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FRICTION COATED METAL BASE

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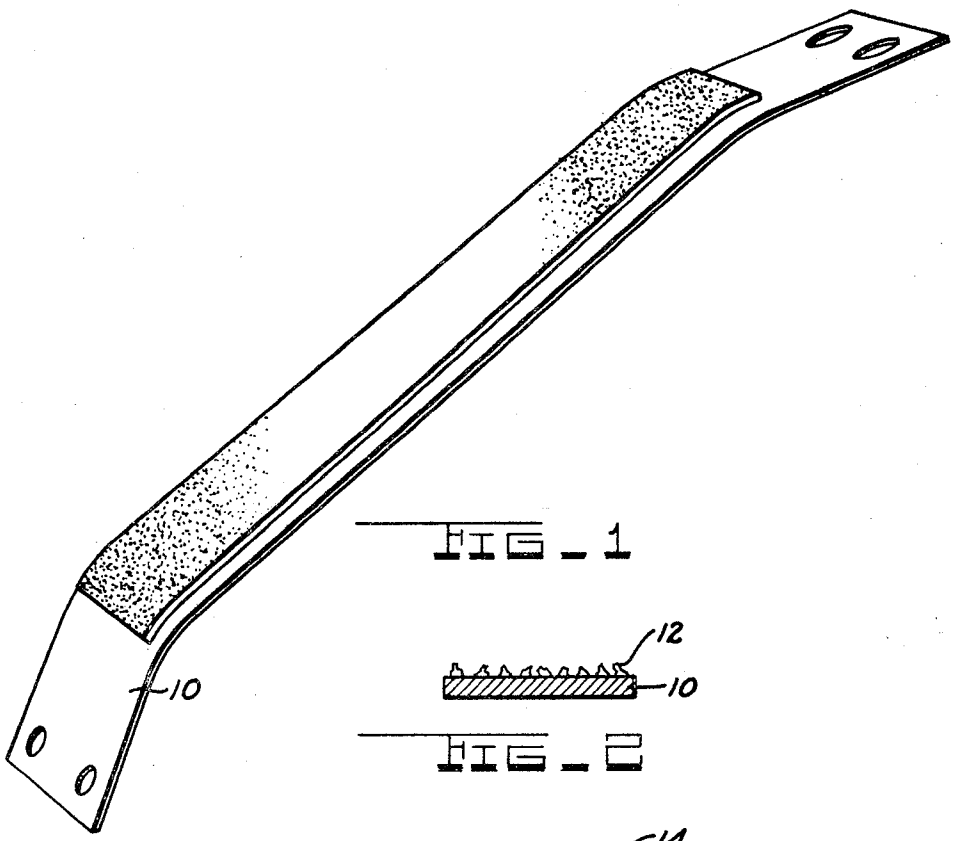


FIG. 1

FIG. 2

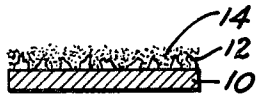


FIG. 3

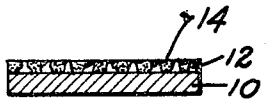


FIG. 4

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The present invention relates to a type of coating in which large size hard refractory grains are arranged in a single layer, and are embedded in a matrix material; and more particularly to a cermet coating of the above nature uniquely suited for rubbing contact with concrete.

An object of the present invention is the provision of a new and improved coating which resists wear during rubbing contact with concrete.

Another object of the present invention is the provision of a new and improved landing skid for high speed aircraft or rocket vehicles.

Another object of the present invention is the provision of a flame sprayed cermet coating in which the ceramic particles are too large or too refractory to be satisfactorily flame sprayed, and to the method of making the same.

The invention resides in certain constructions, and combinations and arrangements of materials, and to certain preferred methods of producing these arrangements; and further objects and advantages of the present invention will become apparent to those skilled in the art to which the invention relates from the following description of the preferred construction, described with reference to the accompanying drawing forming a part of this specification, and in which:

FIGURE 1 is a landing skid for a rocket vehicle, and which embodies principles of the present invention;

FIGURE 2 is a cross section of the skid at one stage of its manufacture;

FIGURE 3 is a cross section of the skid at a later stage of its manufacture; and

FIGURE 4 is a cross section of the skid at a final stage of its manufacture.

Applicant has discovered and proven that a wear resistant surface is provided for rubbing contact with concrete by large grains of a hard wear resistant nonmetallic or ceramic material (hereinafter termed ceramic) embedded in a suitable retensive matrix. The ceramic grains should be harder and larger than the grains of sand which are used in the concrete of the opposing surface, and the ceramic grains can be embedded and held in a layer of softer material such as a metal which rather easily wears away. It has been found that a beneficial affect is obtained, i.e. a higher coefficient of friction is obtained, where the matrix material wears away rather easily to permit the grains of ceramic material to project out of the matrix to a degree where only the ceramic grains are in substantial engagement with the opposing concrete. It appears necessary that the grains of the ceramic material must be larger than a predetermined size relative to the size of the grains of sand in the concrete in order for the cermet coating to exhibit its improved wearing characteristics, and this ratio appears to be approximately two. There does not appear to be any upper limit to the particle size of the ceramic material excepting as praticality dictates as will be hereinafter discussed.

When the materials of the present invention are initially placed in rubbing contact with concrete, there is a continuing wearing away of the matrix material during the initial contact stages with the concrete to a depth of about .010 to .020 inch; and thereafter it appears that any further wearing away of the matrix takes place at a considerably reduced rate.

Generally speaking, .010 to .020 inch is approximately one-half of the thickness of a grain of sand in the usual concrete; and the sand particles are what produce the abrasion of the matrix material. While concrete also contains gravel or other large aggregate having large flat surfaces, this aggregate does not produce apices small enough to enter between the ceramic particles and gouge out the matrix; and furthermore usually do not extend to the surface of the concrete, inasmuch as the usual finishing operation of concrete places a layer of sand and cement over the coarse aggregate.

One preferred embodiment of the invention is shown in FIGURE 1 of the drawings. The landing skid shown in FIGURE 1 was prepared by degreasing a nickel backing member **10**, brazing tungsten carbide particles **12** to its surface, and then flame spraying a powdered metal **14** over the particles to completely cover and embed them. The brazing operation was accomplished by preparing a mixture of 80% by weight of a minus 325 mesh electrolytic powdered copper and 20% by weight of a commercial brazing flux (made of equal parts of KHF_2, $K_2B_4O_7.5H_2O$ and H_3BO_3) with water to form a paste, and spreading a 1/16 inch layer of the paste on the degreased surface. Nominal 1/8 inch crushed tungsten carbide particles **12** ranging in size of from approximately 1/16 inch to approximately 1/8 inch were then sprinkled on the layer of brazing paste, and the particles were then brazed to the backing member by being inserted in an electric furnace for one-half hour, at 2100° F., in a cracked ammonia atmosphere. The brazed backing member was then cooled to room temperature in the cracked ammonia atmosphere; and the brazing appeared to have wet the tungsten carbide particles so that the particles were firmly attached to the backing member. The brazed surface was then sand blasted to clean and roughen the surface, and a 1/8 inch layer of flame sprayed metal was then applied to cover and embed the ceramic particles.

The article shown in FIGURE 1 was flame sprayed with a powdered mixture of 90% copper by weight and 10% nickel by weight using a Metalizing Co. of America powder spray gun model number TJR–1 having a 1/16 inch inch nozzle. The powder was fed through the nozzle using 10 c.f.h. of nitrogen, and the flame was produced by 32 c.f.h. of oxygen and 40 c.f.h of acetylene. The nozzle was held at 8 inches from the work, and the nozzle was cooled by a flow of air passing through the cooling orifices of the gun provided for this purpose. The work was flame sprayed to a depth of approximately 0.150 inch over an area approximately 5 inches wide and 25 inches long, and was then ground down to approximately 0.120 inch above the backing member to partially expose the tips of the tungsten carbide particles.

In order to evaluate the material, it was moved over a concrete paving at 48 ft. per second using an average unit load of 25 pounds per square inch for a distance of approximately 400 feet. It was thereafter moved over the same surface at the same loading using a velocity of 78 feet per second. The skid was then examined and found to have substantially no wear although it looked shiny; and on weighing it was found to have lost only 0.030 pound. On examination, substantially none of the cermet particles appeared to have been either worn or removed from the surface, and it is estimated that the matrix wear was in the order of magnitude of a thousandth of an inch. All of the materials previously tested in a similar manner (including coatings of very hard and tough metals) either failed or had much greater wear. It was decided therefore to see how long the material of the present invention would last; and after many repeated tests, it was found that the maximum wear of the matrix which had been produced was from about 0.020 to about 0.039 of an inch. The coefficient of friction which was developed during the above tests started out at approximately 0.020 and increased to a final level of about 0.50.

A second embodiment was made of a skid prepared according to the above described procedure, excepting that an Inconel backing member was used, and the flame sprayed material consisted of a powdered mixture of 52.5% nickel, 13.8% chromium, 0.75% boron, 2.28% silicon, 0.67% iron and 30% of tungsten carbide particles. The above mixture ranged in particle size of approximately 100 to approximately 200 mesh and the flame sprayed layer was ground off to leave a coating of 0.065 inch. The tungsten carbide particles which were brazed to the backing member were of generally the same size and distribution as in the preceding embodiment.

The second embodiment was tested in much the same manner as the first, and it exhibited a wear resistance of the same degree as the first embodiment. The coefficient of friction developed by the second embodiment was less than that of the first embodiment after a comparable number of stops presumably because the matrix of the second embodiment was a harder material than that of the first and so did not let the particles of ceramic project as far into the concrete.

It appears that the particles of the ceramic "plough" into concrete to some degree. In order for the materials of the present invention to be wear resistant, the ceramic particles must not break loose from the metallic matrix and must be more resistant to shear than are the abrasive particles of the opposing surface (sand). Both the bond strength between the matrix and ceramic particles and the resistance to shear of the ceramic particles increases with their size. Likewise, the amount of "ploughing" of the concrete, or apparent coefficient of friction increases with the size of the ceramic particles, and I have found that the ceramic particles should therefore preferably be at least approximately one and one-half times the size of the sand or abrasive particles in the opposing surface.

The ceramic particles of course generate heat when rubbed against the opposing surface. The local temperatures which are developed by the friction of these particles on the concrete will generally be proportional to the severity of the particular application, and in general, any refractory ceramic that is harder than the abrasive particles of the opposing surface (in this case the sand particles) can be used. Practically all carbides, as for example silicon carbide, boron carbide, tantalum carbide, titanium carbide, etc.; and all oxides, as for example, aluminum oxide, magnesium oxide etc., the nitrides and silicides, etc. can be used.

The primary function of the matrix is to support the ceramic and hold it for rubbing contact with the opposing surface. A hard, wear resistant matrix is not necessary so long as the matrix will retain the ceramic particles. In general, however, matrix wear is greater with the softer metals and is less with the harder metals. The softer metals seem to provide a higher initial coefficient of friction by reason of a deeper penetration or "ploughing" action of the grains of sand on the matrix, which in turn permits deeper penetration of the ceramic particles into the concrete.

While the invention has been described in considerable detail, I do not wish to be limited to the particular constructions and processes shown and described; and it is my intention to cover hereby all novel adaptations, modifications, and arrangements thereof which come within the practice of those skilled in the art, and which come within the purview of the following claims.

I claim:

1. A wear resistant aircraft landing skid adapted for use on concrete and the like comprising: a base metal backing member shaped in an elongated skid form having a substantially flat ground engaging side; a single layer of metal carbide particles greater than approximately 1/16 inch in size metal brazed to said ground engaging side of said metal backing member; a metal matrix layer flame sprayed onto said ground engaging side to a thickness substantially covering said metal carbide particles; said metal matrix being flame sprayed from a powdered mixture ranging in particle size between approximately 100 to 200 mesh; said powdered mixture comprised primarily of nickel and metal carbide powders.

2. A wear resistant aircraft landing skid as claimed in claim 1 wherein said base metal backing member is comprised of nickel.

3. A wear resistant aircraft landing skid as claimed in claim 1 wherein said base metal backing member is comprised of Inconel.

4. A wear resistant aircraft landing skid as claimed in claim 1 wherein said metal matrix is comprised of a powdered mixture having approximately 30% metal carbide particles.

5. A wear resistant aircraft landing skid as claimed in claim 1 wherein said metal carbide particles and powders are tungsten carbide.

6. A wear resistant aircraft landing skid adapted for use on concrete and the like comprising: a base metal backing member shaped in an elongated skid form having a substantially flat ground engaging side; a single layer of metal carbide particles greater than approximately 1/16 inch in size metal brazed to said ground engaging side of said metal backing member; a metal matrix layer sintered onto said ground engaging side to the thickness substantially covering said metal carbide particles; said metal matrix being sintered from a powdered mixture ranging in particle size between approximately 100 to 200 mesh; said powdered mixture comprised primarily of nickel and metal carbide powders.

7. A wear resistant aircraft landing skid adapted for use on conrete and the like comprising: a base metal backing member shaped in an elongated skid form having a substantially flat ground engaging side; a single layer of metal carbide particles greater than approximately 1/16 inch in size metal brazed to said ground engaging side of said metal backing member; a metal matrix layer flame sprayed onto said ground engaging side to a thickness substantially covering said metal carbide particles; said metal matrix being flame sprayed from a powdered mixture of approximately 90% copper by weight and 10% nickel by weight.

8. A wear resistant aircraft landing skid adapted for use on concrete and the like comprising: a base metal backing member shaped in the elongated skid form having a substantially flat ground engaging side; a single layer of metal carbide particles greater than approximately 1/16 inch in size metal brazed to said ground engaging side of said metal backing member; a metal matrix layer sintered onto said ground engaging side to a thickness substantially covering said metal carbide particles; said metal matrix being sintered from a powdered mixture comprising approximately of 90% copper by weight and 10% nickel by weight.

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