

THE  
KEYSTONE CATALOG

(Formerly the Mining Catalog)

**(METAL AND QUARRY EDITION)**

*Sixth Issue (1926)*

A Consolidation of Catalogs Pertaining to the Metallic and Non-Metallic  
Mining, Sand, Gravel, Quarrying, Lime and  
Cement Industries

TOGETHER WITH

ENGINEERING DATA COVERING THE VARIOUS  
OPERATIONS PERTAINING THERETO

DEvised, COMPILED, EDITED AND PUBLISHED BY

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# SECTION VI

## Drilling, Blasting and Explosives

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### *Condensed Catalogs In This Section:*

Atlas Powder Co.	Hercules Powder Co.
California Cap Co.	Illinois Powder Mfg. Co.
Chicago Pneumatic Tool Co.	Ingersoll-Rand Co.
Cleveland Rock Drill Co., The	Knox Manufacturing Co.
Coast Manufacturing and Supply Co.	Loomis Machine Co., The
Cochise Rock Drill Mfg. Co.	Milne A. & Co.
Denver Rock Drill Mfg. Co., The	National Fuse & Powder Co., The
Diamond Machine Co.	New York Belting & Packing Co.
Dixon Valve & Coupling Co.	Peerless Explosives Co.
Du Pont, E. I. de Nemours & Co., Inc.	Sanderson-Cyclone Drill Co., The
Ensign-Bickford Co., The	Scranton Electric Construction Co.
Giant Powder Co., Con., The	Sullivan Machinery Co.
Goodrich, B. F. Rubber Co., The	Trojan Powder Co.
Grasselli Powder Co., The	Ziv Steel & Wire Co.

FOR ALPHABETICAL INDEX OF EQUIPMENT SEE BLUE SHEETS

# ATLAS POWDER CO.

WILMINGTON, DELAWARE

## BRANCH OFFICES

ALLENTOWN, PA.  
BIRMINGHAM, ALA.  
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NEW YORK, N. Y.  
NORRISTOWN, PA.  
PHILADELPHIA, PA.

PITTSBURG, KANS.  
PITTSBURGH, PA.  
POTTSVILLE, PA.  
ST. LOUIS, MO.  
WILKES-BARRE, PA.

## HIGH EXPLOSIVES AND BLASTING POWDERS

The high quality, uniformity and dependability of Atlas Explosives are recognized by all powder men connected with great metal mines. All grades for every requirement can be furnished conveniently by the nearest of our many distributing points. All Atlas Explosives are low-freezing or non-freezing. Nothing weaker than a No. 6 blasting cap should be used to detonate Atlas Explosives.

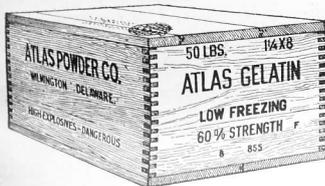


Cartridge—Atlas L. F. Extra 40%

**Atlas Special No. 3**—A new explosive that does not freeze. Made especially for metal mines and not recommended for outside work.

**Atlas Low-Freezing Nitroglycerin Dynamite**—25% to 60%. Very quick and shattering. Fumes of grades lower than 50% not objectionable underground. Partly waterproof. Recommended for work in hard rock that must be broken small.

**Atlas Low-Freezing Extra**—15% to 60%. Spreads and heaves when detonated. Fumes not objectionable. Not absolutely waterproof. Especially recommended for quarries, stripings, cuts and underground blasting that is not very wet and where a highly shattering effect is not desired.



Case—Atlas Gelatin L. F. 60%

the 80%. Waterproof. For tunnel driving and rock blasting of all kinds in mines or under water.

**Atlas Permissibles—COALITE**. Ten grades to meet every coal mining requirement. No objectionable fumes. Cold resisting. All grades have been tested and approved by the U. S. Government Bureau of Mines.



Keg—Atlas Blasting Powder

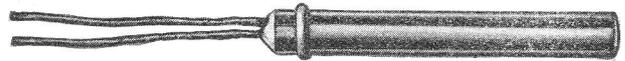
ed, dense, regular, moisture resisting grains. Glazed. Packed in 25-lb. kegs and 5-lb. cans.



## BLASTING SUPPLIES

**Atlas Blasting Caps**—No. 6 and No. 8. Detonated by fuse. Packed 25 to 100 to the tin box, 500 or 5,000 to the case.

**Atlas Electric Blasting Caps**—No. 6 and No. 8. Copper or iron wires. Detonated by electric blasting machine. Packed 25 and 50 to the carton—10 cartons to the case. Wires 4 ft. to 30 ft. long. Longer lengths supplied on request.

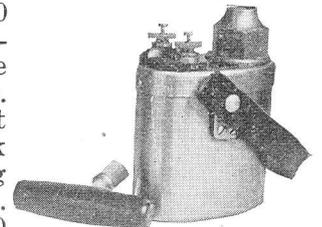


Atlas Electric Blasting Cap

**Atlas Blasting Machines**—Five sizes ranging in weight from 3½ lbs. to 57 lbs., and in capacity from 1 to 150 electric blasting caps.

Three sizes particularly suited for blasting where not more than 1, 5, or 10 shots are fired together. Dimensions: Smallest size 6¼" high by 1⅞" diameter.

**Fuse**—Six different brands for carrying spark to blasting caps or blasting powder under all conditions. Wrapped in rolls of 100 feet. Packed 5 to 60 rolls to the case.



Atlas No. 2 Special Blaster, Capacity 10 Electric Blasting Caps.

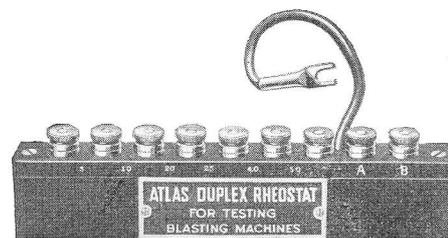
**Atlas Duplex Cap Crimpers**—For attaching blasting caps to fuse in a safe, secure and reliable way.

**Connecting Wire**—Small, insulated copper wire for connecting electric blasting caps to each other. 1-lb. and 2-lb. spools. About 230 ft. to the lb. for No. 20 wire; about 290 ft. to the lb. for No. 21 wire. Sold by the lb.

**Leading Wire**—Heavy, insulated copper wire, used to carry the current from blasting machine to the electric blasting caps. Single leading wire runs about 49 feet to the lb.; duplex, about 26 feet to the lb. Sold by the lb.

**Atlas Galvanometers**—For testing electric blasting circuits. This instrument is enclosed in a leather carrying case, with a sling strap.

**Atlas Duplex Rheostats**—For testing the capacity of blasting machines. Dimensions: ¾" x 1¼" x 7". Weight: 7 oz.



Other Atlas Blasting Supplies include Sureshot Shells, Tamping Bags, Thawing Kettles, Delay Electric Blasting Caps, Delay Electric Igniters, Cordeau-Bickford Detonating Fuse, Blasting Paper, Kapsel, Portable Magazines, Electric Squibs, Miners' Squibs, etc.

Other Atlas Products include Chemicals, Nitro Cellulose Solutions, Leather Cloth, Lacquers, Enamels.

# E. I. du Pont de Nemours & Company, Inc.

General Offices: WILMINGTON, DEL.

## Branch Offices

BIRMINGHAM, ALA.  
BOSTON, MASS.  
BUFFALO, N. Y.  
CHICAGO, ILL.

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SAN FRANCISCO, CAL.  
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SEATTLE, WASH.

SPOKANE, WASH.  
SPRINGFIELD, ILL.  
ST. LOUIS, MO.

## Locations of Explosives Plants and Blasting Accessories Factory:

**High Explosives:** Ashburn, Mo.; Barksdale, Wis.; Carl Junction, Mo.; Du Pont, Wash.; Louviers, Colo.; Ramsay, Mont.; Gibbstown, N. J.

**Blasting Powder:** Connable, Ala.; Du Pont, Wash.; Nemours, W. Va.; Fairchance, Pa.; Jermyn, Pa.; Laurel Run, Pa.; Mooar, Iowa; Moosic, Pa.; Oliver Mills, Pa.; Peckville, Pa.; Wapwallopen, Pa.; Wilpin, Minn.

**Blasting Accessories:** Pompton Lakes, N. J.

## High Explosives, Blasting Powder and Blasting Accessories

In the course of more than a century's experience in the manufacture and sale of explosives, the du Pont Company has acquired a very extensive practical knowledge of the qualities needed in explosives for various purposes and the most efficient methods of using them. Du Pont explosives include types for all classes of blasting, all made from carefully selected materials with a care in manufacture which insures the highest quality and uniformity.



The following paragraphs state briefly the chief characteristics of du Pont explosives adapted for metal mining and quarrying, and describe the accessories needed for firing them. For more complete information as to the selection of the proper explosives and the methods of using them to secure the greatest execution at the lowest cost of accessories, time and labor, consult the catalogs and booklets issued by this Company.

### EXPLOSIVES FOR MINING

**Du Pont Straight 15-60%.** This is a quick, powerful, water resisting, low freezing explosive. It is excellent for open work where a shattering action is desired but is not suitable for underground work unless the ventilation is exceptionally good.

**Red Cross Extra 20-60%.** This explosive works extremely well in mining soft ore and is also suitable for hard ore where it is not desired to shatter the material. It is low freezing.



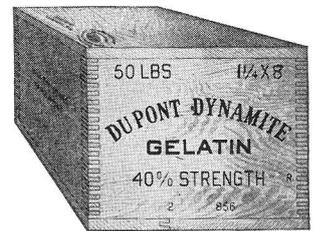
**Du Pont Gelatin 25-90%.** Where other explosives are inefficient this gelatin does its best work. It is adapted to a wider range of work than any other gelatin dynamite for it has all the virtues of density, plasticity, water resistance, and comparative freedom from obnoxious fumes, and is low-freezing. It is especially adapted for close work of every kind and gives excellent results in the hardest rock under the most adverse conditions.

**Du Pont Special Gelatin 35-75%.** This is an improved ammonia gelatin which is being used with satisfaction in a good many metal mines. Like our other gelatin dynamites it is dense, plastic, water resistant and low freezing. It gives good execution and the fumes are not objectionable.

**Du Pont Blasting Gelatin 100%.** This is the strongest and quickest high explosive manufactured. It can be used in close work as it gives a minimum of fumes when exploded. It is practically

waterproof but is not low-freezing. It is especially suitable for blasting hard material in tunnels or in driving shafts.

**Packages.** Du Pont high explosives for mining are packed in cartridges ranging in size from  $\frac{7}{8}$ "x8" to 2"x8". They are shipped in 50 pound cases which contain from 34 to 210 cartridges, depending upon the explosive and the size cartridge.



**Blasting Powder.** Blasting powder is the principal explosive used for blasting where it is necessary to remove the rock or earth covering ore veins. It is also used for blasting ore in open pit mines. The blasting powder breaks and loosens the material so that it can be loaded readily with steam shovels and does not waste or scatter it as would high explosives.

Today the "B" Blasting Powder of the du Pont Company is recognized as the standard by which other blasting powder is rated. The high quality of materials used and their thorough incorporation by means of special machinery give the miner a reliable, efficient explosive. That the miners recognize this is shown by the increasing demand.

"B" Blasting Powder is made in seven granulations, the finer grains being much quicker in their action than the coarser. This variation in the size of the grains makes it possible to adapt the action of the powder to the particular work to be done.

**Packages.** Blasting powder is packed in 25 pound metal kegs having a moisture proof cap.

EXPLOSIVES FOR QUARRYING

**Du Pont Gelatin 25-90% and du Pont Special Gelatin 35-75%.** These are plastic, dense, water resisting and low freezing explosives with strong shattering power. Because of its combination of qualities, gelatin dynamite is proving to be the most satisfactory of all explosives for quarrying hard rock, especially with well drill blasting. Du Pont Gelatin is the leading explosive of this type on the market.

**Quarry Gelatin 25-75%.** This is a recently developed high explosive which has the same density, plasticity, water resistance and low freezing properties that are associated with du Pont Gelatin but is somewhat more shattering grade for grade, this increased strength being especially noticeable in the 25% and 30% grades. Quarry Gelatin is adapted only for open work and must not be used in mines, tunnels or other close places.

**Du Pont Blasting Gelatin 100%.** For a very quick, shattering explosive this will serve best. It is entirely unaffected by water but is not low freezing.

**Du Pont Straight 15-60%.** This is a quick, powerful explosive of great shattering power. It has high water resistance and is low freezing.

**Red Cross Extra 20-60%.** This is an excellent explosive for quarrying stone that is only moder-

ately hard. When a denser explosive is required in the bottom of the hole, Red Cross Extra can often be used as a top load with efficiency and economy. Red Cross Extra is low freezing and fairly water resisting.

**Durox.** This is an explosive of relatively high strength yet low density which is especially adapted for blasting rock where a shattering effect is not desired. It is low freezing.

**Arctic Special.** This is a nitro starch explosive which is non-inflammable, non-freezing and does not produce a headache from handling. In action it is similar to Red Cross Extra but it is a bulkier explosive.

**Du Pont R. R. P.** This is the weakest and slowest high explosive—ranking between blasting powder and dynamite. It will rarely freeze but even when frozen will explode properly if the lumps are crumbled.

**Blasting Powder.** Blasting powders are weaker and slower than high explosives, exerting a lifting and heaving, rather than a shattering effect. "A" powder is made in six granulations and "B" in seven. The fine granulations are quicker than the coarser. Blasting powder cannot be used in wet work although "A" resists moisture better than "B". Neither is affected by cold.

EXPLOSIVES TO MEET VARIOUS QUARRYING CONDITIONS

	GELATIN	STRAIGHT	RED CROSS EXTRA	DUROX	ARCTIC SPECIAL	BLASTING POWDER	R. R. P.
To shatter and throw hard stone...	X	X					
To shatter and throw medium hard stone .....	X	Lower strength					
To turn out hard, tough stone.....	X		40 to 60%		X		
To turn out medium hard stone....	X		Lower strength	X	X		X
To turn out soft or dimension stone .....				X		With air spaces	With air spaces
For wet work .....	X						
In cold weather .....	Except Blasting Gelatin	X	X	X	X	X	X
To avoid shattering .....				X		X	X

Packages—All except R.R.P. (in bags) and Blasting Powder (25 lb. keg) are packed in 25 and 50 lb. cases.

DU PONT BLASTING ACCESSORIES

Blasting Caps, Electric Blasting Caps, Electric Squibs, Delay Electric Blasting Caps, Delay Electric Igniters, Blasting Machines, Rheostats, Galvanometers, Connecting Wire, Leading Wire, Fuse, Cap Crimpers, Tamping Bags, Thawing Kettles.

With so much money involved in the preparation for blasting, it is apparent that it is economy to buy only the best blasting accessories. The confidence miners and quarrymen have in du Pont blasting accessories is manifested by the steadily increasing demand.

In designing the du Pont accessories, care has

been exercised to obtain simplicity of construction and to ensure effective performance. This is particularly true of the du Pont blasting machines and testing apparatus. The detonators are composed of the best materials and the ingredients are selected because of their fitness to accomplish what is required—imparting the necessary shock to the explosive charges to effect complete detonation.

If you wish to save time and money, if you desire to get complete detonation of every charge of explosives, insist upon the use of du Pont blasting accessories.

**Du Pont Blasting Machines**—The du Pont Company makes several sizes of blasting machines having capacities of 1 to 150 electric blasting caps fitted with copper wires. The most popular sizes are the Pocket Blasting Machine and Nos. 3 and 3-A.



Blasting Machine

The No. 3 Blasting Machine is illustrated at the left. The Pocket Blasting Machine also is shown below on this page.

Blasting Machine No. 3 fires 30 copper wire electric blasting caps. It weighs 25½ pounds, is compact, easy to operate and portable.

Blasting Machine No. 3-A is a new machine of modern construction, light weight and high capacity. It is rated to fire 50 electric blasting caps with a considerable margin of safety.

The pocket size fires from one to three electric blasting caps at a time. It has a removable handle to prevent anybody but the shot-firer from firing the charges—a safety device greatly appreciated by quarrymen and miners. A quick, sharp turn of the handle generates the current which passes through the two terminals seen at the top of the case, and then through leading wires attached to the terminals posts.



Pocket Blasting Machine

So much depends on the blasting machine, that the safest thing to do is to purchase the best.

**Galvanometers, Rheostats**—Practically indispensable accessories in electric blasting in mine or quarry are the galvanometer and the rheostat illustrated on this page. The galvanometer is a small, direct-reading ohmmeter used to detect breaks, short circuits, and points of high resistance in blasting circuits.



The rheostat is an electric resistance bridge for testing blasting machines.

**Electric Detonators.** After careful experiments extending over many years, the du Pont Company has developed the No. 6 and No. 8 Electric Blasting



Du Pont No. 8 Electric Blasting Cap—Exact Size

Caps as best fitted for all general work. The selection of the materials and the care in assembling the parts assure a blasting cap that will give complete detonation. These caps are furnished with

wires in lengths varying from 4 to 20 feet. The du Pont Company also manufactures Waterproof Electric Blasting Caps, Delay Electric Blasting Caps and Delay Electric Igniters, and furnishes leading wire and connecting wire. The best results are secured from blasting powder by igniting it in the center and for this purpose the Electric Squib is made.

Du Pont electric detonators are packed in cartons of 50.

**Cap Crimpers.** The du Pont Company furnishes cap crimpers of two types, No. 1 and No. 2. The No. 2 Cap Crimper is made with fuse-cutting jaws. One handle is pointed to serve as a punch for making holes in cartridges.



Cap Crimper



**Safety Fuse.** Safety fuse for use with blasting caps is also sold by the du Pont Company, different types being manufactured for dry, damp or wet work, or work under water. It is made in coils of 50 feet and shipped in wooden cases.

**Cordeau.** This is a lead tube filled with T. N. T. which detonates at the speed of 17,500 feet per second. Placed in a bore hole alongside the explosive, it assures the detonation of the charge at the maximum velocity. Cordeau is made either plain, single countered or double countered. It is sold on spools containing from 100 feet to 500 feet each.

## DU PONT EXPLOSIVES SERVICE

For 124 years it has been the constant aim of the du Pont Company to deliver explosives where they are needed—when they are needed. Today this aim has been achieved by a system of mills and magazines, strategically located near practically every great industrial district.

Prompt delivery is but one factor of du Pont Service. We aim to see that our customers use the kind of explosives that will give the best results for their particular work at least expense—and that they are handled, stored and used most efficiently.

In short, du Pont Service is the result of a sincere effort on the part of the du Pont Company to meet and follow the demand, and to pass on to the users of their products, in a practical way, the results of their 124 years of experience and research in the manufacture of explosives.

When you buy from du Pont, you buy more than explosives; you buy du Pont Service.

E. I. DU PONT DE NEMOURS & CO., INC.  
Explosives Department  
WILMINGTON, DELAWARE

# THE GIANT POWDER CO., CON.

First National Bank Bldg., SAN FRANCISCO, CAL.

BRANCH OFFICES:

Butte, Montana  
Los Angeles, California

Portland, Oregon  
Salt Lake City, Utah

Seattle, Washington  
Spokane, Washington

## High Explosives and Blasting Powder

"EVERYTHING FOR BLASTING"

### Giant Explosives

Made by the pioneer company in the explosive industry, Giant Explosives are still the most popular in the West, because their qualities are recognized as superior in meeting western requirements. Nothing weaker than a No. 6 blasting cap should be used with Giant Explosives.

**Giant Special No. 3**—A new explosive that does not freeze. Made especially for metal mines and not recommended for outside work.

**Giant Low-Freezing Nitroglycerin Dynamite**—25% to 60%. Very quick and shattering. Fumes of grades lower than 50% not objectionable underground. Partly waterproof. Recommended for work in hard rock that must be broken small.

**Giant Low-Freezing Extra**—15% to 60%. Spreads and heaves when detonated. Fumes not objectionable. Not absolutely waterproof. Especially recommended for quarries, stripings, cuts and underground blasting



Case—Giant Extra L.F. 60%



that is not very wet and where a highly shattering effect is not desired.

**Giant V.L.F. Gelatin**—25% to 80%

For rock blasting, tunnel driving and all wet work. Waterproof. Grades under 80% fumeless.

### Giant Coalite

A permissible explosive furnished in ten grades to meet every coal mining requirement, tested and approved by U. S. Bureau of Mines. Cold resisting. No objectionable fumes.

### Giant Judson Improved Powder—5%

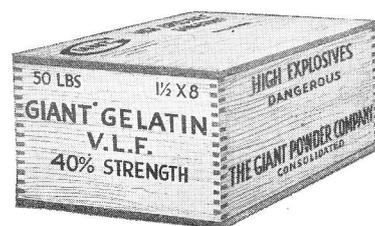
For open excavation including quarry tunnels that is not wet. A granular, high explosive, twice as strong as blasting powder. Put up in 12½ lb. bags packed in 50 lb. cases. 10%, 15% and 20% not granular and put up in cartridges.

### Giant Blasting Powder

For all dry work where a quick acting explosive is not required. All standard granulations. Glazed.



Keg—Giant Blasting Powder



Case—Giant Gelatin V.L.F. 40%

## BLASTING SUPPLIES

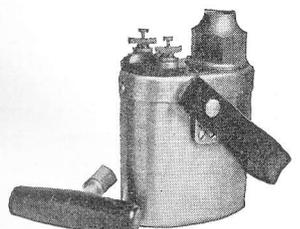
**Giant Blasting Caps**—No. 6 and No. 8. For blasting with fuse.

**Giant Electric Blasting Caps**—No. 6 and No. 8. Copper or Iron wires. For blasting with electric blasting machines.

**Giant Blasting Machines**—Five sizes ranging in weight from 3½ lbs. to 57 lbs., and in capacity from 1 to 150 electric blasting caps.

Three sizes particularly suited for blasting where not more than 1, 5, or 10 shots are fired together. Dimensions: Smallest size 4¾" x 2" x 4½" high.

**Fuse**—For detonating blasting caps or exploding blasting powder.



Giant No. 2 Special Blaster. Capacity, 10 Electric Blasting Caps.

**Giant Cap Crimper**—For attaching blasting caps safely and securely to fuse.

**Connecting Wire**—For connecting electric blast-



Giant Electric Blasting Cap

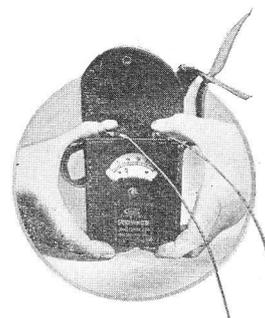
ing caps to each other. Small, insulated copper wire wound on spools containing 1 and 2 lbs.

**Leading Wire**—For carrying electric current from blasting machine to charge. Heavy, insulated copper wire.

**Giant Galvanometer**—For testing electric blasting circuits. Dimensions—1¾" x 3½" x 4½". Weight—1½ lbs.

**Giant Duplex Rheostat**—For testing capacity of electric blasting machines. Dimensions: ¾" x 1¾" x 7". Weight, 7 oz.

**Other Giant Blasting Supplies**—Include Delay Electric Blasting Caps, Delay Electric Igniters, Electric Squibs, Portable Magazines, Sureshot Shells, Cordeau - Bickford Detonating Fuse, Blasting Paper, Celakap, Tamping Bags, Thawing Kettles, etc.



Giant Galvanometer. Weight, including leather case and strap 1½ lbs.

# HERCULES POWDER COMPANY

(Incorporated)

WILMINGTON, DELAWARE

## BRANCH OFFICES

Allentown, Pa.  
Birmingham, Ala.  
Buffalo N. Y.  
Chattanooga, Tenn.

Chicago, Ill.  
Denver, Colo.  
Duluth, Minn.  
Hazleton, Pa.

Huntington, W. Va.  
Joplin, Mo.  
Los Angeles, Cal.  
Louisville, Ky.  
New York City

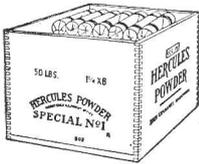
Norristown, Pa.  
Pittsburg, Kan.  
Pittsburgh, Penna.  
Pottsville, Penna.

Salt Lake City, Utah  
San Francisco, Cal.  
St. Louis, Mo.  
Wilkes-Barre, Pa.

## Explosives, Blasting Supplies and Flotation Oils

### Hercules Special No. 1

Because of its high cartridge count and low cost per cartridge, Hercules Special No. 1 is more economical on work for which it is suited than ordinary dynamite. There are about  $\frac{1}{4}$  more cartridges of Special No. 1 in a box than there are of ordinary dynamite in the same size cartridges. Hercules



Special No. 1 frequently replaces 40% dynamite, cartridge for cartridge, at a saving of approximately 15 per cent. Special No. 1 is a "bulky" explosive, hence not as good as gelatin where a concentrated charge is desired, as in tunnel driving in hard tight rock; however, for quarrying, open pit mining, road building, and some underground work it is both effective and economical.

### Hercules Special No. 2

Hercules Special No. 2 is similar to Special No. 1, but is not quite as strong. Special No. 2 is usually more economical for blasting gypsum, clay, shale and some of the easier-breaking rock formations. It has the same high cartridge count as Special No. 1 but costs less per pound and per cartridge.

### Hercules Special No. 3

Hercules Special No. 3 resembles Hercules Special No. 1 and Special No. 2. Because of the small amount of noxious fumes it produces, Special No. 3 is especially desirable for ore, shale, clay, gypsum, and other underground mining. With its non-straining characteristics, Special No. 3 is an excellent salt mining explosive. It has the same cartridge count as Special No. 2, but is a trifle stronger.

### Hercules Gelatin Dynamite

Hercules Gelatin is good for wet work, or for use where ventilation is poor. Its plasticity enables it to be loaded easily and effectively in holes having an upward slant, and the density and plasticity make it extremely well adapted for tight blasting in hard rock, such as tunnel driving and shaft sinking. It is made in strengths from 30% to 90% and packed in standard cartridges, 50 lbs. to the case.



### Hercules Extra (Ammonia) Gelatin

The prevailing market on raw materials makes it again possible to sell Hercules Extra (Ammonia) Gelatin at a lower price than the straight gelatins.

Therefore, it is wise for every user of Gelatin to consider the use of the Hercules Extra Gelatins. They are equal in strength to the

SECTION VI



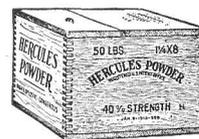
corresponding grades of straight gelatin. The fumes are equal on all grades up to and including 60%, and in higher strengths the Extra Gelatin fumes are better; in other characteristics extra and straight gelatins are practically equivalent.

There may be some work which can be more effectively done with straight gelatins, but it is exceptional. On most jobs there is no difference in results, but there is a gratifying difference in cost.

### Blasting Caps

Blasting Caps are used to detonate charges of high explosives. As the efficiency of any high explosive depends on the initial shock, we do not recommend caps weaker than Hercules No. 6. Standard sizes Nos. 6 and 8. Packed 100 in a box, 5 to 50 boxes in a case.

### Hercules L. F. Straight Nitroglycerin Dynamite



The L. F. Straight Nitroglycerin dynamites are for use when a quick, smashing effect is desired. They produce the best results in muddapping hard rock and boulders; they are also used extensively for propagated ditch blasts. Hercules L. F. Straight Nitroglycerin dynamites are manufactured in strengths from 15% to 60%.

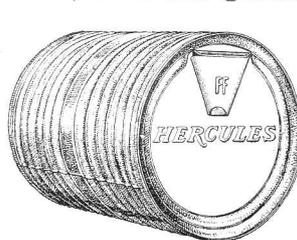
### R. R. P.



Hercules R. R. P. belongs to the class of explosives known as granular dynamite, often called Judson. It is best adapted for use in soft seamy material and for large tunnel or "coyote hole" blasts in hard rock. Packed in paraffine paper bags containing  $12\frac{1}{2}$  lbs. The standard case holds four of these bags, making a net weight of 50 lbs.

### Hercules Blasting Powders

"A" Blasting Powder is for use in dimension stone, slate and granite quarries.



"B" Blasting Powder is for use in non-gaseous coal mines, coal stripping, quarry, and construction work. It is manufactured in all sizes of (glazed) grains, from FFFF, about 1/16-inch diameter, to CCC, about 3/4-inch diameter.

A special granulation called Herco is made for Hercoblasting. It, like other grades of black blasting powder, is packed in kegs containing 25 lbs. net.

KEYSTONE CATALOG

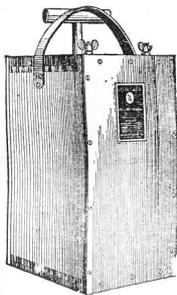
**Cordeau-Bickford Detonating Fuse**

Cordeau-Bickford is a detonating fuse which is being widely used in detonating large and small quarry blasts. As Cordeau extends throughout the length of a hole it detonates almost instantly all parts of the charge. It is the detonator used in Hercoblasting.

It is wound on spools containing approximately 500 ft. and is made with plain, countered, or double countered surface. Cordeau-Bickford can be shipped by express.

**Hercules Blasting Machines**

An apparatus for generating electric current used in firing electric blasting caps, squibs, and igniters. We recommend that no series circuit be used containing over 50 caps. Therefore, we sell no machine larger than Hercules 1-50 hole capacity, although this machine may fire more than this number, as it has a large power reserve.



The Hercules Midget Machine is rated to fire up to five electric blasting caps, connected in series, which allows ample power reserve.

Blasting Machine	Capacity
Midget—Pocket Size	5 Electric Blasting Caps
Hercules No. 2	10 Electric Blasting Caps
Hercules	50 Electric Blasting Caps

**Galvanometers**

A reliable and compact instrument for testing electric blasting circuits, electric blasting caps, and for locating breaks, short circuits and faulty connections. Weight 1 pound.

**Hercules Rheostats**



A small instrument offering the easiest and most effective means of testing the strength of a blasting machine without actually firing a series of electric blasting caps. This instrument gives a resistance equal to from 5 to 100 electric blasting caps, with 30 ft. copper wires.

**Hercules Electric Blasting Caps**

They are made in two strengths, No. 6 and No. 8, and are provided with insulated copper wires or with iron wires. Packed 25 or 50 to the carton, 10 cartons to the case.

**Electric Squibs**

Hercules Electric Squibs are similar in appearance to Electric Blasting Caps, and are used to fire charges of blasting powder. Electric Squibs are made with copper wires. Packed 25 and 50 to the carton, 10 cartons to the case.

**Delay Action Electric Exploders**

These are designed to fire charges in rotation. They are made in ten different delay periods. Furnished with copper wires. Packed 25 and 50 to a carton, 10 cartons to the case.

**Delay Electric Igniters**

These are made in six delays and are used for firing charges of black powder in rotation. If desired, blasting caps may be crimped on the end of the igniter and used for rotation firing of high explosives. Packed 50 to a carton, 10 cartons to a case.

**Leading Wire**

Hercules Leading Wire is an insulated copper wire (No. 14 B. & S. gauge) used for connecting electric blasting caps to the blasting machine. It is furnished in coils from 200 ft. to 500 ft.

**Connecting Wire**

Hercules Connecting Wire is used to join the wires of electric blasting caps. It is insulated copper wire (No. 20 B. & S. gauge), and is put up in one and two pound spools.

**Blasting Caps**

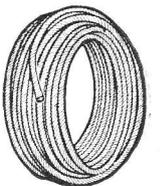
Blasting Caps are used to detonate charges of high explosives. As the efficiency of any high explosive depends on the initial detonation, we do not recommend caps smaller than Hercules No. 6.



Standard sizes Nos. 6 and 8. Packed 100 in a box, 5 to 50 boxes in a case.

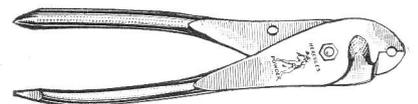
**Safety Fuse**

We are not manufacturers of safety fuse. We purchase and sell the various standard brands of safety fuse as manufactured in this country. The manufacturers of safety fuse give an estimated burning speed for every brand. Fuse is packed in coils of 100 feet. Cases contain from 5 to 60 coils.



**Cap Crimpers**

Hercules Cap Crimpers are especially constructed pliers made for the purpose of fastening blasting caps securely to fuse. One type is equipped with a special fuse cutter. One of the handles on each type is made round and pointed for punching holes in sticks of dynamite in which the detonators are placed. The combination fuse cutter and cap crimper is nickel-plated; the other is nickel-finished. Both are packed in cartons, 12 to the box.



**Other Blasting Supplies**

Miners' Squibs; Storage Magazines; Thawing Kettles. For further detailed information write us.

# THE GRASSELLI POWDER COMPANY

CLEVELAND, OHIO

PITTSBURGH, PA.  
CHICAGO, ILL.  
MIAMI, FLA.

BIRMINGHAM, ALA.  
PHILADELPHIA, PA.

HAZLETON, PA.  
POTTSVILLE, PA.

BLUEFIELD, W. VA.  
WILKES-BARRE, PA.  
ST. LOUIS, MO.

Manufacturers of

## Chemicals, Explosives and Blasting Supplies

For every blasting job there is a Grasselli explosive exactly fitted for that job. We here list briefly the general characteristics of our various grades, and shall be glad to have one of our practical service men call and explain them to you in detail. He will also, if you desire, go over your blasting proposition with you and assist in selecting the grade best suited to conditions in your operation.



### Special Grades

We also manufacture special grades to meet certain special conditions. They vary as to speed, expansion, etc., according to the requirements of the job for which they are to be used.

### Nitro Glycerin Grade

Strengths from 20% to 60%, and Low Freezing or Straight as may be required.

A powerful hard-hitting explosive for shooting hard, tough material. Can be shot successfully in wet holes and is ideal for mudcapping.

### N. G. Gelatin and Ammonia Gelatin Grades

Strengths from 25% to 90% in N. G. Gelatin, and 35% to 75% in Ammonia Gelatin. Both grades Low Freezing or Straight as may be required.

The ideal explosives for very wet work; and particularly adapted on account of their purity and freedom from poisonous gas, for use in operations where ventilation is poor, viz: tunnel work, shaft sinking, etc. Their plasticity enables them to be loaded in upward, slanting or even in vertical overhead holes.

### Quarry Gelatin Grade

Strengths from 30% to 60%, and Low Freezing or Straight as may be required.

These explosives are especially adapted for **Open Quarry Work**. They are similar to the N. G. Gelatins, and Ammonia Gelatins, but must not be used in tunnels, underground or any closed work.

### Ammonia Grade

Strengths from 20% to 60%, and Low Freezing or Straight as may be required.

A general all-around explosive. Especially adapted for open clay mining, construction and agricultural work.

### Blasting Powder

Made in various granulations from CCC which is of slow, heaving action, to FFFF, for shooting material requiring a sharp, quick and more shattering action.

Uniform granulation, hard pressed and well glazed.

### Blasting Supplies

Blasting Caps.

Electric Blasting Caps—Copper or Iron Wires—  
Various Lengths.

Safety Fuse—All Grades.

Cordeau-Bickford—The Detonating Fuse.

Cordeau Accessories.

Blasting Machines—For Firing Electric Blasting Caps—Capacities 1 to 150 holes.

Rheostats—For Measuring Strength of Blasting Machines.

Galvanometers—For Testing Blasting Circuits.

Cables, Lead and Connecting Wire, etc.

# ILLINOIS POWDER MFG. COMPANY

General Offices  
1652 Pierce Building, ST. LOUIS

Works: GRAFTON, ILLINOIS

2027 Straus Building  
310 So. Michigan Bl.  
CHICAGO

305 Central Bank Bldg.  
MEMPHIS, TENN.

308 Victor Bldg.  
KANSAS CITY, MO.

1301 So. Lamar St.  
DALLAS, TEXAS

Branch Offices  
And Many Other Distributing Points

Makers of  
"Gold Medal Dynamite"

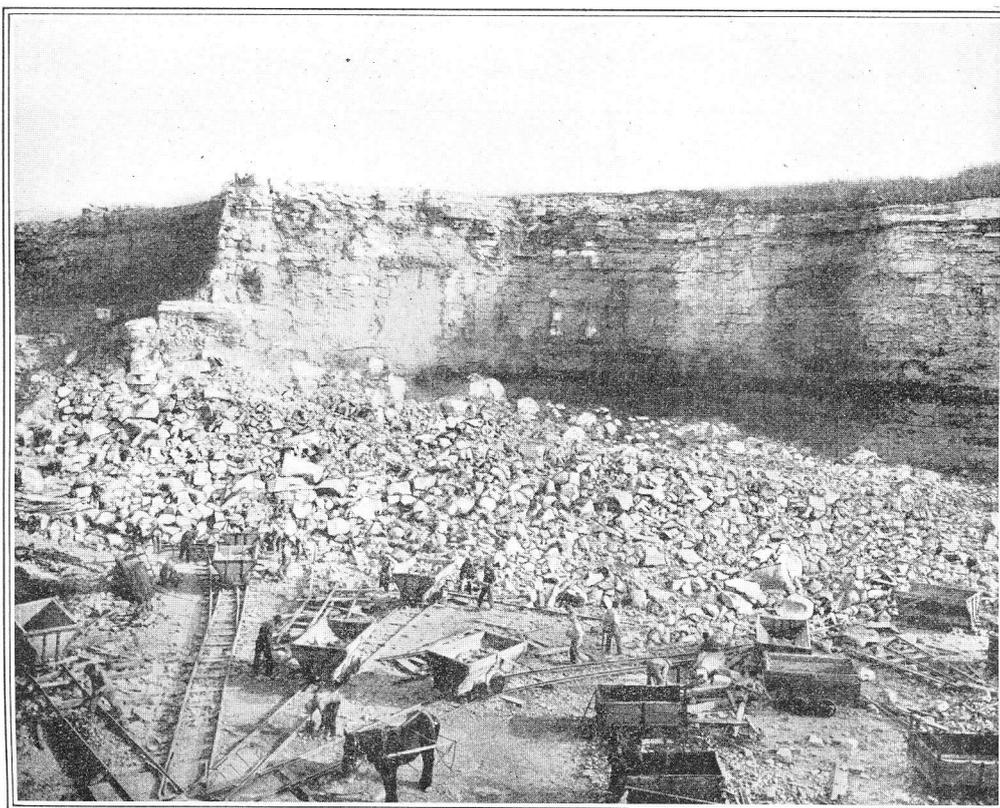
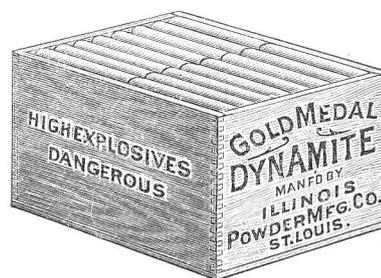
Manufacturers Also of  
BLACK DIAMOND PERMISSIBLES AND BLASTING SUPPLIES—BLASTING POWDER

"Gold Medal" Dynamite—A variety for every need.  
"Gold Medal" Gelatin—All Grades. All Strengths.  
"Gold Medal" Products are Dependable—Uniform.

No requirements too small to receive our careful attention. No demand too large for our facilities.

#### Blasting Supplies

The Illinois Powder Mfg. Co. carries a complete stock of Blasting Machines, Blasting Caps, Safety Fuse, Cordeau-Bickford Detonating Fuse, Electric Blasting Caps, Leading and Connecting Wire, Thawing Kettles, and all other Blasting Supplies. Every order is given careful and prompt attention. Your requirements are solicited.



The Result! It Certainly Shows For Itself  
"Gold Medal" Dynamite—"Stronger and Goes Further"

# PEERLESS EXPLOSIVES COMPANY

Incorporated

Pittsburgh, Pa.

Wilkes-Barre, Pa.

Bluefield, W. Va.

Birmingham, Ala.

Factories

White Haven, Pa.

Suscon, Pa.

Manufacturers of

**Dynamite, Blasting Powder, Blasting Supplies and Permissible Explosives**

Peerless Explosives were formulated only after years of research and study. Velocity of detonation, strength, spread of explosive energy, and thoroughness of detonation—all govern the effect on material blasted, and are controlled by the superior and highly standardized methods we employ.

A grade and strength to fit your particular conditions and requirements will be found in the Peerless assortment.

## Dynamite

Efficient preparation of raw materials in process is reflected in the finished product. The most modern and efficient machinery and equipment in use at our plant insures a dependable uniform quality, so that once the placing of holes and size of charge has been determined, no further experimenting is necessary.

## Gelatin Grades, Low Freezing

The explosive to use when a maximum amount is to be loaded in a given space. Extremely water resisting, used extensively in quarrying, tunneling and where fumes are a consideration. Manufactured in strengths from 25% to 100%.

## Nitro-Glycerin Grades, Low Freezing

Of very quick, concentrated and shattering action. Very effective in hard shooting rock. Made low-freezing and in strengths from 5% to 60%.

## Ammonia Grades, Low Freezing

Has a great spreading and heaving power, and is particularly adapted to headings, strippings, cuts and all around blasting. Though not classed as a water-proof explosive, special treatment affords considerable protection when loaded in holes containing moisture. Made in strengths from 15% to 60% and is low freezing.

## PEERLESS EXPLOSIVES

## Permissible Explosives, Low Freezing

So named because they have been approved by the U. S. Bureau of Mines for use in gaseous and dusty mines. Our success is indicated, not alone by the ever growing demand for Peerless Permissibles, but by the further fact that many miners insist on them, even in mines where mining laws do not require permissible explosives to be used. Sometimes found very desirable for use in quarrying.

## Blasting Powder

Made in granulations ranging from CCC, providing a slow, heaving action, to FFFF, which affords a quick shattering action. Granulations are selected according to local conditions and sizes of material desired.

The careful selection and standardized preparation of raw materials that enter into Blasting Powder, are responsible for the steadfast demand for Peerless brand. The bright glaze, causing the powder to be free-running, and the uniformity of grains, which insures uniform blasting are outstanding features.

## Blasting Supplies

In addition to the above products, we have ample stocks of the following commodities at numerous distributing points located in various sections east of the Mississippi River.

### Blasting Caps.

Cordeau.

Delay Electric Blasting Caps.

Blasting Machines.

Delay Electric Igniters.

Leading Wire and Cables.

Connecting Wire.

### Safety Fuse.

Rheostats.

Galvanometers.

Magazines.

Magazine Locks.

Electric Squibs.

Tamping Bags.



Blast Made With Peerless Explosives.

# TROJAN POWDER COMPANY

General Offices: ALLENTOWN, PA.

Branch Offices

NEW YORK, N. Y.

CHICAGO, ILL.

SAN FRANCISCO, CALIF.

PORTLAND, ORE.

Manufacturers of

## Trojan Explosives

Distributors of Complete Lines of Blasting Supplies

### Products

High Exposives—Trojan Non-Freezing

### Blasting Supplies

Stocks of Blasting Caps, Electric Blasting Caps, Delay Electric Blasting Caps, Safety Fuse—Cordeau-Bickford, Cordeau-Bickford Accessories, Rheostats, Galvanometers, Leading and Connecting Wire, Blasting Machines and Tamping Bags are carried at conveniently located distributing points.

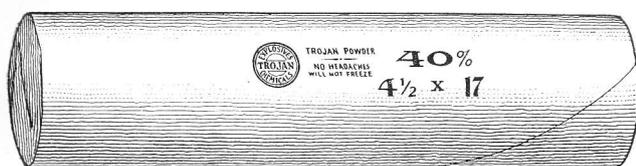
### Trojan Explosives

It is the aim of the Trojan Powder Company to produce explosives embodying the most advanced features of Safety, Efficiency and Economy.

Mines and Quarries continue the use of Trojan Explosives, not only on account of its being an important factor in helping reduce costs, but also on account of giving the blasters and shovelmen the additional features of safety and convenience not found in the average explosive.



Small cartridges are packed in sizes from  $\frac{7}{8}$  inch to 3 inches in diameter. Special packing of cartridges less than 8 inches in length made on order.



Trojan may be packed in large size single cartridges, 4 inches by 10 inches to 5 inches by 17 inches being standard sizes.

### ADVANTAGES

**Non-Freezing:** Its non-freezing feature eliminates the necessity for thawing frozen shells in cold weather—thus enabling you to discard your thawing equipment.

**Non-Headache:** You give your powdermen a day's work without a headache.

**Non-Leaking:** Its non-leaking feature eliminates the possibility of a dangerous liquid ingredient leaking from cartridges even when stored in the hottest climates.

You find in Trojan the explosive energy of a given grade.

You insure your men a maximum of explosive safety.

### Trojan Low Grade Explosives

Operators requiring low grade explosives have turned to the use of "Trojan" on account of the development, during recent years, of Trojan low grade explosives with the same safety and convenient features found in the higher grades.

The explosive you use for initial and secondary blasting is a vital factor in the cost of production. We will be glad to co-operate with you in selecting the explosive best adapted to your work.

We are prepared to send competent men, familiar with the practice and problems of modern developments in the quarrying and mining industry, to study your blasting conditions. The Company has a fund of information available to those interested, gleaned from years of experience in all character of work in quarries and mines in this country and elsewhere, and will gladly furnish you with any information that might be of assistance to you without obligation on your part. Consult our nearest Branch Office for full particulars.

# CALIFORNIA CAP COMPANY

OAKLAND, CALIFORNIA

Manufacturers of

## Blasting Caps and Accessories for High Explosives

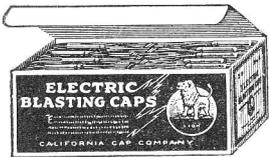
Standard No. 6 and No. 8 strengths; packed 100 in tin box, 50 boxes (5,000) to the standard case. Smaller quantities in suitable packages to order.



all metal; spring operated; action of generator controlled by button; very serviceable and dependable.

### Electric Blasting Caps

No. 6 and No. 8 strengths with insulated copper wires, one yellow and one black, from 4 to 20 ft.; longer lengths to order; also iron wires 4 to 8 feet. Packed 25 and 50 in cardboard cartons, 10 cartons in wooden case. Special waterproof insulations and reinforced cap shells for deep well work to order.



Electric Igniters, same as above without caps.

### Delay Electric Blasting Caps

Ten different delay periods capped and waterproofed ready for use. No. 6 and No. 8 strengths with insulated copper wires, 4 to 20 ft.; one yellow and one black leg to minimize possibility of error when making connections. Many remarkable tunnel and shaft progress records have been made with these California Delay Electric Caps. Standard case contains 50 each 1st to 10th delay. Special assortments and lengths over 20 feet to order from factory.

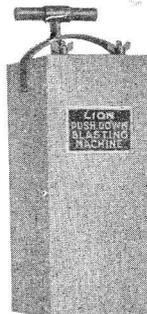
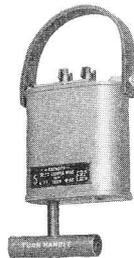
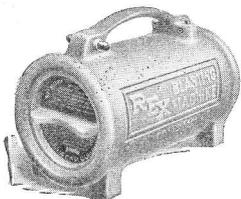


Delay Electric Igniters—Ten different delay periods; uncapped, otherwise same as above.

### Blasting Machines

“POCKET” Twist handle; 5 and 10 caps.

“LION” Pushdown; 10 and 50 cap capacities; wooden case; weight 6¼ and 23 lbs. respectively.



“REX,” the only portable blasting machine having high amperage for combination circuits; capacity 420 watts (3½ amperes at 120 volts). Rated 1 to 50 caps in series or 1 to 3 multiple-series groups, making total capacity 150 caps; weight 25 pounds;

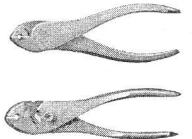
### Bench Crimpers

Hand or foot operated; four steel jaws; all round crimp; fuse cutter attachment using safety razor blades, which make clean cut; blades easily changed. Weight 5½ lbs.



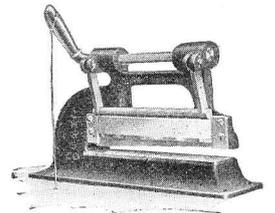
### Cap Crimpers

No. 1, crimping pliers only. No. 2, combination crimper and fuse cutter; dull nickel finish, broad jaw; packed 12 to the carton.



### Bench Fuse Cutters

Hand or foot operated. Capacity 20 pieces at a time, making clean, square cuts without fraying; handy for primer houses; blades easily removed. Weight 5 lbs.



### Galvanometers

For testing blasting caps and circuits; locating breaks, faulty connections and short circuits. Weight 1 lb. including leather case and shoulder carrying strap.



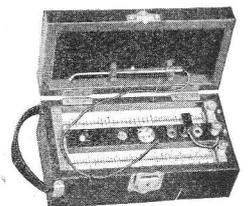
### Rheostats

Electric resistance bridges for testing the strength of blasting machines; capacity 5 to 100 caps. Weight 5½ oz.



### Ohmmeter-Galvanometers (Electric Blasting Type.)

Direct reading for measuring resistance and quickly determining the electrical condition of blasting circuit; reads directly in ohms. Weight 4 lbs., and very convenient.



### “The Detonator”

Not a catalog or a house organ, but a monthly periodical devoted to the interests of users of explosives and featuring practical blasting talks. Distribution is without charge. Merely send name and address to the California Cap Co.,

1540 San Pablo Ave., Oakland, California.

# Coast Manufacturing and Supply Company

LIVERMORE, CALIFORNIA

## Manufacturers of Safety Fuse Since 1867

### Coil Packing

Consisting of 50-foot coils, paper wrapped, two coils nested one within the other, to make a 100-foot package.

Packed regularly in wooden cases, containing 1,000, 3,000 or 6,000 feet. Also, in fibre cases, containing 1,000 or 3,000 feet.

Special wooden cases metal lined or containing 500-foot sealed metal cans, furnished at twenty-five cents extra per thousand feet.



### Reel Packing

Consisting of 3,000 feet, generally in two to four pieces, wound on a light metal reel, thus eliminating waste ends.

Packed regularly in fibre cases, containing one reel of 3,000 feet, or in wooden cases, containing either one or two 3,000-foot reels.

Special metal lined wooden cases furnished at twenty-five cents extra per thousand feet.

### VARIETIES AND USES OF SAFETY FUSE

Select from the following brands the one best adapted to your particular conditions of use. All of these brands have a burning speed of 120 seconds per yard when burned in the open at sea level with an allowable variation of 10%.

Brand	Comparative Qualities of Various Brands					Recommended for
	Price	Waterproofness	Freedom from side spitting	Freedom from Smoke	Ability to withstand rough usage	
Blue Label	Seventh (lowest)	Fourth (Poorest)	Fifth (Poorest)	Third	Fourth (Poorest)	Dry and Damp Ground. Agricultural and Dry Quarry Work. Use with non-inflammable explosives. Black finish, cotton countered.
Dreadnaught	Sixth	Third	Fourth	Fourth (Poorest)	Third	General all-around use for surface and underground. Will withstand ordinary wet work. Black finish, cotton countered.
Sequoia White	Fifth	Second	First (Best)	First (Best)	Third	All uses in very wet work. Will withstand very heavy water pressure if not "laced", "half-hitched" or "kinked". Easy to light as powder core adheres to split ends. Especially recommended for warm climates and for use with inflammable explosives. White finish, cotton countered.
Sequoia Black	Fifth	Second	First (Best)	Third	Second	Same as White Sequoia, except Black finish, cotton countered.
Comet Special	Fourth	Third	Third	Fourth (Poorest)	Second	All uses in wet work. Especially resistant to acid mine waters. Black tape finish.
Victor	Third	Second	First (Best)	First (Best)	Third	All uses in very wet work. Pliable and will withstand wide variations in temperature. White finish, cotton countered.
Bear	Second	Third	Second	Second	Second	All general underground uses in wet work. White finish, cotton countered.
Triple Tape	First (Highest)	First (Best)	Second	Fourth (Poorest)	First (Best)	All uses in very wet work. Especially constructed to withstand heavy tamping. Black tape finish.

### Celakap

This is a reasonably quick drying liquid compound for sealing the crimped joint between blasting cap and safety fuse, rendering it waterproof. It is non-injurious to safety fuse and resists successfully either hot or cold mine water. Being red and transparent, it permits the blasting cap to be visible after dipping, thus reducing the possibility of accidents occurring from attempting to light the wrong end of the fuse, which has happened through the use of a black opaque compound.

Packed in pint, quart and gallon metal containers.

### Cordeau-Bickford

Western distributors of Cordeau-Bickford, which is used to detonate explosives, giving increased speed and efficiency over ordinary methods. It consists of a small diameter lead tube, filled with T.N.T. and detonates with a speed of about 17,500 feet per second. Particularly adapted to well drill quarry blasting, as a strong, quick detonator is in contact with the column of explosive for the full depth of the hole. Cordeau is much safer to handle than ordinary detonating agents.

Furnished wound on wooden spools containing approximately 500 feet; either plain, single countered or double countered.

# THE ENSIGN-BICKFORD CO.

SIMSBURY, CONN.

Manufacturers of  
**Safety Fuse For All Purposes And Cordeau-Bickford  
 Detonating Fuse**

## CORDEAU-BICKFORD

### Products

Safety Fuse; Cordeau-Bickford Detonating Fuse.

Cordeau-Bickford is a detonating safety fuse consisting of a lead tube filled with trinitrotoluene.

It has been manufactured by The Ensign-Bickford Company during the



fired, where it is desirable to break the charge in the drill hole, or where a great many holes are to be fired at one time.

Cordeau is run from the top to the bottom of the drill hole in contact with the explosive charge so that it acts as a continuous detonator, with the result that a more complete and quicker detonation of the explosives is obtained.



A Blast in an Indiana Limestone Quarry. Note Si multaneous Action Obtained in all the Drill Holes.

past ten years and may be obtained direct or through any of the explosive companies.

This type of detonator is waterproof, safe and easy to handle, and will explode a charge of explosive throughout its entire length and also any number of separate charges instantaneously.

Cordeau-Bickford cannot be set off by fire, friction, or any ordinary shock.

Cordeau is particularly adapted to well drill blasting where large columns of explosives are

On account of this, there is a greater shattering effect on the rock, and the secondary blasting is therefore reduced.

Cordeau is also used in the "Coyote" or Tunnel and Pocket method of blasting.

The explosive manufacturers use Cordeau for determining the rate of detonation of their explosives.

Write for booklets on Cordeau and Deep Well Blasting.

**Safety Fuse**

It is essential for the purpose of safety and economy to purchase a brand of fuse adapted to the work for which it is to used.



In quarrying, the work may be dry, damp, or wet; while in metal mining, the work is generally either damp or wet. Dry work means that the fuse does not come in contact with moisture; damp work means that there is moisture present either in the drill hole or in the tamping material (mud-capping, for instance, is generally classed as damp work); and wet work means that the fuse is actually exposed to the direct action of water in the drill hole. In underground work of various kinds, the following characteristics in fuse, in addition to the waterproofing quality, are important: Regularity in burning, freedom from lateral sparking and excessive smoke, ability to withstand reasonable tampering, flexibility, and an exterior white finish which makes it easily distinguishable in the dark.

The standard burning speed of all our brands of fuse at sea level, with the exception of Charter Oak and Clover, is ninety seconds per yard when burned in the open with an allowable variation of 10% either way from standard. Clover and Charter Oak have a standard burning speed of one hundred twenty seconds per yard under the above conditions with an allowable variation of 10% either way from standard.

**TAPED FUSE**

The original waterproof fuses were all of the tape variety. Low temperatures affect the pliability of taped fuse and in work done on the surface in cold weather, the countered fuses such as Beaver, Charter Oak, Crescent, and Clover are best adapted in preference to Single Tape or Double Tape.

**Single Tape**

For use in dry or damp work.

**Double Tape**

For use in wet work. This fuse has two tape coverings which add strength as well as waterproof qualities.

**COUNTERED FUSE**

**Beaver and White Charter Oak**

For dry or damp work, Beaver or White Charter Oak is quite generally used, Beaver being selected by those who have preference for the ninety second standard burning speed, and White Charter Oak by those who prefer the slower standard of one hundred twenty seconds per yard.

**Gray Charter Oak**

Gray Charter Oak is a later development in manufacture which has enabled us to improve the waterproof quality without adding to the cost. Where the requirements for waterproofing are beyond the limits of Beaver or White Charter Oak, we recommend the adoption of Gray Charter Oak.

Gray Charter Oak will meet all the varied requirements of quarry work and is especially recommended for use in the quarries.

**Crescent, Clover**

Where the two principal elements are waterproofing and regularity of burning speed, Crescent is usually preferred; but where other considerations enter in, such as freedom from side spit, freedom from excessive smoke, and economy of time due to slower burning speed, Clover is preferred because it has even greater waterproof qualities than Crescent, and has, in addition thereto, the above mentioned advantages. The paper tape used on Clover enables the fuse to be subjected to extreme climatic changes and long storage without deterioration.

Avoid lacing, half hitching or the kinking of fuse, especially when the fuse is going to be used in a wet drill hole.

Wherever wet work is encountered, some form of cap sealing compound should be used to keep moisture from getting into the cap.

**Coil Packing**

The standard package for Safety Fuse is two fifty foot coils each wrapped in paper and one nested inside the other.

For domestic use, the following size of cases are usually used:

- No. 1—1,000 ft. . . . 13<sup>1</sup>/<sub>4</sub> x 12<sup>1</sup>/<sub>4</sub> x 6<sup>1</sup>/<sub>8</sub> (Fibreboard)
- No. 3—3,000 ft. . . . 13<sup>1</sup>/<sub>4</sub> x 12<sup>1</sup>/<sub>4</sub> x 18<sup>3</sup>/<sub>8</sub> (Fibreboard)
- No. 6—6,000 ft. . . . 27<sup>1</sup>/<sub>2</sub> x 20<sup>1</sup>/<sub>2</sub> x 14<sup>1</sup>/<sub>2</sub> (Wooden)

**Reel Packing**

This style of packing has been recently adopted, as some of the large mining companies find it to their advantage. Three thousand feet of Safety Fuse are wound on wooden reels which are approximately 15<sup>1</sup>/<sub>4</sub>" long by 13" in diameter. For domestic use, one reel is shipped in a fibreboard case; for export use, four reels are shipped in a wooden case.

Price lists, sample cards, and further information will be gladly furnished on application.

# THE NATIONAL FUSE & POWDER CO.

DENVER, COLO.

Manufacturers of

## Safety Fuse for All Kinds of Blasting

### Product

Safety Fuse for All Kinds of Blasting.

The watchword for all blasting operations is EFFICIENCY, with due regard for economy and safety.

A careful study of the various classes of blasting operations and the exacting duty imposed upon Safety Fuse under widely varying conditions has led to the manufacture of standard NATIONAL Brands of Safety Fuse which are constructed to perform certain specified work at the lowest possible cost consistent with safety. It is therefore essential that a careful survey be made of the class of work to be done, with the view of selecting proper type of Safety Fuse. In case there is any question in the mind of the Mining Company as to the proper Fuse to be used, we will be glad to extend our advice.

The NATIONAL Brands of Safety Fuse are the result of years of intensive research work, and only such materials as stand up to most rigid specifications are used in their manufacture, the result being that we believe we produce a Safety Fuse which goes to make the most for Efficiency in blasting operations.

### TAPED FUSE

Taped Fuses have long been Standard types in view of their added strength and excellent resistance to rough treatment.

#### Single Tape

For use in dry or damp work.

#### Double Tape

For use in wet work.

#### Triple Tape

For use in very wet work, where exposed to rough treatment.

### COUNTERED FUSE

Owing to the fact that taped fuses are more susceptible to widely varying weather conditions, the Hard-Finished Cotton Countered varieties are coming more into use.

#### Sylvanite

For use in damp work. Suitable for coal or metal mining, and agricultural blasting purposes.



### White Monarch

For use in wet work—double countered.

### Black Monarch

For use in very wet work—double countered.

### Bear

For use in very wet work. A strong taped, fuse—single countered.

### Recommendations

In extremely wet work, Black Monarch, Bear or Triple should be used.

If work is to be done in extremely cold places, Sylvanite, Monarch or Bear should be used in preference to Single, Double or Triple.

Fuse should be stored in a cool, dry place and not taken into the mine except for immediate use.

When primers are being made up, always cut off a short piece before inserting in the cap.

A sharp, clean cutting edge should be used and the fuse cut squarely across.

### Speeds of Burning

All our brands have a standard speed of 126 seconds per yard when burned dry in the open at an elevation of 5,280 feet, with an allowable variation of 10% either way from the standard.

### Prices

Price Lists and Sample Cards furnished on request. Let us aid you in solving your fuse problems.

### Packages

Fuse is packed in a roll, containing two 50-foot coils, and in the following sized cases:

WOOD		FIBRE	
No. 0.....	500 ft.	No. 0.....	500 ft.
No. 1.....	1000 ft.	No. 1.....	1000 ft.
No. 2.....	2000 ft.	No. 2.....	2000 ft.
No. 3.....	3000 ft.	No. 3.....	3000 ft.
No. 6.....	6000 ft.		

### FUSE AND CAP SEAL

Where water is encountered in drill holes under pressure, or in fact in moderately wet ground, the above compound should be used to seal the fuse and cap joint.

It is easy of application, dries quickly and does not injure the fuse. We strongly recommend its use.

It is put up in pint, quart and gallon containers. Prices on application.

# SECTION XIV

## Lighting

FOR INDEX TO ALL ENGINEERING DATA SEE PAGES 7 TO 16

*Condensed Catalogs In This Section:*

American Carbolite Sales Co.  
Gem Manufacturing Co.  
Justrite Manufacturing Co.  
Mine Safety Appliances Co.  
National Carbide Sales Corporation  
Shanklin Manufacturing Co.  
Union Carbide Sales Co.  
Universal Lamp Co., Inc.  
Wolf Safety Lamp Company of America, Inc.

FOR ALPHABETICAL INDEX OF EQUIPMENT SEE BLUE SHEETS

# MINE LAMPS

## The Carbide Lamp

Acetylene gas was accidentally discovered in 1836 by Professor E. Davy, of Dublin; but not until 1892 was it produced at a commercially cheap rate. It was likewise accidentally discovered by H. Moissay, who, while conducting experiments with an electric furnace, noticed that the wall of the furnace, consisting of lime, fused into a liquid state at 3,000 degrees, Centigrade, and that a combination between it and the carbon of an electrode produced calcium carbide. T. L. Wilson, by accident also, while experimenting with an electric furnace, discovered a method which resulted in the manufacture of calcium carbide on a large scale.

Early claims, made for the greater part by those who chronically opposed any development suggestive of progress, that carbide gas was injurious to health; that fresh or spent carbide represented a hazard in the mine; that the flame of the carbide lamp did not give ample warning of unfavorable mine atmospheres; were quickly disproven by the successful and safe use of carbide lamps by several hundred thousand miners in coal and metal mines. Experience proved conclusively that these claims were actually absurdities such as usually attach themselves temporarily to practically every constructive innovation.

Mine operators, generally, credit lower production costs, increased mining efficiency, and fewer delays due to accidents or other contingencies, to the improved illumination provided by carbide lamps.

The following are conspicuous among the advantages recognized for carbide cap and hand lamps for metal mines:

An abundance of brilliant light. Increased protection from threatening roof, wall, floor and other hazardous conditions; security from personal injuries which in most statistics are classified as minor accidents.

Low cost of lamp. Remarkably low cost of upkeep. Long life of lamp. Light in weight—no burdensome entanglements. Because of great volume of widely diffused light, miner can easily observe conditions relating to the personal safety of himself and fellow miners. A pronounced aid to mine foremen in getting efficient and economical results. Lamp easily understood and easily cared for by every miner.

The miner appreciates a pronounced feeling of security and personal independence because of his ability to easily increase the amount of light afforded by his lamp, when he requires more light for greater speed, comfort and protection.

Miner can always assume the posture—standing, bending or kneeling—which will enable him to

work with greatest comfort, and light is always directed just where he needs it. Minimizes number of accidents resulting from poor illumination.

Size of flame and volume of light easily regulated by miner. If he desires say 3 candle power, he can secure it quickly by decreasing flow of water to carbide. A serviceable candle power of 15 to 18 candles is easily maintained when desired. The candle power of the slightly enlarged flame is variously stated up to 50 candles, some readings indicating a beam candle power of 80 candles.

Carbide gas light closely approximates the natural light of the sun. There is no eyestrain. Eyestrain means loss of general efficiency.

Carbide lamps can always be used as convenient hand lamp or can be hung up. Many miners find them a source of comfort and safety going to mine or going home.

A special advantage of carbide lamps which has been but little stressed is the fact that they may be used to indicate the presence of CO<sub>2</sub> gas, (black damp). When there is insufficient oxygen in the air the acetylene flame burns with a long yellow flame and is very smoky. Such a flame serves as a warning to the miner and has prevented many casualties.

## Cost of Lighting With Carbide Lamp

The cost of lighting with ordinary mine lamps is approximately 5 cents for an eight-hour shift.

## Carbide Lamps in Metal Mines

Carbide lamps are today used quite universally throughout the metal mining industry. Although some cap lamps are used, the greater number of carbide lamps employed are of the type which can be hung up or stood at an advantageous point where miner is working. They have a considerably greater water and carbide capacity, a larger gas consumption, and a correspondingly higher candle power than the carbide cap lamps. Metal mine operators find them very satisfactory and very economical.

## Electric Lamps

Up to the present time the electric lamp has been but little used in metal mines. Recently in Bulletin No. 257 of the U. S. Bureau of Mines it has been suggested that open flame lamps might be replaced, in certain mines, by electric lamps, thereby eliminating possible fire hazards.

Electric lamps may be of two types: (a) The cap lamp; (b) The hand lamp. The cap lamp is widely used in coal mining but is not well known in the metal mines.

# AMERICAN CARBOLITE SALES CO

DULUTH, MINNESOTA

Distributors of  
**Carbolite Calcium Carbide**  
 The Best Carbide For Miners' Lamps

"The Originators of  
 the Miners' Size Carbide"



Widely Distributed Through  
 Warehouses and Jobbers

Because it is specially screened and sized for the purpose, and because of its greater gas yield, Miners' Carbolite is the most economical to use in Miners' Lamps.

Miners' Carbolite is packed in 100 lb. Drums, 25 lb. Drums, 10 lb. Cans—6 Cans per Case, 2 lb. Cans—24 Cans per Case.

The name "Carbolite" has represented our product continuously since its intro-



duction many years ago, and it, together with the distinctive orange color of our packages, is a constant protection to our customers, and a guarantee of its excellence.

Carbolite is also made in all standard generator sizes, and can be furnished promptly in any quantity.

**Write Us For Further Information  
 and Prices**



# National Carbide Sales Corporation

342 MADISON AVE., NEW YORK CITY

Plants:

IVANHOE, VA.

KEOKUK, IOWA

Distributors of

## National Carbide For Miners' Lamps

### NATIONAL CARBIDE FOR MINERS' LAMPS

Is the Carbide which gives the maximum amount of LIGHT PER POUND—therefore it is the most economical, because in the purchase of Carbide you are really buying light by weight.



In the Red Drum

#### This is the Result of—

The use and proper fusing of the purest raw materials, in the most scientific manner, under expert engineering supervision.

NATIONAL CARBIDE specifies and uses only the highest grade limestone from its own quarries and also purchases only the best grade of coke obtainable for use in its product. The plants are located at sources of ample hydro electric power.

The production of this product in modern up-to-date plants, with careful and frequent inspections throughout the entire process, assures excellent selection, screening and sizing of the best gas producing material obtainable.

NATIONAL CARBIDE containers are made of carefully selected steel parts, put together in the most substantial manner to insure the highest degree of protection for the Carbide in shipping and handling.

### NATIONAL CARBIDE FOR MINERS' LAMPS

Is packed in containers of the following sizes:

- 100 pound sheet steel drums, with screw caps.  
(and additional outer seals).
- 25 pound sheet steel drums, with screw caps.  
(and additional outer seals).
- 10 pound cans— 6 cans to the case.
- 2 pound cans—24 cans to the case.

Ask For The Red Drum.



Sold Everywhere.

Warehouses in All Principal Cities.

# UNION CARBIDE SALES COMPANY

NEW YORK  
Carbide and Carbon Bldg.  
30 East 42nd St.

CHICAGO  
Peoples Gas Bldg.

SAN FRANCISCO  
Balfour Bldg.

We Have Union Carbide Warehouses in 175 Cities

## "Miners Lamp" Union Carbide

### Union Carbide For Mine Lamps

"MINERS' LAMP" UNION CARBIDE—Packed in 100-pound drums; 25-pound drums; 2-pound cans—24 cans to the case; 10-pound cans—6 cans to the case.

Manufactured by Union Carbide Company, the Original Producers of Commercial Calcium Carbide and today the world's largest makers of this product.

"MINERS' LAMP" is a size of UNION CARBIDE specially adapted for use in Miners' Carbide Lamps.

Because of its special selection, uniform high gas yield, special sizing and screening, and freedom from dust, "Miners' Lamp" Union Carbide is the most economical and satisfactory Carbide for use in Miners' Lamps.

"Miners' Lamp" Union Carbide will keep indefinitely if protected from air and moisture.

UNION CARBIDE—WORLD'S BEST QUALITY—HIGHEST GAS YIELD.

Union Carbide has for more than twenty-five years been recognized as the World's Standard for Quality in Carbide.

The use of Union Carbide results in greatest satisfaction and lowest cost, because:

It has the greatest gas content and is always uniform and dependable in quality.

Union Carbide is always the same—always highest grade and most carefully selected.

When using highest gas yielding Carbide, lamps and other apparatus require recharging less frequently.

Considerable time and labor are saved by the smaller number of chargings. The time saved can be applied to other duties.

The wear and tear on the lamps, or other apparatus, is lessened by reducing the number of rechargings.

There is a smaller quantity of residue to handle per unit of gas consumed, when highest gas yielding Carbide is used—another worth-while saving in time and labor.

When Carbide having the highest gas value is used, a saving is effected in the cost of transportation and handling charges in proportion to the amount of gas actually generated.

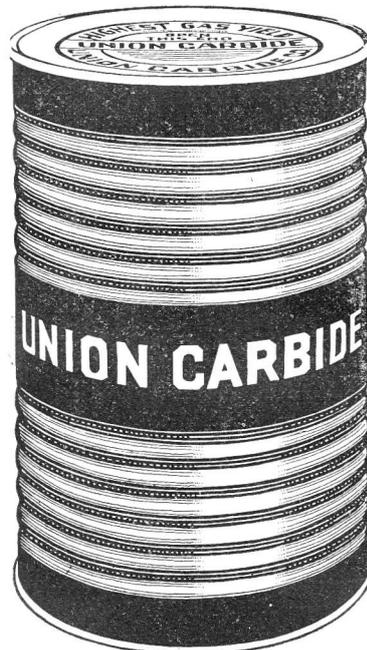
The correct uniform sizing and careful screening of UNION CARBIDE assist greatly in the eco-

nomical, efficient and uninterrupted operation of lamps and generators.

Because of the faithfully sustained, always dependable quality of Union Carbide, it is easy for the Carbide user to estimate his Carbide requirements from time to time.

### What Union Carbide Is Used For

In addition to being used by more than a million miners in cap lamps, hand lamps and other portable and stationary mine lighting equipment, Union Carbide, crushed to the several regular commercial sizes, is extensively used for the following purposes: The lighting of country buildings of all types and sizes; cooking; the oxy-acetylene process for welding and cutting all metals; contractors' torches and flare lights; lighthouses and buoys; train, locomotive, railroad signal and station lighting; motor vehicle lighting; life saving equipment; fire departments; physicians' lamps; scientific and laboratory purposes; searchlights; moving pictures; stereopticons; hunting and trapping, fishing, camping and boat lighting; gathering cotton and small fruits at night; night operation of tractors and other farm implements; steam boiler and other inspection work; and scores of other uses.



### Our Blue and Gray Package

Union Carbide is always packed in distinctive Blue and Gray containers. The excellence of our package is in keeping with our aim

to protect diligently the interests of users of our product in the matter of Carbide quality from the time it is packed at the Works until it is consumed by the user.

Union Carbide will keep for years in the original package without deterioration.

The Blue and Gray package is, therefore, a symbol denoting: best grade Carbide; highest gas value; uniform dependable quality, and purest gas.

### Our Nation-wide Distributing System.

For the convenience and economy of Carbide users we carry large stocks of Union Carbide in our own warehouses, at 175 convenient shipping points throughout the country.

Shipments are made the same day that orders are received.

Directory of Union Carbide Sales Company's Warehouses Appears on Opposite Page

# GEM MANUFACTURING COMPANY

1229-1243 Goebel St., PITTSBURGH, PA.

## Gem Miners' Lamps, Oilers and Welded Ware

### GEM Lamps

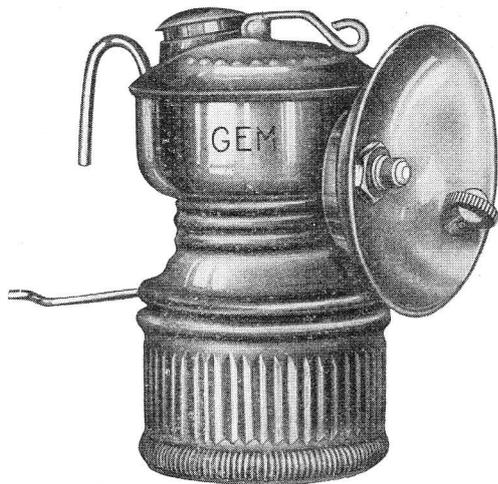
Gem lamps combine all the latest improvements; it is the lightest weight lamp on the market. Being lower in height and more compact fills a need often expressed. The reflector is detachable, being held in place by a small hexagon nut. The felt holder fully protects the felt from the wet carbide. The hook is riveted and soldered to the bottom of the water bowl inside the lamp. Wire brace on back removable, not soldered.

The water supply lever is a full spring and stays put, while the water feed is positive, as it cannot work loose. Brass tip Lava inserts used throughout.

Rubber gasket cannot cut as provision is made for its inception into the screw cap where no contact is made with the edge of the cap. The removable wire hook encircles the outside of the gasket.

All parts interchangeable, damaged parts can be replaced.

Every lamp is carefully inspected before leaving the factory, and carries our guarantee against defect in workmanship and material.



#### POLISHED BRASS

No. 96—2½" Ref. \$15.00 Doz. list  
No. 98—3" Ref. 16.00 Doz. list

Packed 1 dozen in carton, weight 6 pounds  
dozen packed

#### POLISHED NICKEL

No. 106—2½" Ref. \$17.00 Doz. list  
No. 108—3" Ref. 18.00 Doz. list

Packed 1 dozen in carton, weight 6 pounds  
dozen packed

### GEM Welded Steel Ware — Black Enamel Finish

The Gem Method of Electric Welding Produces a line of oilers, torches, carriers and supply cans superior to anything the trade has ever known.

The Gem method of electric welding has been created after many years of experimental work. We have found by tests that it shows 95% of the original strength of the material.

The handles, ears and bails of all our patterns are spot welded securely to the cans.

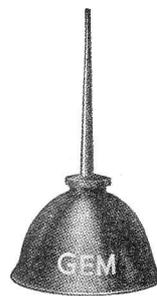
The Gem electric welded line has proven to the largest railroads, factories and mines that it is the most economical and durable and they have adopted it as their standards. We will submit samples and complete specifications on request, free of charge.



Steel Tallow Pots  
1 to 6 Pint Capacity



Broad Top  
Oilers  
1 Pint to 4 Qt.  
Capacity



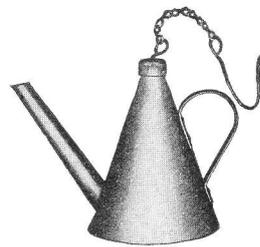
Plain Heavy  
Brazen Steel  
Bench Oilers.  
½, ½, ¾ and  
1 Pt. Capacity



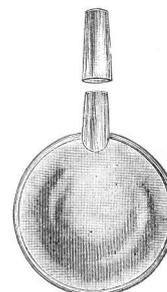
Pyramid  
Oilers  
1 to 6 Pint  
Capacity



Supply Cans  
1 to 5 Gallon  
Capacity



Pyramid Torches  
1 to 4 Pint Capacity



Steel Cadgers  
½ and 1 Pint  
Capacity

# JUSTRITE MANUFACTURING CO.

2061-2081 Southport Ave., CHICAGO, U.S.A.

## Manufacturers of Carbide Miner's Lamps

For All Mining Purposes

### Products

Miner's Lamps—all types—in brass, steel and aluminum.

Miner's Caps—Carbide Flasks—Burners Tips—and all necessary supply parts.

Sanitary Pails, Safety and Oily Waste Cans.

The models illustrated on this page are the most desirable for metal miners, and are known as "Metal Mine Lamps."

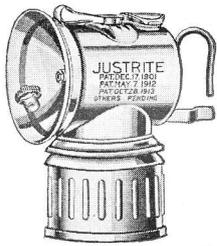


Built to Give Service

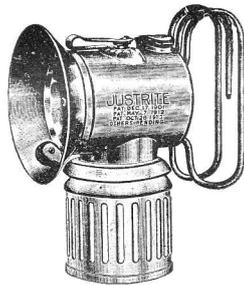
All lamps except "Little Giant" and "Uncle Sam" are equipped with self-lighter attachment. "Justrite" Lamps are constructed on scientific principles—only the very best material and workmanship being used. Every lamp is guaranteed.

If interested in other models, consult our general catalog.

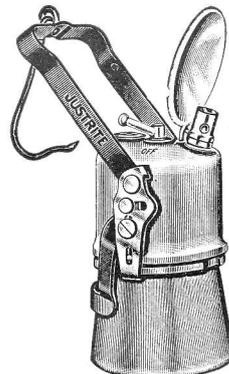
### LARGE TYPE LAMPS



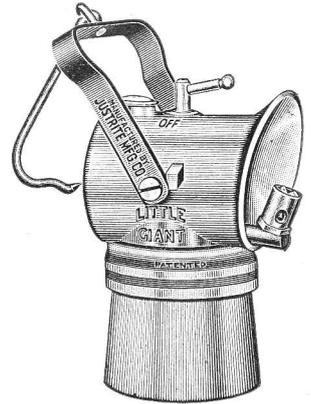
Cap Lamp  
No. 407—Wire Feed  
No. 707—Polygon Feed  
Burns 2½ hrs.  
Brass or Nickel



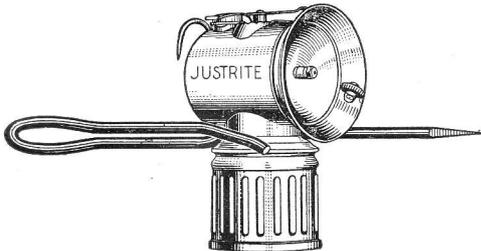
Superintendent's Lamp  
No. 95—Burns 4 hrs.  
Brass Nickelplated



"Uncle Sam"  
No. 306—Burns 6 hrs.  
Aluminum



"Little Giant"  
No. 110—Burns 6 hrs.  
Aluminum



Candle Stick Lamp  
No. 103—Brass. Burns 4 Hours.

### The New "Acme" Steel Lamps Rustproof Finish—Half Shift Size Wind and Water-proof

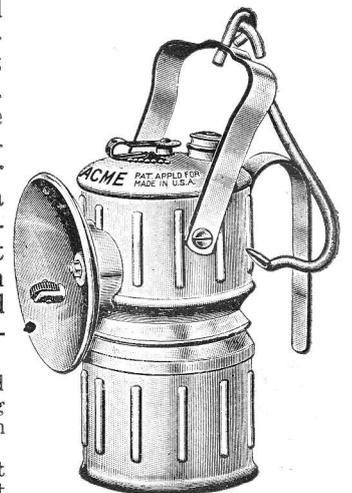
"A Strong and Rugged Steel Lamp."

The "Acme" Lamp is so constructed that it will give the miner a dependable and efficient light at the most economical cost.

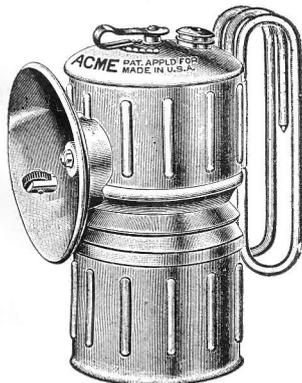
Note particularly the reflector, which fits snugly into the reflector brace, and is held in a permanent and rigid position by the knurled nut—not easily bent, broken or lost. Also equipped with No. 171 Flame Protector.

This lamp has been tried by many of the large mining companies, and has given most excellent service.

Consistent with the cost of this lamp, it is the best value of any steel lamp on the market.



No. 50—With Bail and Hook  
Steel



No. 56—With Folding Handle  
Steel.



No. 171—Flame Protector

### SPECIFICATIONS

- Burning Capacity—5 to 6 hrs.
- Candle Power—18 C. P.
- Weight—17 ounces.
- Charge (¼" Carbide) 5 ozs.
- Height of Lamp—6 inches.
- Height to top of bail—8¼ in.
- Diameter Bottom—2⅞ inches.
- Diameter Reflector—4 inches.

Write For Catalog.

World's Largest Manufacturers of Carbide Miner's Lamps.

# SHANKLIN MANUFACTURING CO.

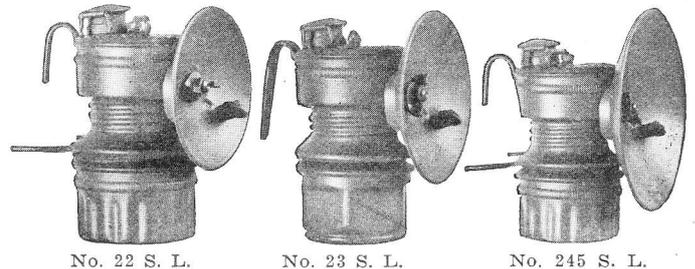
2725-27-29 S. Eleventh St., SPRINGFIELD, ILL.

## Miners' Carbide Lamps and Supplies

There are many reasons why miners prefer Guy Dropper Lamps. The principal one is the Guy patent cleanable valve at the end of the water tube. Simply twirling the nut on the end of the water tube cleans it thoroughly. They have several other exclusive patented features.

It is advisable to use the lamp that is universally satisfactory.

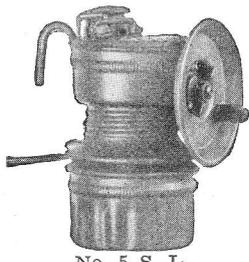
**BE WISE — USE GUYS!**



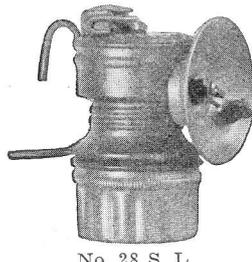
No. 22 S. L.

No. 23 S. L.

No. 245 S. L.



No. 5 S. L.



No. 28 S. L.

**No. 5 S. L.**—Polished brass finish. For miners in low roof mines. With or without Brace, Shallow Reflector, throwing gentle spread light. (No Spot.) Ea. \$1.00.

**No. 28 S. L.**—Polished brass finish. With 2½ inch reflector deep enough to protect the tip from water. Throws bright spot light. With single or double hook. Ea. \$1.00

**No. 280 S. L.**—Same as No. 28 except nickel plated. Ea. \$1.25.

### Supply Kits

These assortments are intended for dealers as a convenience, having only such articles as have ready sale.

They increase the sales for dealers and commissaries.

No. 1 Large assortment \$8.00.

No. 2 Small assortment \$4.50.



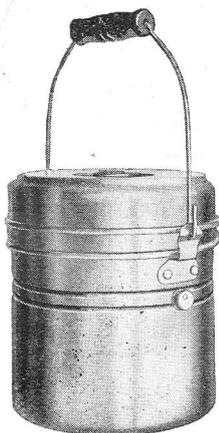
Supply Kit

### Shanco Aluminum Dinner Bucket

It is made of extra heavy aluminum, highly polished. Individually packed.

The valve under the bail ear is used to pour water in the lamp or to drink out of.

Five-quart capacity, 4 piece. Ea. \$2.25.



Dinner Bucket



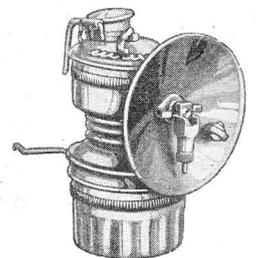
### Shanco Carbide Cans, No. 88

Highly polished, solid brass, of the right size to hold a day's supply of carbide. Air and water tight and may be screwed on lamp in place of regular bottom when hunting or fishing. It is indestructible and will wear longer than any other can on the market. Price, 50c.



### Shanco No. 125 Tip Cleaner

When you are in the dark alone is when you want the Shanco Tip Cleaner. Price, with tip, 25c.



# UNIVERSAL LAMP CO., Inc.

CHICAGO, ILLINOIS

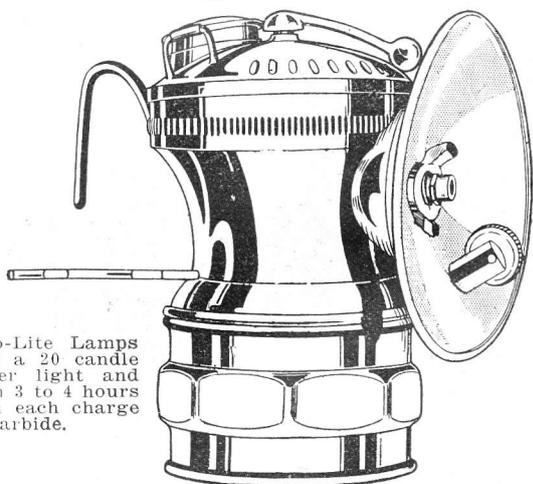
Foreign Office  
LONDON, ENGLAND—Oxford House

Manufacturers of  
**Miners' Acetylene Lamps**

## Auto-Lite Acetylene Lamps

The Auto-Lite enjoys the good will of miners all over the world. It is recognized as the **Standard** Miners' acetylene pit lamp.

Simple in construction—absolutely reliable—strong and durable; yet light in weight. Its many improved features are protected by U. S. Patents and are not to be found on any other Miners' acetylene pit lamp. The Auto-Lite is truly the most dependable Miners' Lamp—**SAFE—SURE—ECONOMICAL**. The Light that never fails.



Auto-Lite Lamps give a 20 candle power light and burn 3 to 4 hours with each charge of carbide.

### Features of the Auto-Lite

Only improvements of proven principals have been applied and due to scientific construction of design and parts, the Auto-Lite today is the strongest miners lamp made.

Here are some of the improved features that make the Auto-Lite the best miners' acetylene pit

## AUTO-LITE

Trade-Mark Registered

lamp on the American market and without a doubt the best in the world today:

Bull Dog Grip Carbide Bottom—reinforced construction.

Extra Strong Reflector Construction with Hex Tip and Wing Nut for easy removal. No tools required.

Auto-Lite water dropper cannot clog—a steady even flame at all times.

Burner tube of re-inforced construction and cannot break loose, not even with a hammer blow.

Lamp design of scientific construction—has maximum capacity for water and carbide, yet smaller in size and lighter in weight than any other Miners' Lamp.

There are 162 separate and distinct operations in the making of one Improved Auto-Lite Lamp and no expense has been spared in order to make it as near perfect a miners lamp as is possible to make one.

Shipping weight, all Auto-Lite Lamps, 6 lbs. to dozen.

### Auto-Lite Supplies and Repair Parts

**AUTO-LITE SUPPLY BOX No. 24**—A complete assortment of standard repair parts for all makes of acetylene mine lamps.

#### CONTENTS

72 Felt Washers	24 Diamond Tips
72 Rubber Gaskets	24 Imported Reamers
48 Sparking Flints	6 Brass Felt Holders

**AUTO-LITE SUPPLIES**—Standard parts for all makes of Miners' Carbide Cap Lamps, as follows:

No. 25 Complete lighter posts.	No. 31 Valve Stems, lever feed.
26 Flints packed in capsules.	32 Brass Felt Holders.
27 Lava Tips.	33 Polished Nickel Reamer Cases.
28 Diamond Tips. Metal with lava insert.	34 Reamers, Imported.
29 Felt Washers.	35 Wing Nuts.
30 Flat Rubber Gaskets.	36 Springs for lighters.

### Inquiries and Prices

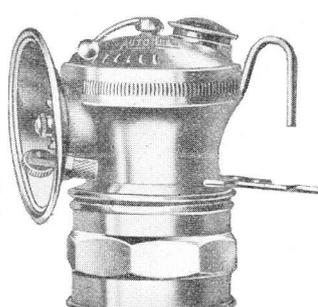
Auto-Lites cost no more than inferior lamps. Inquiries as to prices, etc., promptly handled. Lamps are furnished in brass or nickel finish.



No. 100—Polished Brass Lamp, Deep bell reflector with self lighter.



No. 103—Polished Brass Lamp, 3 inch bright brass reflector with self lighter.



No. 106—Polished Brass Lamp, 2½ inch silver nickered reflector with self lighter.



No. 110—Polished Brass Lamp, 3 inch bright brass reflector with self lighter and flat cap hook as used by metal miners.

# Wolf Safety Lamp Company of America, Inc.

220-224 Taaffe Place, BROOKLYN, N. Y.

## Miners' Carbide Lamps

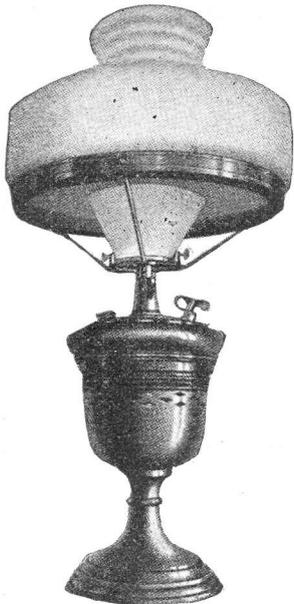
### Products

Miners' Carbide Lamps for hand, cap, trip and general utility purposes. Miners' Safety Lamps burning naphtha, vegetable oil and carbide. Baby Wolf Methane Detectors, Tools and Accessories for all types of lamps. Burners, Burner Cleaners, Reamers, Anemometers.

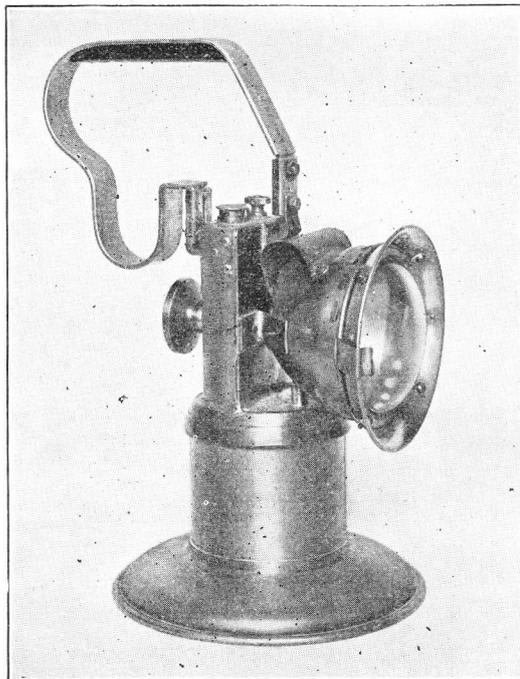


WOLF LAMPS are 100% guaranteed to give satisfaction and on account of their strong construction will outlast cheaper made lamps. Lamps illustrated below are only a few types of our extensive line. Lamps are made in all metals and different sizes. They are either made out of steel heavily tinned or out of brass highly polished or nickel plated.

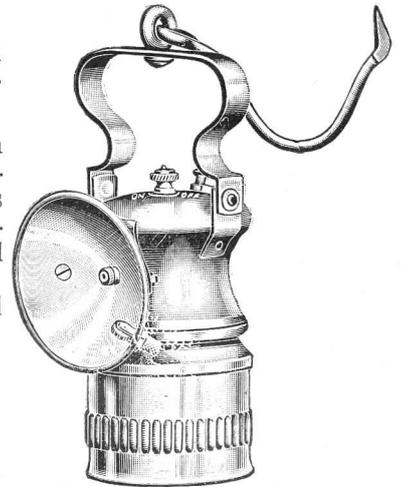
Full Description in Our General Catalogue, Copy of Which Will Be Mailed to You at Once Upon Receipt of Postal.



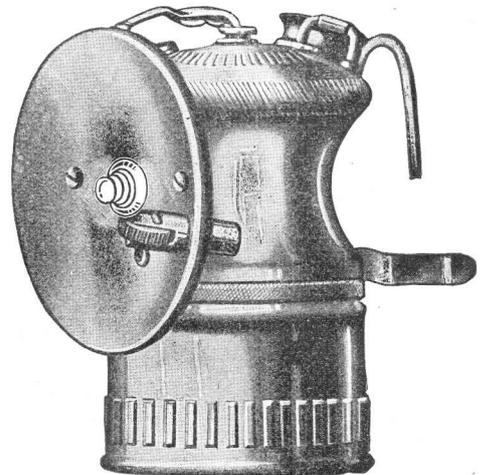
No. 91 Table Lamp.  
(Highly Nickel Polished).



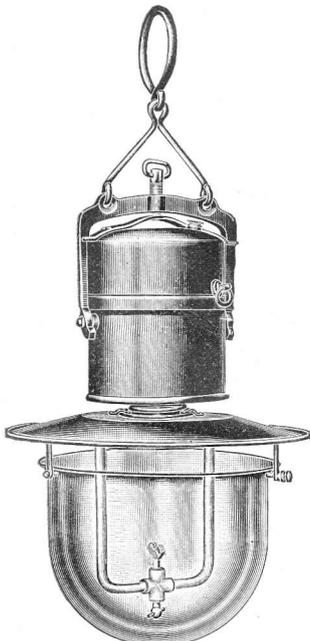
Wolf's Carbide Railroad or Inspection Lamp.  
(With or without rear light showing red or green).  
Patent Pending.



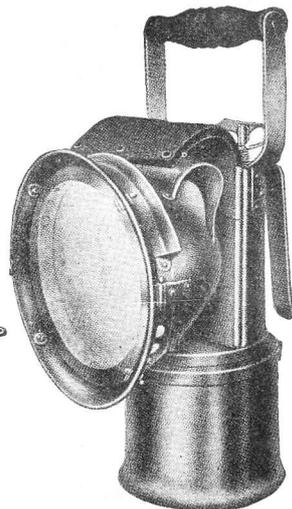
No. 900—Model 1925 Hand Lamp.  
(With automatic feed and solid brass reflector).



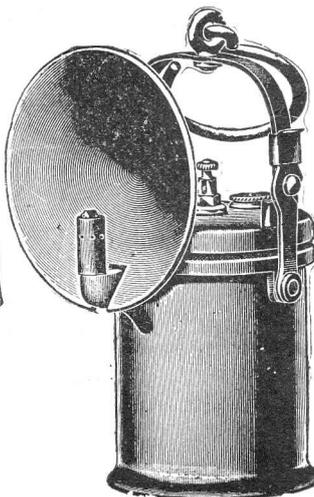
No. 911C Cap Lamp. New Model 1925.  
(With adjustable feed. Made in Brass or Nickel Plated.)



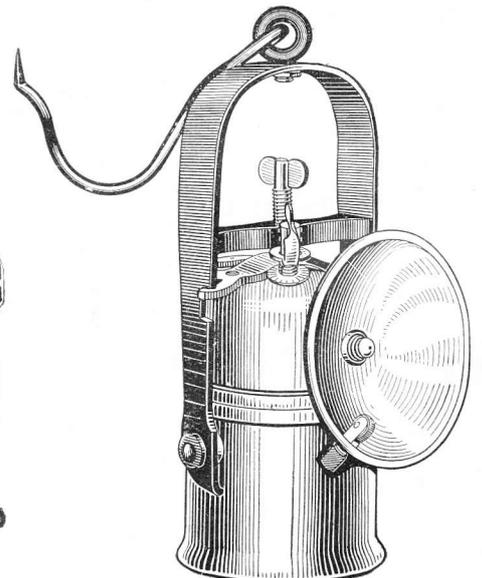
No. 750A. Hanging Lamp.  
(With glass globe, steel tinned).



No. 871 Hand Lamp with reflector hood. (Also used as Trip Light). (With adjustable feed and equipped with white, red or green lens).



No. 856 Hand Lamp. (Made in half or full shift size, with adjustable or non-adjustable water feed, in Steel or Brass).



No. 905A Hand Lamp  
(with adjustable feed).

# MINE SAFETY APPLIANCES CO.

Factory and General Offices:  
 Braddock Ave. and Thomas Boulevard  
 PITTSBURGH, PA.

Branch Offices

NEW YORK  
 PHILADELPHIA  
 JOHNSTOWN, PA.  
 CLEVELAND  
 LOS ANGELES

NEW GLASGOW, N. S.  
 HUNTINGTON, W. VA.  
 CHICAGO  
 SAN FRANCISCO

WILKES-BARRE, PA.  
 (Kingston)  
 ST. LOUIS  
 SEATTLE

MONTREAL, QUEBEC  
 BUFFALO  
 BIRMINGHAM, ALA.  
 DENVER  
 CALGARY, ALTA.

Cable Address—"MINSAF" Pittsburgh

## "Everything for Mine and Industrial Safety"

### The New Edison Model E Electric Safety Cap Lamp

Approved by the U. S. Bureau of Mines. Over 250,000 Edisons installed throughout the United States, Canada and Mexico. Installations everywhere have proved the Safety, Efficiency and Durability of these lamps.



The lamp and battery are constructed largely of steel, with steel-preserving Alkaline Electrolyte, possessing rugged strength, dependability and long life. The battery is free from acid fumes and corrosion, requires a minimum of attention and will stand considerable abuse.



The New Edison Lamp in Use

Due to its non-corroding electrolyte, the Edison may be stored away for months or years without deterioration.

Self - polishing monel metal parts insure a clean lamp at all times.

Write for details of special installation contract requiring no cash outlay.

### Special Features

Provides a clean light of more than six candle power.

Burns 12 hours continually or intermittently without any attention.

Remains indefinitely in charged or discharged condition without deterioration.

Costs less for upkeep and gives more light throughout the average shift than open lights.

Three times as much light as Model "C" (Approved No. 10) Edison Lamp, 50% more illumination than any other approved cap lamp.

### Specifications

Type of Battery .....	M-14
Number of Cells .....	2
Rated Capacity, Ampere hours.....	12
Hours Illumination after full charge.....	12
Normal Charging Rate, Amperes.....	2 1/4
Length of Charge, hrs.....	8

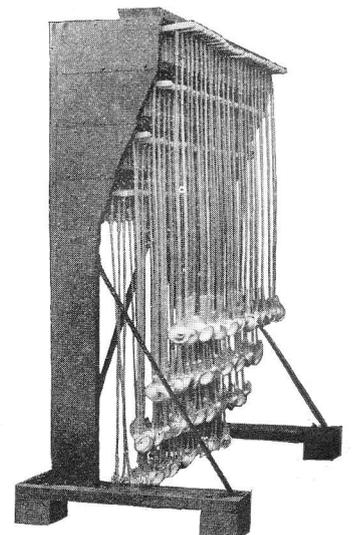
### Weights:

2 Cells Assembled, ozs.....	52
Monel Container, ozs.....	12
Headpiece, ozs.....	20
<hr/>	
Total ozs.....	84

An added advantage of an Edison installation is the simplicity of storing, charging and handling of the lamps. No extensive repairs are required or performed.

A large building is not required — a space about 6 feet square will accommodate 100 complete outfits.

Rack holds 100 New Edisons, head pieces attached to battery, used both for storing and charging.



# SECTION XXII

## Laboratory

FOR INDEX TO ALL ENGINEERING DATA SEE PAGES 7 TO 16.

*Condensed Catalogs In This Section:*

Mine & Smelter Supply Co., The

FOR ALPHABETICAL INDEX OF EQUIPMENT SEE BLUE SHEETS

# PRINCIPLES OF FIRE ASSAYING

By Erle G. Hill, Associate Editor

The aim is to smelt the ore at low temperature by addition of fluxing materials and, at the same time, to collect the precious metals by dissolving them in molten lead, after which the precious metals are separated from the lead by oxidization. The smelting may be accomplished by scorification or by crucible fusion. These will be described later.

## REAGENTS USED

**Fluxes**—Fluxes are materials added for the purpose of forming, with the ore, a slag which will be fusible at a low temperature and liquid at such temperatures as are easily obtained in the assay furnace.

For fluxing purposes, ores may be classified as acid or basic.

### Acid Constituents

SiO<sub>2</sub> (silica)

Al<sub>2</sub>O<sub>3</sub>

### Basic Constituents

Oxides of metals as follows:

FeO	Mgo	Zno
MnO	Na <sub>2</sub> O	PbO
CaO	K <sub>2</sub> O	Cu <sub>2</sub> O

Fluxing causes the acid oxides to combine with the basic oxides, thereby forming a product which melts at a lower temperature than the melting point of the most infusible of the constituents. For instance, a quartz ore, consisting largely of silica, would be fluxed with a basic material such as lead oxide and would form a silicate, as PbO.SiO<sub>2</sub>, which is liquid at a temperature far below the melting point of the quartz.

The common fluxes used in assaying are:

### Acid

Silica SiO<sub>2</sub>. This may be purchased, or barren quartz may be ground. One must be absolutely sure that such quartz carries no precious metal. Bottle glass is sometimes used, but is not pure silica, as the silica has already been fluxed with some bases. Silica is an acid flux commonly added to ores having lime gangue or large amounts of sulphides. An excess is to be avoided.

Borax, Na<sub>2</sub>B<sub>4</sub>O<sub>7</sub> · 10H<sub>2</sub>O, forms borates with basic oxides just as silica forms silicates. Borax

is readily fluxible and forms low melting slags. Due to the large amount of water it contains, it tends to cause excessive boiling of a charge. Therefore borax glass, which is borax deprived of its water, is often used instead.

### Basic

Sodium bicarbonate, NaHCO<sub>3</sub>, is used for its Na<sub>2</sub>O content. It is cheap and pure and therefore used by many assayers. Due to the large amount of water vapor and carbon dioxide liberated when heated it is not as desirable as sodium carbonate.

Sodium carbonate, Na<sub>2</sub>CO<sub>3</sub>, is used for its Na<sub>2</sub>O content and is a powerful basic flux. It also acts as de-sulphurizing agent.

Litharge. PbO. It is used in all crucible assays. Litharge is a basic flux and also an oxidizing and de-sulphurizing agent and furnishes the lead for collecting precious metals. It is readily fusible and forms fusible lead silicates.

Lead. Lead is the main reagent used in the scorification assay. It furnishes the lead for collecting precious metals, and may oxidize to litharge which forms the bulk of the slag produced.

## Oxidizing and Reducing Agents

In crucible fusions the lead buttons should weigh about 25 grams. Therefore, the charge should be so adjusted that such a button will be obtained. If the ore is oxidized, it is necessary to add a reducing agent in order to bring down enough lead to collect the gold and silver. If the ore is not oxidized, but carries sulphide, it may reduce enough lead or else too much, depending upon the amount of sulphide present. If too much lead would be reduced, then an oxidizing agent is added.

### Reducing Agents

Argol. Crude bitartrate of potassium. This is a common reducer. It also furnishes K<sub>2</sub>O which is a good basic flux.

Flour, Sugar and Charcoal. These are used for their carbon content which is the reducing element.

Sulphides. These may occur in the ore. Their reducing values depend upon the amount of sulphur they contain and on the amount of soda in the charge.

Fulton gives the following table which shows the reducing power of various reagents.

**REDUCING POWER OF AGENTS\***

Name of Reducing Agent	Quantity of lead reduced by 1 gram of reducing agent.
Argol .....	9.6
Flour .....	10.92
Sugar .....	11.74
Charcoal .....	26.08
Pyrite .....	9.30
Sulphur .....	18.11

\*Manual of Fire Assay, C. H. Fulton.

**Oxidizing Agents**

Nitre, KNO<sub>3</sub> is the one commonly used. Its oxidizing power varies somewhat with the charge. It varies from 3.7 to 4.7 grams of lead oxidized per gram of nitre added, depending upon the amount of soda present. The larger figure is for charges high in soda.

Oxidization may also be accomplished by roasting the ore, but this method is seldom used. It may be used for low grade, high sulphide ores.

**BALANCES AND WEIGHTS**

**Balances**—For assaying a pulp balance and a button balance are required. The pulp balance should be sensitive to .5 of a milligram and should have removable scoop pans. The button balance should be sensitive to at least .01 milligram. This requires a balance of very delicate construction. It should be set on a firm foundation and when possible a concrete foundation should be used. The button balance should always receive the care that such an instrument requires.

Fluxes are seldom weighed for each assay. Usually a stock flux is made up and then charges measured by volume. Any cheap balance may be used for this purpose.

**Weights**—Ore is weighed on the pulp balance and assay ton weights are used.

- 1 Assay Ton = 29,166 milligrams.
- 1 Short Ton = 29,166 Troy ounces

Therefore, if an assay ton of ore is used in an assay, each milligram of ore or silver obtained corresponds to a Troy ounce per short ton of ore.

Beads are weighed on a bead balance and fine weights are required. Sets of such weights usually contain weight units from 1 to 1000 milligrams.

Where money must be carefully planned in buying assaying equipment the bead balance and the fine weights should be favored.

**Preparation of Ore**

Sampling should be carefully done since a careful assay of a poorly chosen sample is valueless.

Uniform ores should be ground to pass a 100 mesh screen. Spotty ores should be ground to pass a 150 mesh screen.

Ore should be dried at 105° C for a few hours, as all assays are for dried samples.

**SCORIFICATION ASSAY**

This method is limited to assays of fairly high grade silver ores, high grade gold ores, bullions and mattes, due to the small samples used. It is not a good method for basic ores, telluride ores, cyanide precipitates, or ores containing silver chloride. It is a simple method, rapid and cheap. A preliminary assay is not required.

**Procedure**—.1 AT or .2 AT samples are used. The amount of lead depends upon the purity of the ore. For ore containing small amounts of sulphides, 40 grams is enough. As the sulphide content increases, the amount of lead must be increased. Ores very high in sulphides may require 100 grams.

The ore and one-half of the lead are mixed and placed in a scorifying dish. The balance of the lead is placed on top and about 1 gram of borax glass sprinkled around the edge of the charge. If the ore is basic a small amount of silica may be added. If the charge tends to attack the dish rapidly it should be lined with iron oxide before placing the charge in the dish.

The charge is then placed in a hot muffle, the temperature of which should be between 1000° and 1100° C. (a light yellow). The muffle should be closed until the charge is thoroughly fused. The door is then opened and oxidization allowed to continue until the slag, which collects on top of the lead, completely covers it. The charge is then poured into a clean, warm mold. The lead buttons then are cleaned, hammered into a cube and cupped.

**CRUCIBLE ASSAYS**

**Pure Oxidized or Neutral Ores**

This class includes ores which contain only small amounts of sulphur, arsenic, antimony, copper, zinc, etc. Ores which do not contain enough sulphides to produce a proper sized lead button, (25 grams), must have a reducing agent added, as well as fluxes. For proper fluxing the general composition of the ores should be known. Space does not permit giving charges for all types of ores. Ores high in silica require basic fluxes. If the ore is high in bases, silica may be added. A few typical charges are here given\*:

Quartz Ore		
100% Silica		
Ore .....		.5 A. T.
Sodium Carbonate .....		20 grams
Litharge .....		45 grams
Borax Glass .....		6 grams
Reducer for 25 gram button.		

\*Peele's Mining Engineers' Handbook.

Ore	
50% Silica	50% Lime
Ore .....	.5 A. T.
Sodium Carbonate .....	15 grams
Litharge .....	45 grams
Borax Glass .....	5 grams
Reducer for 25 gram button.	

Ore	
100% Lime	
Ore .....	.5 A. T.
Sodium Carbonate .....	30 grams
Litharge .....	70 grams
Silica .....	15 grams
Borax Glass .....	10 grams
Reducer for 25 gram button.	

Clayey ores containing large amounts of  $Al_2O_3$ , (alumina), give sticky slag unless properly fluxed. The following charge is typical:

Ore .....	.5 A. T.
Sodium Carbonate .....	20 grams
Litharge .....	50 grams
Silica .....	12 grams
Borax Glass .....	10 grams
Lime .....	6 grams
Reducer for 25 gram button.	

If ores are low grade, 1 A.T. may be used and the fluxes increased accordingly. For very low grade materials, such as mill tailings, 3 A.T. samples may be used. Such a charge would be about as follows:

Ore .....	3 A. T.
Sodium Carbonate .....	120 grams
Litharge .....	150 grams
Borax Glass .....	15 grams
Reducer for 30 gram button.	

The charge should be well mixed and the crucible placed in either a pot furnace or a muffle. The charge should be quickly brought up to fusion temperature. Temperature of furnace should be about  $1050^\circ C$  (light yellow). Fusion requires about one half hour and is complete when the charge is seen to be quiet, all action having ceased. The charge is then poured into a warm mold. The button is cleaned and cupelled.

### Impure Ores

Impure ores, containing enough sulphur, arsenic, antimony, zinc, copper, nickel or tellurium to cause trouble, if the charges for pure ores are used, must be assayed by special methods. An ore containing 13% pyrite will reduce about the right amount of lead. If more than 13% is present, an oxidizing agent must be added. In order to determine the amount of niter to be added, a preliminary assay should be run, unless the iron nail method is to be used, in order that the reducing power of the ore may be determined.

**Niter Assay**—A preliminary assay is made by fluxing 5 grams of the ore and weighing the reduced button. The weight of the button divided by 5 gives the reducing power of 1 gram of ore. The amount of niter to be added to the final charge

can then be computed. A typical charge and calculations are given below.

Ore .....	5 grams
Sodium Carbonate .....	10 grams
Litharge .....	60 grams
Silica .....	5 grams

If the button produced weighs 35 grams, the reducing power of the ore is  $35 \div 5 = 7$  grams of lead per gram of ore. Therefore, .5 A.T. would reduce 7 times 14.5 or 101.5 grams.

Button desired .....	101.5 grams
	25 grams
Lead to be oxidized .....	76.5 grams
If the oxidizing power of niter is 4.2 grams of lead, then	
	$\frac{76.5}{4.2} = 18$ grams of niter needed

Some typical charges for niter assays are given below:

#### Ore Containing Moderate Amounts of Sulphides

Ore .....	.5 A. T.
Sodium Carbonate .....	20 grams
Litharge .....	90 grams
Silica .....	5 grams
Borax Glass .....	5 grams
Niter for 25 gram button.	

#### Ore Containing Large Amounts of Sulphides

Ore .....	.5 A. T.
Sodium Carbonate .....	20 grams
Litharge .....	150 grams
Silica .....	8 grams
Borax Glass .....	5 grams
Niter for 25 gram button.	

**Iron Nail Assay**—In the niter assay the sulphides are oxidized and most of the sulphur passes off with the gases, but in the iron nail method only part of the sulphur is driven off in this manner, the balance of the sulphur combines with the iron and is dissolved in the slag. A basic slag is needed for this work. The iron is furnished by iron nails added to the charge. Since all the litharge added will be reduced by either the sulphides or the iron, not more than 30 grams of litharge should be added.

The iron-nail assay is simple and gives fairly good results, providing the ore does not carry too much copper or other base metals which would be reduced with the lead. No preliminary assay is required. A typical charge would be as follows:

#### Ore Having a Reducing Power of 4 Grams

Ore .....	.5 A. T.
Sodium Carbonate .....	30 grams
Litharge .....	30 grams
Silica .....	2 grams
Borax Glass .....	5 grams
Three large nails.	

The charge should be heated slowly at first and the temperature gradually increased toward the latter part of the fusion. The fusion is complete when the nails, after being washed in the slag, are seen to be free from lead globules. Fusion requires about 50 minutes.

Some assayers prefer to add a few grams of niter to the iron nail assay to oxidize some of the sulphide.

**Excess Litharge Assay**—This method is based upon the same principle as scorification. A basic oxide slag, composed mostly of litharge, is formed which will dissolve basic oxides readily and prevent to a large extent, the reduction of copper and antimony. It can be used on ores high in copper and is now commonly used on such ores. A typical charge is here given:

**Ore Containing 15% Copper**

Ore .....	5 A. T.
Sodium Carbonate .....	20 grams
Litharge .....	125 grams
Silica .....	5 grams
Niter for 25 gram button.	

The fusion should be made as quickly as possible to prevent undue corrosion of the crucibles.

**Assay of Telluride Ores**—Tellurium, if not eliminated in the crucible fusion, may cause high losses of gold and silver during cupellation. Scorification is not a desirable method. In order to slag the tellurium a high litharge charge is used and a low initial fusion temperature maintained. A low fusion temperature allows the tellurium to oxidize before the litharge unites with the silica. A large button is desired for cupellation. The following charge has been found suitable:

Ore .....	1 A. T.
Sodium Carbonate .....	30 grams
Litharge .....	100 grams
Borax Glass .....	6 grams
Reducer for 30 gram button.	
Silver may be added.	

**CUPELLATION**

Cupellation is a process by which the lead and other impurities in the button are separated from the gold and silver. The button is placed in a cupel and oxidized in a muffle furnace. The lead and other base metals are oxidized and absorbed by the cupel. Small amounts of the oxides are volatilized.

Cupels may be made of bone ash, magnesium oxide, or Portland cement. Magnesium cupels are usually purchased from supply firms, while bone ash cupels are made in the laboratory. Bone ash cupels are made by mixing water with bone ash until it loses its gritty feeling and then compressing it in a cupel mould. Cupels should be air dried for several weeks before using.

The temperature of the muffle should be from 850° to 900° C. (orange). The cupels should be placed in the muffle 15 minutes before being used. The buttons are cleaned, pounded into a cube and placed in the cupel. The furnace door is kept closed until the lead shows a bright, mirror-like surface. The door is then partly opened and the cupellation allowed to proceed. The correct temperature is indicated by the deposition of small crystals of litharge, (feathers), on the inside of the cupel. If the temperature is too low the lead becomes covered with a film of solid oxides, ("freezing"). The button may be "opened" by holding a splinter of soft

wood over the cupel. The end point of the cupellation is reached when all the lead has been driven off. This is preceded by the appearance of iridescent films on the bead and an apparent spinning of the bead. If the bead is large, it should be covered with a hot cupel before removing it from the muffle to prevent sprouting.

When gold ores are assayed, it may be necessary to add some pure silver to the charge in order to part successfully.

**PARTING**

The cupel bead is known as the dore bead. This, when weighed, gives the total weight of gold and silver. The bead is slightly flattened, cleaned and dropped into a parting flask filled with hot nitric acid. The silver is dissolved and the gold left as black, amorphous gold. If the bead remains brassy in color, there is insufficient silver for parting. The gold is washed several times with distilled water and then transferred to an annealing cup and placed in the muffle until heated to a bright red. It is then cooled and weighed. Weight of the dore bead minus the weight of the gold gives the weight of the silver.

The acid for parting may be made by mixing one part of concentrated nitric acid with eight parts of distilled water.

**Assay of Cyanide Solutions for Gold and Silver**

Measure out 5 to 20 A. T. of the solution. Place in a large beaker, bring to a boil, and add 10 to 20% solution of lead acetate. Bring to a boil again, and add 1 to 4 grams of zinc dust. Allow to boil gently until solution clarifies. Remove from hot plate, and add an excess of strong hydrochloric acid (10 to 20 cc.). Return to hot plate, allow to boil gently until effervescence ceases. If solution is free from suspended matter and excess of dissolved salts, decant off liquid, wash lead sponge, and press into a cube. Wrap cube in small amount of sheet lead, and cupel. If alloying silver is necessary, a weighed amount may be added to cupel.

If the solution is not free from suspended matter or excess of dissolved salts, filter, wash precipitation twice. Remove filter paper and precipitate, squeeze out excess water. Place into a 2 1/4" scorifier with 15 grams of test lead, 5 grams of litharge and 3 grams of borax glass. Heat slowly in muffle and, when well melted, pour. Cupel the lead button, weigh, part, etc. If alloying silver is necessary, a weighed amount may be added to scorifier of cupel.

Pipettes calibrated in assay tons may be purchased from supply firms.

The above is but a brief outline of the process of assaying. For details a standard text book on assaying should be consulted.

# THE MINE & SMELTER SUPPLY CO.

DENVER, COLORADO, U. S. A.

SALT LAKE CITY, UTAH

EL PASO, TEXAS

Cable Address  
MINTERPLY.  
Code: Bentleys

NEW YORK CITY: 42 Broadway

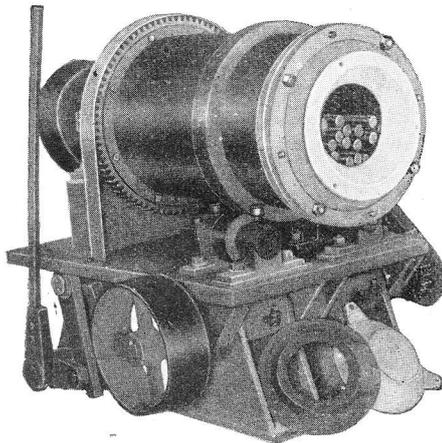
## Outfitters For the Mine, Mill and Laboratory

### Laboratory Apparatus

We handle practically everything required in the laboratory, including Laboratory Ball Mills, Laboratory Rod Mills, Laboratory Concentrating Tables, Laboratory Crushers and Pulverizers, Assay and Analytical Balances, including the famous Heusser Balance; Laboratory Flotation Machines, etc. Every laboratory should have a copy of our special bulletins, which will be gladly sent on request.



### Marcy Laboratory Rod or Ball Mill



Used by many ore dressing testing plants and educational institutions, who have found this little Marcy Mill to be especially desirable for semi-commercial test work, dry or wet grinding. Either steel rods or steel balls are used as a grinding medium.

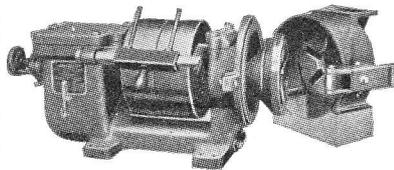
#### SPECIFICATIONS AND PRICE

Size of Grinding Compartment	*Approximate capacity per hour continuous grinding of 1/2" hard rock to 20 mesh	H. P. Required	Speed R.P.M.	Pulley Inches	Overall Dimensions Inches			Weight Mill Lbs.	Price Factory, f.o.b. Denver, Colo. complete with 300 lbs. of Rods or Balls
					L.	H.	W.		
12"x24"	100 lbs	1 1/2	35	10x3 1/2	38	33	30	1100	\$395.00

\*The character of material, size of feed, rate of feed, are some of the principal factors that determine the capacity.

### McCool Pulverizer

The McCool Pulverizer is a disc grinder and has long been the leader in its field—that of fine grinding of almost any material. It pulverizes soft or hard materials to any desired mesh at one operation. Discs remain smooth and serviceable until worn out and are the only wearing parts requiring renewal. Fineness of product may be regulated while machine is running. Dust-tight grinding chamber. Runs quietly. Easily cleaned, large capacity.



Special Bulletin No. 66 describes McCool pulverizer.

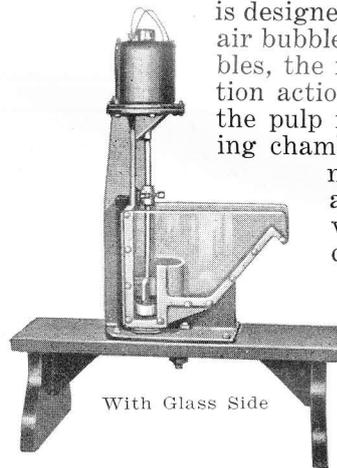
#### MCCOOL PULVERIZER SPECIFICATIONS

Model No.	H.P. Required	Speed R.P.M.	Pulley Inches	Wt. Lbs.	Length Overall In.	Height Overall in.	Width Overall in.	Capacity Per *Hr. Lbs.	Price
6 1/2 F	1	250	11x3	330	30	14 1/2	11	30	\$165.00
9 1/2 K	2	275	12x4	560	34	20	15	60	\$255.00

\* 1/4" Feed of hard rock to 100 mesh.

### Greenawalt Laboratory Flotation Machine

The Greenawalt Laboratory Flotation Machine is designed to meet most effectively the conditions and requirements for the flotation of minerals. It is simple, compact, automatic, and fool-proof. Air is drawn down through a hollow shaft, into a rotating atomizer, and is then discharged into the pulp. The atomizer is designed to deliver extremely fine air bubbles. The finer the air bubbles, the more efficient is the flotation action. Extreme agitation of the pulp is obtained in the agitating chamber, but the froth bed is not disturbed. The froth automatically works its way forward over the discharge lip of the machine.



With Glass Side

The machine will handle a charge of 5 lbs. of dry ore. It is made in four models—belt drive or direct connected and with glass side or all iron. Bulletin No. 70 on request.

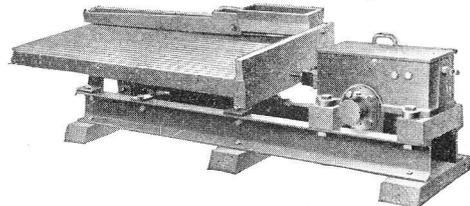
#### SPECIFICATIONS AND PRICES

Model	Description	Drive	Motor Required	Weight Lbs.	*Price f.o.b. Factory Denver, Colo.
A	All Iron Machine	3" Grooved Pulley for 3/8" round Belt †	1/4 H.P. 1725 R.P.M.	250	\$145.00 (without motor)
B	One Glass Plate Side	3" Grooved Pulley for 3/8" round Belt †	1/4 H.P. 1725 R.P.M.	250	\$160.00 (without motor)
C	All Iron Machine	1/4 H. P. motor connected to Shaft. Operate on A. C. lighting circuit.		270	\$185.00 (including motor)
D	One Glass Plate Side	1/4 H. P. motor connected to Shaft. Operate on A. C. lighting circuit.		270	\$200.00 (including motor)

\*Stand furnished with each model as shown in illustration. †By changing size of pulley on motor, any desired speed can be obtained.

### Wilfley Laboratory Concentrating Table

This miniature reproduction of our commercial large-sized Wilfleys is an exceedingly valuable piece of apparatus in the laboratory, test plant, mining school or research laboratory in connection with a concentrating plant, or for obtaining indicative results incidental to plant construction.



Two interchangeable decks are supplied, one riffled for fine feeds and one for coarse feeds. Each deck is equipped with feed and water boxes. Decks are 40 inches long and 18 inches wide.

#### SPECIFICATIONS AND PRICE

Model No.	H.P. Required	Speed R.P.M.	Water Gals. Per Min.	Pulley Inches	Overall Dimensions Inches	Capacity Per Hour	Weight Lbs.	Price, complete Factory, f.o.b. Denver, Colo.
13	1/4	300-375	1/2-4	6x1	15"x45"	100 lbs.	200	\$150.00

**Heusser Balances**

Heusser Balances have always held a unique position in the balance field, owing to the correctness of their general design, judicious selection of their material, perfect workmanship, pleasing and enduring finish. In addition to these qualities the designer of Heusser Balances has invented and perfected several attachments for balances which have met with considerable success among assayers, chemists and scientific research workers.

The characteristic and distinguishing features of the Heusser Balance are as follows:

- All metal construction of the Balance Casing.
- Unit construction of the Balance Mechanism.
- Keyboard operated Multiple Weight Attachment (Groups C, D and G only).
- Mechanical Pan Extractor (Group D only).
- Illuminator and Cover.

**PRICE LIST OF HEUSSER BALANCES**

Prices in Dollars, F.O.B. Salt Lake City, Utah, or Denver, Colo. Prices subject to change without notice.

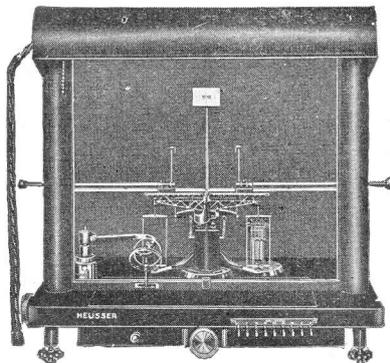
Group	Style	Casing Size	Sensitivity Milligrams						
			1/500	1/400	1/300	1/200	1/100	1/50	1/25
A	Assay	16x16x9	250	235	195	180	165	...	...
B	Assay	20x20x11	275	260	220	205	190	...	...
C*	Assay	20x20x11	385	370	330	315	300	...	...
D*†	Assay	20x20x11	450	435	395	380	365	...	...
F	Analytical	20x20x11	...	...	...	...	160	155	150
G*	Analytical	20x20x11	...	...	...	...	295	290	285

\*Furnished with Multiple Weight Attachment.  
 †Furnished with Mechanical Pan Extractor.  
 Balance Covers: Group A—\$6.00; Groups B to G—\$6.50.  
 Illuminator: Group A—\$13.50; Groups B to G—\$15.00.  
 Magnifying Lens: For all Models—\$13.00.

**Group "D"**—The most complete, accurate, reliable and convenient Assay Balance that can be imagined. Has Multiple Weight Attachment, Mechanical Pan Extractor and can be furnished with Illuminator.

Group C is the same Balance without Pan Extractor.

Group B is the same Balance without Pan Extractor and Multiple Weight Attachment.



**"Silcar" Muffles**

"Silcar" Muffles (Reg. U. S. Pat. Office) is an improved refractory material that has superseded fire clay for muffles, as it gives from six to ten times the service.

In short, Silcar Muffles have set new standards for long life, stability, conductivity, mechanical strength and low ultimate cost.

Silcar, the material, is derived from the best obtainable grade of SILicon CARbide. A rehearsal of its characteristics as a material for muffles, compared with clay, shows the following advantages:

- Stability: Will withstand temperature to 4064° F. without softening or deformation.
- Conductivity: Five to seven times faster.
- Mechanical strength: Vastly superior; ten times as great is a conservative estimate.
- Expectancy of life: From six to ten times as long.
- Ultimate cost: From one-third to one-fifth.

Silcar Muffles have a great range of usefulness, because of their stability. Either gaseous or liquid fuel may be used, with flame impinging directly upon the muffles if necessary.

The temperature desired is rapidly attained, and it will be well equalized throughout all parts of the muffle. The result is a considerable saving of time, reduced fuel cost, and increased output per muffle and per furnace.

There is little chance of breaking these muffles in shipping or handling, on account of their great mechanical strength. Infrequent changes mean other savings.

Having a very low co-efficient of expansion, Silcar is not liable to check or crack under rapid temperature changes. Silcar Muffles are baked at temperatures close to 3,000° F. This temperature of vaporization is well outside those heats ordinarily employed in the metallurgical industries, and thus affords an enormous margin of safety.

**Inertness**—Silcar Muffles are not adversely affected by reagents ordinarily employed in general assaying.

**Plates and Supports**—For best results, Silcar Muffles should be rested upon supports and baffle plates also made of Silcar. In that case there will be no uneven strains thrown upon the muffle from softening or fusing of underlying parts, as Silcar is not affected by even the most severe conditions imposed by oil or gas firing. We can furnish plates and supports of any shape or size.

**Silcarite Cement** (Reg. U. S. Pat. Office)—For luting and plastering Silcar Muffles, No. 6-C Silcarite Cement is recommended because of its close conformity in chemical composition and physical characteristics to those of Silcar.

**Sizes**—Silcar Muffles are made in all customary standard sizes. Special sizes are made to order.

Send for special circular containing diagrams and instructions for ordering Silcar Muffles.

**MASSCO CLAY GOODS**

The high-grade fire clay products distributed by this company are well known to our customers, which include many of the largest smelting, refining and mining companies. They have found that our offerings in this line give consistently satisfactory service, and we can recom-

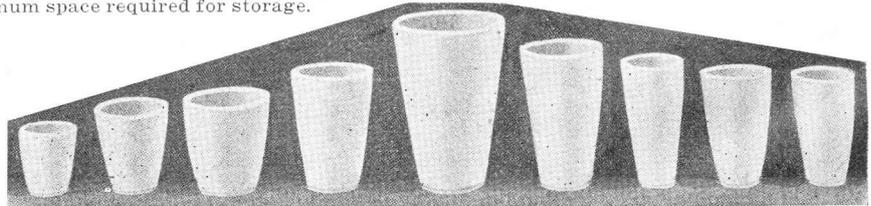
mend these refractories as being of thoroughly dependable quality.

Massco Clay Goods are made from highest grade and selected Western clays by expert clay workers of long experience.

**MASSCO CRUCIBLES.** Uniform in size and of full capacity.

Our crucibles and scorifiers are packed in cartons for convenience in handling and minimum space required for storage.

Size	Outside Dimensions, Ins.		Approximate Number to Carton	Approx. Wt. per 1,000 in Cartons
	Height	At Top		
5 Gm.	2 5/8	2 3/8	100	270 lbs.
10 Gm.	3	2 5/8	100	410 lbs.
12 Gm.	3 1/4	2 3/4	100	440 lbs.
15 Gm.	3 1/2	2 7/8	100	470 lbs.
20 Gm.	3 3/4	3 1/8	100	550 lbs.
25 Gm.	4	3 1/4	100	650 lbs.
30 Gm.	3 7/8	3 1/2	64	750 lbs.



**MASSCO SCORIFIERS**

Will stand a heavy lead charge and are not liable to be seriously attacked during scorification, even with heavy copper ores. Choice of either Bartlett or regular forms.

Outside Diameter Inches	Approximate Number to Carton	Approx. Wt. per 1,000 in Cartons
2	250	132 lbs.
2 1/4	250	156 lbs.
2 1/2	250	263 lbs.
3	160	263 lbs.

