CERMET FRICTION MATERIAL

B. G. Arabei, et al

Foreign Technology Division
Wright-Patterson Air Force Base, Ohio

13 November 1975
FOREIGN TECHNOLOGY DIVISION

CERMET FRICTION MATERIAL
by
B. G. Arabey, I. I. Zverev, et. al.

Approved for public release; distribution unlimited.
REPORT DOCUMENTATION PAGE

1. REPORT NUMBER
PTD-ID(PS)I-2316-75

2. GOVT ACCESSION NO.

3. RECIPIENT'S CATALOG NUMBER

4. TITLE (and Subtitle)
CERMET FRICTION MATERIAL

5. TYPE OF REPORT & PERIOD COVERED
Translation

6. PERFORMING ORG. REPORT NUMBER

7. AUTHOR(s)
B. G. Arabey, I. I. Zverev,

8. CONTRACT OR GRANT NUMBER(s)

9. PERFORMING ORGANIZATION NAME AND ADDRESS

10. PROGRAM ELEMENT, PROJECT, TASK
ARE, & WORK UNIT NUMBERS

11. CONTROLLING OFFICE NAME AND ADDRESS
Foreign Technology Division
Air Force Systems Command
U. S. Air Force

12. REPORT DATE
Aug 1975

13. NUMBER OF PAGES
10

14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)

15. SECURITY CLASS. (of this report)
UNCLASSIFIED

16. DISTRIBUTION STATEMENT (of this report)
Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)
EDITED TRANSLATION

FTD-ID(RS)I-2316-75 13 November 1975

CSL74393005

cermet friction material

by: B. 0. Arabey, I. I. Zverev, et. al.

english pages: 4


country of origin: USSR

translated by: Carol S. Nack

requester: ASD/ETIL

approved for public release; distribution unlimited.

this translation is a rendition of the original foreign text without any analytical or editorial comment. statements or theories advocated or implied are those of the source and do not necessarily reflect the position or opinion of the foreign technology division.

prepared by:

translation division
foreign technology division
WP-afb, ohio.

FTD-ID(RS)I-2316-75

Date 13 Nov 1975
## U. S. BOARD ON GEOGRAPHIC NAMES TRANSLITERATION SYSTEM

<table>
<thead>
<tr>
<th>Block</th>
<th>Italic Transliteration</th>
<th>Block</th>
<th>Italic Transliteration</th>
</tr>
</thead>
<tbody>
<tr>
<td>A a</td>
<td>A, a</td>
<td>P p</td>
<td>R, r</td>
</tr>
<tr>
<td>B b</td>
<td>B, b</td>
<td>C c</td>
<td>S, s</td>
</tr>
<tr>
<td>V v</td>
<td>T, m</td>
<td>T t</td>
<td>T t</td>
</tr>
<tr>
<td>G g</td>
<td>G, g</td>
<td>U u</td>
<td>U, u</td>
</tr>
<tr>
<td>D d</td>
<td>D, d</td>
<td>F f</td>
<td>F, f</td>
</tr>
<tr>
<td>E e</td>
<td>Ye, ye</td>
<td>X x</td>
<td>Kh, kh</td>
</tr>
<tr>
<td>Zh, zh</td>
<td>Ц ц Ц ц Ts, ts</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I i</td>
<td>Ш ш Ш ш Sh, sh</td>
<td></td>
<td></td>
</tr>
<tr>
<td>K k</td>
<td>Y, y</td>
<td>Шч, шч</td>
<td>Shch, shch</td>
</tr>
<tr>
<td>L l</td>
<td>М м М м Y, y</td>
<td></td>
<td></td>
</tr>
<tr>
<td>M m</td>
<td>Я я Я я Y, y</td>
<td></td>
<td></td>
</tr>
<tr>
<td>N n</td>
<td>Э э Э э Е, e</td>
<td></td>
<td></td>
</tr>
<tr>
<td>O o</td>
<td>О о О о Yu, yu</td>
<td></td>
<td></td>
</tr>
<tr>
<td>P p</td>
<td>Р р Р р Я я Я я Ya, ya</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Ye initially, after vowels, and after ь, ь; ё elsewhere. When written as е in Russian, transliterate as ye or ё.
* The use of diacritical marks is preferred, but such marks may be omitted when expediency dictates.

### GREEK ALPHABET

- **Alpha** (Α α)  
  - Nu (Ν ν)
- **Beta** (Β β)  
  - Xi (Χ ξ)
- **Gamma** (Γ γ)  
  - Omicron (Ο ο)
- **Delta** (Δ δ)  
  - Pi (Π π)
- **Epsilon** (Ε ε)  
  - Rho (Ρ ρ)
- **Zeta** (Ζ ζ)  
  - Sigma (Σ σ)
- **Eta** (Η η)  
  - Tau (Τ τ)
- **Theta** (Θ θ)  
  - Upsilon (Υ υ)
- **Iota** (Ι ι)  
  - Phi (Φ φ)
- **Kappa** (Κ κ)  
  - Chi (Χ χ)
- **Lambda** (Λ λ)  
  - Psi (Ψ ψ)
- **Xi** (Ξ χ)  
  - Omega (Ο ο)

FTD-ID(RS)1-2316-75
<table>
<thead>
<tr>
<th>Russian</th>
<th>English</th>
</tr>
</thead>
<tbody>
<tr>
<td>sin</td>
<td>sin</td>
</tr>
<tr>
<td>cos</td>
<td>cos</td>
</tr>
<tr>
<td>tg</td>
<td>tan</td>
</tr>
<tr>
<td>ctg</td>
<td>cot</td>
</tr>
<tr>
<td>sec</td>
<td>sec</td>
</tr>
<tr>
<td>cosec</td>
<td>csc</td>
</tr>
<tr>
<td>sh</td>
<td>sinh</td>
</tr>
<tr>
<td>ch</td>
<td>cosh</td>
</tr>
<tr>
<td>th</td>
<td>tanh</td>
</tr>
<tr>
<td>cth</td>
<td>coth</td>
</tr>
<tr>
<td>sch</td>
<td>sech</td>
</tr>
<tr>
<td>csch</td>
<td>csch</td>
</tr>
<tr>
<td>arc sin</td>
<td>sin&lt;sup&gt;-1&lt;/sup&gt;</td>
</tr>
<tr>
<td>arc cos</td>
<td>cos&lt;sup&gt;-1&lt;/sup&gt;</td>
</tr>
<tr>
<td>arc tg</td>
<td>tan&lt;sup&gt;-1&lt;/sup&gt;</td>
</tr>
<tr>
<td>arc ctg</td>
<td>cot&lt;sup&gt;-1&lt;/sup&gt;</td>
</tr>
<tr>
<td>arc sec</td>
<td>sec&lt;sup&gt;-1&lt;/sup&gt;</td>
</tr>
<tr>
<td>arc cosec</td>
<td>csc&lt;sup&gt;-1&lt;/sup&gt;</td>
</tr>
<tr>
<td>arc sh</td>
<td>sinh&lt;sup&gt;-1&lt;/sup&gt;</td>
</tr>
<tr>
<td>arc ch</td>
<td>cosh&lt;sup&gt;-1&lt;/sup&gt;</td>
</tr>
<tr>
<td>arc th</td>
<td>tanh&lt;sup&gt;-1&lt;/sup&gt;</td>
</tr>
<tr>
<td>arc cth</td>
<td>coth&lt;sup&gt;-1&lt;/sup&gt;</td>
</tr>
<tr>
<td>arc sch</td>
<td>sech&lt;sup&gt;-1&lt;/sup&gt;</td>
</tr>
<tr>
<td>arc csch</td>
<td>csch&lt;sup&gt;-1&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

**GRAPHICS DISCLAIMER**

All figures, graphics, tables, equations, etc. merged into this translation were extracted from the best quality copy available.

FTD-ID(RG)I-2316-75
The invention is related to the field of cermet friction materials which are used for braking gear, for example, aircraft brakes.

We know of a cermet friction material with the following composition, weight %:

- Boron carbide: 10-70
- Boron nitride: 1-5
- Metals from the iron group, taken in any combination: 5-50
- Zirconium carbide: the remainder

The material has a high coefficient of friction and wear.

The purpose of the invention is to raise the thermal, tensile and flexural strength. This is achieved by introducing graphite fiber with the following relationship of components, weight %, into the proposed cermet friction material:
Boron carbide 10-50
Boron nitride 1-5
Metals from the iron group, taken in any combination 3-35
Graphite fiber 2-10
Zirconium carbide the remainder

The thermal strength of this friction material with the introduction of 2-10 weight % of graphite fiber is 125-145 heating-cooling cycles when cooled from 1000 to 20°C in water. The introduction of graphite fiber in a quantity of less than 2 weight % only increases thermal strength insignificantly (from 30-35 heating-cooling cycles), while its introduction in a quantity of more than 10 weight % sharply reduces its mechanical properties, including thermal strength by 35-40 heating-cooling cycles.

This cermet friction material has the following properties:

Specific gravity, g/cm³ 4.8
Coefficient of friction at braking temperature of 600°C 0.50-0.55
800°C 0.45-0.50

Wear at specific braking energies, kg-m/cm²
450 2-6
923 6-11

Stability of coefficient of friction 0.77-0.88

Permissible volumetric operating temperature, °C 800

Thermal diffusivity, W/m·deg
at 100°C 51.2
200°C 44.3
400°C 36.7
600°C 30.3
800°C 25.1
1000°C 26.5
Specific heat, cal/g·deg
at 100°C 0.14
200°C 0.14
400°C 0.15
600°C 0.16
800°C 0.17
1000°C 0.19
Ultimate tensile strength, kg/mm²
at 20°C 42-45
Transverse strength, kg/mm²
at 20°C 70-74

The cermet friction material is obtained by the hot extrusion of a mixture of powders of the initial components in graphite metal dies. The mixture is prepared in a mixer for 30-40 min. with the simultaneous introduction of the graphite fiber in the form of plaits 25-30 mm long.

The hot extrusion of the article is conducted under the following conditions:

Extrusion temperature, °C 1800-1900
Unit extrusion pressure, kg/cm² 250-350
Time of holding under pressure at extrusion temperature, min. 40-60

At the end of the hot extrusion process the articles are extracted from the graphite metal die and are mechanically worked if necessary.

Subject of Invention

A cermet friction material which contains zirconium carbide, boron carbide, boron nitride and metals from the iron taken in any combination which is distinguished by the fact that in order to raise thermal, tensile and flexural strength, graphite fiber is introduced into it in the following relationship of components,
weight %:

<table>
<thead>
<tr>
<th>Material</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boron carbide</td>
<td>10-70</td>
</tr>
<tr>
<td>Boron nitride</td>
<td>1-5</td>
</tr>
<tr>
<td>Metals from the iron group, taken in any combination</td>
<td>3-35</td>
</tr>
<tr>
<td>Graphite fiber</td>
<td>2-10</td>
</tr>
<tr>
<td>Zirconium carbide</td>
<td>the remainder</td>
</tr>
</tbody>
</table>