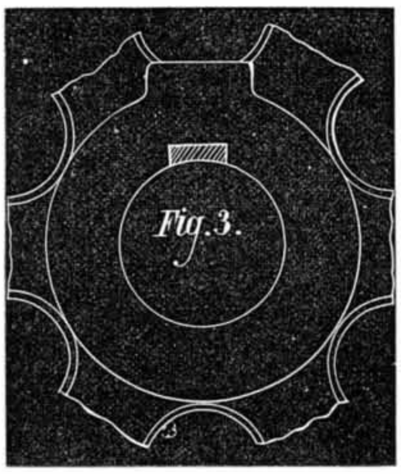
to fit these keys solid sidewise. They will invariably slack off the sides, and then waste their skill on the least important fit. Most visemen seem to think that, when they do this, they have a 'soft thing' in making the fit.

"These taper keys are miserable things anyhow, and cost $1 a lb., if properly fitted. They weaken the shaft, and cannot be made interchangeable. The all-absorbing top and bottom fit tends to split hubs, and makes a key cut and lock. Add to this latter the usual upsetting on the small end, and we have a fine mechanical contrivance.

"Where keys must be used, the proper form is parallel both ways, a neat fit on the sides, and with top clearance. A set screw bearing in the top of the key makes the arrangement firm endwise, and conveniently movable. Such keys are less expensive than taper keys, and can be made interchangeable.

"There is one form of key which possesses all the disadvantages of any taper key, but which has peculiar merits in cases where work is sent out without knowing just where the keyed fits are going to be. It requires no seat in the shaft. It will bruise a shaft enough to spoil it for a bearing, but will not weaken it. Hubs must be reinforced to stand the strain, for such keys drive by friction entirely. It does not look as though they would do the business at all, but they will. Fig. 3 shows the form. It is very much used by the



millwrights of the Northwest. The shops up there plane their keys out concave, from a steel strip. They are then cut off, and a little draft given to them. They are tempered blue. The circle of the key should be a trifle smaller than the shaft."

SETTING CALIPERS.

"Give an ordinary lathesman a pair of inside calipers (Haswell says *calibers*, and I think he is more than half right) and a six inch scale, and tell him to stand where he is and set them at 2 inches. They will be found to be about $\frac{1}{50}$ of an inch too large. Let him try it again, but with the privilege of butting one end of his scale up against something, the planed side of the tail stock of his lathe most generally; and he will get the calipers about $\frac{1}{100}$ too large. I have noticed that good, fair workmen, who have but one end of a thing to look out for, will work just about $\frac{1}{100}$ inch too large always, and many common workmen do worse The natural suggestion to my mind is that a lathesman should have a shouldered rule, one with a flange or button on one end, similar to a lumber rule. In addition a sliding sleeve, without set screw or vernier, would help him. Spring friction, holding the sleeve where set, would allow the calipers to be set by touch, and knocked into nicety, without having to hunt up the place on the scale a dozen times. Every lathesman knows that if, in adjusting his calipers, he goes too far two or three times, he begins to loose nerve and patient vision. The tool described would be a real convenience. The suggestion is made to the Providence scale men, for what it is worth.

FRENCH CALIPERS.

"Did you ever notice the ungainly caliper gages, or rules, or whatever they may be, which the refugees bring over from Alsace and Lorraine? They are big, clumsy things, about 14 inches long, and look like shoemakers' tools; but bad as they look, they are excellent contrivances. When you hire one of these refugees, he finds that we use inches, while his pet tool is graduated by centimeters; so he regretfully locks the ugly thing up for ever." LEFTWICK.

[For the Scientific American.]

GLYCERIN.

Glycerin is one of the constituents of the fixed oils and solid fats; and although discovered by Scheele nearly a century ago (1779), it is but a few years since it has become familiar to the unscientific public. The principal reason for this was that the processes of manufacture, in use until quite recently, rendered it too expensive.

Fats consist of two substances, namely, glycerin and one or more fatty acids, usually stearic and oleic; while the fixed oils are composed chiefly of oleic acid combined with glycerin. Palmitic acid is another of these fatty acids, and occurs in palm oil, in human fat, Chinese tallow, Japan wax, and several other substances. In the manufacture of soap a caustic alkali is added to the oil or fat, and at once takes possession of all the fatty acids present, forming with them stearates, oleates, and palmitates of soda or potash, as the case may be. These compounds we know as soaps, calling the former hard soap and the latter soft soap. In this operation the glycerin is liberated; and in order to separate the soap from the glycerin, salt was formerly added. The glycerin which remained in the lye after "salting out" was thrown away. In the manufacture of lead plaster, which is really a soap in which oxide of lead takes the place of potash or soda, the salting out is unnecessary, and it was in the residuary liquor that Scheele discovered glycerin. He gave it this name from its sweet taste, from the Greek word γλυκύς, sweet. For many years all the glycerin of commerce was obtained in this manner, as it was only necessary to precipitate the lead with sulphydric acid gas and evaporate the filtrate on a water bath to obtain the glycerin.

Modern chemists consider glycerin to be an alcohol, which combines with acids to form ethers. From this point of view fats and oils are compound ethers, called glycerides, and soaps are neutral salts. The chemical formula for glycerin is $C_3H_5(OH)_3$.

The extensive use that stearic acid has found, under the name of stearin, in the manufacture of candles and for other purposes has led to the invention of several new methods for its separation from the glycerin. The best of these is the one invented by our fellow countryman of sand blast fame, Mr. Tilghman. It consists in the saponification of the fats by means of superheated steam, and is largely employed in the manufacture of stearin candles, glycerin being a secondary product. The temperature most favorable to the operation lies between 550° and 600° Fah. Glycerin is purified by distillation in steam and filtration over animal charcoal. The annual production of glycerin in Europe is now 520,000 cwt.

Glycerin, as it appears in commerce, is a sirupy liquid having a specific gravity of 1·26, colorless, inodorous, sweet to the taste, and neutral to test paper. It is combustible but not so readily as ordinary alcohol. It has been frozen when exposed to a low temperature during transportation, and then melted at 45° Fah. Under ordinary circumstances it may be cooled to zero without freezing; but if a crystal of frozen glycerin be dropped into it when cooled to 20° or 21° Fah., it will all become solid. It dissolves in all proportions in water, and thus reduces its freezing point; hence Dr. Wurz proposed in 1858 to use it in gas meters, and it is now largely employed for that purpose. It also dissolves in alcohol and chloroform, but not in ether. Its solvent powers are, however, more important and interesting.

Klever has determined the solubility of forty-eight different substances, and has found that 100 parts of glycerin will dissolve 60 parts of borax, 50 parts of tannic acid, 40 parts of alum, 30 parts of sulphate of copper, 98 parts of carbonate of soda, and various quantities of the alkaloids. When bicarbonate of soda and borax are dissolved in glycerin, effervescence takes place, the carbonic acid being expelled from the former.

The uses which have already been found for glycerin are very numerous. It is frequently applied to the skin as an emollient, and administered internally as a substitute for cod liver oil. It is used as a lubricant on clocks and for delicate machinery. As it neither evaporates nor freezes, it is well adapted for floating compasses, and has been employed for thermometers. For keeping modeling clay moist, to impart to paper the peculiarity of retaining a permanently damp condition so that it may be used in taking copies of letters, to prevent inks drying too rapidly to permit of taking press copies, to prevent printers' inking rollers becoming dry and hard, for keeping photographic plates moist during long exposures, and as a solvent for gum arabic, glycerin is particularly valuable, as also in paste, cement, mortar, mastic, etc., intended for daily use. When mixed with litharge, it forms an excellent cement. Bandages for surgical purposes are treated with glycerin to render them absorbent. It is employed instead of salt for preserving untanned skins and hides. Glycerin dissolves aniline violet, alizarin, and alcoholic madder extract, hence it finds some use in dyeing. A solution of aniline colors in glycerin is often used for stamping with a hand stamp, but cannot be employed as a transparent paint on glass because of its non-drying property. The photographer finds several uses for pure glycerin, first as a test for the purity of the silver bath, secondly (as above stated) to prevent drying of the film in wet plate photography where long exposures are necessary, as in the case of interiors of rooms or shaded nooks. In combination with acetic acid it is used as a restrainer, enabling the outdoor photographer to dispense with the use of water entirely while in the field. After exposing the plate it is developed with iron as usual, and then flowed with the restrainer. At the end of the day's work the plates are taken home, where they can be fixed and finished in the usual manner. Glycerin is employed to extract the perfume from flowers and the aromatic principle of red peppers. Wine made from inferior grapes is improved and sweetened by the addition of glycerin, and an extract of malt made with glycerin is much used by brewers.

In the chemical laboratory, it is used to prevent the precipitation of the heavy metals by the alkalies. It forms the best known blowpipe test for boron in all its compounds, as was recently discovered by Mr. M. W. Iles.

Glycerin may be employed for preserving fresh fruits and meat, and if pure imparts no disagreeable flavor. It is also used instead of alcohol for preserving anatomical specimens. In pharmacy its uses are numerous and important. For disguising medicines, especially those of an oily nature, it is unequaled. It is said that castor oil mixed with an equal part of glycerin, and one or two drops of oil of cinnamon added, has been administered to physicians without their discovering that they were taking castor oil. Cod liver oil, turpentine, etc., are more easily administered when in combination with glycerin. A very little glycerin will obviate the astringent sensation produced by the chloride of iron dissolved in sirup. Carbolic acid is now generally administered in combination with glycerin, and many other acrid substances should be administered in this way. When introduced in small quantities into pills, it prevents induration and decomposition. Vaccine lymph is frequently mixed with glycerin to preserve it. Several different glycerin lotions, ointments, and plasters are described in pharmaceutical works. Sulphate of quinine dissolves in ten parts of glycerin when hot, but when cold separates in clots, which, when triturated with the supernatant liquid, gives it the consistence of a cerate, very useful for frictions and embrocations.

Another use, quite different from the above, to which glycerin is applied is the manufacture of nitroglycerin, $C_3H_5(NO_2)_3O_3$, the most powerful and dangerous explosive employed in the arts. The process of manufacture is exceedingly simple. Strong nitric and sulphuric acids are mixed together, in the proportion of two parts of the former to four of the latter by weight. Into this is poured, with constant stirring, one part by weight of pure glycerin, the temperature of the mixture being kept below 77° Fah. by external cooling with ice. When oil drops begin to form on the surface, the mixture is poured into a large quantity of cold water. The nitroglycerin then separates and is purified by washing and drying. It is a light yellow, oily liquid, inodorous, but has a sweet pungent aromatic taste, and when placed on the tongue produces a fearfully intense headache which lasts for hours.

Its explosive properties are already too well known from the numerous fatal accidents that have recently attended its use hereabouts, to say nothing of the Bremerhaven explosion.

The complex nature of the glycerin molecule renders it peculiarly susceptible to the action of reagents; it readily forms other substitution compounds, and is general a dangerous substance to experiment with. A warm concentrated solution of permanganate of potash poured into glycerin decomposes it with explosive violence; chromic acid and glycerin are likewise explosive, facts which should be remembered when putting up prescriptions containing glycerin.

E. J. H.

A Materialized Hole.

Take a sheet of stiff writing paper and fold it into a tube an inch in diameter. Apply it to the right eye and look steadfastly through it, focussing the eye on any convenient object; keep the left eye open. Now place the left hand, held palm upward, edgeways against the side of the paper tube, and about an inch or two above its lower end. The astonishing effect will be produced of a hole, apparently of the size of the cross section of the tube, made through the left hand. This is the hole in which we propose to materialize another and smaller hole. As we need a genuine aperture, and it would be inconvenient to make one in the left hand, let a sheet of white paper be substituted therefor and similarly held. Just at the part of the paper where the hole equaling in diameter the orifice of the tube appears make an opening ½ inch in diameter. Now stare intently into the tube; and the second hole, defined by its difference of illumination, will be seen floating in the first hole, and yet both will be transparent. The illusion, for of course it is one of those odd pranks our binocular vision plays upon us, is certainly one of the most curious ever devised. Besides, here is the actual hole clearly visible, and yet there is no solid body to be seen to define its edges. It is not a mere spot of light, because, if a page of print be regarded, the lines within the boundaries of the little hole will not coincide at all with those surrounding it and extending to the edges of the large apparent aperture. Each eye obviously transmits an entirely different impression to the brain, and that organ, unable to disentangle them, lands us in the palpable absurdity of a materialized hole.

Inventions Patented in England by Americans.

[Compiled from the Commissioners of Patents' Journal.]

From August 11 to September 11, 1876, inclusive.

AIR BRAKE, ETC.—C. A. Bonton (of New York city), London, England.
ALARM PUNCH.—J H. Small, Buffalo, N. Y.
BENDING WIRE, ETC.—H. W. Putnam, Bennington, Vt.
BOILER CIRCULATOR.—B. S. Koll, Pitsburgh, Pa.
BOOT-SEWING MACHINE.—G. McKay, Boston, Mass.
BOOT-SEWING MACHINE.—J. Cutlan, Philadelphia, Pa.
CARPET LINING, ETC.—O. Long, Brooklyn, N. Y., *et al.*
COTTON OPENER, ETC.—S. D. Keene, Providence, R. I.
CRUSHING QUARTZ, ETC.—D. D. Mallory, Mystic Bridge, Conn.
DRESSING BRISTLES, ETC.—E. B. Whiting, St. Albans, Vt.
FENCE, ETC.—L. E. Evans, New York city.
FLOOR COVERING.—J. F. Gloyn, Astoria, N. Y.
FURNACE.—A. L. Holley, Brooklyn, N. Y.
GAS GOVERNOR.—R. H. Plass, New York city.
GLOVE FASTENER.—J. Lewine, New York city.
HYDRAULIC ELEVATOR, ETC.—T. Stebins *et al.*, Boston, Mass.
KNIFE HANDLE.—J. W. Gardner, Shelburne, Mass.
KNITTING MACHINERY.—J. L. Brown, Chicago, Ill.
MAKING STEEL, ETC.—H. Schierloh, Jersey City, N. J.
MUSICAL INSTRUMENT.—C. F. Hill, Stamford, Conn.
PREVENTING SMOKE,—J. Todd, Potosi, Mo.
PRINTING TELEGRAPH —G. M. Phelps, Brooklyn, N. Y.
PUNCH.—D. L. Kennedy *et al.*, New York city.
RAILWAY.—E. E. Lewis, Geneva, N. Y.
RAILWAY SIGNALS, ETC.—F. W. Brierley, Philadelphia, Pa.
RAILROAD TIE.—G. D. Blaisdell, Cambridge, Vt.
RAISING BLINDS, ETC.—L. H. Gano, New York city.
RIVETING MACHINE, ETC.—J. F. Allen, New York city.
ROTARY BOILER.—C. W. Pierce, New York city.
SEWING LEATHER, ETC.—E. R. Gardner, New Bedford, Mass.
SEWING LEATHER, ETC.—G. V. Sheffield *et al.*, Brooklyn, N. Y.
SEWING MACHINE.—H. P. Garland (San Francisco, Cal.), Dundee, Scotland
SMOOTHING PLANE.—C. E. Smith, Crawfordsville, Ga.
SPINNING MACHINERY.—J. Goulding, Massachusetts.
STEAM ENGINE.—G. B. Massey *et al.*, New York city.
VELOCIPEDE.—S. Gilzinger, Rondout, N. Y.