Messrs. Korting Bros. advance the following claims for this mode of ventilating mines: Certainty of action, no moving parts whatever, and, consequently, no need of lubrication; no need of attention.—*Mech. World.*

ON REMELTING OF CAST IRON.

FROM trials conducted by Ledebur, it appears that cast iron is rendered suitable for foundry purposes—*i. e.*, to fill the moulds well and to yield sharp and definite forms free of flaws, to be cut with a chisel, and turned on a lathe—through a certain percentage of graphite, whose presence depends on that of carbon and silicium. Cast iron free of silicium yields on cooling the entire amount of carbon in the amorphous state, while presence of the former metal gives rise to the formation of graphite, and, consequently, causes a partial separation of carbon. Iron suffers on casting loss of graphite, assumes a finely-grained texture, becomes hard and brittle, and is changed from gray to white. In view of the fact that samples of cast iron with equal percentage of silicium and carbon yield on casting a different product, it has become necessary to institute experiments as to the cause of this behavior. Samples of cast iron were therefore repeatedly melted, and thin sections of each melt examined; these sections exhibited a gray color, though less apparent than in the unmelted sample, and possessed sufficient softness to admit boring and filing. During these processes of fusing, the amount of silicium, carbon, and manganese had been gradually decreased, and amounted to 12·7, 17·6, and 24·4 per centum for silicium in the three samples examined. It also was observed that the more manganese the iron contains the less readily the percentage of silicium is diminished; and since manganese is more subject to oxidation than silicium, it is capable to reduce silicic acid of the slag or lining to metal, and thus to augment the amount of silicium in cast iron. The percentage of carbon also suffers diminution by oxidation, which latter process is impeded by presence of manganese, a fact of some importance in melting of cast iron in the cupola furnace. An excess of manganese renders cast iron hard and brittle, and imparts to it the properties to absorb gases, while an amount of 1·5 per centum, as found in Scotch iron, undoubtedly has the effect to produce those properties for which this iron is held in high repute. The amount of copper is not visibly altered by fusion, but that of phosphorus and sulphur slowly increased.

Experiments in regard to the relation between chemical composition and strength of the material have established that a large amount of silicium, graphite, manganese, and combined carbon reduce the elasticity, strength, and tenacity of cast iron, and that a limited percentage of silicium counteracts the injurious influence produced by an excess of combined carbon. On remelting of cast iron, increase in tensile strength was observed, which attained its maximum in iron with a small percentage of silicium after the third, and in such with a large amount after the fourth melting. The increase in tensile strength was accompanied by a loss of silicium, graphite, and manganese coupled with a simultaneous augmentation of combined carbon. A fifth melting of the cast iron renders it hard, brittle, and white, through oxidation of silicium and subsequent lowering of the amount of carbon. On lessening the percentage of combined carbon with formation of graphite the injurious influence of the accessorial constituents of cast iron is diminished, especially that produced by the presence of phosphorus.—*Eisenhuettentechnik.*

FEEDING BOILERS AT THE BOTTOM.

ONE of the most important things to be considered in boiler construction is the position and arrangement of the feed apparatus, but it is, unfortunately, one of the elements that is most often overlooked, or, if considered at all, only in a very superficial manner. Many seem to think that it is only necessary to have a hole somewhere in the boiler—no matter what part—through which water may be pumped, and we have all that is desired. This is a very grave error. Many boilers have been ruined, and (we make the assertion with the confidence born of long experience) a large number of destructive explosions have been directly caused by introducing the feed water into boilers at the wrong point.

On the location and construction of the feed depends to some extent the economical working of a boiler, and, to a great extent, especially with certain types of boilers, its safety, durability, and freedom from a variety of defects, such as leaky seams, fractured plates, and others of a similar kind. And it is unfortunately true that the type of boiler which from its nature is most severely affected by mal-construction, such as we are now speaking of, is the very one which is the oftenest subject to it. We are speaking now more particularly of the plain cylinder boiler, of which there are many in use throughout the country.

Plain cylinder boilers are, as a rule, provided with mud drums located near the back end. As a rule, also, these boilers are set in pairs over a single furnace, and the mud drum extends across beneath, and is connected to both, and one end projects through the setting wall at the side. Our illustrations show a typical arrangement of this kind. Fig. 1 shows a transverse section of the boilers and setting, while Fig. 2 shows a longitudinal section of the same. It is a favorite method to connect the feed pipe, F, to the end of the mud drum which projects through the wall, and here the feed water is introduced, whether hot or cold; and there is really not so much difference after all between the two, for no matter *how* effective a heater may be, the temperature to which it can raise water passing through is quite low compared with the temperature of the water in the boiler due to a steam pressure of say eighty pounds per square inch. The difference in the effect produced by feeding hot or cold water at the wrong place is one of degree, not of kind.

When a boiler is under steam of say eighty pounds per square inch, the body of water in it will have a temperature of about 324 degrees Fahr., and the shell plates will necessarily be somewhat hotter, especially on the bottom (just *how* much hotter will depend entirely upon the quantity of scale or sediment present). Now introduce a large volume of cold water through an opening in the bottom, and what becomes of it? Does it rise at once, and become mixed with the large body of water in the boiler? By no means. It *cannot* rise until it has become heated, for there is a great difference between the specific gravity of water at 60°, or even 212° Fahr., and water at 324°. Consequently, it "hugs" the bottom of the boiler, and flows toward the *front* end, or hottest portion of the shell. Now let us examine the effect which it produces.

We know that wrought iron expands or contracts about 1 part in 150,000 for each degree that its temperature is raised or lowered. This is equivalent to a stress of *one ton* per square inch of section for every 15 degrees. That is, suppose we fix a piece of iron, a strip of boiler-plate, for instance, ¼ of an inch thick and 4 inches wide, at a temperature of 92 degrees Fahr., between a pair of immovable clamps. Then, if we reduce the temperature of the bar under experiment to that of melting ice, we put a stress of four tons upon it, or one ton for each inch of its width.

Now this is precisely what happens when cold water is fed into the bottom of a boiler. We have the plates of the shell at a temperature of not less, probably, than 350° Fahr. A large quantity of cold water, often at a

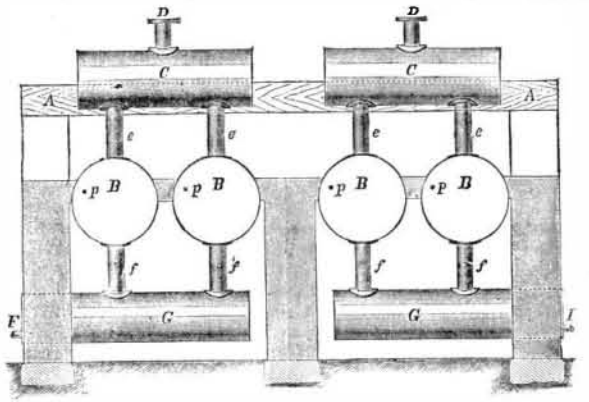

FIG. 1.

temperature as low as 50° Fahr., is introduced through an opening in the bottom, and flows along over these heated plates. If it could produce its *full* effect at once, the contraction caused thereby would bring a stress of 300 ÷ 15 = 20 tons per square inch upon the bottom plates of the shell. But fortunately it cannot exert its full effect at once, but it *can* act to such an extent that we have known it to rupture the plates of a new boiler through the seams on the bottom *no less than three times in less than six weeks* after the boilers were started up.

The effect in such cases will always be the most marked, especially if the plant is furnished with a heater, when the engine is not running, for then, as no steam is being drawn from the boilers, there is comparatively little circulation going on in the water in the boiler, and the water pumped in, colder than usual from the fact that the heater is not in operation, spreads out in a thin layer on the lowest point of the shell, and *stays there*, and keeps the temperature of the shell down, owing to the fires being banked or the draught shut, while the larger body of water above, at a temperature of from 300 to 325 degrees, keeps the upper portion of the shell at *its* higher temperature. It will readily be seen that the strain brought upon the seams along the bottom is something enormous, and we can understand why it is that many boilers of this class rupture their girth seams while being filled up for the night after the engine has been shut down. To most persons who have but a slight knowledge of the matter, we fancy it would be a surprise to see the persistence with which cold water will "hug" the bottom of a boiler under such circumstances. We have seen boilers when the fire has been drawn, and cold water pumped in to cool them off, so cold on the bottom that they felt cold to the touch, and must consequently have had a temperature considerably below 100° Fahr., while the water on top, above the tubes, was sufficiently hot to scald; and they will remain in such a condition for hours.

The only thing to be done, where feed connections are made in the manner described, is to change them, and by changing them at once much trouble, or even a disastrous explosion, may be avoided. Put the feed-pipe in through the front head, at the point marked *p* in Fig. 1, drill and tap a hole the proper size for the feed pipe, cut a long thread on the end of the pipe,

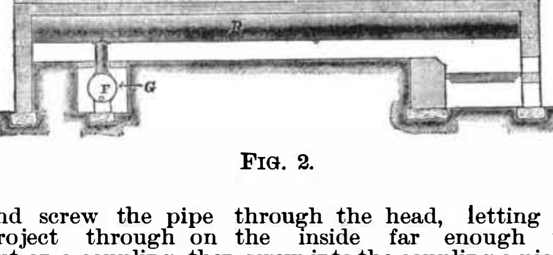

FIG. 2.

and screw the pipe through the head, letting it project through on the inside far enough to put on a coupling, then screw into the coupling a piece of pipe not less than eight or ten feet long, letting it run horizontally toward the back end of the boiler, the whole arrangement being only from 3 to 4 inches below the water line of the boiler, and hot or cold water may be fed indifferently, without fear of danger from ruptured plates or leaky seams. In short, put in a "top feed," and avoid further trouble.—*The Locomotive.*

[MICROSCOPICAL JOURNAL.]

IRON PRINTING AND MICROSCOPIC PHOTOGRAPHY.

By C. M. VORCE, F.R.M.S.

I. FORMULAS FOR PRINTING SOLUTIONS.

Blue Prints.—The best formula for this process, of many that I have tried, is that furnished by Prof. C. H. Kain, of Camden, N. J., in which the quantity of ammonio-citrate of iron is exactly double that of the red prussiate of potash, and the solutions strong. This gives strong prints of a bright dark blue, and prints very quickly in clear sunlight.

Dissolve six grains of red prussiate of potash in one drm. of distilled water; in another drm. of distilled water dissolve twelve grains of ammonio-citrate of iron. Mix the two solutions in a cup or saucer, and at once brush over the surface of clean strong paper. Cover the surface thoroughly, but apply no more than the paper will take up at once; it should become limp and moist, but not wet. The above quantity of solution, two drms., will suffice to sensitize ten square feet of paper, or three sheets of the "regular" size of plain paper, 18x22. As fast as the sheets are washed over with the solution, hang them up to dry by one corner. The surplus fluid will collect in a drop at the lower corner, and can be blotted off.

Black Prints.—Wash the paper with a saturated solution of bichromate of potash, made quite acid with acetic acid. After printing, wash the prints in running water for twenty to thirty minutes, then float them face down on a weak solution (five to ten per cent.) of protosulphate of iron for five minutes, and wash as before. If preferred, the iron solution may be washed over the prints, or they may be immersed in it, but floating seems preferable. After the second washing, wash the prints over with a strong solution of pyrogallic acid, when the print will develop black, and the ground, if the washings were sufficient, will remain white. A final washing completes the process.

If a solution of yellow prussiate of potash be used in place of the pyro solution, a blue print is obtained. Bichromate prints can be made on albumenized paper by floating it on the solution, and by using a saturated solution of protosulphate of iron and a saturated solution of gallic acid. Very fine prints can be so produced nearly equal to silver prints, and at somewhat less cost, but with a little or no saving of time or labor.

Chief Proof Solution.—If old oxalate developer be exposed in a shallow vessel in a warm place, a deposit of light green crystals will be formed, composed of an impure oxalate of iron. If these crystals be dissolved in water, and paper washed with a strong solution, when dry it may be exposed in the printing-frame, giving full time. The image is very faint, but on washing in or floating on a moderately strong solution of red prussiate of potash for a minute or less, a blue positive is produced, which is washed in water as usual to fix it. The unused developer produces the best crystals for the purpose, and the pure ammonio-oxalate is vastly better than either.

All of the above operations, except the printing, should be carried on in the dark room, or by lamp or gas light only. The solutions and the paper should also be kept in the dark, and prepared as short a time as possible before use.

II. COMPOUND NEGATIVES.

In photographing with the microscope, it frequently occurs that the operator, instead of devoting a negative to each of two or more similar objects for comparison, printing both upon the same print, prefers to have the whole series upon one negative, and taking from this a single print. There is often room for two or more images upon the same plate. If the center of the plate is devoted to one, obviously no more can be accommodated on it; but by placing one at each end, or one on each quarter of the plate, both economy of plates and convenience of printing are secured. The end may be readily accomplished by matting the plate as a negative is matted in printing.

Suppose it be desired to photograph four different species of acari on one plate, the image of each when magnified to the desired extent only covering about one-fourth the exposed area of the plate. First, a mat is prepared of card-board or thick non-actinic paper, which is adjusted to exactly fill the opening of the plate holder, lying in front of and close against the plate when exposed, and having one-quarter very exactly cut out. A convenient way to fit this mat is to leave projecting lugs on each side at exactly the same distance from the ends, and cut notches in the plate-holder into which the lugs may closely fit. If this work is carefully done, the mat may be reversed both sidewise and endwise, and the lugs will fit the notches; if so, it is ready for use. The object being focused upon the focusing glass or card, the camera is raised one-half the vertical dimension of the plate and displaced to one side half the horizontal dimension, when the image will be found to occupy one quarter of the plate. The mat being placed in the plate holder, a focusing glass is inserted in the position the plate will occupy, and final adjustment and focusing made. The plate is then marked on one corner on the film side with a lead pencil, placed in the holder without disturbing the mat, and the exposure made. When the plate is replaced for a second exposure, either the mat is reversed or the plate turned end for end; but it is best to always place the plate in the holder in the same position and change the mat to expose successive quarters, but this requires the camera to be moved for each exposure.

With similar objects, and some judgment in making two exposures, negatives may be made with almost exactly the same density in each quarter, and by cutting out slightly less than one-quarter of the mat the four images will be separated by black lines in the print; by cutting out a trifle more than the exact quarter, they will be separated by white lines instead of black.

PRACTICAL DIRECTIONS FOR MAKING LANTERN TRANSPARENCIES.

By T. N. ARMSTRONG.*

WHEN the season for out-door work closes, amateurs begin to look about for means of employment during the dark evenings. There is, fortunately, no necessity for being idle, or to relinquish photographic pursuits entirely, even though the weather and light combine to render out-door work almost impracticable; and most amateurs will be found to have some hobby or favorite amusement which enables them to keep in practice during those months when many channels of employment are closed to them; and probably one of the most popular as well as the most pleasing occupations is the production of transparencies for the lantern.

It is not my desire to enter into any discussion as to this or that being the best means of producing these delightful pictures, but merely to describe a way by which a pleasant evening can be spent at photography, and slides produced of much excellence by artificial light.

* Abstract of a paper communicated to the Glasgow and West of Scotland Amateur Photographic Association.—From the *Photographic News.*