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MICA TREATED METALS

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2 Claims. (Cl. 75—53)

The invention relates to mica and to mica as a treatment material and the method of introducing the treatment material into the metal.

An object of the invention is to treat aluminum, cadmium, chromium, cobalt, copper, iron, lead, magnesium, manganese, molybdenum, nickel, tin, titanium, tungsten, uranium, vanadium, zinc, zirconium, and alloy steels. The alloy steels include iron or steels alloyed with the following elements: silicon, cerium, nickel, nickel-chromium, chromium, vanadium, manganese, tungsten, carbon, molybdenum, lead, titanium. The alloy steels treated with nickel-chromium and chromium are usually referred to in the trade as stainless steel.

Another object of the invention is the compounding of elements to make mica for treatment material.

Another object of the invention is to improve the physical properties of the above mentioned metals as well as to improve the cleanliness thereof and to increase the fluidity during pouring.

Another object of the invention is to reduce the ability of the metal to work harden, particularly copper.

A still further object of the invention is to decrease the size of the grain structure of the metal.

Another object of the invention is to render the metal more ductile.

Another object of the invention is to render the metal stronger and harder.

Another object of the invention is to treat the metals with mica.

Another object of the invention is the treatment of molten metal with elements or materials which separately have a lower boiling or melting point than that of the metal, but which when combined into the form of mica has a boiling or melting point comparable to that of the molten metal.

Another object of the invention is the introduction of a material having a low boiling point into a bath of molten metal whereby danger of explosion and loss of low boiling point material are eliminated.

Another object of the invention is the introduction of a volatile material into a bath of molten metal whereby danger of explosion and loss of volatile material are eliminated.

Other objects and advantages of the present invention will be apparent to those skilled in the art from the following description and claims.

The mica may comprise natural mica or synthetic mica.

Natural mica is a silicate of aluminum and potassium with hydroxyl and sometimes fluorine ions in the complex molecule. Natural mica also contains varying amounts of magnesium, iron or lithium which affects its properties. According to investigations, the mica molecules are flat hexagons which join at their edges to form flat crystals which are most familiar as isinglass. These crystals theoretically can be split into sheets one molecule thick or naturally any multiple thereof. The natural mica may comprise the following types:

(a) Biotite—$H_2K(Mg, Fe)_3(Al, Fe)(SiO_4)_3$
(b) Lepidolite—$(HO, F)_2KLiAl_2Si_2O_{10}$
(c) Lepidomelane—Near biotite plus large amount of ferric iron
(d) Muscovite—$H_2KAl_3(SiO_4)_3$
(e) Paragonite—$H_2NaAl_3(SiO_4)_3$
(f) Phlogopite—$H_2KMg_3Al(SiO_4)_3$
(g) Zinnwaldite—Lithium-iron mica

Synthetic micas are true crystallographic analogs of the natural micas in which the hydroxyl ions found in the natural mica are replaced with the fluorine ions. In synthesizing mica, it is possible to replace any of the cations in the mica molecule in whole or in part with many other cations. Mica may be synthesized in several hundred forms; however, commercial production at present is focused mainly on fluor-phlogopite, which crystallizes at atmospheric pressure and exhibits most of the superior qualities of synthetic micas. The melting point of this fluor-phlogopite mica, as well as other synthetic mica, may range from approximately 2200 to 2500 degrees F. and the manufacture of this material may, on a commercial scale, be produced by means of a process invented by Richard A. Humphrey and more completely disclosed and illustrated in United States Patent No. 2,711,435, issued June 21, 1955. Briefly stated, this method involves the dumping of the raw materials into a large metal shell which contains a simple graphite electrode network. Ordinarily, sixty cycle electric power is applied to the electrodes and after a pool of melt has formed, the passage of current through the molten mass provides the necessary heat for continued melting. The batch thus acts as a container for the melt and also as a sufficient insulator. The synthetic micas suitable for use in the present invention have generally the following compositions which are listed hereinbelow:

	Formula
(1)	$KMg_3AlSi_3O_{10}F_2$
(2)	$KMg_3BSi_3O_{10}F_2$
(3)	$KMg_{3\frac{1}{2}}Si_4O_{10}F_2$
(4)	$KMg_2LiSi_4O_{10}F_2$
(5)	$BaMg_3Al_2Si_2O_{10}F_2$
(6)	$BaMg_2LiAlSi_3O_{10}F_2$
(7)	$Sr_{\frac{1}{2}}Mg_3AlSi_3O_{10}F_2$
(8)	$KMgNi_2AlSi_3O_{10}F_2$
(9)	$KNi_3AlSi_3O_{10}F_2$
(10)	$KCo_3AlSi_3O_{10}F_2$
(11)	$KMg_2MnAlSi_3O_{10}F_2$
(12)	$KFe_3{}^{++}AlSi_3O_{10}F_2$
(13)	$KAl_2AlSi_3O_{10}F_2$
(14)	$NaAl_2AlSi_3O_{10}F_2$
(15)	$KLi_{1\frac{1}{2}}Al_{1\frac{1}{2}}AlSi_3O_{10}F_2$
(16)	$KLi_2AlSi_4O_{10}F_2$
(17)	$CdMg_2LiAlSi_3O_{10}F_2$
(18)	$NaMg_2LiSi_4O_{10}F_2$
(19)	$NaMg_2KSi_4O_{10}F_2$
(20)	$NaMg_2RbSi_4O_{10}F_2$
(21)	$NaMg_2CsSi_4O_{10}F_2$

(22) $CaMg_2NaAlSi_3O_{10}F_2$
(23) $SrMg_2NaAlSi_3O_{10}F_2$
(24) $BaMg_2NaAlSi_3O_{10}F_2$
(25) $KMg_2RbSi_4O_{10}F_2$
(26) $KMg_2CsSi_4O_{10}F_2$
(27) $CaMg_2KAlSi_3O_{10}F_2$
(28) $SrMg_2KAlSi_3O_{10}F_2$
(29) $BaMg_2KAlSi_3O_{10}F_2$
(30) $LiMg_2RbSi_4O_{10}F_2$
(31) $LiMg_2CsSi_4O_{10}F_2$
(32) $CaMg_2LiAlSi_3O_{10}F_2$
(33) $SrMg_2LiAlSi_3O_{10}F_2$
(34) $CaMg_2RbAlSi_3O_{10}F_2$
(35) $CaMg_2CsAlSi_3O_{10}F_2$
(36) $KCaSr_2AlSi_3O_{10}F_2$
(37) $KCaBa_2AlSi_3O_{10}F_2$
(38) $BaMg_2RbAlSi_3O_{10}F_2$
(39) $BaMg_2CsAlSi_3O_{10}F_2$
(40) $KBaSr_2AlSi_3O_{10}F_2$
(41) $SrMg_2RbAlSi_3O_{10}F_2$
(42) $SrMg_2CsAlSi_3O_{10}F_2$
(43) $ZrMg_2KAlSi_3O_{10}F_2$
(44) $ZrMg_2NaAlSi_3O_{10}F_2$
(45) $ZrMg_2LiAlSi_3O_{10}F_2$
(46) $ZrMg_2RbAlSi_3O_{10}F_2$
(47) $ZrMg_2CsAlSi_3O_{10}F_2$
(48) $ZrCa_2AlSi_3O_{10}F_2$
(49) $KZrSr_2AlSi_3O_{10}F_2$
(50) $KMg_2ZrAlSi_3O_{10}F_2$
(51) $KZrBa_2AlSi_3O_{10}F_2$
(52) $NaMg_3BSi_3O_{10}F_2$
(53) $NaMg_2MnAlSi_3O_{10}F_2$
(54) $NaMgNi_2RlSi_3O_{10}F_2$
(55) $NaCo_3AlSi_3O_{10}F_2$
(56) $NaFe_3{}^{++}AlSi_3O_{10}F_2$
(57) $CdMg_2NaAlSi_3O_{10}F_2$
(58) $NaMgTiAlSi_3O_{10}F_2$
(59) $BeMg_2NaAlSi_3O_{10}F_2$
(60) $SnMg_2NaAlSi_3O_{10}F_2$
(61) $PbMg_2NaAlSi_3O_{10}F_2$
(62) $NaMgVAlSi_3O_{10}F_2$
(63) $NaBi_3AlSi_3O_{10}F_2$
(64) $NaCrAlSi_3O_{10}F_2$
(65) $NaMgSeAlSi_3O_{10}F_2$
(66) $ZnMg_2NaAlSi_3O_{10}F_2$
(67) $NaSb_3AlSi_3O_{10}F_2$
(68) $CdMg_2KAlSi_3O_{10}F_2$
(69) $KMgTiAlSi_3O_{10}F_2$
(70) $BeMg_2KAlSi_3O_{10}F_2$
(71) $SnMg_2KAlSi_3O_{10}F_2$
(72) $PbMg_2KAlSi_3O_{10}F_2$
(73) $KMgVAlSi_3O_{10}F_2$

(74) $KBi_3AlSi_3O_{10}F_2$
(75) $KCrAlSi_3O_{10}F_2$
(76) $KMgSeAlSi_3O_{10}F_2$
(77) $ZnMg_2KAlSi_3O_{10}F_2$
(78) $KSb_3AlSi_3O_{10}F_2$
(79) $KMg_3CoSi_3O_{10}F_2$
(80) $KMg_3FeSi_3O_{10}F_2$
(81) $KMg_3BiSi_3O_{10}F_2$
(82) $MgCrAlSi_3O_{10}F_2$
(83) $MgSb_3AlSi_3O_{10}F_2$
(84) $LiMg_3BSi_3O_{10}F_2$
(85) $LiMg_2MnAlSi_3O_{10}F_2$
(86) $LiMgNi_2AlSi_3O_{10}F_2$
(87) $LiCo_3AlSi_3O_{10}F_2$
(88) $LiFe_3{}^{++}AlSi_3O_{10}F_2$
(89) $LiMgTiAlSi_3O_{10}F_2$
(90) $BeMg_2LiAlSi_3O_{10}F_2$
(91) $SnMg_2LiAlSi_3O_{10}F_2$
(92) $PbMg_2LiAlSi_3O_{10}F_2$
(93) $LiMgVAlSi_3O_{10}F_2$
(94) $LiBi_3AlSi_3O_{10}F_2$
(95) $LiCrAlSi_3O_{10}F_2$
(96) $LiMgSeAlSi_3O_{10}F_2$
(97) $ZnMg_2LiAlSi_3O_{10}F_2$
(98) $LiSb_3AlSi_3O_{10}F_2$
(99) $CaMg_3BAlSi_2O_{10}F_2$
(100) $CaMgMnLiAlSi_3O_{10}F_2$
(101) $CaMgNiLiAlSi_3O_{10}F_2$
(102) $CaMg_3CoAlSi_2O_{10}F_2$
(103) $CaMg_3FeAlSi_2O_{10}F_2$
(104) $CaMgCdLiAlSi_3O_{10}F_2$
(105) $KCaTiAlSi_3O_{10}F_2$
(106) $CaMgBeLiAlSi_3O_{10}F_2$
(107) $CaMgSnLiAlSi_3O_{10}F_2$
(108) $CaMgPbLiAlSi_3O_{10}F_2$
(109) $KCaVAlSi_3O_{10}F_2$
(110) $CaMg_3BiAlSi_2O_{10}F_2$
(111) $CaMg_3CrSi_2O_{10}F_2$
(112) $KCaSeAlSi_3O_{10}F_2$
(113) $CaMgZnLiAlSi_3O_{10}F_2$
(114) $CaMg_3SbAlSi_2O_{10}F_2$
(115) $BaMg_3BAlSi_2O_{10}F_2$
(116) $BaMgMnLiAlSi_3O_{10}F_2$
(117) $BaMgNiLiAlSi_3O_{10}F_2$
(118) $BaMg_3CoAlSi_2O_{10}F_2$
(119) $BaMg_3FeAlSi_2O_{10}F_2$
(120) $BaMgCdLiAlSi_3O_{10}F_2$
(121) $KBaTiAlSi_3O_{10}F_2$
(122) $BaMgBeLiAlSi_3O_{10}F_2$
(123) $BaMgSnLiAlSi_3O_{10}F_2$
(124) $BaMgPbLiAlSi_3O_{10}F_2$
(125) $KBaVAlSi_3O_{10}F_2$

(126) $BaMg_2BiAlSi_2O_{10}F_2$
(127) $BaMg_3CrSi_2O_{10}F_2$
(128) $KBaSeAlSi_3O_{10}F_2$
(129) $BaMgZnLiAlSi_3O_{10}F_2$
(130) $BaMg_3SbAlSi_2O_{10}F_2$
(131) $SrMg_3BAlSi_2O_{10}F_2$
(132) $SrMgMnLiAlSi_3O_{10}F_2$
(133) $SrMgNiLiAlSi_3O_{10}F_2$
(134) $SrMg_3CoAlSi_2O_{10}F_2$
(135) $SrMg_3FeAlSi_2O_{10}F_2$
(136) $SrMgCdLiAlSi_3O_{10}F_2$
(137) $KSrTiAlSi_3O_{10}F_2$
(138) $SrMgBeLiAlSi_3O_{10}F_2$
(139) $SrMgSnLiAlSi_3O_{10}F_2$
(140) $SrMgPbLiAlSi_2O_{10}F_2$
(141) $KSrVAlSi_3O_{10}F_2$
(142) $SrMg_3BiAlSi_2O_{10}F_2$
(143) $SrMg_3CrSi_2O_{10}F_2$
(144) $KSrSeAlSi_3O_{10}F_2$
(145) $SrMgZnLiAlSi_3O_{10}F_2$
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(147) $ZrMg_3BAlSi_2O_{10}F_2$
(148) $ZrMgMnLiAlSi_3O_{10}F_2$
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(150) $ZrMg_3CoAlSi_2O_{10}F_2$
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(153) $KZrTiAlSi_3O_{10}F_2$
(154) $ZrMgBeLiAlSi_3O_{10}F_2$
(155) $ZrMgSnLiAlSi_3O_{10}F_2$
(156) $ZrMgPbLiAlSi_3O_{10}F_2$
(157) $KZrVAlSi_3O_{10}F_2$
(158) $ZrMg_3BiAlSi_2O_{10}F_2$
(159) $ZrMg_3CrSi_2O_{10}F_2$
(160) $KZrSeAlSi_3O_{10}F_2$
(161) $ZrMgZnLiAlSi_3O_{10}F_2$
(162) $ZrMg_3SbAlSi_2O_{10}F_2$
(163) $RbMg_2CsSi_4O_{10}F_2$
(164) $RbMg_3BSi_3O_{10}F_2$
(165) $RbMg_2MnAlSi_3O_{10}F_2$
(166) $RbMgNi_2AlSi_3O_{10}F_2$
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(168) $RbFe_3{}^{++}AlSi_3O_{10}F_2$
(169) $CdMg_2RbAlSi_3O_{10}F_2$
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(171) $BeMg_2RbAlSi_3O_{10}F_2$
(172) $SnMg_2RbAlSi_3O_{10}F_2$
(173) $PbMg_2RbAlSi_3O_{10}F_2$
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(183) $CsCo_3AlSi_3O_{10}F_2$
(184) $CsFe_3{}^{++}AlSi_3O_{10}F_2$
(185) $CdMg_2CsAlSi_3O_{10}F_2$
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(187) $BeMg_2CsAlSi_3O_{10}F_2$
(188) $SnMg_2CsAlSi_3O_{10}F_2$
(189) $PbMg_2CsAlSi_3O_{10}F_2$
(190) $CsMgVAlSi_3O_{10}F_2$
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(203) $SnMg_3BAlSi_2O_{10}F_2$
(204) $PbMg_3BAlSi_2O_{10}F_2$
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(214) $MnMgCdLiAlSi_3O_{10}F_2$
(215) $KMnTiAlSi_3O_{10}F_2$
(216) $MnMgBeLiAlSi_3O_{10}F_2$
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(218) $MnMgPbLiAlSi_3O_{10}F_2$
(219) $KMnVAlSi_3O_{10}F_2$
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(222) $KMnSeAlSi_3O_{10}F_2$
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(225) $NiMg_3CoAlSi_2O_{10}F_2$
(226) $NiMg_3FeAlSi_2O_{10}F_2$
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(230) $NiMgSnLiAlSi_3O_{10}F_2$
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(234) $NiMg_3CrSi_2O_{10}F_2$
(235) $KNiSeAlSi_3O_{10}F_2$
(236) $NiMgZnLiAlSi_3O_{10}F_2$
(237) $NiMg_3SbAlSi_2O_{10}F_2$
(238) $BaMg_3CoFeSi_2O_{10}F_2$
(239) $CdMg_3CoAlSi_2O_{10}F_2$
(240) $NaMgTiCoSi_3O_{10}F_2$
(241) $BeMg_3CoAlSi_2O_{10}F_2$
(242) $SnMg_3CoAlSi_2O_{10}F_2$
(243) $PbMg_3CoAlSi_2O_{10}F_2$
(244) $NaMgVCoSi_3O_{10}F_2$
(245) $BaMg_3CoBiSi_2O_{10}F_2$
(246) $BaMg_3CoCrSi_2O_{10}F_2$
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(260) $BaMg_3FeSbSi_2O_{10}F_2$
(261) $KCdTiAlSi_3O_{10}F_2$
(262) $CdMgBeLiAlSi_3O_{10}F_2$
(263) $CdMgSnLiAlSi_3O_{10}F_2$
(264) $CdMgPbLiAlSi_3O_{10}F_2$
(265) $KCdVAlSi_3O_{10}F_2$
(266) $CdMg_3BiAlSi_2O_{10}F_2$
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(280) $KBeVAlSi_3O_{10}F_2$
(281) $BeMg_3BiAlSi_2O_{10}F_2$

(282) $BeMg_3CrSi_2O_{10}F_2$
(283) $KBeSeAlSi_3O_{10}F_2$
(284) $BeMgZnLiAlSi_3O_{10}F_2$
(285) $BeMg_3SbAlSi_2O_{10}F_2$
(286) $SnMgPbLiAlSi_3O_{10}F_2$
(287) $KSnVAlSi_3O_{10}F_2$
(288) $SnMg_3BiAlSi_2O_{10}F_2$
(289) $SnMg_3CrSi_2O_{10}F_2$
(290) $KSnSeAlSi_3O_{10}F_2$
(291) $SnMgZnLiAlSi_3O_{10}F_2$
(292) $SnMg_3SbAlSi_2O_{10}F_2$
(293) $KPbVAlSi_3O_{10}F_2$
(294) $PbMg_3BiAlSi_2O_{10}F_2$
(295) $PbMg_3CrSi_2O_{10}F_2$
(296) $KPbSeAlSi_3O_{10}F_2$
(297) $PbMgZnLiAlSi_3O_{10}F_2$
(298) $PbMg_3SbAlSi_2O_{10}F_2$
(299) $NaMgVBiSi_3O_{10}F_2$
(300) $NaMgVCrSi_3O_{10}F_2$
(301) $KZnVAlSi_3O_{10}F_2$
(302) $KSbVAlSi_3O_{10}F_2$
(303) $BaMg_3BiCrSi_2O_{10}F_2$
(304) $NaMgSeBiSi_3O_{10}F_2$
(305) $ZnMg_3BiAlSi_2O_{10}F_2$
(306) $BaMg_3BiSbSi_2O_{10}F_2$
(307) $NaMgSeCrSi_3O_{10}F_2$
(308) $ZnMg_3CrAlSi_2O_{10}F_2$
(309) $BaMg_3CrSbSi_2O_{10}F_2$
(310) $KZnSeAlSi_3O_{10}F_2$
(311) $KSbSeAlSi_3O_{10}F_2$
(312) $ZnMg_3SbAlSi_2O_{10}F_2$
(313) $CuMg_2NaAlSi_3O_{10}F_2$
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(316) $CuMg_2RbAlSi_3O_{10}F_2$
(317) $CuMg_2CsAlSi_3O_{10}F_2$
(318) $KCuCa_2AlSi_3O_{10}F_2$
(319) $KCuSr_2AlSi_3O_{10}F_2$
(320) $KCuBa_2AlSi_3O_{10}F_2$
(321) $KCuZr_2AlSi_3O_{10}F_2$
(322) $CuMg_3BAlSi_2O_{10}F_2$
(323) $CuMgMnLiAlSi_3O_{10}F_2$
(324) $CuMgNiLiAlSi_3O_{10}F_2$
(325) $CuMg_3CoAlSi_2O_{10}F_2$
(326) $CuMg_3FeAlSi_2O_{10}F_2$
(327) $CuMgCdLiAlSi_3O_{10}F_2$
(328) $KCuTiAlSi_3O_{10}F_2$
(329) $CuMgBeLiAlSi_3O_{10}F_2$
(330) $CuMgSnLiAlSi_3O_{10}F_2$
(331) $CuMgPbLiAlSi_3O_{10}F_2$
(332) $KCuVAlSi_3O_{10}F_2$
(333) $CuMg_3BiAlSi_2O_{10}F_2$

(334) $CuMg_3CrSi_2O_{10}F_2$
(335) $KCuSeAlSi_3O_{10}F_2$
(336) $CuMgZnLiAlSi_3O_{10}F_2$
(337) $CuMg_3SbAlSi_2O_{10}F_2$
(338) $CuMg_3MoAlSi_2O_{10}F_2$
(339) $CuMg_3TeAlSi_2O_{10}F_2$
(340) $KCuUAlSi_3O_{10}F_2$
(341) $MoMg_2NaAlSi_3O_{10}F_2$
(342) $MoMg_2KAlSi_3O_{10}F_2$
(343) $MoMg_2LiAlSi_3O_{10}F_2$
(344) $MoMg_2RbAlSi_3O_{10}F_2$
(345) $MoMg_2CsAlSi_3O_{10}F_2$
(346) $KMoCa_2AlSi_3O_{10}F_2$
(347) $KMoSr_2AlSi_3O_{10}F_2$
(348) $KMoBa_2AlSi_3O_{10}F_2$
(349) $KMoZr_2AlSi_3O_{10}F_2$
(350) $MoMg_3BAlSi_2O_{10}F_2$
(351) $MoMgMnLiAlSi_3O_{10}F_2$
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(353) $MoMg_3CoAlSi_2O_{10}F_2$
(354) $MoMg_3FeAlSi_2O_{10}F_2$
(355) $MoMgCdLiAlSi_3O_{10}F_2$
(356) $KMoTiAlSi_3O_{10}F_2$
(357) $MoMgBeLiAlSi_3O_{10}F_2$
(358) $MoMgSnLiAlSi_3O_{10}F_2$
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(361) $MoMg_3BiAlSi_2O_{10}F_2$
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(370) $TeMg_2LiAlSi_3O_{10}F_2$
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(372) $TeMg_2CsAlSi_3O_{10}F_2$
(373) $KTeCa_2AlSi_3O_{10}F_2$
(374) $KTeSr_2AlSi_3O_{10}F_2$
(375) $KTeBa_2AlSi_3O_{10}F_2$
(376) $KTeZr_2AlSi_3O_{10}F_2$
(377) $TeMg_3BAlSi_2O_{10}F_2$
(378) $TeMgMnLiAlSi_3O_{10}F_2$
(379) $TeMgNiLiAlSi_3O_{10}F_2$
(380) $TeMg_3CoAlSi_2O_{10}F_2$
(381) $TeMg_3FeAlSi_2O_{10}F_2$
(382) $TeMgCdLiAlSi_3O_{10}F_2$
(383) $KTeTiAlSi_3O_{10}F_2$
(384) $TeMgBeLiAlSi_3O_{10}F_2$
(385) $TeMgSnLiAlSi_3O_{10}F_2$

(386) $TeMgPbLiAlSi_3O_{10}F_2$
(387) $KTeVAlSi_3O_{10}F_2$
(388) $TeMg_3BiAlSi_2O_{10}F_2$
(389) $TeMg_3CrSi_2O_{10}F_2$
(390) $KTeSeAlSi_3O_{10}F_2$
(391) $TeMgZnLiAlSi_3O_{10}F_2$
(392) $TeMg_3SbAlSi_3O_{10}F_2$
(393) $TeMg_3MoAlSi_2O_{10}F_2$
(394) $KCuUAlSi_3O_{10}F_2$
(395) $NaMgUAlSi_3O_{10}F_2$
(396) $KMgUAlSi_3O_{10}F_2$
(397) $LiMgUAlSi_3O_{10}F_2$
(398) $RbMgUAlSi_3O_{10}F_2$
(399) $CsMgUAlSi_3O_{10}F_2$
(400) $KCaUAlSi_3O_{10}F_2$
(401) $KSrUAlSi_3O_{10}F_2$
(402) $KBaUAlSi_3O_{10}F_2$
(403) $KZrUAlSi_3O_{10}F_2$
(404) $NaMgUBSi_3O_{10}F_2$
(405) $KMnUAlSi_3O_{10}F_2$
(406) $KNiUAlSi_3O_{10}F_2$
(407) $NaMgUCoSi_3O_{10}F_2$
(408) $NaMgUFeSi_3O_{10}F_2$
(409) $KCdUAlSi_3O_{10}F_2$
(410) $KBeUAlSi_3O_{10}F_2$
(411) $KSnUAlSi_3O_{10}F_2$
(412) $KPbUAlSi_3O_{10}F_2$
(413) $NaMgUBiSi_3O_{10}F_2$
(414) $NaMgUCrSi_3O_{10}F_2$
(415) $KZnUAlSi_3O_{10}F_2$
(416) $KSbUAlSi_3O_{10}F_2$
(417) $KCuUAlSi_3O_{10}F_2$
(418) $KMoUAlSi_3O_{10}F_2$
(419) $KTeUAlSi_3O_{10}F_2$

It will be noted that in Formulas 1 through 419 fluorine is present in each. It is, however, possible to substitute other members of the halogen family in place of the fluorine, for example, chlorine, bromine or iodine. Without writing each of the formulas out completely, it is understood that Formulas 1 through 419 are rewritten as a second list of formulas with the chlorine substituted for fluorine and that the second list of formulas with chlorine are numbered 420 through 838. That is to say, the Formulas 420 through 838 are the same as the Formulas 1 through 419, except that chlorine is substituted for fluorine. Further, it is understood that the Formulas 1 through 419 are rewritten as a third list of formulas with the bromine substituted for fluorine and that this third list of formulas with the bromine are numbered 839 through 1257. That is to say, the Formulas 839 through 1257 are the same as the Formulas 1 through 419 except that the bromine is substituted for fluorine. Further it is understood that the Formulas 1 through 419 are written as a fourth list of formulas with the iodine substituted for fluorine and that this fourth list of formulas with the iodine are numbered 1258 through 1676. That is to say, the Formulas 1258 through 1676 are the same as the Formulas 1 through 419, except that iodine is substituted for fluorine.

The elements included within the classification of rare

earths may be utilized to replace the cations in the synthetic mica compounds listed above. The elements included within the rare earth classification comprise lanthanum, cerium, praseodymium, neodymium, semarium, europium, gadolinium, dysprosium, holmium, and lutesium. These substitutions make additional formulas, the same as though they were written out.

The cations, or the purifying, or physical change inducing agents of the synthetic mica in Formula 1 would include the potassium, magnesium and aluminum as distinguished from the silicon. The fluorine, chlorine, bromine, or iodine appear to function as a wetting agent to make the mica miscible with the molten metal.

The cations, or the purifying, or physical change inducing agents of the synthetic mica in all the formulas include the rare earth elements, aluminum, antimony, barium, beryllium, bismuth, boron, cadmium, calcium, cesium, chromium, cobalt, copper, iron, lead, lithium, magnesium, manganese, molybdenum, nickel, potassium, rubidium, selenium, sodium, strontium, tellurium, tin, titanium, uranium, vanadium, zinc and zirconium.

The synthetic micas of the present invention are silicates of the constituents selected from the class of elements in the preceding paragraph and include fluorine, or chlorine, or bromine, or iodine.

The specific gravity of the synthetic fluor-phlogopite mica, such as identified by Formula 1, is normally in the neighborhood of 3.0 as compared to water and the melting point is usually in the neighborhood of 2200 to 2500 degrees F. Some of the volatile constituents or purifying or physical change inducing agents from which synthetic mica is made have a very low melting and boiling point. It is known that the temperature of most molten baths usually exceed the boiling temperature of the volatile constituents from which mica is made. Thus, for example, the introduction into a molten metal bath of solid elemental magnesium, which is a purifying or physical change inducing agent, produces a reaction of explosive violence. The introduction of magnesium into molten metal has been generally regarded as being impossible on a practical scale. Proposals have been made by the prior art to solve an analogous problem encountered in the introduction of various highly volatilizable elements into molten baths, for example, U.S. Patent No. 1,931,144 relating to the introduction of sodium, as sodium vapors into a molten bath to purify the bath. However, with the present invention, the volatile constituents, including sodium as well as the others appearing in the listed formulas, from which mica is made may be introduced into the molten iron bath without any explosive violence or without any loss of the volatile constituents.

In the present invenion, the mica may be introduced into the metal by putting mica into the ladle before pouring the molten metal into the ladle, or the mica may be added directly into the molten meal in the ladle.

In most cases the mica tends to float on top of the heavier molten metals because it has a lower specific gravity than the molten metal. The molten metal in the ladle should be of sufficient temperature to melt the mica. It appears that when the mica becomes in a complete liquid state, that is, after a certain temperature has been reached, it then becomes "miscible" with the molten iron. In other words, the amount of mica which tends to go into the molten iron is automatic depending upon the impurities in the molten metal which are to be removed or to be compounded with the constituents of the mica. Thus, the more impurities in the metal, the more mica is absorbed or taken into the metal to react with the impurities and to control the physical changes. The term "miscible" amount of mica which goes into the molten metal is that amount required (1) to remove the impurities or to combine them with the constituents of the mica to thereby eliminate their effect and (2) to conrol the physical changes. The introduction of the mica into the molten metal is automatic in the sense that mica which is added to the metal is dissolved into the metal until a saturation point is reached, whereat the molten metal refuses to take any more mica. This is sufficient to produce physical changes in the metal. Mica added in excess of this "miscible" amount generally floats on top of the metal as a slag where it may be conveniently removed by any conventional method. The "miscible" mica may not occur as mica in the molten metal, but may dissociate into the individual constituents of the mica. The "miscible" mica in the metal includes the mica as such, as well as the dissociated individual constituents of the mica.

All of the micas exert a double action on the metal. One of the actions is that of a purifying or physical change inducing agent. The other action is that of a wetting agent.

Metal treated with mica makes a "clean pour," in that the molten metal flows freely. It has a high fluidity. The grain structure of the finished castings is small, producing sound metal free from porosity. The metals are ductile. The metals are reproducible on a commercial level because there is no waste of the volatile constituents as they are introduced into the molten metal. The amount of mica which needs to be introduced can be determined ahead of time. When a procedure is established on a commercial level for a particular purpose, the operation may be successfully repeated with the use of mica to produce good sound metal.

The mica used as a treating material may have related forms other than that suitable for electrical insulation. The treatment material in this invention comprises silicates selected from the class of elements listed above and includes fluorine, chlorine, bromine, or iodine. The treating material may have a melting temperature above 1200 degrees F. and below 2700 degrees F.

Depending upon the impurities in the molten metal, the mica which is introduced may range from 0.05% by weight to about 15%. When 40% by weight of mica was introduced, a large amount thereof was slag. This is because the metal accepts what is needed. Preferably, the amount introduced may be 1.0% to 5.0%. It is only necessary to introduce an amount of mica in excess of the "miscible" amount, and the extra amount may be removed as a slag.

When the treating mica of the present invention is added to metals which have molten temperatures less than the temperature at which mica melts, the mica is taken into the metal by what might be referred to as a dissolving action. The dissolving action is hastened by putting the mica in powder form of preferably 100 mesh, or finer. In other words it is desirable to reach the melting point of the mica, since at this temperature it is more easily taken into the metal but it is not necessary because it will be dissolved by the molten metal, the action being slightly more time consuming.

The treated metal has improved physical properties. The treated molten metal makes a clean pour and has a high fluidity giving sharply defined shapes. The ability of the metals to be work hardened is reduced particularly in copper. The grain size of the treated metal is tighter and smaller giving a more dense section. The metal also has the unique and novel property of being more ductile. The metal is also stronger and harder.

The retained amount of volatile agents or purifying or physical change inducing agents in the metal is substantially proportional to the percentage-wise amount of the said agents in the mica, if all the mica becomes miscible or goes into the molten metal. On the other hand, if some of the mica remains as slag, then said proportion of retained amount of agents may vary, depending upon the relative activity of the agents themselves in the molten metal and the receptivity of the molten metal to receive the respecive agents. The retained amount of volatile or purifying or physical change inducing agents may range from a small trace, as low as 0.01% to 0.5%.

The present disclosure includes that contained in the appended claims, as well as that of the foregoing description.

Although this invention has been described in its preferred form and preferred practice with a certain degree of particularity, it is understood that the present disclosure of the preferred form and preferred practice has been made only by way of example and that numerous changes in the details of construction and the combination and arrangement of parts and steps may be resorted to without departing from the spirit and scope of the invention as hereinafter claimed.

What is claimed is:

1. A solid cast metal selected from the group consisting of aluminum, cadmium, chromium, cobalt, copper, lead, magnesium, manganese, molybdenum, nickel, tin, titanium, tungsten, uranium, vanadium, zinc, zirconium, steel, and alloy steel, said solid cast metal containing mica introduced in molten metal prior to casting said mica being made of materials having both silicate and halogen compounds of at least one of the elements selected from the group consisting of the rare earths, the alkali metals, the alkaline earth metals, and non-ferrous metals consisting of aluminum, boron, copper, molybdenum, bismuth, nickel cobalt, chromium, titanium, antimony, manganese, uranium, lead, tin, zinc, tellurium, vanadium, selenium, cadmium and zirconium, the mica being in an amount ranging from 0.05% by weight to 15.0%, said halogen compounds selected from the class including fluorine, chlorine, bromine, and iodine.

2. The method of producing a casting of solid metal selected from the group consisting of aluminum, cadmium, chromium, cobalt, copper, lead, magnesium, manganese, molybdenum, nickel, tin, titanium, tungsten, uranium, vanadium, zinc, zirconium, steel, and alloy steel, said method comprising the steps of establishing a molten bath of said metal, introducing mica into said molten bath to produce a mica treated bath, and finally pouring the casting from said mica treated bath, said mica being made of materials having both silicate and halogen compounds of at least one of the elements selected from the group consisting of the rare earths, the alkali metals, the alkaline earth metals, and non-ferrous metals consisting of aluminum, boron, copper, molybdenum, bismuth, nickel, cobalt, chromium, titanium, antimony, manganese, uranium, lead, tin, zinc, tellurium, vanadium, selenium, cadmium and zirconium, the mica being in an amount ranging from 0.05% by weight to 15.0%, said halogen compounds selected from the class including fluorine, chlorine, bromine and iodine.

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