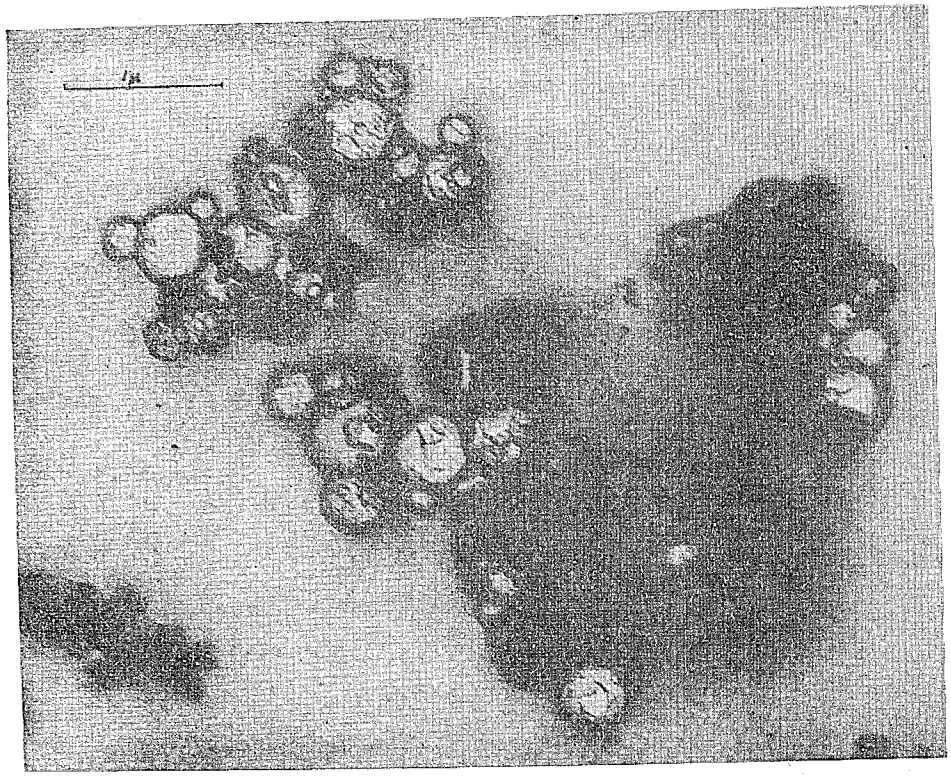
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EXPLOSIVE COMPOSITION

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William F. Van Loenen
INVENTOR

BY

James E. Toomey
AGENT

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EXPLOSIVE COMPOSITION

William F. Van Loenen, Los Altos, Calif., assignor to The Permanente Metals Corporation, Oakland, Calif., a corporation of Delaware

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1

This invention relates to an explosive composition and more particularly to an explosive composition containing magnesium dust, or very finely divided magnesium metal.

The explosive composition of this invention comprises an oxidizing agent and finely divided magnesium, or magnesium dispersoid, obtained by shock-chilling magnesium vapor or gas mixtures containing the same. The shock-chilling is effected with fluid agents, such as hydrogen, natural gas, hydro-carbons, etc., which are substantially inert toward the magnesium under the conditions of operation. A preferred method of obtaining the magnesium dust, or dispersoid, useful in this invention is to recover the crude condensate obtained in the carbothermic process for making magnesium metal. In addition to the magnesium dust, modified to suitably decrease its reactivity, the composition preferably includes a solid oxidizing agent in sufficient amount to satisfy all of the combustible material in the composition.

The magnesium dispersoid useful in this invention and obtained as described is of a fineness beyond any obtainable by mechanical comminution of massive metal. The particle size of the magnesium obtained by shock-chilling the metal vapor approximates colloidal sizes. Such small particles cannot be obtained commercially in any case by grinding, and there are special disadvantages encountered in grinding magnesium which becomes so highly reactive upon sub-division, for instance that grinding must be effected under an inert atmosphere. Thus, it is not known that magnesium can be mechanically comminuted to the ultimate particle sizes characteristic of the magnesium dust useful in this invention, as more fully described below. This magnesium is so finely divided that, more than being merely pyrophoric, it reacts with explosive violence when exposed to sources of oxygen.

It has now been found that the magnesium dispersoid is not only explosive in gas dispersion but also when dispersed in a liquid, with sufficient oxidizing agent, and when it is present in a solid mixture, with sufficient oxidizing agent, although the means of initiating the explosion may vary with these three states, as well as with the explosive reaction desired.

As stated above, a preferred method of obtaining the magnesium dispersoid is by recovery of the crude magnesium metal condensate obtained in the carbothermic process for making magnesium metal, in which process magnesium oxide is reduced by a carbonaceous reducing agent as disclosed in U. S. Patent 1,884,993, to Hansgirg, and in U. S. Patent 2,328,202, to Doerner, and other patents and journals. Therein a mixture of magnesium oxide and carbon is converted into magnesium vapor and carbon monoxide by the heat of an electric arc furnace. This gaseous mixture is discharged from the region of the arc at a high enough temperature (above 1800° C.) that reversal of the reaction does not occur to an appreciable extent, and is then suddenly cooled and diluted by injecting large volumes of a shock-chilling agent, which may be hydrogen, helium, natural gas, hydrocarbon vapor or even a spray of liquid hydrocarbon.

2

In one particular practice of the process natural gas is employed. The magnesium vapor is condensed to magnesium metal in the form of extremely fine dust which is essentially a smoke. Some of the vapor recombines with carbon monoxide with the result that the solid material precipitated in the condensing chamber comprises a substantial proportion, from 30% to 65%, of magnesium dust with the remaining 70% to 35% comprising carbon, magnesium oxide and impurities.

This condensate, that is, the magnesium dust with admixed impurities, is modified in various ways to reduce its activity in air in order that it may be processed to an explosive composition. By activity is meant the tendency of the material to react chemically.

A particularly advantageous method of modifying the magnesium dispersoid is to treat it with liquid hydrocarbon or a liquid mixture of hydrocarbons to provide the magnesium particles with a protective coating. This method is simple, effective and economical, and, in fact, is inherent in the process where the magnesium vapors are shock-chilled with a liquid hydrocarbon spray or a hydrocarbon gas which condenses under the conditions of operation.

The dust wetted with hydrocarbon is for convenience called carbothermic magnesium paste. The magnesium dust, or crude condensate, recovered from the shock-chilling step is usually treated with a liquid hydrocarbon such as kerosene or oil, having a flash point above 100° F., and with or without added asphalt or pitch, to produce a relatively stiff plastic mass.

The average analysis of the magnesium dust from the carbothermic process is, for example:

	Per cent
Magnesium	50
Carbon	19
Inert (principally MgO)	31

A small percentage of the magnesium (approximately 5%) exists as one or both of the carbides, MgC_2 and Mg_2C_3. It is believed that the presence of these carbides is advantageous in that they may yield acetylene in combination with the water formed by the oxidation of the hydrocarbon, the acetylene being explosive under mildly increased pressures. There is generally a trace of sodium which is believed to be in elemental form and possibly minor traces of other carbides such as those of calcium, silicon and/or aluminum originating from the ash constituents from the metallurgical coke in the reduction furnace, or the minor ash constituent of the petroleum coke reducing agent, or impurities associated with the starting oxide. With the exception of occasional carry over of particles from the reduction zone, all of these materials have an ultimate particle size below the resolving power of optical microscopes. Electron microphotographs reveal agglomerates several microns in diameter but ultimate particles are in the neighborhood of 0.1 micron diameter.

The hydrocarbons which may be employed for wetting the crude magnesium dust may advantageously comprise a mixture of coke still distillate or kerosene and of asphalt which is a well-distilled residue of an uncracked asphalt base oil. Although the proportions may vary as stated below, it is usually preferable to employ mixtures containing about 5% to 45% asphalt and about 95% to 55% distillate or kerosene. A 90/10 mix contains 90% distillate and 10% asphalt, a 55/45 mix contains 55% distillate and 45% asphalt, and so forth. The percentages given are by weight. Typical analyses of the components of the mixture are as follows:

Distillate

Gravity, °API at 60° F	10.2
Flash point Pensky-Martin closed cup °F	180
Viscosity Saybolt seconds Universal at 100° F.	60

Asphalt

Gravity, °API at 60° F	10.2
Flash point Pensky-Martin closed cup °F	430
Viscosity Saybolt seconds Furol at 210° F	145

The hydrocarbon mixture may contain any desired proportion of asphalt, such as the above-described asphalt, pitch or like substance.

In the production of a mixture of magnesium dust and hydrocarbons, safe for shipment and suitable for compounding explosive mixtures the shock-chilled dust is conveyed in a closed atmosphere under hydrogen or natural gas, or other inert gas, to a suitable mixing machine where it is thoroughly mixed with the desired hydrocarbons and can then be loaded into open drums. Practical concentrations are usually made of between 55% and 70% solids, the balance hydrocarbons. For reasons of safety it is undesirable to include low flash hydrocarbons at this stage. Various mixtures of fuel oils, or kerosenes in a considerable range, are practical from a production standpoint. This magnesium material when thoroughly wetted with hydrocarbons is not easily ignited nor will it flash or explode upon handling.

Magnesium or powdered magnesium has heretofore been known to the art as a constituent of explosive compositions. These compositions have been made by first producing magnesium in solid metal form and then subdividing it. By the method of the present invention the raw powder coming from the shock-chilling step of the carbothermic process is directly used in the composition. The metal in its dry dust or dispersoid form is of a state of subdivision far greater than that which it is possible to produce by mechanical subdivision. The finely divided magnesium produced in the carbothermic process has a particle size of substantially less than one micron, and as heretofore stated is capable of spontaneous combustion with the atmosphere unless coated with a material such as a liquid hydrocarbon or otherwise modified. It is obvious that a particle size of this order cannot be achieved in quantity on a commercial scale by the use of mechanical means. Thus particular characteristics of this invention are that it utilizes finely divided magnesium and carbon of a particle size never before utilized in explosive compositions, and yet such finely divided magnesium and carbon are capable of rapid and economic production, and the mixture can be safely handled.

In employing the carbothermic magnesium dust, as described above, in the explosive composition of this invention, there are provided in the composition particles of magnesium which approximate colloidal size as well as particles of carbon of similar or even smaller size. When the vapors from the reduction zone, comprising Mg and CO, are shock-chilled to produce the crude condensate some back-reaction occurs inevitably, although shock-chilling holds it to a minimum. The reversal is as follows:

$$Mg+CO=MgO+C$$

This reaction serves to produce materials of extremely small particle size. It is believed that the fineness and purity of the carbon obtained are advantageous in this invention. It is also believed that the highly adsorbent characteristic of the carbon of the carbothermic dust is advantageous in the composition of this invention. Figure 1 is an electronmicrograph, taken at 32,000 diameters magnification, of crude magnesium dust recovered as condensate in the carbothermic process as described above. It will be observed that the greater proportion of the dust appears as submicronic spheres and the metal particles are held in agglomerates which also contain carbon, MgO and other impurities. Many extremely fine particles are scattered over the field. The subdivision of the constituents speeds up the combustion of the magnesium, and other fuel which may be present, to cause detonation.

In an explosive composition, according to this invention, which comprises carbothermic dust uniformly dispersed within and modified by a protective coating of hydrocarbon, and a solid oxidizing agent, it is believed that when the explosive reaction is initiated the protective coating is either burned off or the lighter constituents thereof volatilized, exposing some of the magnesium surface, which then oxidizes with extreme rapidity, in the presence of sufficient oxidizing agents. This produces sufficient heat of combustion to vaporize the balance of the hydrocarbon, probably with cracking. Inasmuch as the hydrocarbon is a contributing fuel but must be vaporized to be burned, this vaporizing by the combustion of the magnesium is believed to increase the speed of burning of the hydrocarbon and to thereby realize an effective explosive reaction. It is generally held by observers of explosive dust cloud reactions that the velocity of propagation of combustion is accelerated by the presence of an inflammable gas and by very fine dust particles in Brownian movement. It is believed with re-

gard to the present invention that, after initiation of the reaction, the burning of the first magnesium particles effects vaporization of combustible hydrocarbon, thus producing very rapidly countless small gaseous systems in which there are present inflammable gases as well as the extremely small combustible particles as hereinabove described which are then enabled to exhibit Brownian motion, with consequent tremendous acceleration of the propagation of the combustion. It is also to be noted that hydrogen is quite soluble in magnesium, this solubility increasing with the temperature, and, therefore, in carbothermic magnesium dust recovered by shock-chilling of the magnesium-containing vapors with hydrogen or with hydrocarbons which crack to yield hydrogen, the metal dispersoid particles contain hydrogen in solution or in occlusion, which will also be available in the explosive reaction and will thus enhance the reactivity of this material.

The oxidizing agents useful in the composition of this invention are solid oxiding agents, for example, nitrates of sodium, potassium, ammonium, guanidine, strontium, barium, lead etc.; metal chlorates, such as sodium or potassium chlorate; metal perchlorates, such as sodium or potassium perchlorate; or mixtures of such oxidizing agents. In general, mixtures of two or more oxidizing agents result in slightly more sensitive compositions. In addition to these oxidizing agents, the presence of small amounts of water, preferably not greater than 1%, is sometimes advantageous. It is not necessary that the oxidizing agent component be employed in the anhydrous state, so long as the water content does not exceed about 1% of the total explosive mix, and it is therefore helpful in some cases to add a small amount of water to the finished mixture, or to employ a deliquescent oxidizing agent, such as, for example, ammonium nitrate. A preferred oxidizing agent, in many uses, is a mixture of sodium nitrate with a minor proportion of potassium nitrate. The use of potassium nitrate enables preparation of a composition which behaves well upon pressing, as in mudcapping operations.

It is among the objects of the invention to produce an explosive partaking of some of the characteristics of a black powder, in that for example it can be deflagrated under some conditions, and also partaking of some of the characteristics of a detonating explosive, in that it can be detonated upon proper initiation, as by a blasting cap. The explosive composition of this invention exhibits advantages over both types of explosives mentioned. One of the advantages of the present explosive is that the ingredients can be mixed and the composition prepared without the development of headaches by the workers, which often occur in working up the nitrated organics. Also, the present composition can be controlled to act either as a deflagrating or as a detonating explosive by suitably choosing the means to initiate its reaction. The present composition can be compounded in as little as 5 minutes mixing, in the same type of apparatus as that in which 3 hours mixing time is required for compounding black powder. The composition of this invention is effective as an explosive at lower bulk densities, which is advantageous in blasting operations wherein the charge is placed by pneumatic means. Other objects and advantages will be apparent from the further description below.

Depending upon the use for which it is intended, the explosive composition is set off by a spitter fuse, by a blasting cap, by a combination of both of these means, or by using a blasting cap and a detonating fuse. For instance, to use the composition as a blasting powder where a greater shattering is desired, it is most suitable to initiate reaction with a blasting cap and a safety fuse, or a booster charge such as tetryl or trinitrotoluene. A suitable safety fuse is the well known Cordeau or Cordeau-Bickford, which is trinitrotoluene encased in a tube of lead.

In preparing the explosive composition of this invention, the magnesium dispersoid, modified to reduce its activity to where it will no longer spontaneously burn upon exposure to air, is admixed with solid oxidizing agent. The two compounds are suitably first comminuted separately to the desired degree if necessary, for instance, by grinding the oxidizing agent and separately crushing the magnesium dispersoid-hydrocarbon mixture when the latter mixture is dry and solid enough to crush; and then the comminuted components are mixed together. Such mixing is sometimes effected by tumbling the components together, and sometimes it is carried out in a Clearfield mixer or other mixer of the muller type. Any desired mixing means can be employed. When the magnesium dispersoid-hydrocarbon mixture is quite pasty, the paste is suitably mixed into the dry oxidizing agent which usually sorbs sufficient of the liquid constituents to convert the mixture to a fine-grained powder. Alternatively, the oxidizing agent can be mixed into the paste. To reduce grinding time, in preparation of the oxidizing agent, a grinding aid can be added if desired. A suitable grinding aid has been found to be the residue obtained after distilling or subliming magnesium metal out of the crude carbothermic magnesium condensate or dust, this residue consisting principally of finely divided MgO and carbon and small amounts of impurities carried over from the carbothermic reducing zone or those formed in the shock-chilling step, such a magnesium carbide.

It has been found that an explosive effect is obtained with as little as about 15% by weight of oxidizing agent, based on the total weight of the composition, when the reaction is initiated in a suitably confined space. In many cases it is preferred to have at least 30% by weight of oxidizing agent present. In making a granular, or solid, explosive it is preferred that the composition contain from about 65% to about 85% by weight of oxidizing agent per from about 35% to about 15% by weight of magnesium dispersoid modified to reduce its activity in air. Excellent results as to strength and brisance are obtained when the composition includes about 75% by weight of oxidizing agent and about 25% by weight of the modified magnesium dispersoid. With the smaller proportions of oxidizing agent it has been observed that the explosive compositions of the invention are effective as propellants for projectiles or rockets.

The following examples will serve to illustrate this invention, but are not intended to be limiting.

Example I

200 lbs. of fertilizer grade sodium nitrate and 5 lbs. of a grinding aid which is the residue remaining after sublimation of magnesium metal from crude carbothermic dust and which comprises chiefly finely divided carbon and MgO, are ground together in a ball mill for 10 minutes, after which all of the mixture passes through a

40 inch screen. It is advantageous to screen the mixture to remove any tramp metal therefrom. The screened mixture is placed in a Clearfield mixer and there are added 66⅔ lbs. of 55/45 carbothermic magnesium paste. The mixer in this example includes a rotating bowl over which are suspended one or more heavy wheels which revolve on an axle which is free to move only in a vertical plane, and the wheels are conveniently maintained about ¾ inch above the grinding or mixing surface of the bowl. In this mixer means are also provided to break up any caked material and re-direct material beneath the muller. Any other desired mixer can be used. The one here described gives a mulling action to the mixture and includes both a pressing and a rubbing action. When the components of the mixture have been placed in the mixer, the mixing action is begun and is completed in about 10 minutes. The result is a powder, and it is transferred to suitable containers for transport to storage or to the place of use.

The composition as described in Example 1 is used in a number of ways. For instance it is used in quarrying operations for providing quartz for use in ferrosilicon production. In one such operation, several vertical holes of three-inch diameter are drilled to a depth of 18 to 20 feet in the quartz deposit. The holes are sprung with about 3 lbs. of a quite brisant explosive as described below in Example 3. After blowing out the holes to remove shattered particles, about one-half the total charge for each hole, of the composition of Example 1 is poured into the holes. A primer or ignition device which is a small bag of say, ¼ lbs. of the composition of Example 1 surrounding an electric blasting cap and provided with suitable insulated lead wires, is then lowered on top of the first portion of the powder charge, and then the balance of the powder charge is poured in, leaving sufficient space for stemming the hole. The hole is stemmed, finally, with loose sand. Explosion is then initiated, with excellent recovery of rock.

In another instance, the hole is prepared as above described but initiation of the explosive reaction is accomplished by means of a Cordeau (detonating fuse). The Cordeau is strung into the hole, the powder charge of Example I poured in, leaving stemming space, and the hole stemmed with loose sand. An electric blasting cap is attached to the Cordeau and the explosion initiated thereby, to obtain a greater shattering effect.

To obtain maximum explosive effect, the explosive composition of Example 1 is placed by pneumatic means. For instance, 3'' holes are drilled, both horizontally and at an angle to the horizontal, in the quarry face, and a detonating fuse is placed the full length of each hole. The powder explosive charge is then placed by means of an aspirator using compressed air, and the air flow is of such slow velocity as to permit the solids carried thereby to settle by gravity into the hole. By this method of placement, the charge is deposited in loose, fluffy condition and maximum explosive effect is thereby obtained.

When the hole is charged to the desired depth, a clay plug is pushed into the hole with distortion to cause it to swell and grip the sides of the hole, taking care not to compact very greatly the outer end of the charge. Then the rest of the hole above the plug is packed tightly with clay or other stemming material before explosion is initiated.

Another method of blasting with the composition of Example I is to package it in paper cartridges about 2½ inches in diameter and 12 inches long, which are tamped into the drilled holes without compacting the powder to any appreciable extent. The explosion is conveniently initiated by a detonating fuse as before. In the foregoing tests, electric blasting caps have been used to initiate the explosion as, in using a free flowing powder as charge, the hazards of handling are minimized. However, the use of spitter fuse and cap to ignite the charge is also successful, care being taken to see that no loose powder is permitted to remain near the fuse.

The foregoing tests have described a blasting powder of the detonating type, useful especially where a shattering effect is desired. The explosive composition according to this invention is also useful as a deflagrating explosive, in operations where shattering from too great brisance is not desired, an example of which follows.

Example 2

80 lbs. of sodium nitrate and 20 lbs. of potassium nitrate are ground together in a ball mill. The ground mixture is placed in a mixer of the type described above and mixed for 10 minutes with 33 lbs. of 60/40 carbothermic magnesium paste, the paste containing about 70% solids, and the starting magnesium dust condensate about 47% magnesium metal dispersoid.

The composition of Example 2 is used, in one test, to split an oak log 20 inches in diameter and 6 feet long. A hole ⅞ inch in diameter and 10 inches deep, is bored, on a diameter, about 12 inches from the end of the log. About 40 grams of the composition of Example 2 are poured loosely into the hole and a spitter fuse is inserted into the charge. The hole is then filled up with loose sand and closed with a wooden plug provided with a hole just large enough to allow the fuse to pass through in close-fitting relationship, the plug filling the top of the hole without effecting appreciable compacting of the charge. The spitter fuse is ignited, and the resulting explosion splits the log on its diameter and for its whole length.

When the explosion is initiated in a confined space by means of a spitter fuse, the detonation is much less brisant than if the same charge is set off by means of an explosive detonator. For example, in another test with a log 20 inches in diameter and 6 feet long, a hole is bored as described above, and charged in the same way except that a No. 6 electric blasting cap is used instead of spitter fuse. The explosion initiated by the blasting cap shatters the log into several segments, with breaking across the grain.

Another use of the powder composition of Example 2 is in limestone quarrying operations. For instance, a 12 inch vertical hole is drilled to a depth of 100 ft., approximately parallel to and about 30 feet back of the face of a limestone quarry from which it is desired to obtain limestone for manufacturing cement, for which purpose the stone should be well broken up by the blasting action. A detonator is prepared by attaching small pellets of tetryl which is a brisant booster explosive, to a loop of cordeau, the pellets being about 12 inches apart. The loop so prepared is lowered into the hole and the charge or the composition of Example 2 is poured into the hole to fill about 75 feet of its depth (requiring about 3000 lbs). The balance of the hole is

stemmed, or filled, with loose sand, and explosion initiated by cap and fuse. The quarry face is shattered by the explosion with excellent recovery of small-sized limestone particles.

Example 3

In another test of the composition according to the present invention, it is used in an operation known as "mudcapping." For this operation a brisant explosive is required and is made as before described except that the components comprise 75% by weight of potassium nitrate and 25% by weight of carbothermic magnesium paste. The final mixture is a free flowing powder. In the explosive of this example, somewhat greater density of loading is suitable in using the explosive, that is, the powder can be slightly compressed. Thus, the powder is particularly useful in surface blasting or mudcapping. Potassium perchlorate is also useful in the composition when intended for these operations.

In an example of this use, 15 lbs. of the explosive composition of Example 3 are placed on top of a boulder consisting of about 650 cu. ft. of dolomite. The powder is placed in a conical pile over a depression in the rock surface, and a 10-gram tetryl pellet is placed thereon, with a No. 6 blasting cap placed in contact with the pellet. Paper is laid over the charge, and then a layer of mud is added and patted down firmly. The compression thereby effected does not reduce the force of the explosion and, upon initiation, the rock is shattered. A suitable amount of cordeau can be substituted for the tetryl booster.

Example 4

A composition is prepared by admixing 70 lbs. of sodium nitrate passing a screen having 40 meshes to the inch with 34 lbs. of 55/45 carbothermic magnesium paste, and then adding 35 lbs. of potassium perchlorate. Four lbs. of this composition are effective in blasting out an oak stump five feet in height and ten inches in diameter, with complete removal of the stump.

In making a deflagrating explosive, such as is used in firecrackers, potassium perchlorate is mixed with 90/10 carbothermic magnesium paste which has been dried to granules. Suitably the granules are ground to pass a 20-mesh, or smaller, screen and then mixed with the oxidizing agent.

Example 5

A composition is prepared as follows: 45 lbs. of sodium nitrate are ground in a ball mill until the product passes through a 40-mesh screen. In a separate operation on a dough-mixer, 75 lbs. of 55/45 carbothermic magnesium paste are mixed with sufficient oil, as determined by observation, of the same composition as was used in making the paste, that is, 55% kerosene and 45% asphalt residium, to produce a sticky plastic mass. The ground sodium nitrate is added to the sticky mass in the dough mixer and mixing is continued for approximately 10 minutes, or until a uniform dispersion is obtained. To this is added more of the 55/45 oil to bring the total amount of oil added to a total of 25 lbs. This added oil reduces the consistency of the mixture to a thick slurry which is useful as a propellant explosive for rocket projection. The mixture is a deflagrating composition which when fired in a shell with a suitable orifice burns with sufficient rapidity that the ejected products cause rapid movement of the projectile.

In a test of this material, 160 lbs. of a composition made as above is loaded into an aerial bomb shell weighing 250 lbs. before filling and provided with an orifice at the rear which has an inside diameter of 2½ inches. In this test, the closure of the orifice is effected by sealing within it a glass bottle of suitable diameter, containing the initiating charge and having a plastic screw cap. The wires of the detonator are threaded through an aperture in the cap and sealed therein with a sealing compound. The initiating charge in the glass bottle (or other frangible container) comprises about 60 grams of black powder, or other slow deflagrating composition, and an instantaneous electric detonator. Within the nose of the bomb shell is disposed a second powder well made of thin metal in which are placed about 40 grams of black powder and an instantaneous blasting cap. When the reaction is initiated with a suitable electric contactor, the explosion resulting does not burst the bomb casing but instead the products of explosion are discharged through the rear orifice, opened by the breaking of the glass, or other, container, propelling the projectile for approximately one mile.

Alternatively to the examples shown above, when using the composition as a deflagrating explosive, reaction is conveniently initiated by means of a squib. In operations where greater brisance is required, some of which have been described in the above examples, initiation of the reaction with the aid of brisant booster explosive is advantageous. Such a booster can be tetryl, cordeau, primacord, nitroglycerin dynamite or other booster explosive. Brisance can also be increased by increasing the resistance, or pressure, against which the composition explodes, without effecting compression of the explosive composition itself; that is, the heat of combustion and products of combustion are confined for a short period at the time of explosion. In other words, the explosive action is intensified or enhanced, or sometimes even effected, when the means which are employed to contain the explosive are of higher breaking strength, such as a suitably sealed shell casing, or a strongly capped or plugged aperture in a rock or other strong mineral formation.

The present application is a continuation-in-part of my earlier applications, Serial No. 492,989, filed July 1, 1943, and Serial No. 555,767, filed September 25, 1944.

The above examples and detailed description have been given for purposes of illustration only, and it is to be understood that variations and modifications may be made therein without departing from the spirit and scope of the appended claims.

What is claimed is:

1. A granular explosive composition comprising magnesium dispersoid obtained by shock-chilling magnesium vapor, said dispersoid being protectively coated with hydrocarbon containing from 5% to 45% asphalt to reduce its activity in air, and a solid oxidizing agent in the proportion of from about 65% to about 85% by weight oxidizing agent and from about 35% to about 15% by weight of said modified magnesium dispersoid.

2. A granular explosive composition comprising magnesium dispersoid containing material obtained by shock-chilling the vaporous products issuing from a reaction zone wherein magnesium oxide is reduced by a carbonaceous reducing agent, said dispersoid containing from 30% to 65% magnesium dust and having a protective

coating of hydrocarbon containing from 5% to 45% asphalt, and a solid oxidizing agent in the proportion of from about 65% to about 85% by weight of oxidizing agent per from about 35% to about 15% by weight of said modified material.

3. An explosive composition as in claim 2 wherein the oxidizing agent is a nitrate.

4. An explosive composition as in claim 2 wherein the oxidizing agent includes sodium nitrate.

5. An explosive composition as in claim 2 wherein the oxidizing agent includes a perchlorate.

6. A granular explosive composition comprising magnesium dispersoid containing material obtained by shock-chilling the vaporous products issuing from a reaction zone wherein magnesium is reduced by a carbonaceous reducing agent, said material containing from 30% to 65% magnesium dust and having a protective coating of hydrocarbon containing from 5% to 45% asphalt, and a solid oxidizing agent in the proportion of about 75% by weight of said oxidizing agent per about 25% by weight of said modified material.

7. A granular explosive composition comprising magnesium dispersoid-containing material obtained by shock-chilling the vaporous products issuing from a reaction zone wherein magnesium oxide is reduced by a carbonaceous reducing agent, said material containing from 30% to 65% magnesium dust and having a protective coating of hydrocarbon containing from 5% to 45% asphalt, and a solid oxidizing agent in the proportion of from about 65% to about 85% by weight of oxidizing agent per from about 35% to about 15% by weight of said modified material, said solid oxidizing agent containing a small amount, less than about 1% of moisture.

8. A granular explosive composition comprising about 25% by weight of magnesium dispersoid-containing material obtained by shock-chilling the vaporous products issuing from a reaction zone wherein magnesium oxide is reduced by a carbonaceous reducing agent, said material containing from 30% to 65% magnesium dust and being protectively coated by a hydrocarbon containing from 5% to 45% asphalt, and about 75% by weight of potassium nitrate.

9. A granular explosive composition having maximum explosive effect at low bulk density which comprises 200 parts by weight of sodium nitrate and 66⅔ parts by weight of magnesium dispersoid-containing material obtained by shock-chilling the vaporous products issuing from a reaction zone wherein magnesium oxide is reduced by a carbonaceous reducing agent, said material containing from 30% to 65% magnesium dust and being protectively coated by a hydrocarbon containing from 5% to 45% asphalt.

10. A granular explosive composition comprising $NaNO_3$ in the proportion of 4 parts by weight and KNO_3 in the proportion of 1 part by weight per 1.65 parts by weight of Mg dispersoid-containing material obtained by shock-chilling the vaporous products issuing from a reaction zone wherein MgO is reduced by a carbonaceous reducing agent, said material containing from 30% to 65% magnesium dust and being protectively coated by a hydrocarbon containing from 5% to 45% asphalt.

11. A granular explosive composition comprising magnesium dispersoid-containing material obtained by shock-chilling the vaporous products issuing from a reaction zone wherein magnesium oxide is reduced by a carbonaceous reducing agent, said material containing about 47% of magnesium dust and having a protective coating of liquid hydrocarbon containing about 40% of asphalt, and a solid oxidizing agent in the proportion of about 75% by weight per about 25% by weight of said modified material.

12. A granular explosive composition comprising magnesium dispersoid-containing material obtained by shock-chilling the vaporous products issuing from a reaction zone wherein magnesium oxide is reduced by a carbonaceous reducing agent, said material containing about 50% of magnesium dust and having a protective coating of liquid hydrocarbon containing about 45% of asphalt, and a solid oxidizing agent in the proportion of about 75% by weight per about 25% by weight of said modified material.

13. A granular explosive composition comprising magnesium dispersoid-containing material obtained by shock-chilling the vaporous products issuing from a reaction zone wherein magnesium oxide is reduced by a carbonaceous reducing agent, said material containing about 50% of magnesium dust and having a protective coating of liquid hydrocarbon containing about 10% of asphalt and 90% of distillate, and a solid oxidizing agent in the proportion of about 65% to about 85% by weight of said oxidizing agent per from about 35% to about 15% by weight of said modified material.

WILLIAM F. VAN LOENEN.

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