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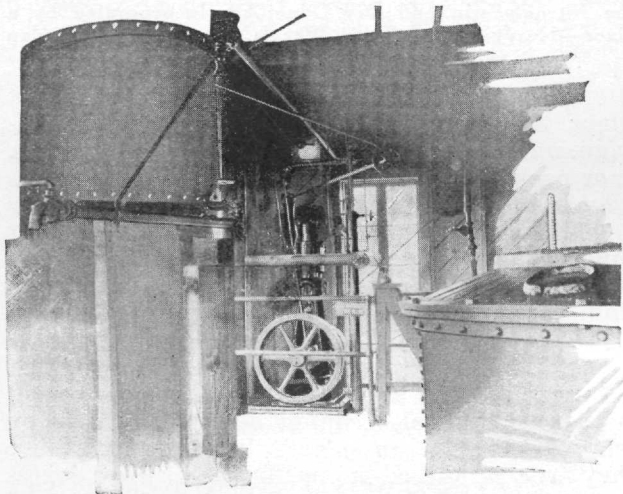
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The Manufacture of Dynamite and Gelatin

By E. M. SYMMES

Dynamite is unique in not having been invented by the Chinese or mentioned by Shakespeare. It was first introduced by Nobel, the Swedish engineer, in 1866, after numerous accidents had resulted from the use of nitroglycerin alone. Mr. Nobel discovered that by mixing nitroglycerin with kieselguhr, an absorbent earth, it became safe to handle, and its explosive power was not seriously reduced. Modern practice has eliminated kieselguhr in spite of statements to the contrary in nearly every text book on the subject and substituted an absorbent composed of nitrate of soda, nitrate of ammonia, wood pulp, flour, etc., which give an active dope, that is, one that will assist in the explosion instead of acting as an absorbent only, as is the case with kieselguhr.

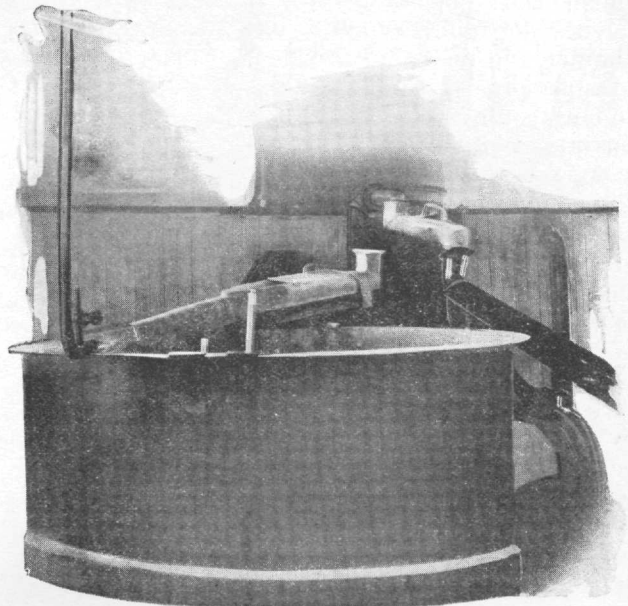
The method of manufacture and preparation of the various ingredients will be considered briefly before discussing the actual making of dynamite according to the process employed by the Hercules Powder Company.



The Nitrator Tank on the Right Contains Mixed Acid into Which Glycerin is Fed from the Scale Pot on the Left, and the Mixture Agitated by Power from the Small Engine in the Center

Nitroglycerin is made by adding slowly to a mixture of strong nitric and sulphuric acids a comparatively pure glycerin, agitating the mixture meanwhile by large, mechanically driven paddles and removing the heat by coils through which cold brine is circulated. A modern nitrator produces about 3,000 pounds of nitroglycerin at one operation, consuming 7,000 pounds of mixed acids and about 1,200 pounds of glycerin. After all the glycerin has been slowly added to the nitrator, which consists merely of a steel tank with the brine coils around its outer edge, the mixture is let down into a lead tank and allowed to stand until the nitroglycerin rises to the top and the acid falls to the bottom. The top layer of nitroglycerin is then drawn off and delivered to a tank of warm water, where it is washed free from acid by agitation with compressed air. The acid left from this operation is treated at the acid recoveries to regain the nitric and sulphuric acids contained in it. The nitroglycerin is then given

a final wash with soda ash solution to remove the last traces of acid, as acid nitroglycerin cannot be kept any length of time without serious decomposition, with possible danger of explosion.



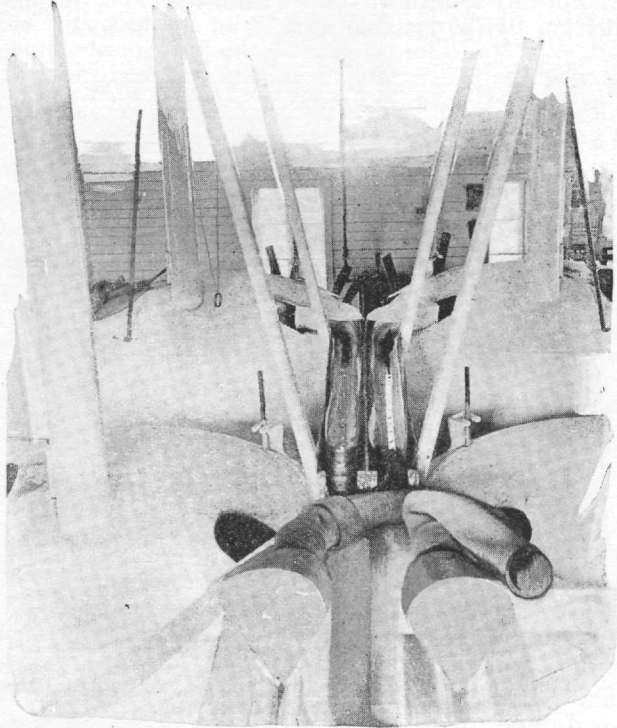
The Mixture is Allowed to Stand in this Separator Until the Nitroglycerin Rises to the Top

The absorbent material known as dope is prepared by mixing and screening proper proportions of dry and ground nitrate of soda, nitrate of ammonia, wood pulp, flour, starch, sulphur, chalk, etc., and is taken in fibre barrels to the mixing house and put into a dynamite mixing machine, an illustration of which accompanies this article. Nitroglycerin, after preparation and treatment as outlined above, is taken by means of the copper-lined, rubber-tired buggies (see illustration) to the mixing house and is added to the dope. This mixing machine consists of a wooden bowl with large wooden wheels running in it. These wheels are edged with ebonite, or hard rubber, thus allowing no metal actually in contact



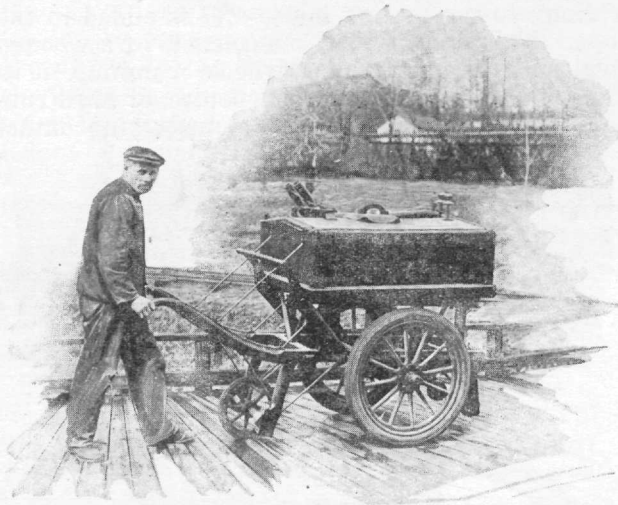
Rubber-Lined Gutters in Which the Nitroglycerin Flows to the Storehouse

with the dynamite while being mixed. The driving of these machines is done with large overhead pulleys made of wood, which obviate any possibility of rubbing metal, thereby producing sparks. Five minutes' kneeding under the wheels of the mixer suffices in most cases properly to incorporate the nitroglycerin throughout the mass of dope.



The Nitroglycerin is Washed in these Lead Tanks and by Neutralization the Last Traces of Acid Are Removed

This material, which is now loose dynamite, is removed from the machine by wooden shovels and put into wooden tubs, which are used to transport it to the Hall machines, where it is packed into paraffined paper shells by the action of wooden tamps, tipped with rubber. These shells are made by a machine which takes roll paper of from

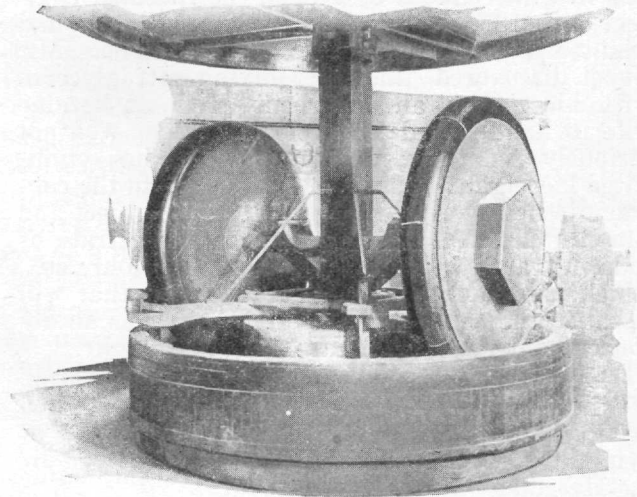


Rubber-Tired Buggies Are Used to Convey the Nitroglycerin from the Storehouse to the Mixer

18 to 24 inches wide, cuts, prints, and crimps one end, and discharges into the collector, as shown in the illustration, at the rate of from 180 to 200 per minute. They are packed loosely into crates

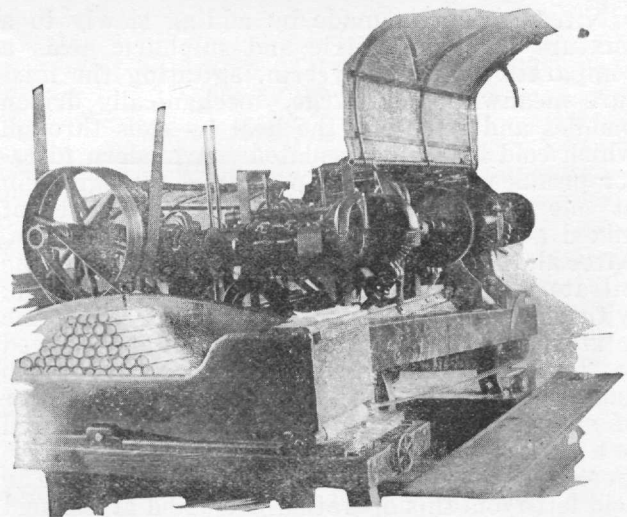
and taken by a traveling chain through a chamber, where they are sprayed with hot paraffin to impregnate the paper and prevent absorption of the nitroglycerin. They are then delivered by tram truck to the Hall or the gelatin machines.

These Hall machines mentioned above are very nearly automatic and it is only necessary to maintain a supply of loose powder and sufficient shells

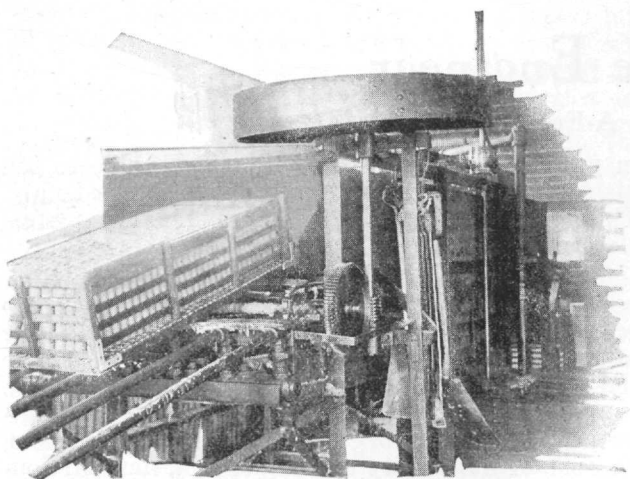


The Nitroglycerin and Dry Dope Are Incorporated by a Mixer—Heavy Rubber-Tired Wheels Revolve in a Wooden Bowl Which Contains the Ingredients

in order to perform the complete operation of filling the cartridges to the required amount, crimping the top, and laying them out on a table. They pack at each revolution either 25 or 30 cartridges and have a capacity of approximately 30,000 pounds every eight hours. This is a great improvement over the old days when each shell was filled through a funnel by hand operation, requiring every stick to be handled several times. These cartridges of dynamite are then carried in wooden tubs to the packing house, a view of which accompanies this article, where they are sealed so that the dynamite cannot absorb moisture by being dipped for an instant in molten paraffin. They are then placed in paraffin-paper lined boxes, containing a small amount of sawdust for a cushion, are weighed, and nailed up by an automatic nailing machine which completely fastens the cover in two operations. From there the boxes



Paper Cartridges Are Printed and Rolled by a Shell Machine Prior to Being Loaded with Loose Dynamite or Gelatin

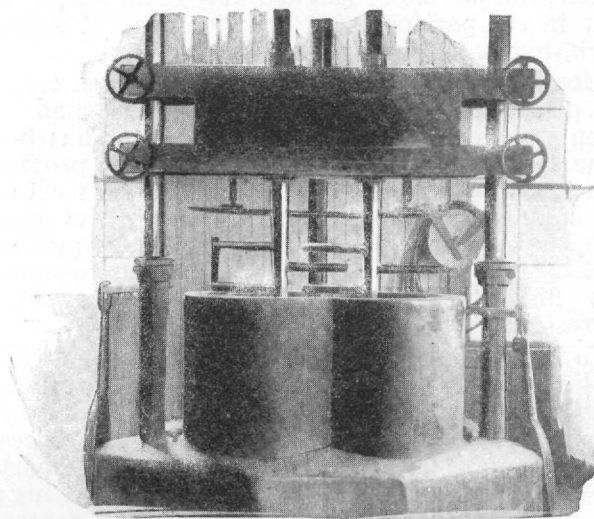


The Empty Shells Are Automatically Sprayed with Melted Paraffin to Render Them Waterproof

of powder are taken to the magazine, which is merely an unheated, barricaded storehouse situated on a broad-gauge spur for convenience in shipping. This completes the manufacture of dynamite.

Since dynamite does not withstand the action of water very well, it was long ago discovered that the addition of small amounts of nitro cotton to the mixture of nitroglycerin with various absorbents produced a material somewhat similar to jelly. This material resists the action of water exceedingly well and is known as gelatin dynamite. Due to its nature, gelatin manufacture has to be carried on differently from that of dynamite. The nitroglycerin and dopes, prepared as outlined above, are taken to a gelatin mixing machine which consists of a bronze bowl surrounded by a lead jacket containing warm water and two

bronze paddles used for kneading the dough-like mixture. These hold from 500 to 600 pounds of the gelatin for each charge. The mixed gelatin looks very much like ordinary dough made from war flour, although the taste may be somewhat different. This is shoveled out into wooden boxes by the wooden scoops, an illustration of which is shown herewith, and taken to a machine which by the action of a worm forces this material through nipples into paraffin-paper shells placed directly underneath. This is known as the gelatin machine or Schrader and is necessary because such a sticky mixture as gelatin cannot be handled

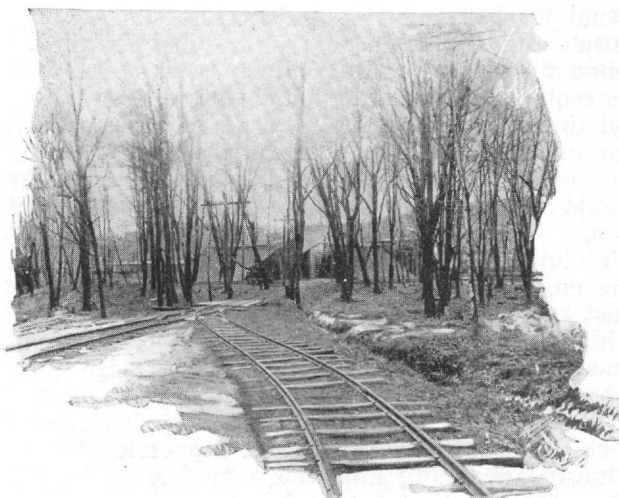


Nitroglycerin Is Incorporated with a Special Dope in a Different Type of Mixer to Make Gelatin

through the Hall machines mentioned above. The rest of the operation of gelatin manufacture, consisting of packing in boxes and storage in magazines, is exactly the same as that of dynamite. The manufacture of dynamite or gelatin may seem like a very simple process, but very close attention is necessary at every stage. The amount of



The Filled Cartridges Are Placed in Wooden Boxes Lined with Paraffin Paper at the Box Packing House



A Typical View of a Dynamite Line—The Building in the Background Is a Mixing House—Note the Barricade

moisture in the finished product must be held at a minimum, due to the serious effect water has on the ageing and strength of dynamite and gelatin.

The manufacture of nitroglycerin requires the closest supervision, not only from the standpoint of danger but also to obtain the best results possible.

(Continued on page 24)

THE MANUFACTURE OF DYNAMITE AND GELATIN

(Continued from page 19)

ble. The fineness of the nitrate of ammonia and nitrate of soda used in the dope is an important factor, and also requires close supervision. The pressure of the tamps in the Hall machines determines the density of the finished dynamite and also determines the number of sticks that a 50-pound box will contain. All dynamite and gelatin is tested before shipment by obtaining samples daily, and analyzing these to determine the degree of accuracy with which the ingredients have been employed.