revolution, the amount of their sliding movement through the driving drum when exposed to the pressure of the water is very small, the chief sliding movement taking place during the remainder of the revolution, when the arms are in equilibrium. The pump thus works with but very little friction, and the flow is very regular.

Correspondence.

The Locomotive.

To the Editor of the Scientific American:

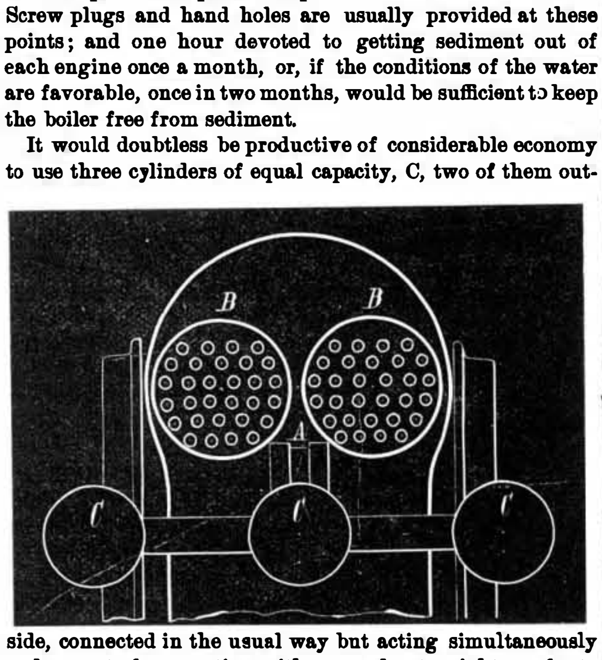
The locomotive has probably attained a degree of simplicity and efficiency which is susceptible of but little improvement. It is true that it does not always possess complete symmetry and just proportion in all of its details, and it yet remains for some fortunate inventor to do for the valve mechanism of the locomotive precisely what Corliss has done for that of the stationary engine: with this difference, however, that the complexity of the Corliss device must be avoided in that of the locomotive, for the reason that the peculiarly rough nature of railroad work demands the utmost simplicity in everything pertaining to its prosecution. The Corliss device (leaving off the "dash pots") would doubtless effect as great a saving of steam in the locomotive as it has done in the stationary engine; but the idea of having eight valves, valve seats, and valve stems (with their connecting rods and studs) to keep in repair, instead of two, is hardly compatible with the present prevailing ideas of railroad men. Such complication will not be admissible in railroad practice (however great the possible saving) until fuel shall have become much more costly than it now is.

Anything differing from the present valve gear of the locomotive, to meet with approval, must possess all the economic qualities of the Corliss device, name, independent exhaust of at least three times the capacity of the inlet, the least possible steam space between the valves and the piston, not more than two valves to each cylinder (and these flat ones, and as accessible as the present single valve), and two valve stems, operated by the present reverse link without diminishing the size of exhaust ports. Such a device would probably find ready acceptance among locomotive makers and railroad men.

The greatest source of waste in locomotives is in their consumption of fuel. Probably not one half (some say not one quarter) of the fuel used is utilized; and inventors are zealously at work upon the problem of devising means by which the gas and sparks may be appropriated. A device has been in use sometime in this vicinity for the purpose; it was first used on the Worcester and Nashua Road, I believe. It consists of a cast iron pan, similar in form to a bed pan, but much larger; it is placed bottom up in the top of the chimney, directly above the exhaust pipe, the inner smoke pipe being so formed as to deflect the smoke and sparks into this pan by the power of the exhaust steam. A large conduit from the opposite sides of the pan conveys the sparks, etc., down the chimney, and thus around the boiler back to the fire box; and a powerful draft is kept up through these conduits while the engine is at work, by the partial vacuum in the fire box caused by the exhaust steam. This apparatus serves an excellent purpose, not only as an economizer of fuel but as a preventor of fires along the line in dry weather. Another device has been applied with considerable success; it was first used, I think, on the Boston and Providence road. It consists of an arch or partial partition in the fire box, placed so as to give an inward direction to the products of combustion, and keep them as long as possible in the fire box, and thus cause a more perfect consumption of them. Perhaps a combination of these two devices would form the great economizer sought.

An important source of waste in the locomotive is the clogging-up of the bottom of the water legs around the fire box and around the lower flues in the barrel of the boiler. Engineers can have no valid excuse for allowing sediment to collect at these points, as it frequently does, to such an extent as not only to render utterly inoperative as generators the lower flues and much valuable surface in the fire box, but to expose these parts to rapid destruction from over heat. Screw plugs and hand holes are usually provided at these points; and one hour devoted to getting sediment out of each engine once a month, or, if the conditions of the water are favorable, once in two months, would be sufficient to keep the boiler free from sediment.

It would doubtless be productive of considerable economy to use three cylinders of equal capacity, C, two of them out-



side, connected in the usual way but acting simultaneously and a central one acting with a crank at a right angle to to the outside cranks, and exhausting its steam into them through a superheater; but the engine should be so arranged that direct steam could be used in all three in case of emergency. Such an engine would be extremely steady upon the track, however rapid its motion. This plan would, owing to the central crank, A, bring the center of gravity of an engine rather high. This could, however, be easily remedied by making the boiler with two barrels, B, so that the sweep of the crank would come partially between them. By filling these barrels nearly full of the usual flues, the generating power would be fully as great as that of the single barrel.

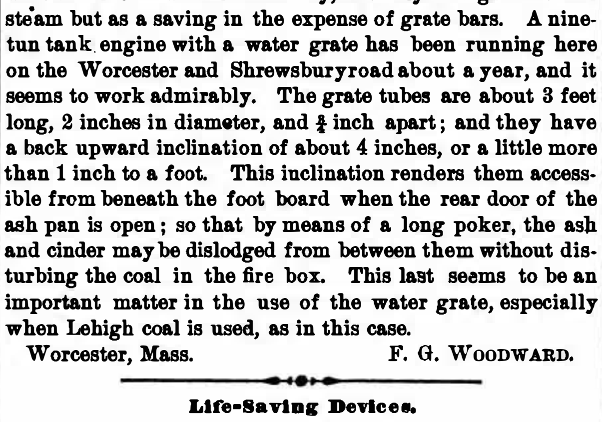
I wish that such engineers as have experience with the water grate would give us their opinion of it, as to its economic value, etc. It has always seemed to me that, if properly put in, with the tubes inclining considerably and with screw plugs opposite the ends of each tube, it would be productive of considerable economy, not only as a generator of steam but as a saving in the expense of grate bars. A ninetun tank engine with a water grate has been running here on the Worcester and Shrewsbury road about a year, and it seems to work admirably. The grate tubes are about 3 feet long, 2 inches in diameter, and ½ inch apart; and they have a back upward inclination of about 4 inches, or a little more than 1 inch to a foot. This inclination renders them accessible from beneath the foot board when the rear door of the ash pan is open; so that by means of a long poker, the ash and cinder may be dislodged from between them without disturbing the coal in the fire box. This last seems to be an important matter in the use of the water grate, especially when Lehigh coal is used, as in this case.

Worcester, Mass. F. G. WOODWARD.

Life-Saving Devices.

To the Editor of the Scientific American:

The engraving herewith given will suffice to illustrate an idea for saving life from shipwrecks. I propose to run a sheaved rope out on a small rocket line in the following man-



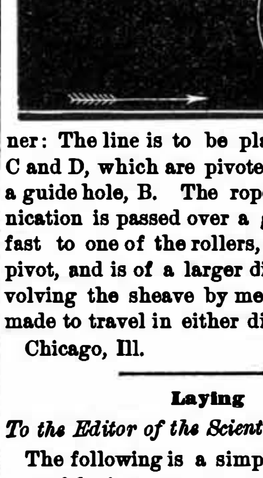
ner: The line is to be placed between two griping rollers, C and D, which are pivoted on a frame, A, and passed into a guide hole, B. The rope to establish permanent communication is passed over a griping sheave, E, which is made fast to one of the rollers, and revolves with it on the same pivot, and is of a larger diameter than the rollers. On revolving the sheave by means of the rope, the whole can be made to travel in either direction. B. FRESE.

Chicago, Ill.

Laying Out a Square.

To the Editor of the Scientific American:

The following is a simpler, quicker, and just as correct a way of laying out a square as that given on page 325 of your current volume.



First draw a perpendicular on the middle of A B, by describing, from A and B as centers, the arcs at D and H. (The arcs at F are better than those at H, but can only be drawn when there is room below the base.) Then draw a line, E D, through the two intersections, and this line will be perpendicular to and will bisect A B; make now E G=EA, and draw, with G A as radius, the arcs at K and L. Then draw the diagonal, B K, through B and G, and A L through A and G; the points where they intersect the arcs, L and K, will be the corners of the square.

Proof.—As K B is the diameter of a half circle which may be drawn through the points, B, A, and K, the angle at A must be a right angle, and for the same reason the other angles will be right angles. The triangles, A G B, A G K, etc., being made equal, their corresponding sides must be equal; the figure thus drawn has right angles and equal sides, and is a square. X.

New York city.

On the Recovery of Silver from Cast Iron Crucibles.

In a recent number of Dingler's *Journal*, two Vienna chemists, named Tavorsky and Priwoznik, describe the new methods for obtaining the silver absorbed by cast iron crucibles used in some mints and other establishments for fusing silver and its alloys. A cast iron crucible can be used 10 to 15 times for fusing silver; then the cracks are so considerable that it must be thrown aside. These crucibles were formerly broken up, and the bottoms and other portions which contain much silver thrown into the very impure mother liquor from the crystallization of sulphate of copper. This liquor is not easily utilized in any other manner; but on putting in the iron, the copper is precipitated, while the iron goes into solution. The cement copper thus prepared, and containing all the silver, along with the graphite, silica, and other insoluble constituents of the cast iron, is treated in the usual manner for the separation of the silver. This process, however, is tedious, and the amount of material to be worked is increased instead of being diminished, for 100 lbs. of cast iron yields about 113 lbs. of cement copper.

The late director of the mint at Vienna, Von Schrötter, proposed a method for overcoming this difficulty. The crucibles are first broken up and then dissolved in dilute sulphuric acid without heat. To avoid the trouble of evaporating a large quantity of water, in order to crystalize the green vitriol, in the first experiment the sulphuric acid was only moderately diluted, and consequently large quantities of anhydrous protosulphate of iron separated, and enveloped the undissolved pieces of iron, protecting them from the action of the acid. As soon, however, as the acid was diluted to 20° B., the iron dissolved rapidity. Wherechamber acid can be easily obtained, it would doubtless be the cheapest. Even with acid of 60° B., it is not expensive, and the latter offers the advantage that the heat generated in diluting it helps the reaction and hastens the solution. The iron is dissolved in wooden vessels lined with lead, 12 to 15 feet long, 6 feet wide, and 20 inches deep, with a grating made of laths, about 8 inches from the bottom, on which the pieces of crucible are placed. As the solution becomes more concentrated, it sinks to the bottom, and the iron is continually brought in contact with fresh acid. If the precaution be taken to cover the vessel tightly, the extremely disagreeably smelling gases evolved will not prove a serious disturbance.

In from ten to fourteen days, the acid becomes saturated, and the solution settles and has a concentration of 20° B. By evaporation to 66° B., the green vitriol crystalizes out. The inseluble residue amounts to about 20 per cent. It contains all the silver, silica, graphite, sesquioxide of iron, copper, and small quantities of sulphur and phosphorus. The larger pieces of silver are picked out, and the smaller are obtained by sifting and amalgamating the residue. Only the old slick and the amalgamation residue, which still contains 1·4 per cent silver, are worked over in the silver works.

This process of recovering silver is much more rapid than the method previously in use. It has the advantage that 80 per cent of iron is removed before proceeding to the recovery of the silver, so that the argentiferous material is reduced to one fifth its original weight. The experience of those who have employed it in Vienna show that it is thoroughly practicable, and that the green vitriol produced pays for the labor.

In the Royal-Imperial mint at Vienna, 315 old cast iron crucibles, weighing 115,192 lbs., have been treated in this way producing 405,574 lbs. of commercial sulphate of iron. The weight of the residue was 23,038 lbs. The poorer portion, and the residue from amalgamation, weighing 13,429 lbs., was smelted. Nearly 737 lbs. of silver was obtained, worth 30,143 gulden (about $15,000), from which the percentage of silver in the cast iron is calculated at 0 64 per cent. The amount of silver in a cast iron crucible depends on the richness of the alloy melted in it; those used for rich alloys of course contain more silver than those in which poor ones are melted. Most of the crucibles worked up so far had been used for the alloy from which the Austrian small change is made, and which contains only 45 to 50 per cent silver. The results obtained with those in which alloys containing 83·5 per cent are fused will, no doubt, be more favorable.

A New Form of Leclanche's Cell.

A new form of Leclanché's cell has been constructed by Dr. Muirhead, in which the carbon and black oxide of manganese are packed in the outer case around a glazed porcelain jar perforated with holes about ¼ inch in diameter, the jar containing a zinc plate bent into the form of a cylinder.

The advantages gained are that a much larger surface of zinc is exposed, and the perforations of the jar are in no danger of being choked up by deposition of chloride of zinc.

A New Theory of the Nebulæ.

M. Planté has recently communicated to the French Academy of Sciences the results of some experiments which may lead, it is believed, to a new theory for the circumstances to which are due the spiral forms of many of the nebulæ. The experiments consist in the exact reproduction of these forms by the combined action of electricity and magnetism. Two copper electrodes of a battery of 15 elements, being plunged in water acidulated to 1-10 with sulphuric acid, the end of the positive electrode is brought to one pole of the magnet. The cloud of metallic matter carried from the electrode by the current at once assumes in the liquid a gyratory spiral movement, of which the general disposition strongly recalls that of the nebulæ. The investigator is proceeding with further experiments in the light of this idea.

"Healthy body, healthy appetite, healthy feelings, though accompanied with mediocrity of talent, unadorned with wit and imagination, and unpolished by learning and science, will outstrip in the race for happiness the splendid irregularities of genius, and the most dazzling success of ambition."
—*Greville's Memoirs of George IV.*

MARKET Street Bridge in Philadelphia was recently totally destroyed by fire. The loss pecuniarily amounted to but $115,000; but a large section of the city was temporarily greatly inconvenienced, owing to the breakage of the gas connections. The Pennsylvania Railroad will shortly erect a temporary bridge for their traffic, which will be replaced by a very costly and handsome structure, probably equal or superior to the Girard avenue bridge which has been illustrated in these columns.