brake shoes, an aluminum brake drum may be employed with an externally disposed contracting type lined friction member, and in such case the intermediate layer 13 will be secured to the outer surface of flange 11 and the layer 12 outermost thereover.

When lower energies are developed, the layers 12 and 13 may be relatively thin, whereas other or higher heat loads such as in operation of trucks or like vehicles or in aircraft vehicles, these two layers may be thicker as on the order of .030 for the buffer zone metal layer 13, and .008" for the wear layer 12.

With, for example, a copper buffer zone layer 13 having a thickness of .020 inch and a chrome plated friction track .003" thick, the calculated temperature in the first instance of brake application can reach in the neighborhood of 1250° F. in normal severe service.

In normal automobile passenger car usage, the temperature generated in the first instance of engagement at the interface between the rotatably mounted metal brake drum and the relatively stationary brake shoes will not exceed about 800° F. in the layers 12 and 13, and therefore a structure can be employed wherein a copper layer 13 and a chromium layer 12, each having a thickness of .005 inch, can be employed.

For the friction track, nickel or chromium are both particularly good because of their high inherent hardness when plated with the so-called hard plate processes. In addition, both have coefficients of expansion which are definitely lower than the underlying aluminum and copper. Further, both of these metals can be plated quite readily to an underlying coat of copper.

Copper is the preferred underlying metal for the buffer zone 13 because of its well-known high heat transfer property and its coefficient of expansion which is below that of aluminum. Copper is also virtually essential if plating is to be utilized, since it adheres to aluminum and gives a much more reliable bond than if chromium or nickel were plated direct. Copper also has a satisfactory melting point, being intermediate between melt points of nickel and aluminum.

Silver, of course, can be substituted for copper, although this is not generally economically feasible. Alloys of copper or silver having thermal conductivity and melting points higher than that of aluminum, such as a thermal conductivity of at least 40 and preferably 60% upwards of that of electrolytic copper and melting above 1500° F., may also be employed for the buffer zone metal layer 13. Substantially pure metal such as bus bar or electrolytic copper have been found to be eminently suitable.

The high melting point metals for the friction track layer 12, and particularly chromium or nickel, may be sprayed on the surface. However, in view of the fish-scale-like surfaces presented on sprayed surfaces, it is necessary to grind and/or polish the surface in order to provide a suitable fit for the cooperative brake shoe lining. It therefore is preferred to provide the friction surface track layer 12 by means of electroplating. The copper preferred is relatively pure copper by virtue of its high heat conductivity, but in the case of sprayed metal it is unavoidable that some copper oxide be present which is slightly detrimental.

As previously indicated, high heat conductivity metal

alloys may be used for the buffer zone layer metal 13. Illustrative of these are chrome copper, zirconium copper, and cadmium copper, which have relatively high coefficients of heat transfer. However, these are more expensive than pure copper and do not function quite as well, since they have lower heats of conductance and the stability of the coefficient of heat transfer is affected adversely by high temperatures.

It will thus be apparent that we have provided aluminum brake drums with an improved wear track characterized by an intermediate buffer zone metal, making the use of aluminum brake drums, with their light weight and fair heat conductivity, feasible with high energy brake applications. Although we have shown and described our invention as adapted for conventional air-cooled employment, it will be understood that such composite structure as the arrangement of the layers 11, 12 and 13 may be employed with liquid cooling of the opposed uncoated surface of the aluminum flange 11.

As a further alternative, in lieu of the brake drum 10 being attached to a rotatable wheel, the movement of which is to be stopped, the principle of the present invention may be employed for drive shaft brakes as well as for disc type braking clutch elements.

In an integral aluminum wheel and drum assembly, it is presently customary to use a cast iron liner for the friction track. The use of a copper buffer zone and a hard surfacing material in the ranges of thickness heretofore indicated can substitute for the cast iron liner eliminating the heat dam at the junction of the metals, the press or shrink fit problems and, additionally, would provide some reduction in weight since the high specific gravity friction track and buffer zone would be thinner than the cast iron liner.

I claim:

1. An aluminum brake drum comprising a cylindrical flange portion, a metallic friction track facing member having an average thickness of from about .002 to about .008 inch lining said cylindrical flange composed of metal of higher melting point, greater hardness, lower thermal conductivity and lower coefficient of thermal expansion than said brake drum, and a layer of high heat conductive metal selected from the group consisting of silver, copper, and alloys of said metals having a melting point and a thermal conductivity greater than said brake drum metal disposed between and in integrally bonded relationship with said aluminum flange surface and said high melting point metal friction track.

2. The structure of claim 1 wherein the friction track component is composed of metal melting at a temperature above 2000° F.

3. The structure of claim 1 wherein the high heat conductive intermediate metal layer is composed of copper.

4. The structure of claim 1 wherein the friction track layer is composed of chromium.

5. The structure of claim 1 wherein the friction track layer component is composed of nickel.

6. The structure of claim 1 wherein the high heat conductive interlayer member has an average thickness of from about .003 to about .030 inch.

7. An aluminum brake drum comprising a cylindrical flange portion, a continuous chromium friction track facing layer having an average thickness of from about .002 to about .008 inch lining said aluminum flange and a continuous copper buffer zone layer having an average thickness of from about .003 to .030 inch disposed between and in integrally bonded relationship with said aluminum flange surface and said chromium friction track.

8. An aluminum brake element, a metallic friction track facing member thereon having a thickness of from about .002 to about .008 inch composed of metal of higher melting point, greater hardness, lower thermal conductivity and lower coefficient of thermal expansion

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than said brake element, and a layer of high heat conductive metal selected from the group consisting of silver, copper, and alloys of said metals having a melting point and a thermal conductivity greater than said brake element disposed between and in integrally bonded relationship with a surface of said aluminum element and said high melting point metal friction track.

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