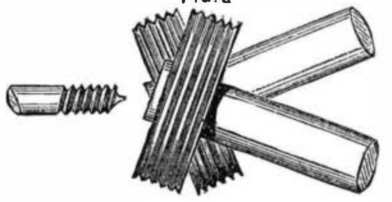
SCREW FORGING MACHINE.

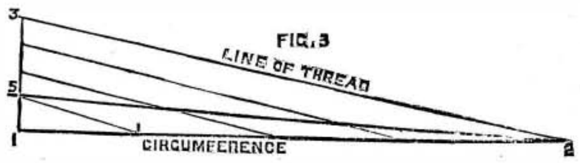
The accompanying engraving illustrates a very ingenious machine for rolling or forging wrought iron and steel screws, designed by Fairbairn & Wells, of Manchester, and described in a recent number of the *Engineer*. Several years have been occupied in perfecting the machines and the process of rolling large screws

FIG. 2



hot and small screws cold, and several of them have now been at work for about nine months in the works of the New Russia Company, of Queen Victoria Street. The machine we illustrate is for making large screws, and is fitted with three rollers, the screws being rolled

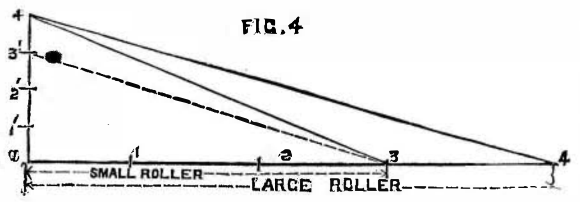
FIG. 3



hot. Screws below $\frac{1}{2}$ in. in diameter are made with four rollers, and are rolled cold.

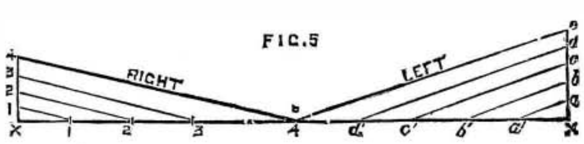
The advantages of screw rolling as compared with screw cutting, for very many of the purposes to which they are applied, are sufficient to make an effective

FIG. 4



machine of great importance. The material which is wasted in cutting a screw in the ordinary way is utilized, and the screw blanks may be considerably shorter in consequence, effecting a saving in some screws—

FIG. 5



such as coach screws—of over 30 per cent. The threads are, moreover, much stronger when rolled than when cut out. The engravings we publish of the sections of screws are facsimiles of screws rolled by these machines, all of which are perfectly made.

For the manufacture of screws by rolling, the machines employed may be divided into two kinds. The first kind has usually three rollers of equal diameter, revolving in the same direction and at the same speed. Grooves are cut in the peripheries of the rollers, of the same pitch and angle as the threads on the bolt blanks to be screwed. The rollers are placed in the form of a trigon parallel to one another, and while revolving are made to open to receive the bolt blank, and then close on it under great pressure. The blank revolving between the rollers receives from the grooves the impression of a thread; but as it simply revolves without longitudinal motion, the thread is raised half its depth above the size of the iron, and the other half sunk into the body of the bolt. Any inequality in the sizes of iron from which the blanks are made makes a corresponding difference in the screws. This machine is, therefore, useless as regards accuracy in fitting nuts.

The second class of machine is entirely different. It can have only two rollers, with plain, straight grooves cut on the peripheries. The axes of the rollers are then set in the machine to give a twist to the rollers, which brings the straight grooves to the angle of thread desired, as indicated in Fig. 2. The blank revolving between the rollers receives the impression of the thread, but for every revolution it makes on its axis it moves out or in one thread, or rather the distance between two threads. This machine also raises the thread, so that it is larger than the blank, a result of insufficient rolling or work. Thus, in making a 1 in. screw with eight threads per inch, and say 2 in. long, the blank would only make sixteen revolutions.

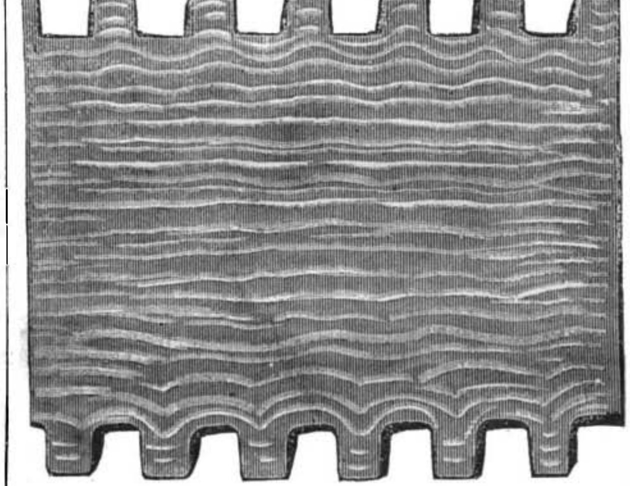
The first machine made by Messrs. Fairbairn & Wells had two plates grooved and sliding in opposite directions, the blank being pressed between them. It was, however, soon found that a screw made between two surfaces while hot is very liable to become hollow or spongy in the center. After a great many experiments three rollers were adopted, but for the purpose of explanation we must describe the machine with two rollers.

If, instead of plain concentric grooves, as shown at Fig. 2, grooves in the rollers are cut to one-half the true angle, or angle of the screw thread, the angle or twist of the rollers must then be reduced, as where the angle of the grooves is increased a corresponding reduction in the angle or twist of the axes of the rollers must be made. For instance, if we suppose the angle of Whitworth threads is 12 deg., and it is desired to give the blank, say, eight revolutions in moving between two threads, then Mr. Fairbairn makes the angle of the grooves on the roller, say, 10·5 deg., and sets the roller's axes to an angle of 1·5 deg.—*i. e.*, 10·5 + 1·5 = 12 deg. In order to produce a right-hand screw, the rollers are cut left-handed. The method used by Mr. Fairbairn is thus described by him: "Suppose a set of rollers is used 4 in. in diameter and, say, $\frac{1}{4}$ in. in pitch of thread, on 1 in. coach screw, then $\frac{4 \text{ in.}}{1 \text{ in.}} = 4$ revolutions of iron for one of rollers, and $4 \times \frac{1}{4}$ in. = 1 in., total and true pitch for cutting grooves on rollers. But we want the screw blank to make four revolutions while moving between two threads. Fig. 3 is a diagram of the true pitch with four threads, and axes parallel. Then the line 2–5 becomes the basis, and instead of four threads we get three, and the total pitch becomes $\frac{3}{4}$ in. instead of 1 in., the other $\frac{1}{4}$ in. being supplied from the twist of rollers. Generally, the less the twist of rollers, the less the longitudinal motion and better finish given to the screws.

The principal objection to this machine is that the rollers are necessarily small, and so, when making from 4,000 to 5,000 screws per day, one after another, the wear and tear must be great.

The size adopted for the rollers is six times the small-

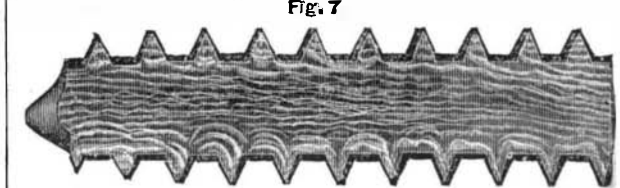
Fig. 6



est diameter of the screw at the bottom of thread. Thus, for $\frac{5}{8}$ in. coach screw, the largest possible size would be: diameter of screw at bottom of thread $\frac{5}{16}$ in. full, and $\frac{5}{16}$ in. $\times 6 = \frac{30}{16} = 1\frac{7}{8}$ in., diameter of roller. This is small, although a set of 3 in. rollers has been working eighteen months without change.

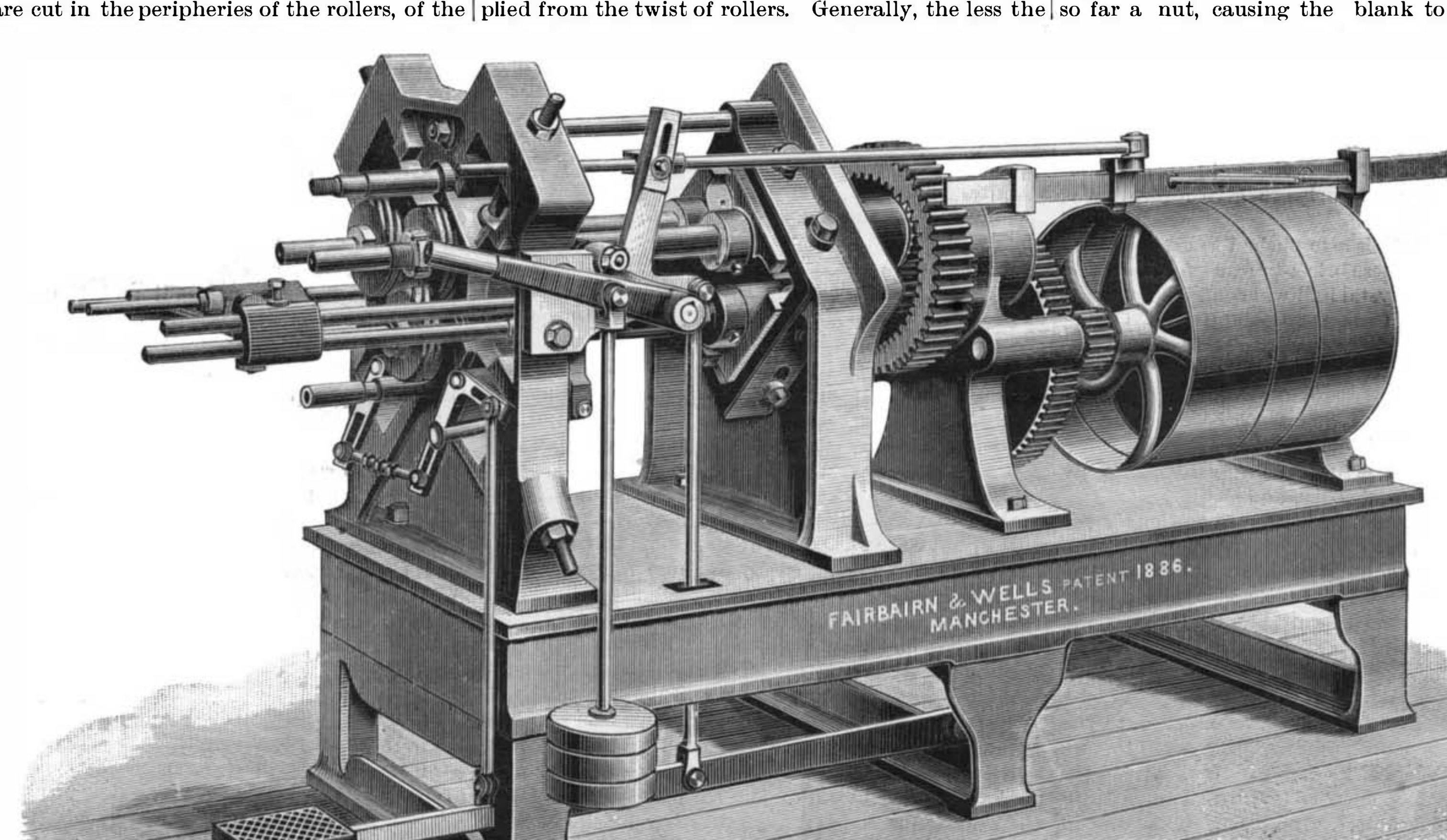
To obviate these disadvantages, the four-roller machine has been made, in which larger rollers for any purpose and of one size can be used and run always in one direction, *i. e.*, no reversing of the machine. He obtains longitudinal motion of the screw with two of the rollers paralleled, and two smaller ones, with just as much of twist as will make up for the difference of angles due to two rollers of unequal size having the same number of grooves and cut to the same total pitch; for instance, *a* to 3=circumference of small roll, and *a* to 4 of large roller. The difference in these circumferences is equal to one re-

Fig. 7



volution of a blank screw. The twist or reduction of angle on the small roller removes the line to 3′ 3, which makes the same angle as the large one, or 4′ 4.

The two large rollers, then, are parallel, while the small rollers are brought to the same angle of grooves. They make the same number of revolutions in the same time. By the twist on the smaller rollers greater resistance to slipping is obtained, and the blank slips on the larger rollers, which thus become so far a nut, causing the blank to screw itself out



IMPROVED SCREW FORGING MACHINE.

from the machine. Apparently, the three and four roller machines produce longitudinal motion by different means, but when examined closely the methods are similar.

In making left-hand screws on the three-roller machine, the obvious rule is to reverse the operation by cutting three grooves the opposite angle and then twisting or increasing the angle of the rollers until they equal four grooves. The same result may be obtained with the axes of the rollers in the same position for both in this way. For right-hand screws three grooves are cut, and their effect increased to four by the twist of the axes. In the same way, for left-hand screws, five grooves are cut on the rollers, and their effect as regards direction obtained by reducing them. The diagram, Fig. 5, illustrates the right-hand screw with three grooves—1 to 4 becomes x to 4; and for left-hand on the same axes with the rollers cut to five grooves, x to e becomes a to e.

Mr. Fairbairn proposes rolling fish bolts with right and left hand grooves on the same rollers, say three-quarter inch right-hand and eleven-sixteenths inch left-hand on the point of the bolt to act as a lock-ing nut; and from the experience he has had, he sees nothing very difficult in doing it successfully. The two screws would be made at one operation of the machine, the blank being hot.

Experiments made by Mr. D. Kirkaldy show the tensile strength of the rolled screws to be considerably greater than that of the cut screws. We are informed that from 4,000 to 5,000 three-quarter inch coach screws, 4 inches long, can be made in a day with one machine. The wear of the rollers is very small as compared with the wear of cutters, and a machine may work for several weeks, we are informed, without change of rollers. Threads of any form may be made, square threads for railway couplings with right and left hand screws, and armor plate bolts being exceedingly well made. The section, Fig. 6, shows one of this kind. Fig. 7 shows smaller screws with different forms of threads.

AN ITALIAN ARTIST'S RESIDENCE—SIXTEENTH CENTURY.

In the picture herewith of Tintoretto's house we have a suggestion of the many-sided development of Italian art during the last days of its most glorious period. Here, before his death in 1576, in his ninety-ninth year,

TINTORETTO'S HOUSE, VENICE, 1576.

Titian may easily be supposed to have often spent many agreeable hours with one of the only two Italian painters then worthy to be his companions, and one destined to sustain for almost a generation after him the glory of that school of which Titian had been the bright particular star. The house itself, as will be seen, is just on the water's edge, access thereto, as in the case of most of the finest buildings and residences of Venice, being from gondolas. The city itself seems from every direction to be floating on water, and presents a unique appearance of fairy-like picturesqueness, while some of its buildings and monuments, bringing before us as they do the history of more than a thousand years, offer much that is worth the study of all who are interested in tracing the development of artistic ideas in architecture.

Air Injectors for Liquid Fuels.

The Forges et Chantiers Company of France have again brought forward the principle of burning liquid fuel for furnaces by means of air injectors, originally introduced by M. Sainte-Claire Deville. The use of steam to spray the naphtha, creosote, or other liquid fuel is a serious inconvenience on board ship, owing to the great consumption of fresh water which it renders necessary. The importance of this point is obvious, when it is remembered that the burner spray requires from one-twelfth to one-tenth of the total production of steam of the boilers.

GROTTO OF MARIE DE MEDICI, THE LUXEMBOURG, PARIS.

Modern steamships are all fitted with engines of the surface condensing type, using high pressure steam. The water evaporated for the steam jet must be replaced by salt water, causing wear and tear of the evaporating apparatus and a certain amount of additional danger. In the case of a steamship of 3,000 tons, for example, about 530 cubic feet of water is evaporated every hour. Supposing the best type of steam atomizer is used, requiring only one-twelfth of the steam evaporated, or say 44 cubic feet of water per hour, then 486 cubic feet of water will go in the shape of steam into the engines, returning in due course, diminished only by small leakages, into the boilers. The 44 cubic feet of water required by the steam jet will escape from the chimney as steam. In the course of a ten days' run, such a ship would consume from the atomizing jets not less than 10,560 cubic feet of water, all of which must be drawn from alongside or distilled for the special purpose. Distilling apparatus for such a purpose is out of the question; and the alternative is not likely to recommend itself to sea-going engineers. It should not be forgotten, moreover, that the steam mixed with it in the spraying apparatus greatly diminishes the efficiency of the naphtha.

It is with a view to the removal of these objections that the spraying of the liquid fuel by air instead of steam has been revived. There are two ways of applying this principle: by using compressed air in place of steam, or by so modifying the burner that all the necessary air for combustion shall pass through it, and be mixed as intimately as possible with the combustible. The first method is easily arranged, the only additional apparatus required being a small steam pump in the boiler room to compress the air into a reservoir for the service of the injectors. To avoid waste of water, the exhaust steam from this pump is led into the condensers. The second method is more delicate, but is preferable, as it permits of the realization of high evaporation duty. It can be secured by a fan driving into the furnace (not at an extreme velocity) all the calculated volume of air supply, partly as a cylindrical jet and partly as an annular jet enveloping the former, leaving the liquid fuel to flow between the two portions, and be thus atomized and projected into the furnace.

An Ocean Oil Well.

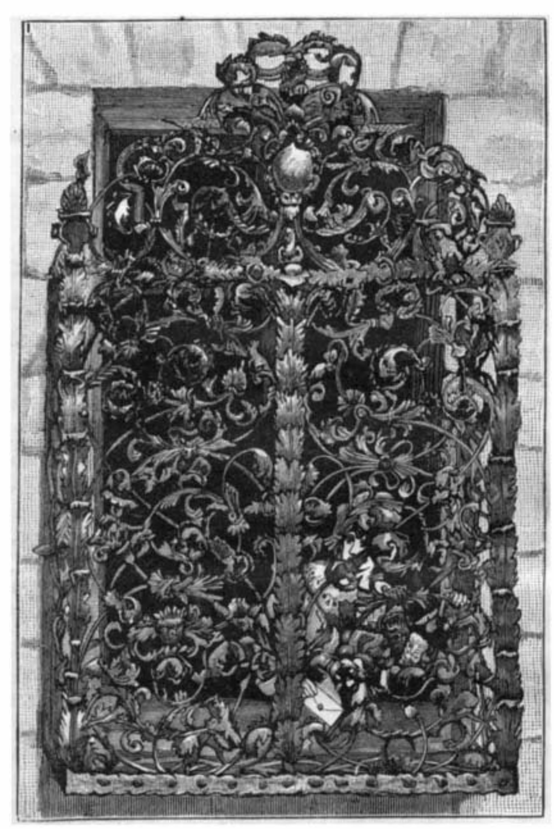
Captain Eden of the British schooner Storm King, bound from Utilla to New Orleans, reports on Thursday, March 11, passing over a submarine mineral oil spring, bubbling and rippling all around the vessel, and extending out over 150 to 200 yards. This was in latitude 25° 48' north, longitude 86° 20' west, about 250 miles southeast of the Passes. At 11 A. M. they were over the spring proper, and at 11:30 A. M. outside the circumference of the oil circle. It is supposed that this spring is the oil cargo of a foundered vessel, which, breaking through the casks, caused this peculiar marine freak, or that it may be a natural phenomenon.

ART IN THE GARDEN.

The magnificence of the historic palaces of France has been wonderfully diminished of late years, and their extensive parks and gardens, now no longer for the exclusive enjoyment of those of royal station or aristocratic birth, have been greatly curtailed. In the gardens of the Luxembourg there are now comparatively few relics of its former grandeur, but among these is the grotto of Marie de Medici, shown in our illustration, built some two hundred and fifty years ago. It is a broad basin, where the ladies of the court were wont to go and bathe, and though everywhere surrounded by trees, forms itself a sunny space that seems hewn out of the forest, the surrounding trees having formerly been kept trimmed and clipped above. The fountain and the highly ornamented miniature temple or arcade, the costly sculptures and the collections of rare flowers, make up a picture to delight the senses, and almost imperceptibly lead the imagination to conjure up the appearance of the brilliant throngs for whose enjoyment such lavish expenditure was made during the whole reign of Louis XIV.

A WINDOW GRILLE OF THE SEVENTEENTH CENTURY.

The accompanying engraving shows a very elaborate work of a German artist of the seventeenth century, in forged, chiseled, and hammered iron, having return ends, so that when fixed it projected in front of the window. It is now an exhibit at the National Industrial Art Museum at South Kensington, London. Its richness of effect as a decorative work, and great strength as a protection of a window, will be at once recognized. The design is divided into two panels, each balancing the other in the leading lines of the ornamentation, although there is also a suggestion of a cross in the whole. The division up the center and the side lines are made of acanthus leaves of hammered and chiseled iron laid over each other, the base of one leaf springing from behind the curved point of that below. The top is surmounted by a pediment having an oval escutcheon in the center, divided from the square of the grille by foliation starting horizontally from each side. The details are of a very ornate character, most of the work having been shaped while hot and chiseled afterward, while some grotesque terminal figures are introduced, which are entirely forged, and afterward finished with chisel and file. The artist's fancy has led to the introduction, also, of a suggestion of probably prohibited correspondence with the outside world on the part of some fair occupant of the apartment behind the grille.



WINDOW GRILLE.

Artificial Cocaine.

Merck is said to have prepared cocaine by synthesis. Cocaine is benzoic methylecgonine. Benzoic ecgonine is treated with iodide of methyl in slight excess in the presence of methylic alcohol at 100° C.; the excess of iodide and methylic alcohol is driven off by heat; from the resulting sirupy liquid cocaine is extracted. This artificial cocaine melts at 98°, like its prototype, and it possesses all the reactions of the natural product.