THE MANUFACTURE OF DYNAMITE.

Our illustrations show the apparatus commonly used for the preparation of nitroglycerin, the dangerous substance to the peculiar properties of which the fearful slaughter at Bremerhaven is due. A contemporary states that Nobel, the inventor of dynamite, tried many experiments "in order to bring nitroglycerin within the range of articles of transport, and finally hit by accident upon the one which resulted in the production of the powder known as dynamite." This description is a severe criticism on the inventor and his discovery, for every change of temperature produces free nitroglycerin from dynamite, and the latter substance is thus far more dangerous than the former; and an attempt to send dynamite over land or sea will soon show how it is regarded

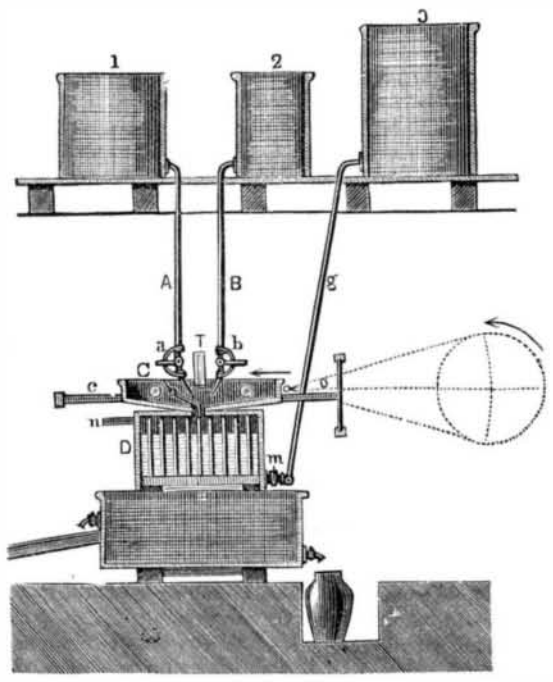


Fig. 1.—PREPARATION OF NITROGLYCERIN.

as an article of article of freight by railroad and ship authorities.

Nitroglycerin is usually commenced by mixing 2 parts nitric acid with 4 parts sulphuric acid. This mixture heats spontaneously, and is left for 24 hours to cool. Then 1 part glycerin is added to the combination of the two acids by the method shown in Fig. 1, the acids being in the vat marked 1, and the glycerin in vat 2, the vat 3 being a reservoir of water. The vats 1 and 2 communicate with a box, C, which is lined with lead, and divided into compartments which open into the trough, D. This box is provided with machinery to give it an oscillating motion, indicated by the dotted lines; it also has a thermometer to show the temperature. A constant stream of cold water is made to flow around the vat, D, and out at N. As soon as everything is ready, the acid is allowed to flow through A into C, and the glycerin through B into the same vessel. At the same time an oscillating motion is imparted to C by workmen who are stationed at a distance of thirty or forty feet, protected by a strong wall. As soon as all the glycerin has flowed in, the operation may be considered as ended, for the nitration takes place instantly. The oil from D is drawn into the vat below, which is half filled with water. The nitroglycerin sinks to the bottom and can be decanted from the dilute acids.

The nitroglycerin being now ready for use, the next step is to mix the oil with inert silica. The infusorial earth has three constituents which must be removed —water, organic salts, and coarse gravel. The first two are removed by calcining at a red heat in an oven with four shelves, one above the other, on which the earth is placed and slowly pushed from the upper to the lower. The organic matter which is considered dangerous to the stability of the dynamite, but which is less dangerous than the nitroglycerin, is thus burnt out. It is then pressed with hard rollers

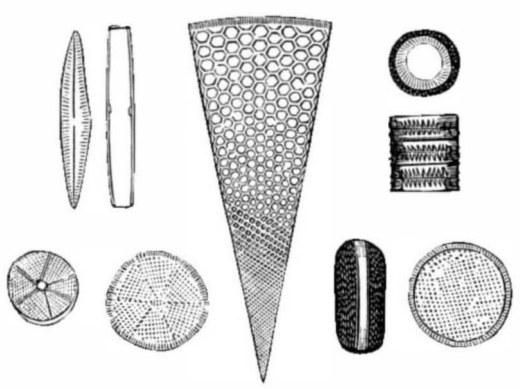


Fig. 3.—MICROSCOPIC ENLARGEMENT OF INFUSORIAL EARTH.

and sifted, which separates it from the larger grains. It is now ready for use.

Fifty lbs. of the infusorial sand are put into flat wooden tanks and covered with 150 lbs. nitroglycerin, when the workmen mix them with the naked hand. Gloves of india rubber were at first provided, but the workmen preferred to knead the mixture with the free hands. In half an hour the incorporation of the oil with the sand is complete, and the dynamite is ready for filling in the cartridge molds. The cartridges are simple cylinders, protected by parchment paper. If ordinary paper is used the oil soaks into it, and there is great danger of premature explosion. Dynamite is a brownish gray, sometimes reddish, inodorous, pasty, greasy mass, having the specific gravity of 1·6. When ignited by an ordinary flame it burns up quickly without detonation, and must therefore be fired with a patent exploder containing fulminate of silver inclosed in a copper capsule. When in its normal state, it requires a heavy blow of a hammer on an anvil to explode it, and even then only the portions struck are fired. Nitroglycerin, however, is easily exploded by percussion, and it exudes from dynamite on the slightest change of the temperature; and the wood of the boxes in which dynamite is packed becomes, by slow degrees, impregnated with nitroglycerin, and forms a most dangerously explosive material, which may give rise to serious accidents in warehouses where it is stored.

The sulphuric acid used in this dangerous manufacture is the oil of vitriol of commerce, an acid too well known to need description here. The nitric acid is usually made from native saltpeter, imported from Chili or elsewhere; and as it is required to be highly concentrated, the preparation of it is a peculiar process, which is shown in our Fig. 2. In a cast iron vessel, A, is placed the nitrate to be operated upon, to which is added, by means of a funnel, strong sulphuric acid. The lid is replaced, and the vessel connected, by means of the clay-lined tube, B, with the glass tube, C, dipping into the large stoneware flask, D, which serves the purpose of a receiver. This flask is connected by means of a tube, *a*, to a similar vessel, D′, and that to a third vessel, D″, and so on, in order to completely condense the vapors which might have escaped through the first, second, and third vessels. The iron vessel, A, is heated by means of the fire placed in the hearth, F, the smoke and hot gases being carried off by G, H. At the outset of the operation, the damper, *d*, is so regulated as to shut off the lower channel and cause the smoke and hot gases to pass through E, heating the vessels, D, D′, and D″, this precaution being required to prevent their cracking by the hot acid vapors entering from A. As soon, however, as the distillation has fairly commenced, the damper is altered to shut off E, and pass the hot air and gases through G. The product from each retort is so mixed that the average specific gravity shall be equal to 47° or 48° B. A weaker acid than this does not work well.

The acids being mixed as above described, the next step is the mixture of them with the infusorial earth, called by the Germans *kieselguhr*, which is found in most countries. The polishing powders known as tripoli and electro-silicon are specimens of it; and it is composed of the skeletons of a vast number of diatoms, which yield a spongy silica, admirably adapted for a polishing powder, or as an absorbent for oils and liquids. It is also used in the preparation of soluble

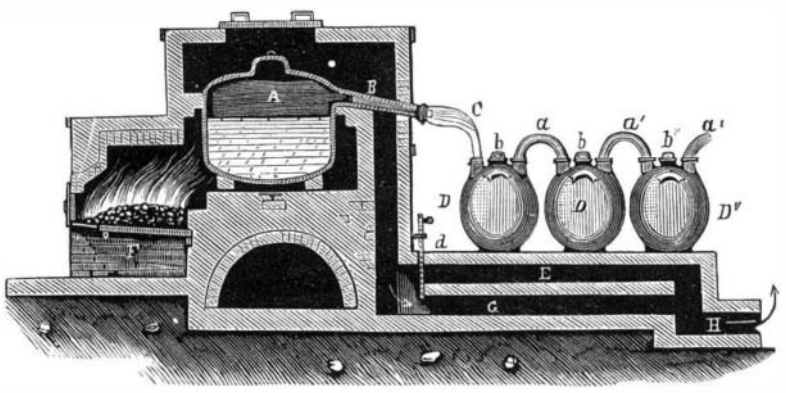


Fig. 2.—PREPARATION OF NITRIC ACID.

glass for pigments, and fireproof packing and numerous other purposes. A microscopic view of a portion of this substance is shown in Fig. 3, which fully exhibits the remarkable porosity which makes it adaptable for absorbing the perilous fluid which gives it its efficiency as an explosive.

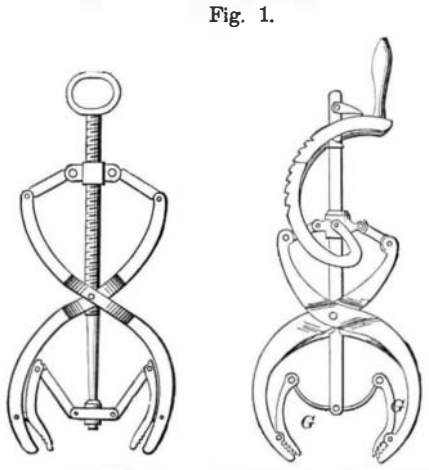
BOOT AND SHOE APPARATUS.

The illustrations, selected from Knight's "Mechanical Dictionary,"* given herewith represent apparatus used in the manufacture of boots and shoes. The engraving, Fig. 1, represents

LASTING TOOLS,

which are employed to grip the upper leather of a boot or

Fig. 1.



Lasting-Pinchers. *Tool for lasting Boots and Shoes.*

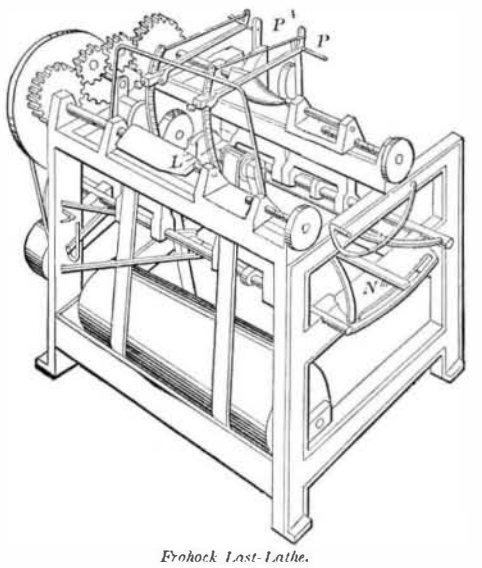
*Published in numbers by Messrs. Hurd & Houghton, New York city.

shoe, and draw it over the last. In the tool on the left, the two jaws act simultaneously upon the leather through the motion of the nut, C, upon the screw. The same movement brings the jaws toward each other and stretches the leather around the last. The two pairs of jaws in the second tool engage the sides of the leather, and are then drawn thereupon and also inwardly by the action of the cam lever. Lasts are usually made upon the ordinary type of lathe employed for turning irregular forms. For this purpose, however, special machinery has been devised, to which class belongs the

LAST LATHE,

represented in Fig. 2. In this machine, the block, L^5, from which the last is to be cut, is, by a train of gearing, made to present a face to the cutters precisely corresponding to the face of the model against the guides, P P^4. By moving links on these rods, up or down on their graduated scales, the last

Fig. 2.



Frohock Last-Lathe.

may be enlarged or reduced in its relative proportions to the model. A similar variation of the bar, N‴, on the sector at the end of the machine, will vary the work in relation to its length as compared with that of the model.

In Fig. 3 is a

BOOT SHANK MACHINE,

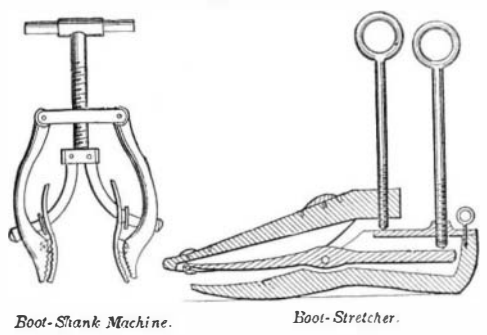
used for drawing the leather of the upper or boot leg over the last into the hollow of the shank. The leather being placed over the last is inserted between the jaws, which are pivoted to the plate. The screw connecting the jaws by arms is thus turned, causing the jaws to be brought together, and thus stretching the leather. The same figure also shows a boot stretcher, for stretching the uppers. The last is divided into an upper and an under section which are connected by a lever. The fore end of the upper section is pivoted to the fore end of the lever, and the middle end of the lever has its fulcrum at the mid-length of the lower section. The screws operate to raise the rear end of the upper section directly, and its fore end through the medium of the lever. The upper surface of the last has changeable knobs to stretch the leather in particular places.

Fig. 4 represents a

BOOT HOLDER

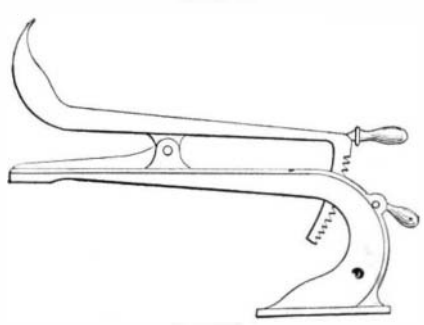
or jack, for holding the boot during the process of manufacture. The base piece is attached to the bench and has a stationary prong. The movable prong containing the foot piece is attached to the other, and is held at its adjustment by a rack and pawl. The operation may be clearly

Fig. 3.



Boot-Shank Machine. *Boot-Stretcher.*

Fig. 4.



Boot-Holder.

understood from the engraving. A similar device is sometimes used to stretch the boot while blacking or varnishing it.