

The New Thames Tunnel.

A representative of the *Pall Mall Gazette* having visited the new tunnel in course of construction between the Monument and the Elephant and Castle, gives the following account of this remarkable work:

One striking feature of the new subways is their depth. They run right down underneath water and gas mains and sewers, and almost wholly keep to the line of the public thoroughfares, so that the projectors are not handicapped by heavy compensations, at one point only payment having been made. The depth under the roadways ranges from 40 feet to 45 feet, and under the Thames it is about 15 feet. Starting from the terminus, which will have a commanding corner position immediately above the Monument, the tunnels extend across the road, and passing down Swan Lane, they enter the river bed at the Swan pier, about 50 yards above London Bridge. There are two independent tunnels, one for the up and the other for the down traffic, and as Swan Lane is very narrow, there was no space to place them side by side without encroaching on the contiguous property. The engineer has overcome the difficulty by running one over the other with about 5 feet of earth between, and gradually the lower one is raised until they run parallel, but separated by about 5 feet.

The work is being carried on from a temporary shaft sunk at the Swan pier, with a depth of 60 feet to the first tunnel and 75 feet to the second, and having a diameter of 13 feet. Down this shaft we were swung, and at the bottom we found ourselves in a long iron cylinder 10 feet in diameter. At present it is dimly lighted with gas and lamps, but we could see ahead for a considerable distance, the tunnel taking a straight line. A temporary tramway for the removal of the excavated material, and for carrying forward the iron plates with which the cylinder is built up, runs along the whole length of the subway. We found the path somewhat treacherous, for the passage of the greasy clay had made the boards very slippery. We arrived at the extremity, however, without mishap, and in a slightly heated atmosphere watched operations.

The principle on which the tunnel is made was exactly pictured by the Irishman who, when describing the manufacture of a gun, said a hole was first made and then iron was put round it. A hole is cut into the clay, and then piece by piece the cylinder is built up. And in this connection it may be noted that the London clay through which the subway will run its whole course is admirably adapted for the work, but at the same time sand or other loose soil can also be tunneled with a slight change in the machinery and method. First of all, a small heading is driven into the clay, and supported by timbers. With pick and shovel about 18 inches of the soil to the extent of the tunnel's circumference is next taken out, and then the "shield," as it is termed, begins work. This might be likened to the cap of a telescope, the telescope itself representing the tunnel in which the men are at work. Steel cutters are fixed round the outer edge of the cap (to maintain the simile), and hydraulic pressure (500 lb. to the square inch) is brought to bear upon it from within, driving it into the clay. The hole which was partially made by hand labor is thus rounded off, and the "shield" has been pushed forward in less than a quarter of an hour 18 inches. The "cap" is not wholly off the telescope, however. A plate of iron affixed to the "shield" covers the space bored until another section of the tunnel is added. Thus section after section is built up as the progressive movement is effected.

The circle is made up of six pieces, with a key piece at the top. They are 18 inches wide and 1 inch thick, with flanges through which they are securely bolted together, and weigh about $4\frac{1}{2}$ cwt. each. The metal is

cast iron, which will not corrode. The tube fits exactly to the shape of the hole which the "shield" has cut, less the thickness of the iron plate which the cap of the telescope typifies in the description. As the shield goes forward this hollow is filled with "grout" or liquid lime, which is forced through a hole in the iron plate by pneumatic pressure, and it very soon solidifies. There can thus be no risk of instability by the subsidence of the soil. In the matter of strength the engineer gave it as his opinion when the bill was before Parliament, the question of weakening the foundations of London Bridge having been raised, that forty London Bridges piled on the top of each other would not damage the cylinder.

Something like 10 feet can be driven each day, and in sixteen weeks the Thames was tunneled. The contrast with the ancient methods is amazing. The first Thames tunnel occupied about eighteen years, and although recent works have been more expeditiously completed, they have been much more prodigal of time

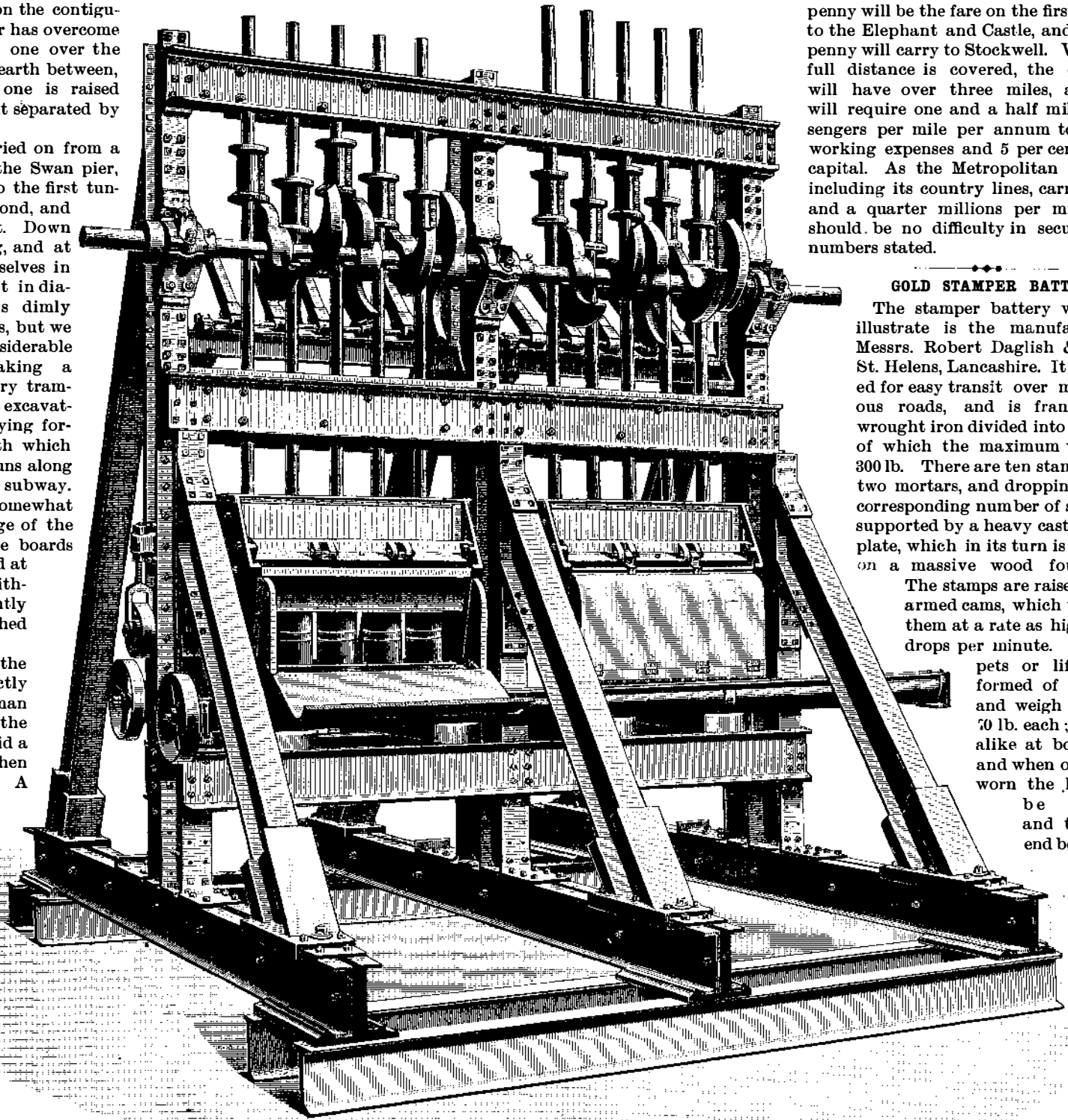
sengers. The carriages will be about 6 inches from the top of the tunnel, and about 1 foot 6 inches, measured from the center, at the sides. They will start every two or three minutes, and the distance over the first section will be covered in six or seven minutes. The speed will be about double that of road conveyances. The machinery for working will be placed at the Elephant and Castle. With respect to ventilation, the engineer anticipates no difficulty. There will be no foul smoke from engines, as in the case of the underground, and, as the trains in each tunnel will always be running in one direction, they will create a current of air. If that, however, is not thought sufficient, a fan can be placed at the intermediate station, and by the expenditure of one horse power the atmosphere in the whole of the subway can be changed every hour.

The promoters of the line, of course, believe it will pay. They are going in for cheap fares and fast conveyance, and with the enormous traffic to and from the City they have no fear of the result. A penny will be the fare on the first section, to the Elephant and Castle, and another penny will carry to Stockwell. When the full distance is covered, the company will have over three miles, and they will require one and a half million passengers per mile per annum to pay all working expenses and 5 per cent on the capital. As the Metropolitan Railway, including its country lines, carries three and a quarter millions per mile, there should be no difficulty in securing the numbers stated.

GOLD STAMPER BATTERY.

The stamper battery which we illustrate is the manufacture of Messrs. Robert Dalglish & Co., of St. Helens, Lancashire. It is designed for easy transit over mountainous roads, and is framed with wrought iron divided into portions, of which the maximum weight is 300 lb. There are ten stamps set in two mortars, and dropping on to a corresponding number of steel dies, supported by a heavy cast iron bed plate, which in its turn is mounted on a massive wood foundation.

The stamps are raised by two armed cams, which will work them at a rate as high as 110 drops per minute. The tappets or lifters are formed of cast iron, and weigh 60 lb. to 70 lb. each; they are alike at both ends, and when one face is worn the lifter can be reversed, and the other end be brought

**IMPROVED STAMPER BATTERY.**

than the one under review. The cost, also, can bear no comparison. 200,000*l.* per mile is regarded as the ultimate cost, and including stations, land, and indeed every outlay, the authorized line of $1\frac{1}{2}$ miles will be completed for 300,000*l.* Hydraulic lifts will raise and lower the passengers at the stations, of which there are to be three, the intermediate one being at St. George's Church in the Borough, where the car traffic for the City is emptied. If the extension beyond the Elephant and Castle is approved, stations will be placed at Kennington Park, Kennington Oval, and the terminus at Stockwell. This would add $1\frac{1}{4}$ miles to the line, which would mean an additional outlay of 250,000*l.*, or 550,000*l.* in all for $3\frac{1}{4}$ miles.

All the details of working the line are not complete, but trains of three or four carriages somewhat after the style of a tram or Pullman car will be run, the motive power being the endless cable. The cars will be more roomy than omnibuses or even ordinary railway carriages. A driver and conductor will be in charge of each train, which will carry about one hundred pas-

into use. The stamp head or socket is cylindrical, and is strengthened by wrought iron bands shrunk on. The stems run through guides of green-heart timber constructed in halves, so that they may be adjusted for wear.

The crushed ore, in the dry process, passes through screens of woven wire, varying in fineness from 900 to 10,000 meshes per square inch; in wet working, the screens are plates perforated by punches varying in size from No. 0 to No. 10 common sewing needle. The crushed ore falls into worm conveyers, by which it is delivered to whatever type of amalgamating apparatus may be employed. The conveyers are driven by a belt which is kept taut by a tightening pulley.

The perspective view shows the stamper framed in the makers' shops in this country, while the detail views illustrate the additional timber work to be fitted to it at the mine.—*Engineering.*

THE body of a nine-year-old girl has recently been cremated at the crematory near Pittsburg.

Mixture for Writing on Glass.

The preparation for writing on glass called "diamond ink," says the *American Druggist*, is to be used with a common pen, and at once etches a rough surface on the parts of glass it comes in contact with. It proves to be a very useful article for labeling bottles which are to contain liquids that will destroy common labels.

At the request of Professor Maisch an analysis was made, which proved it to be prepared ammonium fluoride, barium sulphate, and sulphuric acid. The barium sulphate seems to act as an absorbing medium, and when the semi-fluid mass is used, it makes a white mark, and prevents the spreading of the watery liquid; it also seems to make the acid etch a rougher surface.

It is made by mixing barium sulphate 3 parts, ammonium fluoride 1 part, and sulphuric acid a quantity sufficient for decomposing the ammonium fluoride and making the mixture of a semi-fluid consistency.

The sample examined was contained in a glass bottle holding nearly two fluid drachms, and which was thickly coated on the outside with asphaltum, on the inside with a thick stratum of beeswax, and was stoppered with a rubber stopper.

It is claimed by the manufacturer that the mixture contains no hydrofluoric acid and does not corrode a pen; but of course it does corrode a pen, and hydrofluoric acid is the one thing that does the etching. Any one making this mixture and wishing to keep it in a glass, may coat the bottle inside with paraffin, beeswax, or rubber. It should be prepared in a leaden dish, and is preferably kept in a gutta percha or leaden bottle.

NOVEL METHOD OF PROTECTING VESSELS AGAINST TORPEDO ATTACKS.

The idea that a small torpedo or torpedo boat can most effectually and thoroughly destroy the largest ironclad afloat, if the explosion takes place immediately against the hull of the vessel, is extremely general. The protection of the hulls of these vessels against attacks by submarine torpedo boats has, therefore, received wide attention, although it does not seem that the art, so to speak, has advanced as far as that of the torpedo; and if this be the case, much remains to be done before these powerful little annihilators can be considered contemptible. The accompanying engraving clearly illustrates a method—proposed by Mr. E. F. De Celis, of Los Angeles, Cal.—by means of which a vessel may be warned of the approach of a submarine torpedo. Briefly, this plan consists in providing the hull with a series of bull's eyes below the water line, through which a powerful light may be thrown to illuminate the surrounding water. Alongside of each bull's eye is a glass-covered opening, through which a close watch of the water may be maintained, and the approach of a torpedo noted. Commenting upon the probable effectiveness of this method, Mr. De Celis says: "Is there anything to prevent it (the ironclad) from exploding the torpedo or torpedo boat by means of a dirigible torpedo before it comes

within the proper distance to do any harm? This device can be applied at very small cost to any vessel," and "now that 'Uncle Sam' is going into ship building for war purposes, it would not be a bad idea to suggest this possible improvement for the *to be men-of-war*."

certainly, if private capital shall undertake the building of this latest wonder of the world, Mexico can afford to favor the enterprise in every legitimate way without spending any money thereon. Under the provisions of the bill passed by the Senate of the

United States, the capital stock of the Ship Railway Company is fixed at \$100,000,000, of which ten per cent must be subscribed and \$1,000,000 paid in cash before a meeting of the directors is held and certificates issued. Bonds are not to be authorized, or issued, until the paid up capital amounts to \$5,000,000. There is, of course, under this arrangement, no mention of a government guarantee of interest payments. We are glad that the scheme has been taken out of the domain of governmental guardianship, for, if the plan be a sound one, there are plenty of bold investors who will furnish the money to construct what we believe will be a formidable rival to De Lesseps' ship canal at Panama. It is quite within the domain of probability that Captain Eads will be conveying ships across the narrowest part of Mexico many years before De Lesseps will be towing ships through his great ditch at the more southern isthmus."

The above is from the *Mexican Financier*, the most influential newspaper in the interests of banking, railroads, and commercial affairs published in Mexico. The death of Captain Eads may re-

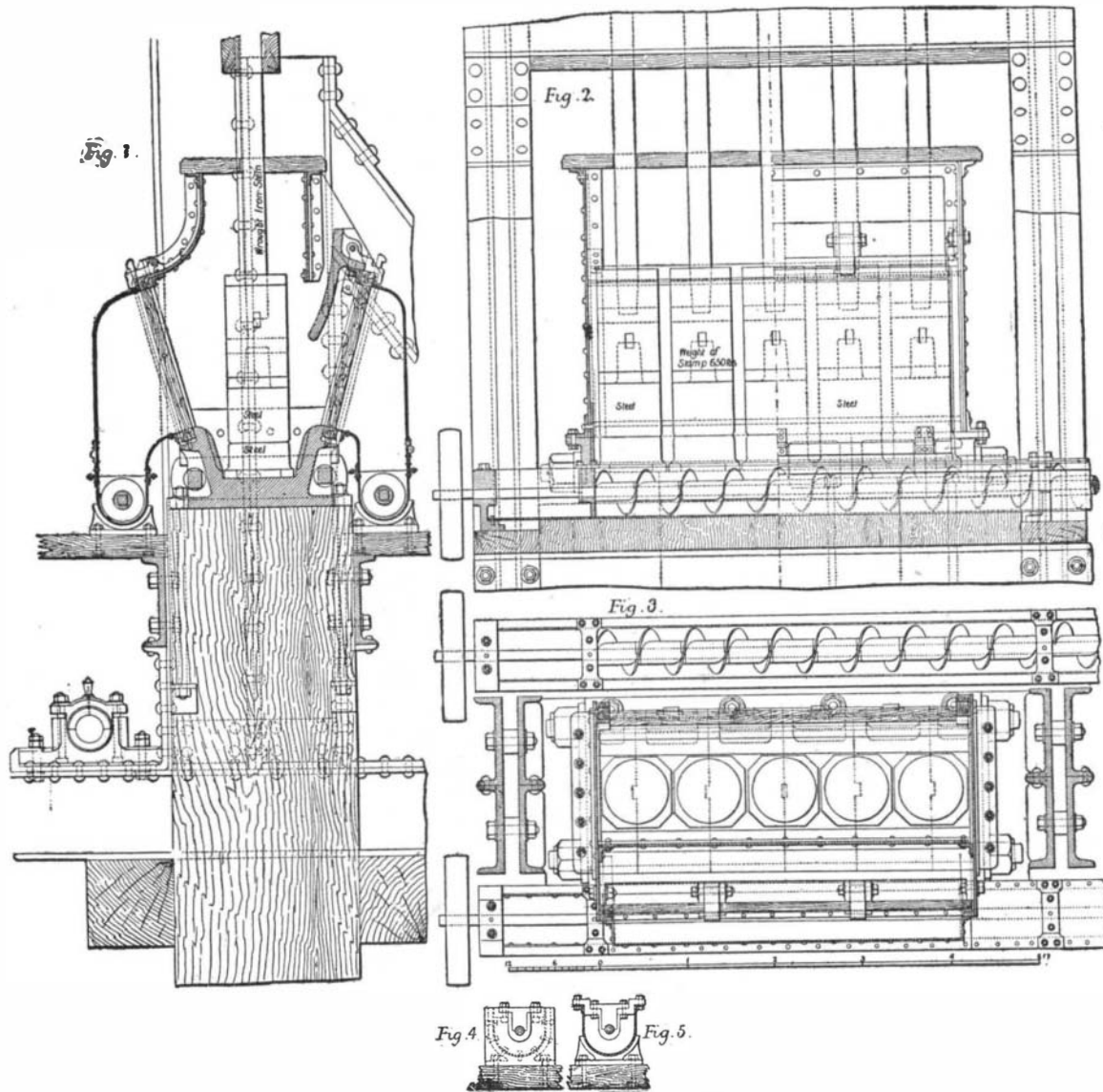
tard the ship railway enterprise, but there are other living promoters of the enterprise, who are energetic and determined on carrying forward the work so well begun by Captain Eads.

Artesian Wells in the Desert.

Respecting the plan of Colonel Landas for fertilizing the African desert by means of wells, Sir R. Lambert Playfair, in the course of a consular tour in Tunis, has visited the ground where the first well was sunk, and reports most favorably as to the success of the project. A space of 375 acres has been cleared, and sown with cereals and lucerne, a vegetable garden been made, and a nursery of young trees planted. Two other wells are being sunk, which on completion will irrigate 7,500 acres of land. The Bey of Tunis has conceded to the company 25,000 acres of land, which they can select themselves from districts which are at present of no value.

Freezing Mixture.

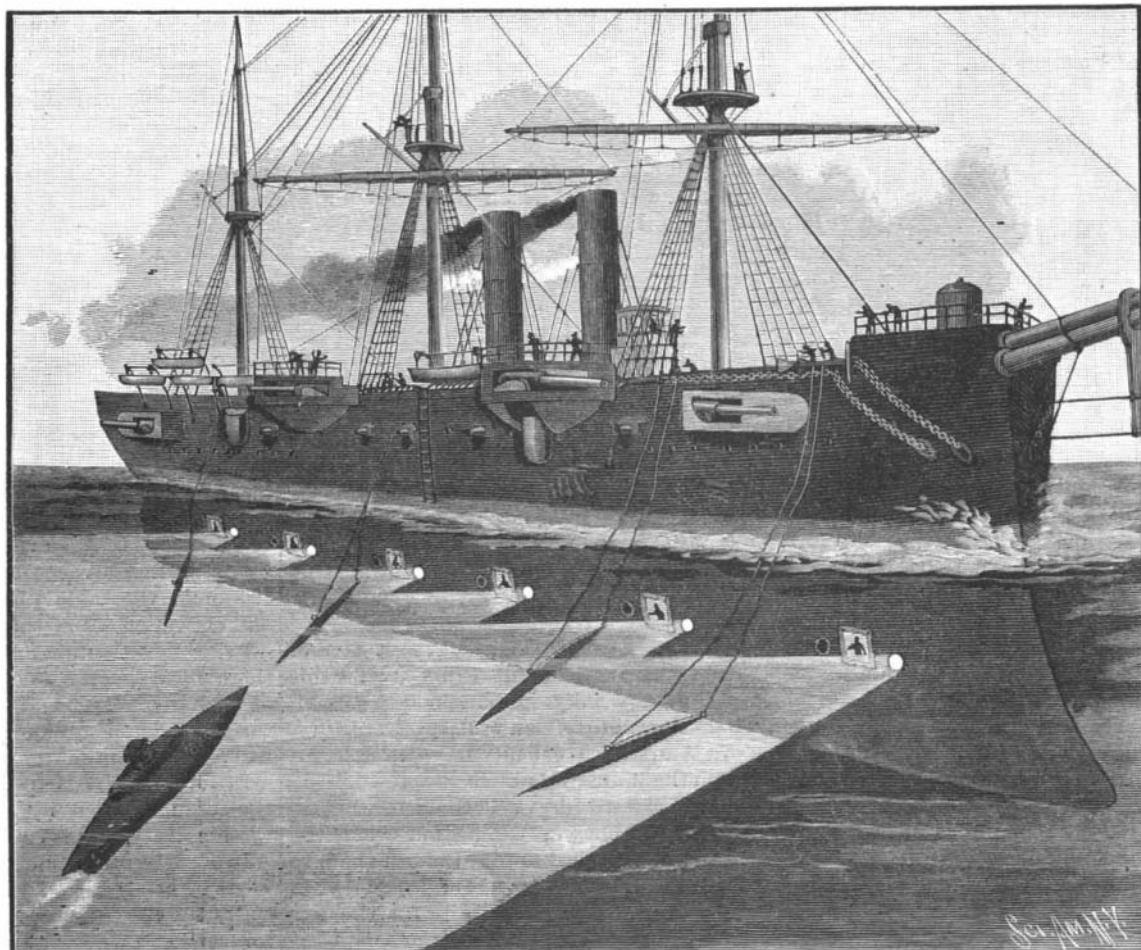
A liquid invented by Raoul Pictet, of Geneva, Switzerland, for use as a disinfectant, answers well as a freezing mixture for hardening microscope specimens. Sulphur dioxide and carbon dioxide, having been mixed and cooled, are compressed until they are liquid, and stored in siphons. When liberated, they rapidly evaporate with great reduction of temperature. By this means mercury may be frozen, and animal or vegetable tissues rendered solid in a few seconds. It is as easily managed and more effective than ether, the odor being the principal objection.



IRON FRAMED STAMPER BATTERY.

The Tehuantepec Ship Railway.

"Should the House of Representatives at Washington pass the Senate bill incorporating the Ship Railway Company, this huge scheme will be then presented to the attention of the great capitalists of the world, and, as the plans of Captain Eads have received the cordial approval of a great number of eminent naval engineers and competent constructors, it may be considered as certain that he will meet with a respectful and attentive hearing. Now that Captain Eads and his friends have abandoned the scheme of a joint governmental guarantee, Mexico may be regarded as entirely released from any future demands on her treasury on account of the ship railway; and



SUBMARINE LIGHT FOR TORPEDO BOAT.