

Permissible Explosives

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Many mines in sedimentary ground can be gaseous; coal mines, which are notorious for this, also often contain well-trampled, well-pulverized, fine coal dust. Both of these elements have been the cause of many mine disasters in the form of explosion and fire. Later studies conducted by the U.S. Bureau of Mines proved that explosives, especially blasting powder, threw a flame during explosion which ignited mine gas and dust. The shock waves generated by the detonation of high explosives were also proven to suspend near-by coal dust in some instances, making it more vulnerable to ignition.

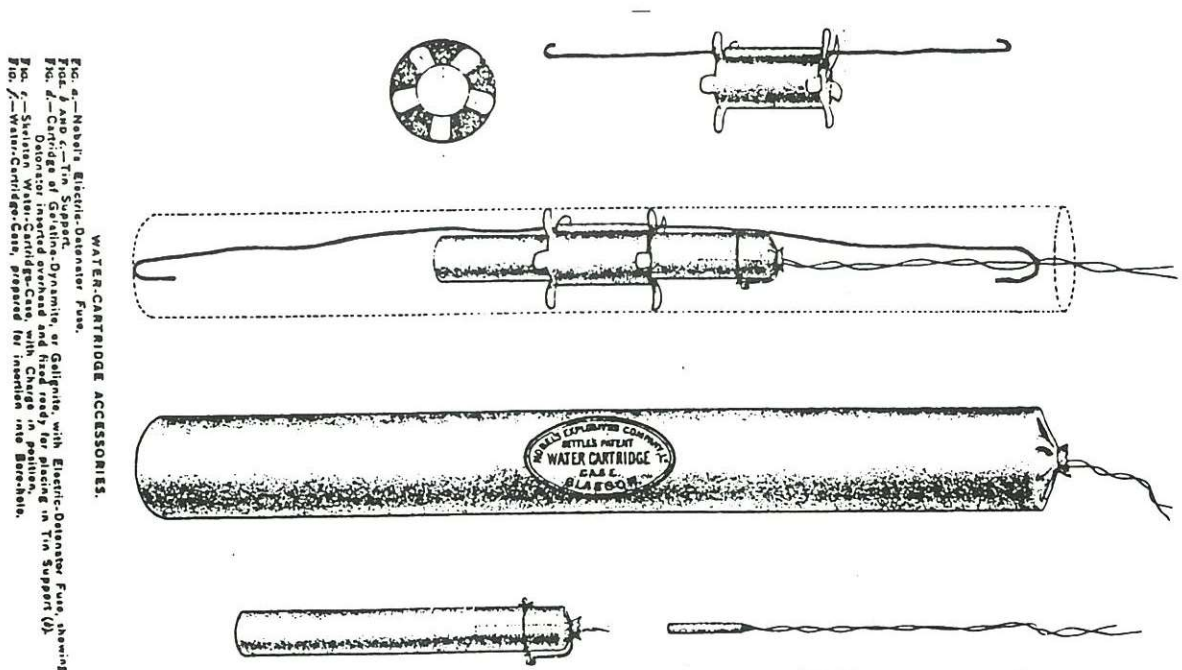
The hazard presented by explosives in coal mines was acknowledged early on in Europe and by the late 1870's and early 1880's several commissions had been appointed to develop solutions.

Despite this, the problem explosives posed in gaseous and dusty mines in the United States was not formally addressed until shortly after 1900.

The first solutions, which were devised in England in the 1880's, were very awkward indeed. Several "safety devises" developed at this time included: a water canister which was tamped into a loaded drill hole on top of the charge and designed to

rupture the water squelching any stray flame; an explosive charge which was suspended in the center of a water-filled canister by spokes; a special sprinkler system to shower the working face in a mine with water during a blast; and attempts using saturated moss as tamping material. Needless to say, these attempts at suppressing blast flame were rather inconvenient to use and probably not very effective.

The first practical solution was an attempt to modify the explosive rather than modifying the blasting environment. It came in the form of a "safety explosive" patented in 1887 under the name of "Carbonite" in Germany



SETTLE'S PATENT WATER CARTRIDGE

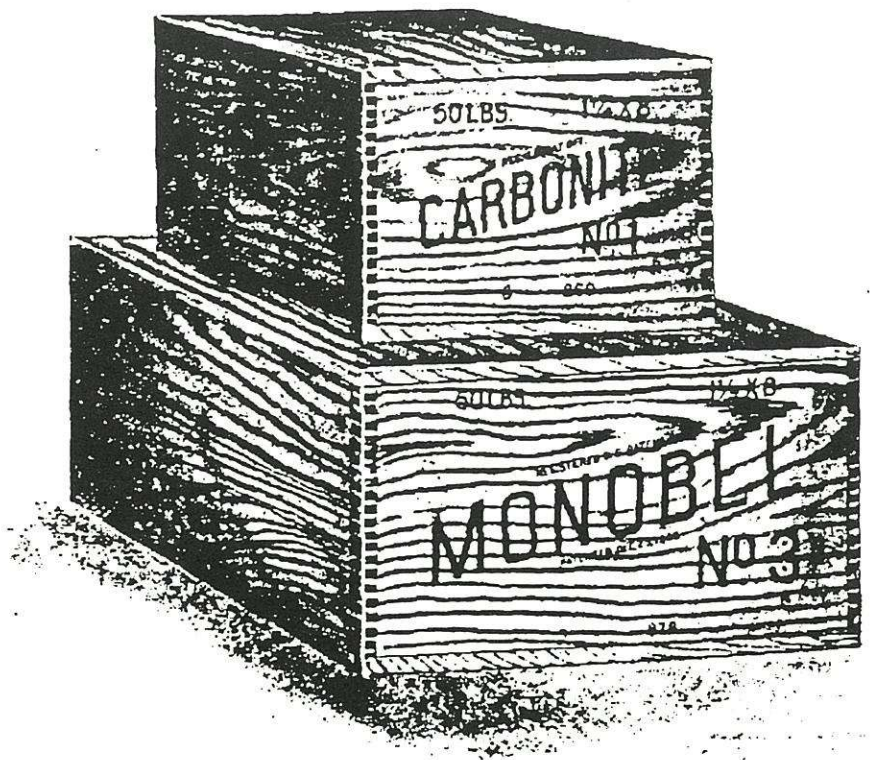
Dynamite cartridge (d) is held in center of tube of water (e) by sleeve (b). Entire assembly is tamped into drill-hole. Water in tube suppresses flame given off by detonation of dynamite. Patented in early 1880's.

by a Mr. Bichel. "Carbonite" was a breakthrough for the explosives industry because although it was based on a straight dynamite, carbonaceous matter had been incorporated into the formula which had a cooling effect on the explosion. Unfortunately, it had the drawback of producing a lot of carbon monoxide gas due to the carbon in the formula.

Shortly after "Carbonite" was developed, "Monobel" was patented in England based on an ammonium nitrate/nitroglycerine formula which incorporated hydrated salts. Ammonium nitrate produced a naturally cool explosion which was further cooled by the hydrated salts, while producing cleaner gases than "Carbonite."

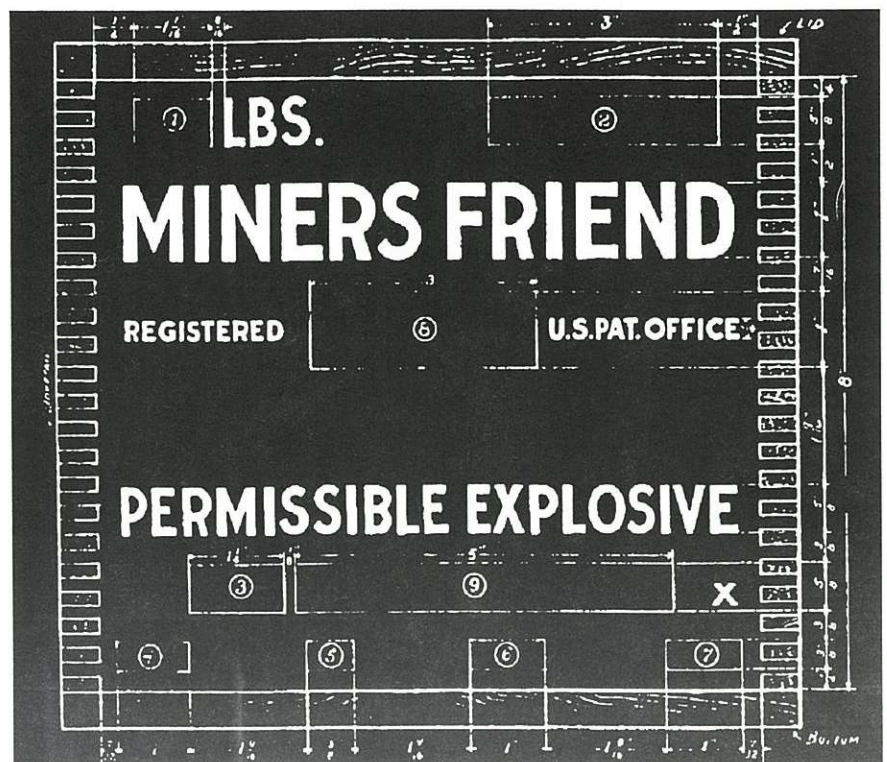
Although it was not until 1907 that a group was formally organized in the United States to study the problem of explosives in gaseous and dusty mines, the problem was certainly well known amongst miners in coal mining districts.

Serious research and development and mass marketing of "short-flame" explosives was undertaken by DuPont beginning in 1902. In that year DuPont sent its chemical director, Dr. Charles Reese to Europe to study state-of-the-art research and manufacturing techniques. Two years later, DuPont established its Eastern Laboratories at the sprawling Repauno Plant in New Jersey and research on "safety explosives" was undertaken immediately. By 1905 DuPont's experts concluded that the two most practicable and economical formulas to make were "Carbonite" and "Monobel", the former of which was made by DuPont for at least 40 years. Manufacture and distribution commenced at once.



Above: The first "safety explosives" offered by the E.I. DuPont de Nemours Powder Co., c. 1908.

Below: A blueprint for the box of one of the Atlas Powder Co.'s first permissibles. This brand-name was taken from the Hecla Dynamite Co. and was used by Atlas for a very short time, c. 1915. Courtesy of Curt Kremer.



1907 began the chain of events which ultimately gave rise to the widespread use of "safety explosive", later known as "permissibles." That year Dr. Joseph Holmes, who directed the Technologic Branch of the United States Geological Survey organized a formal study on the effect of explosives in gaseous and dusty mines.

In 1909 the Technologic Bureau made a general announcement to explosives manufacturers that it was ready to begin testing of formulas to determine if they were safe. Those which passed certain tests would be posted on a list of "permissible" explosives. Perhaps the term "permissible" suggested to explosives makers future regulation

of explosives permitted in gaseous and dusty mines, for the Pittsburgh Testing Station received no less than 134 samples in one year. Later in 1909, the first list of "Permissible Explosives" was published, and after that a list of new permissibles was published at least once per year until 1913.

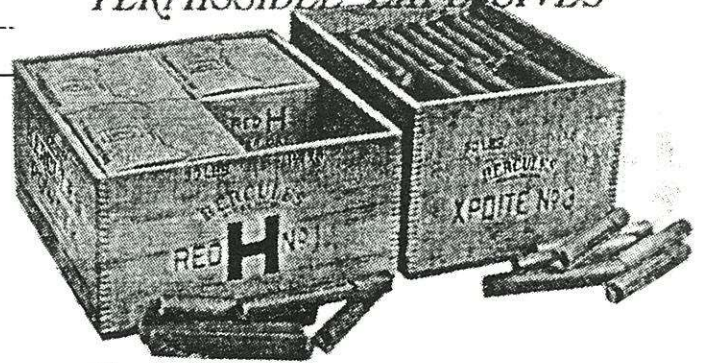
List of permissible explosives as of 1911

Brand.	Manufacturer.
*Aetna coal powder A	Aetna Powder Co., Chicago, Ill.
*Aetna coal powder AA	Do.
*Aetna coal powder B	Do.
*Aetna coal powder C	Do.
*Aetna coal powder D	Do.
*Bental coal powder No. 2	Independent Powder Co. of Missouri, Joplin, Mo.
*Bituminite No. 1	Jefferson Powder Co., Birmingham, Ala.
*Bituminite No. 3	Do.
*Bituminite No. 4	Do.
*Bituminite No. 5	Do.
*Bituminite No. 7	Do.
*Black Diamond No. 3	Illinois Powder Manufacturing Co., St. Louis, Mo.
*Black Diamond No. 4	Do.
*Carbonite No. 1	E. I. du Pont de Nemours Powder Co., Wilmington, Del.
*Carbonite No. 2	Do.
*Carbonite No. 3	Do.
*Carbonite No. 4	Do.
*Carbonite No. 1-L. F.	Do.
*Carbonite No. 2-L. F.	Do.
*Coalite No. 1	Potts Powder Co., New York City.
*Coalite No. 2-D	Do.
*Coalite No. 2-D. L.	Do.
*Coalite No. 3-X	Do.
*Coal special No. 1	Keystone National Powder Co., Emporium, Pa.
*Coal special No. 2	Do.
*Coal special No. 3-C	Do.
*Coal special No. 3-W	Do.
*Coal special No. 4	Do.
*Coal special No. 6-L. F.	Do.
*Collier powder No. 2	Do.
*Collier powder No. 4	Do.
*Collier powder No. 5	Do.
*Collier powder No. 5 special	Do.
*Collier powder No. 5-L. F.	Do.
*Collier powder No. X	Do.
*Collier powder No. 2-L. F.	Do.
*Collier powder No. 3	Do.
*Collier powder No. 6-L. F.	Do.
*Collier powder No. 8-L. F.	Do.
*Detonite special	The Detonite Co., Cincinnati, Ohio.
*Eureka No. 2-L. F.	O. R. McAbee Powder & Oil Co., Pittsburg, Pa.
*Giant A low-flame dynamite	Giant Powder Co. (Consolidated), Giant, Cal.
*Giant B low-flame dynamite	Do.
*Giant C low-flame dynamite	Do.
*Ilecla No. 2	E. I. du Pont de Nemours Powder Co., Wilmington, Del.
*Kanite A	W. H. Blumenstein Chemical Works, Pottsville, Pa.
*Masurite M. L. F.	Masurite Explosives Co., Sharon, Pa.
*Meteor A X X O	E. I. du Pont de Nemours Powder Co., Wilmington, Del.
*Mine-ite A	Burton Powder Co., Pittsburg, Pa.
*Mine-ite B	Do.
*Monobel No. 1	E. I. du Pont de Nemours Powder Co., Wilmington, Del.
*Monobel No. 2	Do.
*Monobel No. 3	Do.
*Nitro low-flame No. 1	Nitro Powder Co., Kingston, N. Y.
*Nitro low-flame No. 2	Do.
*Titanite No. 3-P	Waelark Titanite Explosive Co., Corry, Pa.
*Titanite No. 7-P	Do.
*Titanite No. 8-P	Do.
*Trojan coal powder A	Pennsylvania Trojan Powder Co., Allentown, Pa.
*Trojan coal powder B	Do.
*Trojan coal powder C	Do.
*Trojan coal powder D	Do.
*Trojan coal powder E	Do.
*Trojan coal powder F	Do.
*Tunnelite No. 5	G. R. McAbee Powder & Oil Co., Pittsburg, Pa.
*Tunnelite No. 6	Do.
*Tunnelite No. 7	Do.
*Tunnelite No. 8	Do.
*Tunnelite No. 6-L. F.	Do.
*Tunnelite No. 8-L. F.	Do.

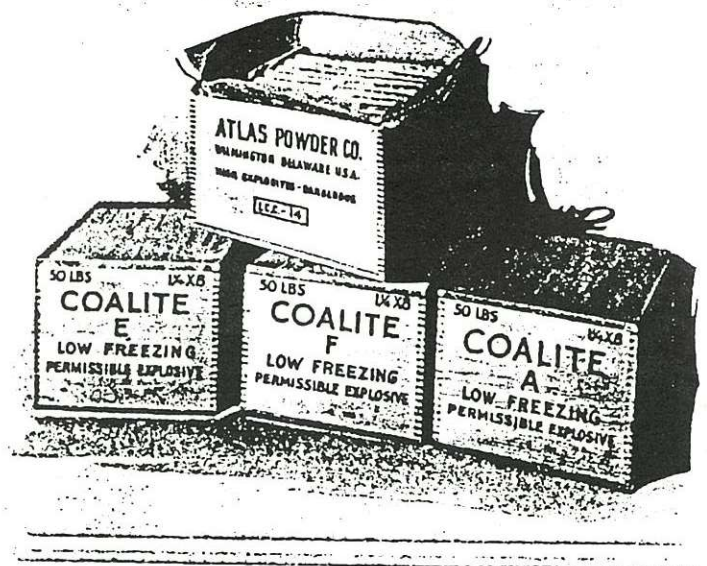
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- Atlas Powder Co., *Explosives and Other Products* 1923, Atlas Powder Co., Wilmington, DE.
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 Hall, Clarence, *The Nature of Permissible Explosives*, Mining Science, June 29, 1911.
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PERMISSIBLE EXPLOSIVES



Hercules Powder Co. permissible, c. 1915-1925. "Red H" is named after U.S.B.M. permissible test "H" conducted in 1915.



Atlas Powder Co. permissibles, c. 1913-1923. Each letter designation represents a permissible test that particular formula passed. Coalite was a brand-name once belonging to the Potts Powder Co., which Atlas bought in 1913.