This invention relates to a product for tipping small bases. In the tipping of small bases such as pen points with point materials, it has heretofore been the usual custom to employ metals of relatively high melting point and considerable corrosion resistance which have been either formed upon the pen nib by fusion or fused prior to their attachment to the nib. The result of either of these operations is to produce a tip the crystal structure of which is that normally resulting in metals from cooling from fusion temperature. As is well known, any fluid object in crystallizing tends to form liquid bodies which later form crystals, according to the equation: velocity of solidification $= K(T_m - T)/V$ in which $T_m$ represents the melting point of the solid on the absolute scale, $T$ the temperature at the surface separating liquid and solid and $V$ the viscosity of the liquid—$K$ being a constant. As is well known, metals, particularly alloys, have a characteristic tendency to develop dendritic forms of crystals on cooling. The result is that metal bodies develop characteristic hair-line cracks and cleavage planes as well as more prominent flaws such as the pipe in steel ingots. The harder the metal and the higher its melting point the worse many of these defects are in general. These defects are particularly disadvantageous in connection with point pen materials because the pen nib must be flexible and the tip is therefore under considerable strain. Therefore it frequently happens that a pen tip will break or split. Moreover, any line of weakness may also be a line of weakness for corrosion and the pen may develop pits or crevices which make it unfit for writing.

The invention is diagrammatically illustrated in the drawing, in which—

Fig. 1 represents a pen nib having a tip 2 of the homo-heteroaxial material herein described, which has been attached to a nib in accordance with known methods and ground, polished and split for attachment, the split 3 extending back 45 into the nib in the usual manner; and

Fig. 2 represents a block or slug 4 from which the granules 5 shown in Fig. 3 may be formed by crushing.

Fig. 4 is a perspective view of a cylindrical 50 granule 6 of predetermined size.

Fig. 5 shows a hemispherical granule.

In accordance with the present invention tip material of a homo-heteroaxial crystal structure may be produced which has no lines of weakness, hairline cracks or other defects common to the fused metal points. The term “homo-heteroaxial” as here employed denotes that the crystal structure of the tip material is homogeneously heterogeneous with respect to the axes of the crystals so that a cross-section of the material in any direction will show the same polyhedral or non-dendritic structure of fine crystals.

The invention is particularly applicable to extremely high melt point materials, for example those melting above 3500°F. With alloys of this type the melting point is too high to permit ready individual fusion of small spheroids by surface tension. In practice, tip material of this type has been made by casting a relatively large ingot of the material and then crushing it to produce small granules or slivers of tip material. The usable material from such a method is low and much of the material must be scrapped and re-fused. Likewise the usable material is subject to the defects already noted. A block prepared in accordance with the present invention may be crushed with a much larger yield of usable tip material and at the same time the material will be free from the defects resulting from casting.

The invention is likewise applicable to metals and alloys whose melting point is so high as to prevent their use for tip material by present methods. For example, one of the best alloys for pen point purposes consists predominantly of tungsten and osmium, but the melting point of an alloy of the two metals is so high that in practice an alloy of, say, osmium, tungsten and another metal to bring down the melting point is employed. By proceeding in accordance with the present invention the other metal may be eliminated wherever desired, and thereby the corrosion resistance and hardness of the resulting tip material are increased.

As an example of the invention finely divided osmium metal and finely divided tungsten were mixed in equal proportions and treated in a ball mall for several hours. After this treatment the metals were pressed in a die under heavy pressure, for example, 20-50 tons per square inch, into a block. The block resulting from this treatment has sufficient cohesion to enable it to be handled readily and is then preferably slowly heated in a reducing atmosphere, for example hydrogen, to a temperature of, say, 2000°F. It is preferred to bring the temperature up slowly in the beginning, taking at least one-half hour to heat to 2000°F. During this operation any oxidized metal is reduced by the hydrogen. This pre-
liminary heating operation causes further binding of the metal, but it is preferred to continue the treatment at a much advanced temperature, for example by heating at about 4000° F. for 4 to 15 minutes in an induction furnace, care being taken, however, in each case to remain below the melting point of the material. This operation, like the former, is preferably carried out in a reducing or at least an inert atmosphere.

The resulting material is a unitary block of metal having all of the characteristics of a true alloy but showing no cleavage planes and being entirely homo-heteraxial in its crystal structure and non-dendritic.

The block thus formed may be crushed in the usual manner to produce granules suitable for tipping material, and the resulting granules, as already explained, have remarkably good properties for this purpose. Moreover, each granule is like every other in hardness, composition, toughness and other properties, whereas granules made from a cast block vary.

Instead of first forming the metal in the form of a block and then crushing it, granules may be made up individually to a predetermined size and shape by pressing in dies, or a block may be formed in a preliminary operation at relatively low temperatures and then crushed before it has completely hardened, in either event the hardening operation being subsequently carried out upon the granulated material.

In the manufacture of individual granules it is preferred to form granules of symmetrical form adapted for ready attachment to a point. Preferably, the granules are formed in blocks, either right-angled or cylindrical, or spheres or sections of spheres.

The heat treatment already described may be carried out in one operation or it may be divided into several steps. For example, the first heat treatment may be at 2000° F. for two to three hours and may then be followed by a heat treatment at 2600° F. for a considerable period and then followed by a short exposure to the extreme temperatures.

Ruthenium may be substituted in whole or in part for osmium in the process and product here-in described. The process is also extremely valuable for those alloys in which other platinum group metals are employed with or without ruthenium or osmium.

In connection with tungsten-osmium alloys it is preferred to use from 25%–75% of each metal based upon the content of these materials.

However, small amounts of either metal may materially modify the resultant material. Alloys within the range of 10%–90% of each metal based on the content of these metals have considerable value, but within the broader ranges more care must be taken in the addition of extraneous materials. Modifying agents such as beryllium, zirconium, tantalum, columbium or molybdenum may be added as desired, preferably in small proportions, say, of the order of 10% or less.

Where desired, a metal of the iron group may be added, but for the better class of tip materials it is preferred not to use a metal of this type.

It is preferred, particularly for pen point use, that the resulting material be compact as distinguished from porous.

The invention is also applicable to other metals besides alloys of tungsten and osmium and may be used on pure metals. For pen point and other tipping purposes it is preferred to use corrosion-resistant high melt point hard materials.

The invention has particular application to pen point materials because of the stresses and strains as well as the extreme corrosion to which pen tips are subjected. It may also be used, however, in connection with other small tips such as those upon phonograph needles or meter pivots.

This application is a continuation-in-part of our copending application, Serial No. 134,630 filed April 2, 1937.

The foregoing detailed description has been given for clearness of understanding only, and no unnecessary limitations should be understood from the same, but the appended claims should be construed as broadly as permissible in view of the prior art.

We claim:

1. A metal for tipping small bases comprising a hard and granule having homo-heteraxial crystal structure and containing at least about 25% of metal of the group of metals consisting of osmium and ruthenium.

2. A hard compact granule adapted for tipping small bases consisting essentially of tungsten metal and metal of the group of metals consisting of osmium and ruthenium and having homo-heteraxial crystal structure.

3. A pre-formed hard, tough, corrosion-resistant symmetrical granule comprising at least 25% of metal of the group of metals consisting of osmium and ruthenium and having homo-heteraxial crystal structure.

4. A pen point comprising a pen nib having firmly attached thereto a small tip of hard, tough, corrosion-resistant compact metal having homo-heteraxial crystal structure.

5. A pen point comprising a pen nib having firmly attached thereto a small metal tip of tough, corrosion-resistant metal including at least 25% of metal of the group consisting of osmium and ruthenium, and said tip having at the time of application homo-heteraxial crystal structure.

6. A pen point comprising a pen nib having firmly attached thereto a preformed small metal tip of tough, corrosion-resistant metal including at least 25% of metal of the group consisting of osmium and ruthenium, and said tip having at the time of application homo-heteraxial crystal structure.

7. A pen point comprising a pen nib having firmly attached thereto a preformed small metal tip of regular size and shape and of tough, corrosion-resistant metal including at least 25% of metal of the group consisting of osmium and ruthenium, and said tip having at the time of application homo-heteraxial crystal structure.

8. An article for tipping small bases comprising a preformed granule of tough corrosion-resistant metal having homo-heteraxial crystal structure and including at least 25% of metal of the platinum group.

9. A preformed granule as set forth in claim 8, in which the granule is rectangular.

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