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# [54] GELLED NITROPARAFFIN EXPLOSIVE COMPOSITION CONTAINING AIR-ENTRAPPER PLUS INERT WEIGHTING MATERIAL

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**Related U.S. Application Data**

[63] Continuation-in-part of Ser. No. 96,260, Dec. 8, 1970, abandoned.

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[51] **Int. Cl.** .......... **C06b 1/04**

[58] **Field of Search** .......... 149/2, 5, 21, 47, 149/89, 62, 90

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## [57] ABSTRACT

A cap-sensitive explosive suitable for use in underwater seismic work including a gelled nitroparaffin, a nitrate, a weighting material and an air-entrapping material; and method for making same including the steps of premixing the gelled nitroparaffin and nitrate to form a relatively dry mixture and admixing therewith a weighting material and an air-entrapping material. This abstract is neither intended to define the invention of the application, which of course is measured by the claims, nor is it intended to be limiting as to the scope of the invention in any way.

**10 Claims, No Drawings**

# GELLED NITROPARAFFIN EXPLOSIVE COMPOSITION CONTAINING AIR-ENTRAPPER PLUS INERT WEIGHTING MATERIAL

This application is a continuation-in-part of our pending application Ser. No. 96,260 filed Dec. 8, 1970, now abandoned.

This invention relates to explosives, and particularly to explosives suitable for use in underwater seismic work.

Explosives are used in the seismic exploration for oil and natural gas deposits beneath the ocean floor. Energy from shock waves produced by the detonation of explosives placed beneath the surface of the water, and frequently on the ocean floor, travels downward beneath the ocean floor and is then partially reflected upward by the various subterranean formations. The energy returning to the surface is picked up by a receiving apparatus and transmitted into impulses which are recorded. Interpretation of the recorded information permits the skilled geophysicist to determine geological structures where oil and gas are likely to have accumulated.

Among the explosive compositions which have proved useful in seismic exploration are those containing nitro-paraffins and an inorganic nitrate. See, for example, U.S. Pat. No. 3,475,263. Among the nitroparaffins suitable for such explosives are nitromethane, nitroethane, 1-nitropropane, 2-nitropropane, and mixtures of two or more of such nitroparaffins. Among the inorganic nitrates suitable for such explosives are ammonium nitrate, sodium nitrate, lithium nitrate and mixtures of two or more such nitrates.

It has been observed in connection with explosives, such as that disclosed in U.S. Pat. No. 3,475,263, that when they are used at depths where the pressure is approximately 75 psig, or greater, they sometimes fail to detonate, or, when detonated, the explosion sometimes fails to propagate throughout the charge. The measure of the ability of an explosive to detonate and propagate properly under given conditions is often termed the "sensitivity" of the explosive. It is therefore an object of the present invention to provide a gelled nitroparaffin-nitrate explosive with increased sensitivity.

Another object is to provide such an explosive having satisfactory detonation and propagation characteristics under pressures in excess of 75 psig.

A further object is to provide such an explosive having a density greater than 1.0 which may be used advantageously in underwater work.

These and other objects and advantages will be apparent from the specification and the claims.

The ammonium nitrate-gelled nitromethane explosive disclosed in U.S. Pat. No. 3,475,236 when used under water exhibits two shortcomings: (1) Having a specific gravity of less than 1.0, it tends to float; and (2) as explained, it is not sufficiently sensitive when the pressure reaches approximately 75 psig, or greater. Experimentation undertaken to develop a gelled nitroparaffinnitrate explosive which would be free of these disadvantages has revealed that the addition of an inert weighting material, such as barite, produces an explosive having the desired density without substantially affecting the sensitivity. Further research has been directed toward improving the sensitivity of this heavier explosive.

The sensitivity of an explosive is primarily dependent upon those factors which will enhance the propagation of a detonation wave through the explosive mixture. A generally accepted view is that the detonation wave receives its propatation energy from the reaction initiated by local "hot spots" in the mixture. These hot spots are primarily initiated by: (1) Friction between given boundaries for solids of a high melting point; and (2) adiabatic compression of small gas pockets trapped in the explosive. The second mechanism appears primarily responsible for reaction initiation in the gelled nitroparaffin-nitrate explosive. This accords with observations that the explosive detonates well at atmospheric pressures but poorly at elevated pressures. Tiny gas pockets in the explosive which support the detonation at atmospheric pressure would be squeezed out of the mixture or compressed by elevated pressures. At some point, apparently around 75 psig, this compression becomes sufficient to significantly reduce the adiabatic heating of these spots by the detonation waves so that the "hot spot" temperature is too low to initiate or propagate the chemical reaction. One method for overcoming this problem is to provide means for maintaining the air pockets in the explosive mixture at or near atmospheric pressure, even though the remainder of the explosive is subjected to higher pressures.

In accordance with the present invention, it has been discovered that incorporation in the explosive mixture of a finely divided air-entrapping material which acts to maintain the entrapped air at approximately atmospheric pressure when the explosive is subjected to higher ambient pressures, will increase the sensitivity as desired. Examples of such air-entrapping material which have been found acceptable are resin balloons and glass Microballons. Resin balloons are thin-walled hollow spherical balloons of a polymerized thermosetting resin selected from the group consisting of urea formaldehyde and phenol formaldehyde. Such resin balloons are commercially available and are more fully described in U.S. Pat. No. 3,101,288. Microballoons are similar glass-walled balloons marketed under the trademark "Microballoons" by the Minnesota Mining & Manufacturing Company.

The range of compositions for gelled nitroparaffin-nitrate explosives, including a weighting material and an air-entrapping material, which has been found acceptable is as follows:

15 to 30 percent by weight gelled nitroparaffin
50 to 65 percent by weight inorganic nitrate
10 to 20 percent by weight inert weighting material
2½ to 5 percent by weight air-entrapping material

Within these percentage ranges small amounts of additional inert filler material may be added if desired. Examples of inert fillers are ground rice hulls, oatmeal, wheat bran, sawdust and the like. As is well known in the art, the gelled nitroparaffin may be prepared by incorporating with the nitroparaffin any of various well known gelling agents such as the nitrocellulose or methyl vinyl ether disclosed in U.S. Pat. No. 3,475,236, or the ethyl cellulose, cellulose acetate, cellulose acetate butyrate, or polyoxyethylene disclosed in U.S. Pat. No. 3,377,217. Other gelling agents are disclosed in U.S. Pat. Nos. 2,954,350 and 2,338,165. The amount of gelling agent used will vary depending upon the particular gelling agent employed and the viscosity desired for the particular explosive composition, all as well known to those skilled in the art. For example, approximately 1 percent to 10 percent by weight of nitrocellulose is mixed with liquid nitromethane to produce gelled nitromethane. The preferred composition is:

20 percent by weight gelled nitromethane
60 percent by weight ammonium nitrate
15 percent by weight barite
3 percent by weight phenolic resin balloons or Microballons
2 percent by weight inert filler material

An explosive prepared according to this composition is cap-sensitive to a number 6 or number 8 blasting cap at pressures of 75 psig. (Also lower and higher pressure).

Another aspect of the present invention is the method by which the explosive is manufactured. It has been found that the air-entrapping material, such as resin balloons, if exposed directly to the gelled nitroparaffin, tends to absorb liquid resulting in decreased sensitivity of the explosive. Therefore, the preferred method to be followed in compounding the explosive is to add the air-entrapping material after the gelled nitroparaffin and nitrate have been mixed. Pre-mixing these two components produces a relatively dry mixture from which the air-entrapping material does not tend to absorb liquid. Otherwise, the compositions of the present invention are prepared by known mixing procedures using conventional equipment.

The foregoing disclosure and description of the invention is illustrative and explanatory thereof, and various changes in the process and in the material and amounts thereof may be made within the scope of the appended claims without departing from the spirit of the invention.

What is claimed is:

**1.** An explosive comprising,

a. gelled nitroparaffin in an amount of from about 15 to about 30 percent by weight,
b. an inorganic nitrate in an amount of from about 50 to about 65 percent by weight,
c. inert weighting material in an amount of from about 10 to about 30 percent by weight, said inert weighting material serving to increase the overall specific gravity of the explosive to more than 1.0,
d. air-entrapping material selected from the group consisting of resin balloons and glass microballoons in an amount of from about 2½ to about 5 percent by weight.

**2.** The explosive according to claim **1** wherein said nitroparaffin is selected from the group consisting of
nitromethane, nitroethane, 1-nitropropane, 2-nitropropane and mixtures of two or more of said nitroparaffins.

**3.** The explosive according to claim **1** wherein said nitrate is selected from the group consisting of
ammonium nitrate, sodium nitrate, lithium nitrate and mixtures of two or more of said nitrates.

**4.** An explosive comprising,
15 to 30 percent by weight gelled nitromethane,
50 to 65 percent by weight ammonium nitrate,
10 to 20 percent by weight barite,
2½ to 5 percent by weight air-entrapping material selected from the group consisting of resin balloons and glass microballoons.

**5.** An explosive comprising

a. 20 percent by weight gelled nitromethane,
b. 60 percent by weight ammonium nitrate,
c. 15 percent by weight barite,
d. 3 percent by weight air-entrapping material,
e. 2 percent by weight inert filler material.

**6.** The explosive according to claim **5** wherein said air-entrapping material is resin ballons.

**7.** The explosive according to claim **5** wherein said air-entrapping material is glass Microballoons.

**8.** A method of manufacturing an explosive comprising the steps of

1. forming a relatively dry homogeneous mixture of a gelled nitroparaffin and a nitrate,
2. admixing with said mixture a weighting material and an air-entrapping material.

**9.** The method according to claim **8** wherein said gelled nitroparaffin comprises 15 to 30 percent by weight of said explosive, said inorganic nitrate comprises 50 to 65 percent by weight of said explosive; said weighting material comprises 10 to 20 percent by weight of said explosive, and said air-entrapping material comprises 2½ to 5 percent by weight of said explosive.

**10.** A method of manufacturing an explosive comprising the steps of

1. forming a homogeneous mixture of gelled nitromethane and ammonium nitrate in amounts equal to 20 percent and 60 percent by weight, respectively, of said explosive,
2. admixing with said mixture inert weighting material, air-entrapping material, and inert filler material, in amounts equal to 15 , percent 3 percent and 2 percent by weight, respectively, of said explosive.

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