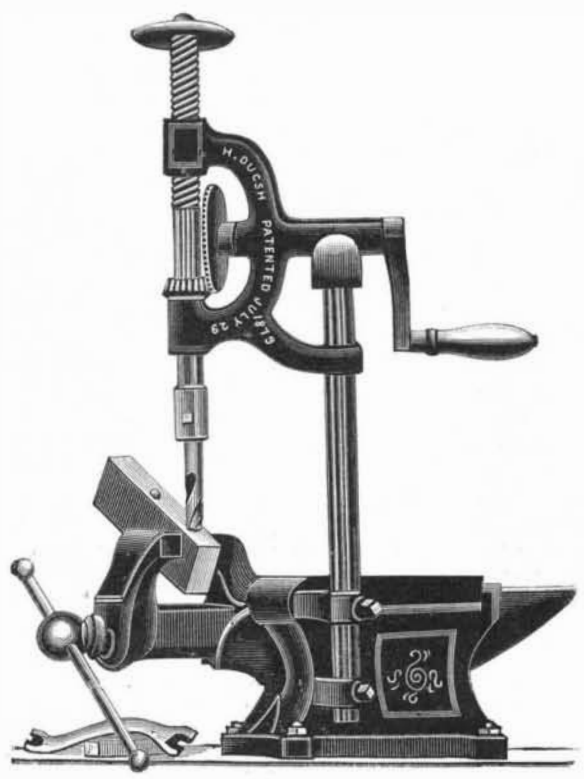
coal thus deprived of the yellow substance, or containing mere traces of it, there is poured anhydrous ether, or, better still, light petroleum oil, which does not dissolve the yellow substance. Those solvents take up the chlorophyl, and yield a deep green liquid, from which the latter can be crystallized out by slow evaporation in the dark."

NEW VISE AND ANVIL DRILL.

We give herewith an engraving of a combination tool of great utility, made by the Miller's Falls Company, of Mil-



VISE AND ANVIL DRILL.

ler's Falls, Mass., and 74 Chambers street, New York city. With this tool the work can be held in the jaws of the vise in any desirable position, and a hole may be drilled either straight or at any required angle. It seems well adapted to the work of machinists and all other mechanics working in metals. It is fastened on a bench like an ordinary vise, as shown in the engraving. The drill press can be removed in an instant when the vise or anvil is wanted separately.

This combination tool is capable of a wide range of application in various kinds of iron and steel hand work. It is well made in all its parts, and only the best materials are used in its construction. The shaft to which the drill press is fastened and the spindle are both made of steel. Each machine is furnished with a chuck capable of holding drills from half an inch down.

A Supposed Unseen Outer Planet.

In a paper communicated lately to *La Nature*, M. Flammarion shows reason for supposing that probably a planet exterior to Neptune has been the determining cause of the orbit of the comet of 1862 (which has been surely determined), and describes its course round the sun, about the distance of the aphelion of this comet, and of the classical stream of meteors of the month of August. (It is known that Leverrier attributed to Uranus the introduction into our system of the stream of November meteors, and supposed the perturbation to have occurred in the year 126 of our era.)

ELECTRICAL PRESSURE INDICATOR.

The annexed engraving represents an improved pressure temperature indicator, designed to serve the very important office of indicating maximum and minimum pressures and temperatures. The importance of this class of inventions must be acknowledged by engineers, superintendents, and others who are required to give daily attention to these matters.

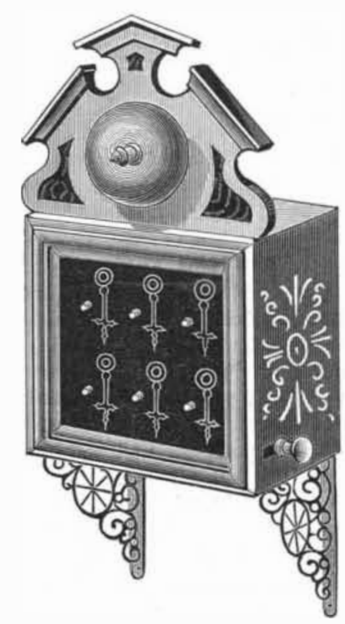
In all operations pertaining to the use of pressure or temperatures, there is generally some considerable range of pressure or temperature not in any way injurious; but extremes of high or low pressure or temperature are to be avoided for obvious reasons. If the pressure is too low, work is delayed and in some cases goods are injured. In either case loss will ensue; while, if the pressure run to the other extreme, it may reach a point where rupture must result. To avoid these extremes, the ordinary instruments indicating the pressures or temperatures are required to be carefully watched by the attendant, a duty that is sure to become wearisome in time, with a possibility of neglect at an important moment. Disaster is too often traceable to inattention of this kind.

The indicator shown in the engraving is a faithful servant, standing sleeplessly on guard day and night, ready to give warning when the extreme of either high or low pressure is approached by ringing a small bell placed in any room however distant, within hearing of the operator, thus enabling the attendant to perform other duties with an assurance that he will receive prompt notice of any considerable variation of pressure or temperature. When the device is to be used for indicating pressure it is attached to any of the ordinary spring pressure gauges, and when used to indicate temperatures it is connected with a pyrometer.

The device shown in Fig. 1 represents an ordinary spring pressure gauge, on the spindle of which is secured a crank arm, A, with a projecting crank pin on its outer end; the glass front of the gauge is bored for the reception of a post that has double washers on the opposite side of the glass to which pins, B and C, are attached. The washers turn upon a central screw in the post, enabling the pins, B and C, to be moved and secured in any desired position around the center of the post. A wire connects the central post with the batteries, passing in the circuit through a switch, D, and bell, E, back to the gauge.

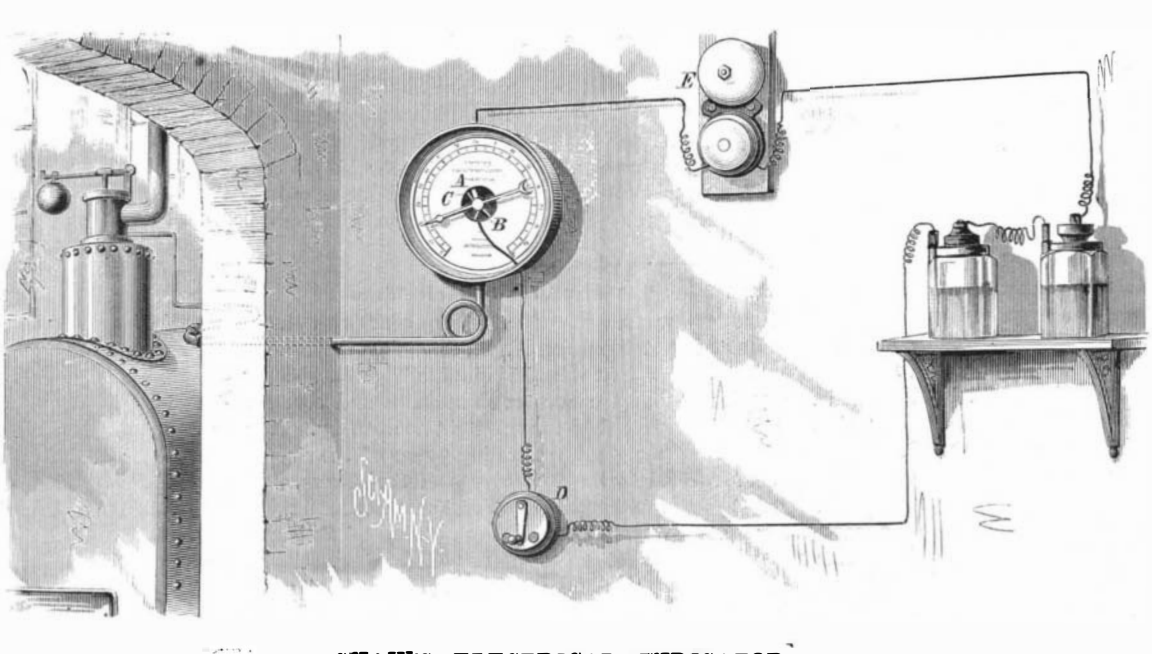
The electrical circuit is completed or broken automatically by the rotation of crank arm, A, which coming into contact with the pin, C, completes the electric circuit, and rings the bell, E. This bell may be placed at any distance from the instrument, and will indicate the minimum pressure. A reverse movement of the spindle brings crank arm, A, into contact with pin, B, indicating the maximum pressure. An alarm at either extreme signifies that the attention of the attendant is now required. The switch, D, is provided to admit of disconnecting the electrical indicator whenever desired. This is found necessary when the device is used in connection with water tanks, reservoirs, etc., to prevent the bell ringing after the proper attention has been given.

In cases where it is desired to connect a number of boilers or tanks to one bell, a device not unlike a hotel annunciator is used (Fig. 2). The bell rings at the proper time, and the needle point shows the location of the boiler that requires attention.



SHAW'S PRESSURE ANNUNCIATOR.

This appliance is adapted to all kinds of spring gauges, and to Shaw's standard mercury gauges. The batteries employed are reliable, requiring only a little water to supply waste of evaporation once in the course of two or three months, and about once a year a few crystals of sal ammoniac are to be added.



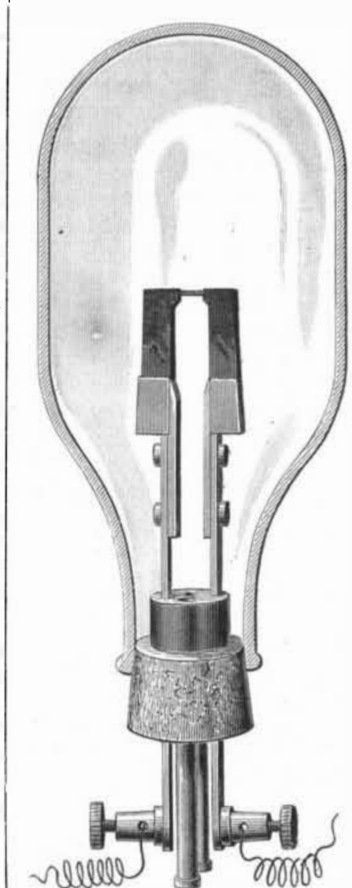
SHAW'S ELECTRICAL INDICATOR.

In large works the electric bell may be placed in the office or any part of the building, and will give instant notice if steam is too low to perform work, or so high that it is dangerous. The device seems capable of a great variety of applications, and will undoubtedly prove a watchful, faithful, and inexpensive servant.

For further particulars address the patentee, Mr. Thos. Shaw, at steam gauge warerooms, 915 Ridge Avenue, Philadelphia, Pa.

IMPROVED ELECTRIC LAMP.

We give herewith an engraving of an electric lamp patented by the well known electrical inventor, Mr. Moses G. Farmer, of Newport, R. I. A globe made of glass, and having an air-tight stopper fitted to its lower end, contains a small bar of carbon supported by two large blocks of the same material, mounted on the ends of two bars of metal extending downward through the stopper, and provided with binding posts for receiving the wires from an electrical generator. Two small tubes enter the globe through the stopper, for the purpose of substituting for the common air contained in the globe a vacuum or an atmosphere of some suitable gas. The small carbon rod offers great resistance to the passage of the electrical current, and is consequently heated to incandescence, and produces a brilliant light without consuming either itself or the gas contained in the globe.



FARMER'S ELECTRIC LAMP.

The Harnessing of Electricity.

Mr. W. H. Barlow, the new president of the Institution of Civil Engineers, London, in his recent inaugural address, speaking of the rapid growth of telegraphy and other practical applications of electricity, said that the diminution of power, from increased length of the conducting wire, had been surmounted by relays of power at fixed stations. (This was the discovery of Morse.) By employing this ingenious expedient on the Indo-European Telegraph, Calcutta had frequently been put in direct communication with London, a distance of 7,000 miles.

He further stated that Dr. C. W. Siemens had ascertained that, including all sources of loss, 50 per cent of the original power could be realized by electric wires at a distance of one mile from the motor; and that with adequate provisions against heating it would be no dearer to transmit electromotive power to a greater than to a smaller distance. Sir William Armstrong, by means of an electro machine and wire works his circular saw at a distance of a mile from the water wheel that turns the electric machine. By the same means Dr. Werner Siemens works a locomotive that carried thirty persons.

ENGINEERING INVENTIONS.

Mr. James A. Stout, of Belleville, Ill., has patented a traction engine in which the propelling power is applied directly to an adjustable front axle, and the axle is provided with a universal or ball joint motion. The boiler is of novel construction and designed with a view to economy and safety.

An improved rock drill, patented by Mr. John Brown, of Ishpeming, Mich., is so constructed that the piston and tool may be rotated by the entering air or steam, and that the entrance and exit of the air or steam will be controlled by the movements of the piston.

Mr. James E. Purdy, of Tallahassee, Fla., has patented a means for connecting cars, which is so constructed that the cars will couple themselves when run together, and will not be liable to become accidentally uncoupled.

Mr. James Morton, of Philadelphia, Pa., has patented a hydraulic engine of peculiar construction for converting into mechanical power and motion the pressure of a column of water.

A wheel guard for railway cars, patented by Mr. Salomon Brisac, of New York city, is designed to prevent injury to persons who may accidentally fall in front of car wheels, and also to prevent the car wheels from coming in contact with obstructions on the track.

Mr. Orlando H. Jadwin, of New York city, has patented an improvement in the system of car propelling, in which an endless cable of wire rope is made to travel over a given route by the action of stationary engines, and the cars or other bodies are either connected to the cable to be drawn along by it, or are disconnected from it, by means of a clutch affixed to the car. The invention consists in this clutch or tension device, which is loosely connected with the car and formed of three principal parts—a pulley, a foot for holding the rope to the pulley, and a brake upon the opposite side of the pulley from the foot—these parts being arranged in such relation that a pressure of the brake upon the periphery of the pulley projects the pulley against the rope, and gradually clamps the same between the pulley and foot until the car attains the speed of the traveling cable.

Determination of Carbonic Acid in the Atmosphere.

The amount of carbonic acid in the atmosphere out-of-doors varies but little from day to day and from year to year. In-doors it is quite otherwise. In winter we close the windows to keep out the cold air, and in so doing prevent the exit of the impure air poisoned by combustion of coal in the stoves and oil in our lamps, as well as the exhaled effluvia of the breath. To determine the quantity of carbonic acid in a church, school, or theater is a guide in judging of the success or failure of its ventilation. The usual method consists in drawing a measured quantity of such air through baryta solution and weighing the precipitated carbonate.

Kapusstin has described a quicker and easier method, dependent upon the fact that 70 per cent alcohol will not dissolve carbonate of soda, while dilute alcohol will do so.

He dissolves ½ gramme of caustic soda in 1 liter of alcohol. He pours 75 c.c. of this solution into a 5 liter bottle full of the air to be tested, shakes it for half an hour, and pours it out, stirs it well, and draws off 25 c.c. of the turbid liquid. To this he adds water from a burette until the turbidity, due to undissolved carbonate of sodium, disappears, and multiplies the amount of the water by three. The following formula now gives the number of cubic centimeters (x) of carbonic acid at normal temperature and pressure contained in 5 liters of air, when n is the number of cubic centimeters of water necessary to dissolve the carbonate of sodium:

$$x = \frac{n - 6{\cdot}5}{0{\cdot}55}$$

This method is specially recommended for sanitary purposes, as the number of determinations made can be very large.

Oxalic Acid and its Salts.

BY DR. J. SCHNAUSS.

Oxalic acid is found pretty abundantly in the juices of plants in combination with calcium and potassium, and in the latter case in the form of acid salt of potassium. The juice of *Rumex acetosa, Oxalis acetosella,* and other similar plants, all contain this substance.

This acid oxalate of potassium is soluble with difficulty in cold water, on account of the property it possesses of dissolving ferrous salts almost to as great an extent as oxalic acid itself; it is used for removing ink and iron-mould spots. Oxalic acid can be prepared from this salt, as also from sugar, by oxidizing it with nitric acid. Of late years it has been obtained from sawdust, by heating that substance with sodium carbonate in the form of hydrous acicular crystals ($C_2H_2O_2+2H_2O$). It can be easily deprived of its water of crystallization, and this anhydrous acid is said to be capable of sublimation undecomposed; but if the hydrate be heated quickly in closed vessels it decomposes into carbonic oxide, carbonic anhydride, and formic acid. Heated with concentrated sulphuric acid (H_2SO_4) it separates into equal parts of carbonic acid gas and carbonic oxide.

In photography, oxalic acid is employed on account of its property of reducing the salts of the precious metals in the presence of light and heat, and also of readily dissolving the salts of iron, which are otherwise insoluble in water, even when in combination with a base. In the latter case the corresponding double salt is formed. The acid is often used as a reducing agent for the salts of silver; and it may be also so employed for those of gold, instead of the generally recommended iron sulphate. Recently oxalic acid, in combination with iron and potassium, has been employed for developing gelatine emulsion plates; it has been applied also to photometry, by Van Monckhoven, in combination with uranium, and by Eder in combination with mercury.

The uranium and mercury oxalates owe their employment for photometrical purposes to the fact that, when exposed to the sunlight, they are immediately decomposed, and give off carbonic acid gas, which, by means of a simple apparatus, can be made to raise a column of fluid in a small graduated tube. In this case, however, the pressure of the fluid column and the absorption of the gas must be taken into consideration or eliminated.

Of the less known oxalates, perhaps the most interesting is the double oxalate of iron and manganese. It can be easily prepared by nearly saturating acid oxalate of ammonia (or the neutral salt, acidulated with free oxalic acid) with hydric peroxide of manganese (MnO_2+H_2O), the operation must be effected in the dark. A solution of a splendid red color is formed, which, brought into the clear light of day, almost instantaneously loses its color with violent effervescence.

The hydric oxide of manganese required for this reaction may be prepared by precipitation from a solution of manganese sulphate ($MnSO_4$) by means of the so-called *Eau de Javelle,* a solution of sodium hypochlorite ($NaClO$) rendered alkaline by the addition of a slight quantity of sodium hydroxide. This black precipitate is well washed on the filter or by decantation, and then dissolved in acid ammonium oxalate.

Very sensitive is a piece of filter paper dipped in a mixture of permanganate of potash ($KMnO_4$) and oxalic acid—of course prepared in the dark. When exposed to direct sunlight, decomposition ensues instantaneously; even in the dark the red color is only permanent for a few minutes. If a solution of copper sulphate be mixed with one of ammonia oxalate of iron, and a glass vessel full of the mixture be set in the sun, the side of the vessel which is towards the sun will be coated with metallic copper. This reduction does not take place in the dark. Nevertheless, it is a question whether it be due to the direct action of light on the oxalate of copper that is formed; probably ferro-oxalate is first formed, and this, by loss of oxygen, is converted into ferri-oxalate.—*Photo. News.*

The Value of the Diamond Drill.

Mr. A. J. Severance, of San Francisco, says that the diamond drill has played a very important part in developing the mineral wealth of the West. The first great treasure house which these drills opened up was that known as the Consolidated Virginia and the California Bonanzas, which have yielded $107,000,000, of which the stockholders have received $74,000,000 in dividends. One of the owners of the mines told Mr. Severance that the diamond drill had realized for him $5,000,000. All of the principal Comstock mines, and many of the largest mining properties located in California and Nevada, use these drills. They are also extensively used in Colorado; have pushed their way to most of the Territories; have been introduced and operated in New Mexico, old Mexico, and Australia. The Japanese Government has also been supplied with them.

Mr. Severance enjoys the distinction of having perfected the diamond drill, and of proving its utility by running a horizontal hole (then regarded an impossibility) eight hundred feet, taking out a complete cylindrical core, and showing the strata of every inch of rock passed through. This was done in Vermont. Soon after he introduced the drill upon the Pacific coast, with the results already noted.

Artificial Vanilline.

Whenever the synthetical chemist produces any well known substance artificially it meets with more or less opposition from persons who are not convinced that it is identical with the natural product. The *Badische Gewerbe Zeitung* publishes for artificial vanilline the following indorsement from Prof. Meidinger:

Artificial vanilline possesses undeniable advantages over natural vanilla. The latter loses its aroma easily and frequently spoils completely, while the former can be kept for any desirable length of time without the slightest change in quality. The activity of vanilla is very unequal, as the percentage of vanilline in the beans varies; hence a uniform flavor can only be obtained by the use of vanilline. The vanilla bean contains only 2 per cent of valuable material, with 98 per cent or more of worthless or even injurious matter, coloring and resinous, the removal of which is troublesome and tedious, before the pure flavor can be obtained. Cases of illness that occasionally follow the use of vanilla ices are probably referable to such impurities extracted from the bean itself.

In Germany the vanilline is mixed with sugar and put up in packages of different strength for different purposes. That prepared for chocolate manufacturers is 70 times as strong as good vanilla, or 50 times the strength of the finest vanilla. That intended for family use is put up in packages equal to one bean, and sold at 9 cents each. The vanilla essence for liqueur manufacturers contains 2 per cent of vanilline, and 2 grammes will flavor 1 liter of the liquor employed.

Dr. Meidinger has used artificial vanilline in his own house, and is able to speak from personal experience as well as from a chemical knowledge of its preparation and constitution.

Penetrative Power of the Electric Light.

Some time ago we mentioned an experiment with the Maxium light made at Saratoga, N. Y., to test the distance at which the electric light would illuminate a given spot, and it was found that a concentrated beam carried seven miles (to Ballston) furnished enough light to read by. A more crucial test of the great penetrating power of the electric light is furnished by the experiments of the officers of the French-Algerian Triangulation Service, who recently saw the electric light from the Spanish station of Zetica, from a distance of more than 164 miles. This observation is proof, if proof were wanted, of the great value of the light for maritime purposes, when it is exhibited from sufficiently elevated positions.

Cements.

Quite as much depends upon the manner in which a cement is used as upon the cement itself. The best cement that ever was compounded would prove entirely worthless if improperly applied. The following rules, says the *Druggists Circular,* must be rigorously adhered to if success would be secured:

1. Bring the cement into intimate contact with the surfaces to be united. This is best done by heating the pieces to be joined in those cases where the cement is melted by heat, as in using resin, shellac, marine glue, etc. Where solutions are used, the cement must be well rubbed into the surfaces, either with a soft brush (as in the case of porcelain or glass), or by rubbing the two surfaces together (as in making a glue joint between two pieces of wood).

2. As little cement as possible should be allowed to remain between the united surfaces. To secure this the cement should be as liquid as possible (thoroughly melted if used with heat), and the surfaces should be pressed closely into contact (by screws, weights, wedges, or cords) until the cement has hardened.

3. Plenty of time should be allowed for the cement to dry or harden, and this is particularly the case in *oil* cements, such as copal varnish, boiled oil, white lead, etc. When two surfaces, each half an inch across, are joined by means of a layer of white lead placed between them, six months may elapse before the cement in the middle of the joint has become hard. In such cases a few days or weeks are of no account; at the end of a month the joint will be weak and easily separated, while at the end of two or three years it may be so firm that the material will part anywhere else than at the joint. Hence when the article is to be used immediately, the only safe cements are those which are liquefied by heat and which become hard when cold. A joint made with marine glue is firm an hour after it has been made. Next to cements that are liquefied by heat are those which consist of substances dissolved in water or alcohol. A glue joint sets firmly in twenty-four hours; a joint made with shellac varnish becomes dry in two or three days. Oil cements, which do not dry by evaporation, but harden by oxidation (boiled oil, white lead, red lead, etc. etc.) are the slowest of all.

Aquarium Cement.—Litharge, fine, white, dry sand, and plaster of Paris, each 1 gill; finely pulverized resin, 1-3 gill. Mix thoroughly and make into a paste with boiled linseed oil to which drier has been added. Beat it well, and let it stand four or five hours before using it. After it has stood for 15 hours, however, it loses its strength. Glass cemented into its frame with this cement is good for either salt or fresh water. It has been used at the Zoological Gardens, London, with great success. It might be useful for constructing tanks for other purposes or for stopping leaks.

Casein Mucilage.—Take the curd of skim milk (carefully freed from cream or oil), wash it thoroughly, and dissolve it to saturation in a cold concentrated solution of borax. This mucilage keeps well, and as regards adhesive power far surpasses the mucilage of gum arabic.

Casein and Soluble Glass.—Casein dissolved in soluble silicate of soda or potassa makes a very strong cement for glass or porcelain.

Cheese Cement for Mending China, etc.—Take skim milk cheese, cut it in slices and boil it in water. Wash it in cold water and knead it in warm water several times. Place it warm on a levigating stone and knead it with quicklime. It will join marble, stone, or earthenware so that the joining is scarcely to be discovered.

Chinese Cement (Schio-liao).—To three parts of fresh beaten blood are added four parts of slaked lime and a little alum; a thin, pasty mass is produced, which can be used immediately. Objects which are to be made specially waterproof are painted by the Chinese twice, or at the most three times. Dr. Scherzer saw in Pekin a wooden box which had traveled the tedious road via Siberia to St. Petersburg and back, which was found to be perfectly sound and waterproof. Even baskets made of straw become, by the use of this cement, perfectly serviceable in the transportation of oil.

Pasteboard treated therewith receives the appearance and strength of wood. Most of the wooden public buildings of China are painted with schio-liao, which gives them an unpleasant reddish appearance, but adds to their durability. This cement was tried in the Austrian Department of Agriculture, and by the "Vienna Association of Industry," and in both cases the statements of Dr. Scherzer were found to be strictly accurate.

Faraday's Cup Cement.—Electrical Cement.—Resin, 5 oz.; beeswax, 1 oz.; red ocher or Venetian red in powder, 1 oz. Dry the earth thoroughly on a stove at a temperature above 212°. Melt the wax and resin together and stir in the powder by degrees. Stir until cold, lest the earthy matter settle to the bottom. Used for fastening brass work to glass tubes, flasks, etc.

Cement for Glass, Earthenware, etc.—Dilute white of egg with its bulk of water and beat up thoroughly. Mix to the consistence of thin paste with powdered quicklime. Must be used immediately.

Glass Cement.—Take pulverized glass, 10 parts; powdered fluorspar, 20 parts; soluble silicate of soda, 60 parts. Both glass and fluorspar must be in the finest possible condition, which is best done by shaking each in fine powder, with water, allowing the coarser particles to deposit, and then to pour off the remainder, which holds the finest particles in suspension. The mixture must be made very rapidly, by quick stirring, and when thoroughly mixed must be at once applied. This is said to yield an excellent cement.

Gutta Percha Cement.—This highly recommended cement is made by melting together, in an iron pan, two parts common pitch and one part gutta percha, stirring them well together until thoroughly incorporated, and then pouring the liquid into cold water. When cold it is black, solid, and elastic; but it softens with heat, and at 100° Fah. is a thin fluid. It may be used as a soft paste, or in the liquid state, and answers an excellent purpose in cementing metal, glass, porcelain, ivory, etc. It may be used instead of putty for glazing windows.

Iron Cement for Closing the Joints of Iron Pipes.—Take of coarsely powdered iron borings, 5 lb.; powdered sal-ammoniac, 2 oz.; sulphur, 1 oz.; and water sufficient to moisten it. This composition hardens rapidly; but if time can be allowed it sets more firmly without the sulphur. It must be used as soon as mixed and rammed tightly into the joint.

2. Take sal-ammoniac, 2 oz.; sublimed sulphur, 1 oz.; cast iron filings or fine turnings, 1 lb. Mix in a mortar and keep the powder dry. When it is to be used, mix it with twenty times its weight of clean iron turnings, or filings, and grind the whole in a mortar; then wet it with water until it becomes of convenient consistence, when it is to be applied to the joint. After a time it becomes as hard and strong as any part of the metal.

Kerosene Oil Lamps.—The cement commonly used for fastening the tops on kerosene lamps is plaster of Paris, which is porous and quickly penetrated by the kerosene. Another cement which has not this defect is made with three parts of resin, one of caustic soda, and five of water This composition is mixed with half its weight of plaster of Paris. It sets firmly in about three quarters of an hour. It is said to be of great adhesive power, not permeable to kerosene, a low conductor of heat, and but superficially attacked by hot water.

Cement for Uniting Leather and Metal.—Wash the metal with hot gelatine; steep the leather in an infusion of nut galls (hot) and bring the two together.

Cement for Leather Belting.—One who has tried everything says that after an experience of fifteen years he has found nothing to equal the following: Common glue and isinglass, equal parts, soaked for 10 hours in just enough water to cover them. Bring gradually to a boiling heat and add pure tannin until the whole becomes ropy or appears like the white of eggs. Buff off the surfaces to be joined, apply this cement warm, and clamp firmly.

Litharge and Glycerine Cement.—A cement made of very finely powdered oxide of lead (litharge) and concentrated glycerine unites wood to iron with remarkable efficiency. The composition is insoluble in most acids, is unaffected by the action of moderate heat, sets rapidly, and acquires an extraordinary hardness.

Cement for Attaching Metal to Glass.—Copal varnish, 15; drying oil, 5; turpentine, 3. Melt in a water bath and add 10 parts slaked lime.

Paris Cement for Mending Shells and other Specimens.—Gum arabic, 5; sugar candy, 2; white lead, enough to color.

Porcelain Cement.—Add plaster of Paris to a strong solution of alum till the mixture is of the consistency of cream. It sets readily, and is said to unite glass, metal, porcelain, etc., quite firmly. It is probably suited for cases in which large rather than small surfaces are to be united.

Soft Cement.—Melt yellow beeswax with its weight of turpentine, and color with finely powdered Venetian red. When cold it has the hardness of soap, but is easily softened and moulded with the fingers, and for sticking things together temporarily it is invaluable.

Soluble Glass Cements.—When finely pulverized chalk is stirred into a solution of soluble glass of 30° B. until the mixture is fine and plastic, a cement is obtained which will harden in between six and eight hours, possessing an extraordinary durability, and alike applicable for domestic and industrial purposes. If any of the following substances be employed besides chalk, differently colored cements of the same general character are obtained: 1. Finely pulverized or levigated stibnite (gray antimony, or black sulphide of antimony) will produce a dark cement, which, after long burnishing with an agate, will present a metallic appearance. 2. Pulverized cast iron, a gray cement. 3. Zinc dust (so-called zinc gray), an exceedingly hard gray cement, which, after burnishing, will exhibit the white and brilliant appearance of metallic zinc. This cement may be employed with advantage in mending ornaments and vessels of zinc, sticking alike well to metals, stone, and wood. 4. Carbonate of copper, a bright green cement. 5. Sesquioxide of chromium, a dark green cement. 6. Thénard's blue (cobalt blue), a blue cement. 7. Minium, an orange colored cement. 8. Vermilion, a splendid red cement. 9. Carbon red, a violet cement.

Sorel's Cement.—Mix commercial zinc white with half its bulk of fine sand, adding a solution of chloride of zinc of 1·26 specific gravity, and rub the whole thoroughly together in a mortar. The mixture must be applied at once, as it hardens very quickly.

Steam Boiler Cement.—Mix two parts of finely powdered litharge with one part of very fine sand, and one part of quicklime which has been allowed to slake spontaneously by exposure to the air. This mixture may be kept for any length of time without injuring. In using it a portion is mixed into paste with linseed oil, or, still better, boiled linseed oil. In this state it must be quickly applied, as it soon becomes hard.

Turner's Cement.—Melt 1 lb. of resin in a pan over the fire, and, when melted, add ¼ of a lb. of pitch. While these are boiling add brick dust until, by dropping a little on a cold stone, you think it hard enough. In winter it may be necessary to add a little tallow. By means of this cement a piece of wood may be fastened to the chuck, which will hold when cool; and when the work is finished it may be removed by a smart stroke with the tool. Any traces of the cement may be removed from the work by means of benzine.

Wollaston's White Cement for Large Objects.—Beeswax, 1 oz.; resin, 4 oz.; powdered plaster of Paris, 5 oz. Melt together. To use, warm the edges of the specimen and use the cement warm.

The Steam Fire Engine.

The following suggestions to engineers who have not had much experience in running engines are taken from the general orders of the New York Fire Department, and contain hints that should be useful in the care of all kinds of steam machinery:

1. In laying your fuel in the fire-box first lay plenty of shavings, then light dry kindling wood, filling your furnace full, which in most cases will give you steam enough by the time you arrive at a fire to commence work, provided you light your fire when you leave the house, which, as a general rule, is advisable.

2. If you use coal, be careful to keep a thin fire and not clog it. Use the coal in as large lumps as possible, and do not break it up unnecessarily in the furnace. The best coal for this purpose is clean cannel in lumps free from dirt and dust.

3. Be careful not to let so much fire collect under your engine as to burn the wheels. When working for a long time at fires there is some danger of doing so.

4. The Amoskeag boiler is an upright tubular boiler, with a submerged smoke-box and fire-box, surrounded with water. When the engine is running the water in the boiler should be carried so as to stand at the third gauge cock, which is placed near the top of the tubes, and it should never be carried below the center of the tubes, at which point the first gauge cock is located.

5. Avoid using an unnecessary amount of steam, the tendency is to use more than is required. From sixty to eighty pounds is as much as you will generally require to do good fire duty.

6. The engine has two suitable feed pumps for supplying the boiler with water. One of the pumps should be worked nearly all the time in order to keep water in the boiler at the proper height, and to preserve an even pressure of steam.

7. If brackish water is used for supplying the boiler, or if the boiler becomes foul from long use without being blown off, it is likely to foam or prime. If foaming occurs while the engine is working at a fire it may be prevented or diminished by opening the surface blow-off cock. After the engine is returned to the house, the water should be blown entirely out of the boiler through the blow-off cock near the bottom of the boiler with a steam pressure of about twenty pounds, and the boiler refilled with fresh water. This process may be repeated until the boiler becomes clean.

8. The pump upon the Amoskeag engine is a vertical double acting pump, with the cylinder surrounded by a circular chamber, divided vertically outside the cylinder so as to answer both for the suction and discharge chambers of the pump; it has a separate valve plate at the top and bottom of the pump carrying both the suction and discharge valves, the suction valve upon one side of the plate and the discharge valve upon the other. Each of those valve plates can be reached by taking off the top and bottom of the pump, which is so constructed as to be readily removed. The discharge and suction parts of the water chamber surrounding the cylinder are connected by a valve in the vertical partition which is called a relief valve.

9. With a single long line of hose it may be necessary to open your relief valve a little, but at all other times be particular to have it closed, except when you want to feed your boiler without forcing any water through the hose.

10. In the smokepipe, directly over the upper flue sheet, a valve is placed which is called the variable exhaust valve. By operating this valve the size of the aperture for the escape of the steam from the steam cylinder is increased or diminished, thus regulating the draught of the chimney and the heat of the fire. This valve should be closed when the engine is started until a fair working pressure of steam is obtained, after which it may be opened.

11. Care should be taken to have the suction hose and its connections air tight.

12. Open your discharge gate and cylinder drain cock before starting your engine.

13. Don't let the flues of your engine get filled up.

14. Be particular to take your engine off the springs before you work it and to place it on the springs again when done working.

15. With a long line of hose on be particular to open your throttle gradually. If you open it too suddenly you are liable to burst your hose.

16. The pumps of the engine should be examined at least once in six months to see that the valves and all parts are in good condition. The pump valves should have a lift of about three-eighths of an inch and the suction valves the same lift.

17. The inside of the steam cylinders and the steam valves should be oiled or tallowed always after the engine has been worked at a fire, and as often as it may be necessary to keep them well lubricated, and all the parts of the engine where liable to friction should be kept well oiled. Be particular to use an abundance of oil on the link block, where there is more friction than in any other part.

18. The running gear and every part of the engine liable to disarrangement or accident should be thoroughly examined every time after the engine has been out of the house, whether it has been worked at a fire or not.

19. Whenever your engine is repaired try to help to do it yourself, as by so doing you get familiarity with it that you can in no other way obtain. If the feed was turned on and the feed pumps were at work, but if the water did not run into the boiler, what would be done in such a case? To examine the hydrant and see if it was turned on or off; examine the check valve to see that it was in operation; this can be done by applying the ear to the chamber and ascertaining if the valve rises and falls at each stroke of the pumps, and also apply the hand to the pipe below the check valve in order to ascertain if it is cool; if they are all right, examine the blow-off cock and all other connections with the boiler to ascertain if they were closed; and if they are closed, the pumps must be pumping air into the boiler instead of water; also examine the pumps and induction pipes, in order to ascertain if they were not leaking, and if so stop the leak. If the check valve should not be in operation, examine the pumps, also the pump valves, and see if they were not bursted, either of which causes prevent the pumps from delivering water to the boiler.

There are four causes for feed pumps becoming hot, namely: 1st. There may be so small a quantity of eyedetious water used to cause it. 2d. It may be carried from muddy water or tight packing. 3d. The check valve and relieving valve may be caught up or very breaky, allowing the hot water from the boiler to run back to the pumps. 4th. External application of heat, the pumps being situated near the boiler.

Steam is a thin elastic fluid generated by the application of heat to any fluid (water generally used); the power of steam is its expansion; superheated steam is any steam which has been heated in a separate state to a high degree of temperature under pressure; in this condition its mechanical and chemical power are wonderfully increased. Water will boil at 212° Fah.

The following are the supplies which every engine in the department is furnished with: 20 feet of suction hose, a suitable brass strainer for suction hose, a brass hydrant connection for suction hose, a brass signal whistle, two plated gauges, one to indicate the pressure of steam upon the boiler and the other the pressure of water at the pumps or leading hose; two discharge pipes for leading hose, with a complete set of changeable nozzles, from ⅝ inch diameter to 1¼ inches diameter inclusive; two brass-bound fireman's hand lanterns, a large brass oil can, a jackscrew for convenience in oiling the axles, a coal shovel, and fire poker. A small tool-box furnished with such small tools as may be required about the engine when in use, such as hammers, wrenches, and the like.

Dimensions of a second-class double plunge engine, crane neck frame: Height from floor to top of smokestack, 8 feet 8 inches; length over all, including tongue, 23 feet 2 inches; diameter of boiler, 2 feet 7 inches; diameter of pumps, 4¼ inches; stroke of pumps, 8 inches; diameter of steam cylinders, 6⅝ inches; number of discharge gates, 2; capacity in gallons per minute, 700; weight, about 5,400 pounds. Second-class double pump crane neck engine: Diameter of grate surface, 32 inches; size of door, 8 by 12 inches; number of tubes, 258; diameter of tubes (internal), 1⅛ inches; bottom of boiler to bottom of fusion pipe, 20 inches; bottom of fusion pipe to 1st gauge cock, 12 inches; distance between gauge cocks, 5 inches; number of gallons to 3d gauge cock, 40 cubic feet; steam room, 3 feet.

American Losses by Fire.

The amount of losses in the United States by fire during 1879, as reported to insurance companies, was $77,703,700; add to this the uninsured losses that are not reported, and it will fall but little short of the $100,000,000 claimed as the annual loss in this country. Canada is not included in these reports.

In the four years, 1875-6-7 and 8, there were burned wholly or in part, in the United States: 1,354 hotels, 263 churches, 182 school houses, 40 court houses, 42 almshouses, hospitals, and asylums—1,883 in all. It would naturally be supposed that buildings of the character named would be built with more than ordinary care, but the record does not show such to be the case. Indeed, the more pretentious the building, the more careless seem to be the owners.

AGRICULTURAL INVENTIONS.

Mr. Joseph Custer, of Goshen, Ohio, has patented a seed planter, so constructed that it may be used for planting potatoes and small seeds, as required.

Mr. Nathan L. Brass, of Juniata, Neb., has patented an improved sulky-harrow, which is simple and convenient in use, being easily raised from the ground and adjusted to work at any desired depth in the soil.

A combined scraper and fork, patented by Mr. George P. Ruhle, of Swengel, Pa., is intended for use as a scraper, hay lifter or fork, and dung fork; and the invention consists in a novel combination and arrangement of parts, whereby the apparatus may be conveniently used for the purposes named.