duced in capacity between the pump and the discharge, especially in feeding boilers. Where pipes are branched to divide the discharge it must be remembered that the area of a pipe primarily governs its capacity; two 1-inch pipes discharge about the same amount of water as one pipe 1½ inches in diameter. The length of a pipe must also be taken into consideration. A pipe two inches in diameter and 100 feet long will only deliver one-fourth as much water as a pipe of the same diameter and only two inches in length.

The suction pipe especially should be made as direct as possible and, above all things, should be perfectly tight. A very small leak in it will greatly impair the efficiency of the best pump. A large one will positively neutralize its action. In locating a pump with regard to suction, it must be remembered that the ordinary suction pump will hardly lift water at sea level more than thirty feet with the most perfect vacuum ordinarily obtainable. It is unwise to depend on a pump doing as much as this, differences in elevation, etc., being considered, and from twenty to twenty-five feet should be the limit to which a pump should ordinarily be taxed. Where water is to be raised to a greater height than this, a force pump, or combined force and suction pump, should be employed. Very hot water cannot be handled by a suction pump, the reduction of atmospheric pressure prior to the lift causing its transformation into steam and vapor. The placing of an air chamber in the suction pipe, by keeping a large body of water near the plumger, makes the supply steadier. It should be made long in the neck, so that when the water is passing through the pump barrel it may not be forced up into the chamber. This would result in an absorption of the air in the chamber and a consequent reduction of the supply of water. Every pump drawing its supply from tanks, wells, rivers, ponds, etc., should have the end of the suction pump covered by a strainer.

The exhaust pipe of a steam pump should be made to run downward when convenient. This will enable the water of condensation to flow out in place of requiring to be driven out by the exhaust.

Finally, the pipes of all pumps located in exposed situations should be provided with unions, so that on extremely cold nights the pump may be detached to prevent freezing. For the same reason the drip cocks of both steam and water cylinder shauld be left open whenever the temperature is likely to fall below freezing while the pump is standing idle.

Steam pumps, like all other machines, require careful attention to insure their efficiency and durability. It is necessary to see that they are well lubricated and well wiped at regular times and at frequent intervals, especially in the case of boiler feeding or circulating pumps, they should be looked at to make sure that they are not only running, but doing their work. The check valve furnishes one indication of their satisfactory operation. If it rises and falls regularly with each stroke of the pump and its vibrations are communicated to the feed pipe below the valve, the pump is working. It is as well to shut off the stop cock between the check valve and the boiler in a feed pump now and again, and, taking out the check, allow the pump to make a few strokes, which will remove any sediment or foreign substance from the seat. If, although the pump may be running, the water in the tank or boiler does not show its effects, some defect may be looked for. A leak in the suction pipe, worn or loose packing, water or check valves obstructed by some foreign particles, water supply shut off, or, in the case of a well fed by springs, fallen below the point of suction, or pipes choked with such mineral sediments as lime, salt, and other water deposits are among the commonest causes, and can be remedied by any engineer. In the case of a boiler feed pump located near the boiler it is likely to become heated and may, in such a case, fail to lift. The pet cock in the pump barrel may be opened and the accumulated hot water run out, after which it will usually be found that the pump will resume work.

The above points include such as may be regarded as of general importance. There are others that will occur to our readers from time to time, especially where pumps are employed as in breweries, oil refineries, distilleries, chemical works, etc., for moving thick or volatile fluids, or such as are likely to exercise a destructively corrosive effect on metals or packing substances.

A Strikers' Paradise.—Strikers seem to have a paradise in New South Wales. At Sydney the dock laborers threatened to suspend operations unless they were allowed a certain period of the day to smoke their pipes or cigars. Rather than precipitate a conflict with their men on so trivial a matter, the masters have allowed them three-quarters of an hour per day for indulgence in tobacco, and have agreed to pay them for it, too. The next step in concession will be to supply these hard-worked operatives with a particularly fine brand of tobacco and highly ornamented Dutch pipes. But it must be said in favour of this agreement that men work with freshened energy when they have occasional intervals of rest or idling.

A New Canadian Enterprise.

The Dominion Iron and Steel Company has been incorporated at St. John, New Brunswick, with a capital stock of $500,000. The company is formed for the purpose of erecting and operating mills for the manufacture of rolled and hammered iron, bar iron, cut nails and spikes, horseshoes, railroad and other spikes, fish plates, polished shafting and other articles. The plant is to be built in the vicinity of the city of St. John, on the Bay of Fundy, accessible by vessels and adjacent to lines of railway that connect with all the points east and west. The building will contain four train rolls, ten furnaces, nail and spike factory with 50 machines, a horseshoe machine, with a general machine shop and shafting department. The mills will be built, equipped and operated in the most modern and approved manner, and will strive to equal the output of similar concerns in the United States. The capacity of this plant per month is to be 240 tons cut nails and spikes, 760 tons scrap iron bar and 40 tons horse-shoes, besides shafting and other articles of manufacture. The men who are at the head of this enterprise point to the fact that 40,000 tons of rolled and hammered iron were imported into the Dominion of Canada from Great Britain in 1887. They further recite the fact that while scrap iron enters the Dominion at a tariff duty of $2 per ton, the duty on nails is 1 cent per pound, and that on scrap bar iron, etc., is $13 per ton.

This plant will be fed with Nova Scotia and New Brunswick coals, and by being located on the Bay of Fundy it hopes to escape the high freights now paid by the Western Iron Works, which plant is compelled to carry also a stock of coal sufficient for the winter months. The water location selected will admit of weekly supplies being received the year through. They say they will be able to put the finished product of their plant in Montreal, Toronto, and other western towns of the Dominion at the same rate per ton as it costs the iron plants there to freight their coal. The erection and equipment of this plant will cost $200,000. The company will use scrap iron imported from foreign countries until Canadian pig can be produced cheaply enough to compete with the cost of scrap.

This company makes the following comparison with the prices in the United States markets to show the prospects for good profits:—Cut nails in the Canadian market are worth, at wholesale, $2.60 per keg of 100 pounds for two-penny and upwards; other sizes in proportion, while in the Boston market they are selling at $2.05, a difference of 55 cents per keg of 100 pounds, equal to $11 per ton.

Colliery Ventilation.

In a recent paper read before the summer meeting of the Institute of Mechanical Engineers Mr. E. Bainbridge said:—

"The elements of danger, waste and inconvenience in furnace ventilation for mines have caused an almost general adoption of mechanical ventilators; and many endeavours have been made to improve the ventilating fans which were in existence twenty years ago.

Fæns.—The considerations to be aimed at in selecting a mechanical ventilator are as follows:—First cost of fan, engine and foundation; future cost of maintenance; economy of fuel and stores; useful effect of fan. Several committees of mining engineers have been formed to report upon the relative merits of various machines; and as at the present time a series of exhaustive experiments is being made by a committee of the Northern Institute of Engineers, it may be sufficient if in this paper the writer simply refers to some of the chief types of ventilating fans in operation in this country, at the same time giving particulars of a case in which each seperate fan is now adopted. These fans are the Guibal fan, Walker's improved Guibal fan, Cockson's, Schiele's, Capell's, Waddell's and Lupton's fans.

The Guibal fan is that most largely adopted, and is so well known that it needs no description. In Walker's improved Guibal fan the chief variation in the style is the same results with a small diameter of fans and the air, instead of being admitted, as in the Guibal fan, on one side only, is admitted on both sides. The Guibal movable shutter is replaced by an anti-vibrating shutter, which is very effective in its action. The tendency recently has been to adopt fast-running fans, which, however, are most suitable where limited qualities of air are required. Four years ago the writer adopted this principle at the Woodthorpe Colliery, near Sheffield, by applying an 8 foot Cockson fan, driven direct without gear by one of Willans and Robinson's direct acting engines, which runs very quietly at a speed of 280 revolutions per minute. At this speed the fan gives about 58,000 cubic feet of air per minute, with 3 inches of water-gauge. The engine since it was started has run about 500 million revolutions, and has cost a very small amount for repairs. The actual economy in the useful effect of a fan depends upon the cost of fuel; but bearing in mind that the useful effect is found to vary from about 15 per cent. to 70 per cent., the matter is of importance; and in the ordinary carrying on of a colliery the quantity of fuel used in driving a fan engine, which practically never stops working, may be said to be one-fourth of the entire fuel used. A simple contrivance in connection with ventilating machines, which the writer is adopting at the Nunnery Colliery, may here be mentioned. A new engine-house which is now being completed will be ventilated by taking a pipe from the roof and passing it into the fan chamber; the air leaving the house will pass up through two ventilators placed in the roof, and thence to the fan.

Steel Production in Great Britain in 1888 and 1889.

In 1888 Great Britain made 979,083 tons of Bessemer steel, a decrease of 42,764 tons from the product of 1887. In 1889 the production was 943,048 tons, a decrease of 36,035 tons from that of 1888, and the total decreased manufacture in both 1888 and 1889, amounted to 78,799 tons. Bessemer steel rails, in both years, nearly made up 50 per cent. of the total output. In 1888 the aggregate production of Bessemer steel rails was 979,083 tons, in 1889, 943,048 tons. As far back as 1882 the maximum output of these rails exceeded that of 1889 by 292,737 tons. Other descriptions of Bessemer steel production in the five principal districts of Great Britain in 1889 amounted to 1,665,122 tons. The average production of steel per converter in 1888 was 23,003 tons, in 1889 it was 25,156 tons. In 1889 the number of converters in operation was 60⅜ acid and 22½ basic; total number in the kingdom at that time, 91 acid and 26 basic.

The total British production of basic steel in 1889 was 493,919 tons, or about 14 per cent. of the total output of Bessemer and open hearth steel of all kinds, which amounted together to 3,569,960 tons.

The aggregate output of basic steel in England, Germany, Luxemburg, Austria, France, Belgium and other countries in 1888 was 1,953,234 tons, of which 1,493,032 tons was under 17 per cent. of carbon; in 1889, 2,274,552 tons, on which 1,764,639 was under 17 per cent. of carbon.

Great Britain's production of open hearth steel in 1889 was 1,429,169 tons, an increase of 136,427 tons over that of the previous year, and 448,062 tons over that of 1887. The gain was principally made in the Cleveland district. The net increase (there was decrease in two districts) in 1889 was 136,427 tons. Of the total production of open hearth ingots throughout the kingdom in 1889, 1,357,461 tons were acid and 71,708 tons basic.

At the end of 1889 there were 274 acid and 17 basic open hearth furnaces existing in the kingdom, a total of 291, or three more than at the end of 1888.

Nickel and its Uses*.

Dr. E. D. Peters, Jr.

Common observation would suggest that the consumption of nickel for plating has increased markedly in late years, and as a fact it has more than doubled in the last decade, and even in the past two years has shown a further though moderate increase, which is true also of the German silver manufacture. But the effort is being made in Europe to extend the consumption of nickel in all possible directions. For example, by the introduction of rolled nickel plate as an advance over tin plate. Among the proposed uses none attract so much interest as the use of nickel in alloy with steel to increase the latter's strength. A French invention has effected means for preparing such alloys with regularity and even composition. Lately Mr. James Riley, of Glasgow, Scotland, has published a valuable contribution to the knowledge of the physical characteristics of various sorts of steel when alloyed with nickel which is here abstracted from "Engineering." In the first place, a visit to the place of mauufacture in France demonstrated to his entire satisfaction the degree of certainty with which the desired products could be obtained from the crucible. A number of casts were made, the composition being varied at will and the quality and properties of the metal being indicated beforehand. Subsequently it was shown at English works that the composition of the metal can be as effectually controlled in the open-hearth furnace as in the crucible. Mr. Riley states that the alloys can be made in any good open-hearth furnace working at a fairly high temperature. The charge can be made in as short time as an ordinary "scrap" charge of steel—about seven hours. Working the steel requires no extraordinary care; in fact, not so much as is required in working many other kinds of charges, the composition of the resulting steel being easily and definitely controlled.

No special arrangements are required for casting, ordinary ladles and molds being sufficient. If the charge is being properly worked, nearly all the nickel will be found in the steel; almost none is lost in the slag—very different in this respect from charges of chrome steel.

The steel is steady in mold, it is less viscous than ordinary steel, it sets more rapidly and appears to be