Technical and Bibliographic Notes / Notes techniques et bibliographiques

The Institute has attempted to obtain the best original copy available for scanning. Features of this copy which may be bibliographically unique, which may alter any of the images in the reproduction, or which may significantly change the usual method of scanning are checked below.

L'Institut a numérisé le meilleur exemplaire qu'il lui a été possible de se procurer. Les détails de cet exemplaire qui sont peut-être uniques du point de vue bibliographique, qui peuvent modifier une image reproduite, ou qui peuvent exiger une modification dans la méthode normale de numérisation sont indiqués ci-dessous.

- ☐ Coloured covers / Couverture de couleur
- ☐ Covers damaged / Couverture endommagée
- ☐ Covers restored and/or laminated / Couverture restaurée et/ou pelliculée
- ☐ Cover title missing / Le titre de couverture manque
- ☐ Coloured maps / Cartes géographiques en couleur
- ☐ Coloured ink (i.e. other than blue or black) / Encre de couleur (i.e. autre que bleue ou noire)
- ☐ Coloured plates and/or illustrations / Planches et/ou illustrations en couleur
- ☑ Bound with other material / Relié avec d'autres documents
- ☐ Only edition available / Seule édition disponible
- ☑ Tight binding may cause shadows or distortion along interior margin / La reliure serrée peut causer de l'ombre ou de la distorsion le long de la marge intérieure.

- ☐ Coloured pages / Pages de couleur
- ☐ Pages damaged / Pages endommagées
- ☐ Pages restored and/or laminated / Pages restaurées et/ou pelliculées
- ☑ Pages discoloured, stained or foxed/ Pages décolorées, tachetées ou piquées
- ☐ Pages detached / Pages détachées
- ☑ Showthrough / Transparence
- ☑ Quality of print varies / Qualité inégale de l'impression
- ☐ Includes supplementary materials / Comprend du matériel supplémentaire
- ☐ Blank leaves added during restorations may appear within the text. Whenever possible, these have been omitted from scanning / Il se peut que certaines pages blanches ajoutées lors d'une restauration apparaissent dans le texte, mais, lorsque cela était possible, ces pages n'ont pas été numérisées.

☑ Additional comments / Commentaires supplémentaires: Continuous pagination.

CANADIAN MAGAZINE OF Science and the Industrial Arts.

Patent Office Record.

Vol. 13. SEPTEMBER, 1885. No. 9.

Communications relating to the Editorial Department should be addressed to the Managing Editor, P. O. Box 128, Montreal.
Business communications and subscriptions to be sent to the Burland Lithographic Co., Montreal.
The Editor does not hold himself responsible for opinions expressed by his correspondents.
No notice will be taken of anonymous communications.

NIAGARA FALLS MADE FREE TO THE WORLD.

(*Concluded.*)

The peril of degradation is one to which Niagara has long been exposed. The noble forest growths which once crowned these banks have in large measure disappeared. The tender draperies of foliage and flower which everywhere concealed the nakedness of the rocks have in many places been rudely stripped away. Unsightly structures, erected for what may be justly called, in such surroundings, merely sordid purposes, everywhere meet the eye. And, in addition, the ordinary accompaniments of places of public resort, the showman, the vendors of small wares, the guides and other officers of petty and often needless services, with their small, but continual exactions, make up a sum of disturbing and irritating influences which tend to supplant with resentment and disgust the high emotions which the scene would otherwise inspire.

It was this degradation of the surroundings of Niagara which induced the effort of which we celebrate today the successful accomplishment. The residents of this neighbourhood, justly proud of the possession of a great natural spectacle of sublimity and beauty which drew to them visitors from every part of the civilized world, the fond votaries of the scene, long accustomed to resort to it, and to study its features until they had

> "got by heart
> Its eloquent proportions"—

took alarm at the progress of the devastation. They knew, indeed, that the mighty rush from these inland seas could never be arrested, nor the thunders of the cataract silenced by human power—

> "Man marks the *earth* with ruin—his control
> Stops with the shore."

Lieut. Gov. Robinson of Ontario was received with an enthusiastic welcome, and spoke shortly of the far-reaching benefits of the scheme, and hoped that at no very distant date he might have the pleasure of taking a part in a similar ceremony in Canada.

The Hon. Mr. Mowat, who was called upon, was received with great applause, and made a long and telling speech which, for its conciseness, was much admired and commented on.

He pointed out that while we have a large country in point of extent, we have not a large population. New York State has fully five millions of people, whereas Ontario has only two millions, to undertake a similar work, because the Dominion Government show no signs of assisting. The present wealth of the two states is in much larger proportion in favor of New York.

He stated that 50 years ago the population of New York was two millions, and promised that although it had taken New York 50 years to make up their minds, Ontario would certainly not take nearly so long.

An order has just been given to the Gilbert Car Co., Troy, N.Y., for the construction of four Mann Boudoir Cars, of the most elaborate and handsome character, for the South Australian Railways. The cars are already in work, and are to be delivered in four months. They will be built in sections for shipment, and are to be the most perfect types of the Mann Boudoir car yet turned out. This order has been given after careful investigation by a Commission appointed by the South Australia Government Railway administration, to determine the best "Sleeping" car that could be obtained. The Commission visited this country last year, and also went to Europe where the Mann Cars are almost universally used. In this connection, we may note that the progress of the Mann cars in this country is almost marvellous, the Company now having forty three cars in regular operation, and are constantly extending their service. They have recently begun a service on the Boston & Lowell road, and have extended their lines between Chicago and Detroit, on to London, Ont., over the Great Western road of Canada, an entering wedge to the Grand Trunk system.

THE International Inventors Exhibition at London, England, has been on the whole a very decided success.

It has been a valuable and instructive concentration of the advancement and scientific achievements of many minds engaged in every conceivable trade and industry, and not the least advantage is—that it has afforded special privileges and facilities to journals to publish and illustrate cheaply many of the inventions.

The Exhibition Buildings are situated at South Kensington, in connection with the great world-renowned Albert Hall. A great feature of ingress to the Exhibition Grounds is a sub-way nearly a quarter-of-a-mile long from the nearest railway station, all lighted up with the incandescent electric light, and the sides and top of sub-way lined throughout with white glazed brick, so popular with the English for public buildings.

The greatest feature of the Exhibition is the completeness with which it has been lighted up by electric lights having globes of all colours, so wonderfully arranged with rockeries and water fountains,etc., as to make the scene one of surpassing artificial grandeur never to be forgotten.

Thousands of people stand round to witness the display of aquatic pyrotechnics, while military bands ensconced in artistic pavillons make the place quite a dreamland.

The most striking edifice is the middle Court where all the prime-movers, steam engines, railway appliances and instruments of destruction are located.

Mr. Maxim, the great American inventor, has four of his guns on view. Mr. Gladstone, some time ago paid him a visit and fired the gun himself; the instrument, it will be remembered by our readers, fires automatically from 600 to 700 shots per minute, and is the most valuable instrument of destruction of its kind. The gun, by a clever arrangement of mechanism, after being started once is able by its recoil to load itself, fire itself and discharge its own cartridges.

Mr. Maxim has been promised fabulous sums for his invention, but he is content at present to wait his time.

The Aeronautic Department is, considering its peculiarity and novelty, fairly well represented—there being steering balloons and flying machines, but it would be better if the inventors would practically demonstrate the value of their appliances, because we believe many of the so-called flying machines are useless, and the same might be said of some of the steering balloons—but we hope ere long this Department may yet prove to be as practical as it is theoretical.

The greatest display is in the line of railway appliances, from the ponderous locomotive down to the delicate electric switch, or in other words "from a needle to an anchor."

The Musical Dept. is very good, being represented by all parts of the world, and although this is the first musical exhibition ever held in Britain, strange to say there are but few really new and important inventions exhibited.

—A large number of men are to be at work on extension of the Florida Southern Railroad from Lakeland to Charlotte Harbor.

—THE machine and car shops of the Alabama Great Southern Railroad are to be located at Birmingham, Ala. Ground 200x1,360 has been secured for the location.

A GREAT disadvantage which has always attended iron ships has been the rapidity with which their bottoms have become incrusted with sea-weed, shells, etc., thereby impeding their progress through the water. Many schemes have been devised for counteracting this tendency, the greater number of which have consisted in coating the bottom with a substance intended to prevent the growth of such bodies.

Although many of these compositions are successful in keeping the bottom clean for a short time, and partially prevent oxidation of the plate, yet they are quite useless in the case of ships which have to keep the sea for a long time, like those of the Royal Navy, often situated in distant stations.

The only satisfactory mode yet arrived at of keeping the bottom free from fouling for any lengthened period, is, first, to sheath it with wood and then with copper or zinc outside all, in fact similar to the old safe and durable plan for many years in practice for wood ships.

Certain precautions are necessary, however, in covering iron ships.

It is well known that galvanic action is set up between copper and iron when immersed in water, if either actually in contact, or if both should be exposed to the water.

The result of this chemical action is a rapid decomposition of the iron; hence the necessity of insulating the two materials by some intervening non-conducting material, such as wood, pitch, etc.

When zinc is used these precautions are not necessary, because the galvanic action results in the decomposition of the zinc.

Indeed, this decomposition is often utilized for the ship's benefit, because the decomposition takes place on the outside, and the wash of the water carries it away along with whatever foreign substances, such as shells, etc., which may have adhered to it.

Hence, when zinc sheathing is used on the wood covering the iron bottom, the wood is not caulked, nor are the fastenings and plating insulated, but rather a free communication is allowed between the zinc, iron and sea-water.

It should be remarked here that notwithstanding the advantages of zinc, copper is often used, because it possesses a valuable property when under water of exfoliating and then carrying with it the substances collected upon the surface.

When copper is used, two thicknesses of wood are used instead of one, as in the case of zinc, and great precaution taken to ensure complete insulation between the inner and outer metal by specially devised fastenings arranged to suit.

—THE Common Council of Minneapolis, Minn., have passed resolutions ordering new walks, curbs, gutters, sewers, etc.; the amount to be expended will foot up into the hundreds of thousands.

THE NAILS.—The growth of the nails is more rapid in children than in adults, and slowest in the aged; goes on faster in summer than in winter, so that the same nail which is renewed in 132 days in winter, requires only 116 in summer. The increase of the nails of the right hand is more rapid than those of the left; moreover, it differs for the different fingers, and in other corresponds with the length of the finger, consequently it is the fastest in the middle finger, nearly equal in the two on either side of this, slower in the little finger and slowest in the thumb. The growth of all the nails on the left hand requires 82 days more than those of the right.

PUMPS FOR ABERDEEN GRAVING DOCK.

We illustrate a very fine pair of centrifugal pumps lately erected by Messrs. Drysdale & Co., of Glasgow, at the new graving dock at Aberdeen. The water enters at one side of each pump by a pipe 24 in. in diameter. The blades measure 60 in. across and have a circumferential velocity of 2514 ft. a minute. The engines have cylinders 17 in. in diameter by 16 in. stroke, and are capable of running at 160 revolutions per minute. The crankshafts are coupled together, uniting both engines and pumps, but either engine and pump can be thrown out of action. The pumps were specified to lift 350,000 cubic feet of water out of the dock in three hours from high tide, but the engineer's certificate states that they threw 564,000 cubic feet in that time, and thus greatly exceeded the guarantee.

The dock was opened on July 8, and is 500 ft. long on the floor, the width at the top being 74 ft., and at the bottom 48 ft. ; the depth from the coping level to the main invert is 25 ft., and from the high-water level to the main inverts 20 ft. The floor and west end of the dock are built of concrete and the ten alter steps along each side of solid granite. The entrance is closed by one of Kinipple's shifting caissons. A leakage pump, similar in construction to the large pumps, is used to completely drain the dock, the suction and delivery pipes being 8 in. in diameter. The four large sluice valves for regulating the admission of water to the dock are 4 ft. in diameter with gun metal faces. The hydraulic machinery for the dock gates was supplied by Messrs. Tannett, Walker, & Co., of Leeds, Mr. William Smith is the resident harbour engineer.—*Eng.*

BRICK-MAKING MACHINE.

Messrs. Bradley & Craven, Westgate Common Foundry, Wakefield, exhibited one of their standard brick-making machines, which we illustrate. There is nothing novel about this machine ; indeed, it has been for a number of years the standard type made by Messrs. Bradley & Craven, who are probably the oldest manufacturers of this class of machinery. The machine exhibited was a single one, weighing 10½ tons, and having a capacity of from 10,000 to 12,000 bricks per day of ten hours, which are produced without any skilled labour. The speciality of the machine is that it produces from the plastic clay delivered from a mixer into a pug mill, and by a continuous process, a dense and perfectly formed brick ready for immediate kniling without any preliminary drying process. The illustration gives a very good idea of the machine. The clay, either crude from the ground, if it is in suitable condition, or after preliminary treatment in a roller mill, is delivered to a platform at the back of the machine, and thence to a mixing apparatus which prepares it for entering the pug mill. This part of the machine is shown on the right-hand side of the engraving ; it is driven, as will be seen, by powerful bevel gear from the second motion shaft. As will be seen, on the further end of this shaft is a bevel pinion, driving a vertical shaft, on the bottom of which is the large cam that controls the intermittent motion of the revolving table of the machine that contains the moulds, and which sweep beneath the bottom of the pug mill. When at each movement of this table sufficient clay is fed into the mould beneath the pug mill to form a brick, pressure is exerted from beneath to force the clay into the mould, and give it a considerable compactness. During the pause made to fill the mould, another mould, which had previously been charged, delivers its partly formed brick to the powerful press shown in the front of the engraving. This press is worked off the first horizontal shaft, and it will be seen that this pressing portion of the machine stands in advance of the main frame. The whole process, which is practically continuous, and entirely automatic, is very simple, and the bricks produced are of a very high quality, which indeed is the necessary consequence of the perfection to which the machine has been carried. We may mention that Messrs. Bradley & Craven are makers of these pressed bricks on an extensive scale, as well as manufacturers of brickmaking machinery.

The naval board appointed to examine plans and specifications for the proposed cruisers has adjourned subject to the call of Commodore Walker, the president. The acceptable portions of the various plans examined were placed in the hands of Commander Goodrich and Naval-Constructors Bowles and Gatewood, with instructions to embody them in one plan.

USE OF OPIUM.

A writer of the New York *Sun* publishes an article on the increase of the habit of opium smoking, in which an attempt is made to prove by the official returns showing the importations of opium prepared for smoking, that the increase in the rate of duty from $6 to $10 per pound had the effect to cheapen the price of opium, and therefore to increase the importations and the habit of smoking that article. The writer in the *Sun* says : The attention of Congress was called to the fact that in 1880 the importations of opium for smoking purposes were 77,196 pounds, and those for 1883 were 288,153 pounds. Congress then attempted to check the traffic, and the duty of $6 per pound was, in July, 1883, increased to $10. The imports for 1884 fell to 1,066 pounds, and for the first six months of this year, they were practically nothing. Now, continues the writer, has Congress checked opium smoking by this big duty ? No. The practice was never more prevalent and it is spreading all over the country. The action of Congress had the effect of advancing the duty and cheapening article.

The figures used in this statement are correct, but the use the writer makes of them is misleading. The attention of Congress may have been called to the fact that over 77,000 pounds were imported in the year ending June 30, 1880, but the attention of the body could not have been directed to the fact that 288,153 pounds were imported during the year ending June 30, 1883, because the act by which the duty was increased to $10 per pound was passed March 3 of that year, four months before the close of the fiscal year, and at least six months before before the official figures for that year were made up. The large increase in the importations in 1883 of opium for smoking were due, not in the increase in the smoking habit, but to the fact that it was proposed to add $4 per pound to the rate of duty then existing. In anticipation of the large increase to the rate of duty importers bought in unusually large quantities of opium for smoking in the interval between March 3, the date of the passage of the act, and July, the date when it became operative. This is shown by the official returns. Of the 288,153 pounds imported during the fiscal year of 1883 the entries for the last quarter of that year—April, May, and June—were 169,583 pounds, which exceeds the entire quantity imported during the preceeding nine months of that year. As the proposed increase was known at least two months prior to the passage of the act it is fair to assume that importations for part of February and all of March were in consequence unusually large. It will thus be seen that the increased importation of opium for smoking in 1883 was not owing to the increase of the opium habit, as alleged, but to the fact that advantage was taken by importers of the four months' time intervening between the date of the passage and the date fixed for the operation of the act increasing the rate of duty to lay in large supplies of smoking opium.

THE IMPORTS.

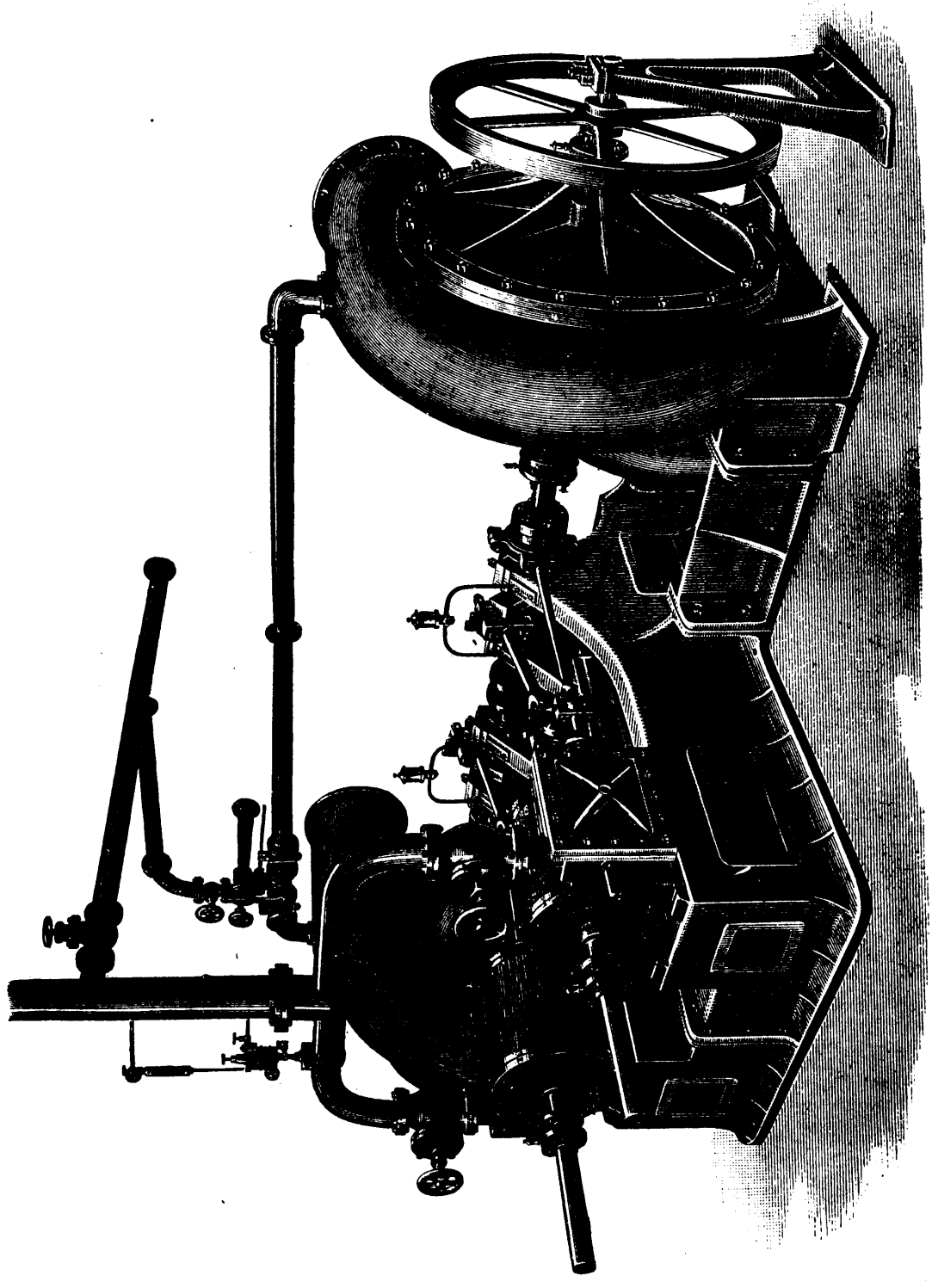
The annexed table shows the number of pounds of green or gum opium and opium prepared for smoking imported into the United States during the fiscal indicated, the figures for 1885 being for the nine months ending March 31 last :

	Gum. opium	Smoking opium
1879	278,554	60,648
1880	245,211	77,196
1881	385,059	76,446
1682.	227,126	106,241
1883	229,011	288,153
1884	264,746	1,066
1885	243,434	21,403

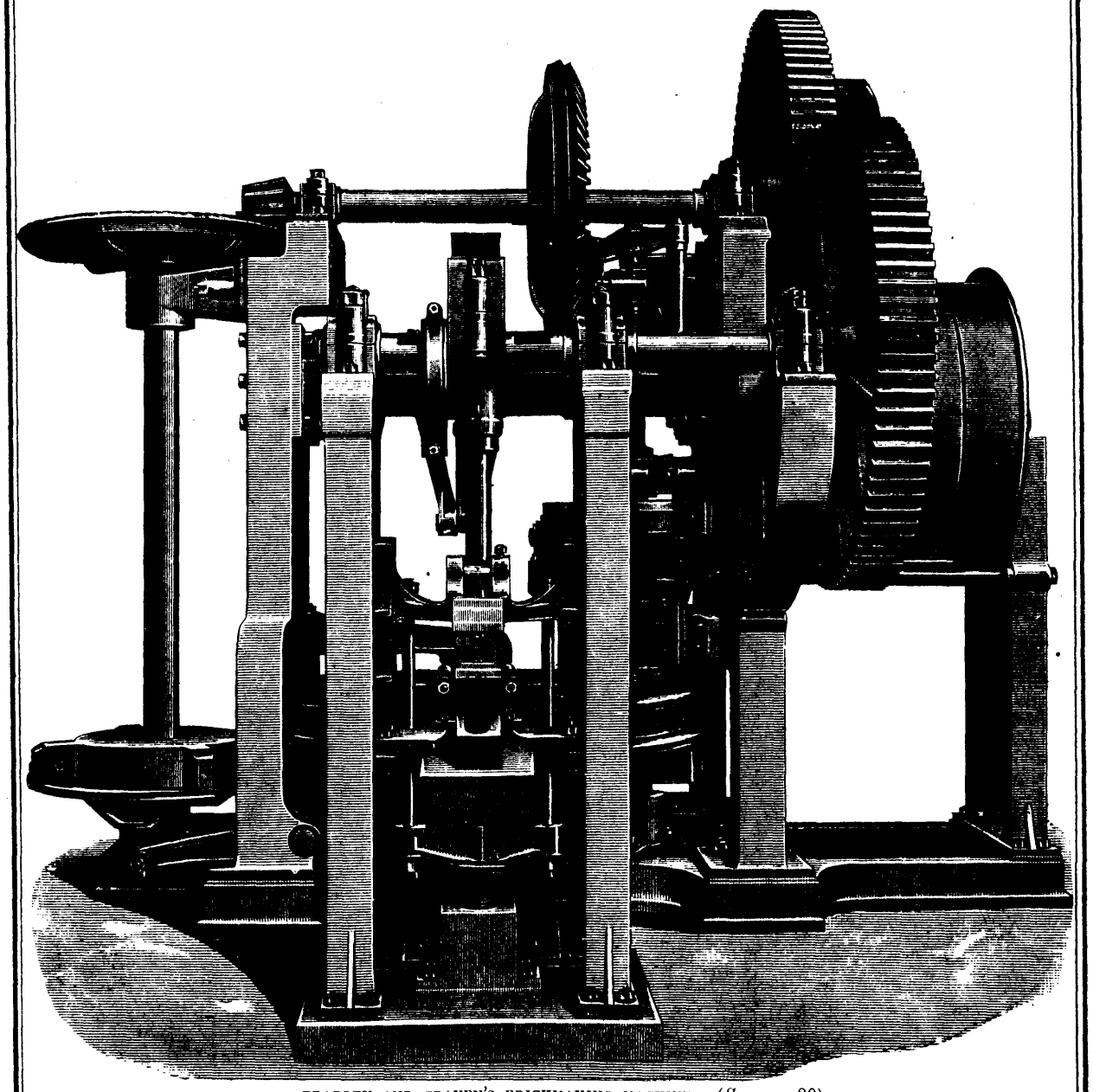
Estimating the entire importation of smoking opium for 1886 at 30,000, would give a total importation for the past three fiscal years of 319,219 pounds, an annual average of 106,416, which is about the quantity imported in 1882.

In explanation of this theory that the increased rate of duty on smoking opium has reduced the revenue receipts about $1,000,000 per annum, without checking the opium habit, the writer in the *Sun* says : "The imports of crude opium, which is used to manufacture morphine and quinine and other drugs, are daily becoming larger. The duty on that kind of opium is only $1 per pound. * * * Since this duty of $10 was imposed a new industry has sprung up on the Pacific coast. It is the manufacture of smoking opium from the crude article. This industry is carried on very extensively in California."

CENTRIFUGAL PUMPS.



BRICK-MAKING MACHINE.



BRADLEY AND CRAVEN'S BRICKMAKING MACHINE. (*See page* 80).

It is doubtless true that crude opium is purchased in the manner and for the purpose alleged, but an examination of the figures above does not indicate that crude opium is so used to the extent charged. Assuming that the imports for the last three months of 1885 were proportionately as large as for the preceding nine months, the imports for the year would be 24,578 pounds, and for the past two years 589,324, against 612,185 pounds for the two years ending June 30, 1882. If the imports of both crude and smoking opium for the three years ending June 30, 1882 it will be found that for the period first named the total was about 1,135,000 pounds, against 1,115,259 pounds for the last. This does not show much increase. However the official figures of imports show that the increased rate of duty on opium under the act of March 3, 1883, has checked the importation of that article, and has reduced it about 75 per cent. The purchase of the crude opium and its preparation for smoking is a matter with which Congress can not interfere. That is a subject for State and municipal legislation.

FINDING A REMARKABLE CAVE.

A party of northerners, who have been prospecting for mineral in this neighborhood for some time, writes a Chulafinee, Ala., correspondent to the New York *Sun*, arrived here this morning from Riddlesbride, on the Tallapoosa river. They report the finding by them of a remarkable cave near there, and give a graphic account of their meeting with the inhabitants of the cave. The entrance of the cave is near the head of a small ravine, about one mile from the Tallapoosa river, and is barely large enough for one person to enter at a time. The party entered the cave at 4 p.m. and spent two hours exploring it. The cave is about four hundred feet in length, varying in width from ten to sixty feet, with an average height of fifteen feet, and is dimly lighted throughout by small fissures in the rocks, extending from the roof to the ground above.

When the explorers were about to leave the cave they were terrified at finding the exit blocked by a writhing mass of big rattlesnakes. The noise made by the party had doubtless roused the snakes from their hiding-places among the rocks, and they had gathered in large numbers near the entrance. Deeming discretion the better part of valor, the party retreated to that part of the cave most remote from the entrance to wait for the snakes to return to their hiding-places. The explorers were compelled to remain in the cave until morning. Soon after dark one of the party struck a match to light a cigar, and after lighting it threw the still burning match on the bottom of the cave. He was startled by seeing a bright flame flash up from the rocks where the match had fallen, which rose to the height of four feet, burning brightly all night, and was still burning when they left the cave in the morning. A small fissure could be seen in the rocks beneath the flame, and the supposition is that a volume of natural gas was escaping through this fissure.

Daylight came at last to the great relief of the explorers, the entire party having remained awake all night. Going forward to the entrance of the cave they found that the snakes, with the exception of one or two had gone back to their hiding places. Those that remained were quickly dispatched with stones, and the explorers made their exit from the cave in safety. A large party will go from here to-morrow prepared to extinguish the snakes and fully explore this wonderful cave.—*Chicago Journal of Com.*

THE DAVEY DOMESTIC MOTOR.

The Davey domestic motor has, since it was first shown to the public a year ago at the Shrewsbury Show, been considerably modified and improved. At that time, while giving considerable promise, it was in an experimental stage, and the experience gained with the motors of the original type, suggested alterations which have been made with the result that the engine in its present form leaves little to be desired. We illustrate one of the latest patterns of this motor. Since our engravings have been prepared, however, a further improvement has been made in the engine, and of this improvement which exists in the case of the engines shown at Preston, we shall speak presently. The motor thoroughly merits the title of "domestic," inasmuch as the only attention that it requires is that it shall be kept clean, and that the fire shall be attended to from time to time. The grate is made larger, and the firebox much deeper than in the early types, and the engines, when once started with a properly made-up fire, will run continuously for three hours without any attention. At the end of that time the fire has to be made up. The jet condenser which was used originally, and which was formed in one piece with the boiler, is now replaced by a surface condenser placed behind the boiler and connected to it by the exhaust pipe at the top, and by a second pipe at the bottom leading to the air-pump, which occupies its old position on one side of the boiler outside the firebox. In the engines shown in our illustration the air-pump is open-topped, and the feed for the boiler is taken from the condensing water by means of a pipe connected to the tank in which the condenser is placed. In the engines shown at Preston, however, the air-pump is close-topped, the plunger working through a struffing-box, and the pump discharging into a small open-topped hot-well made by partitioning off a portion of the condenser tank. This hot-well is at a sufficiently high level to feed the boiler in the manner we are about to explain, while a small hole which places it in communication with the condenser tank enables it to draw water from the latter in the event of any water being required to make up losses by leakage. The feed regulator is contained in a box on the side of the boiler, and is provided with a glass front, so that the level of the water can always be seen; the necessity for a water gauge thus ceases to exist. The regulator is shown in detail by Figs. 1 and 4. It consists of a cylindrical float having a broad strap or stirrup at the lower end which passes over the end of the pipe brought from the hot-well, or, in the case of the arrangement shown by our engravings, from the condenser tank. In the underside of this pipe a nozzle is screwed and a suitable seating on the bottom of the stirrup closes the nozzle when the float has risen to its highest position; this latter of course falls as the water in the boiler is evaporated, and the nozzle is uncovered, allowing more water to enter, and the normal level to be restored. The boiler is of cast iron, and has much the same form as before, except as regards the altered proportions of the firebox, the door of which is hinged at the bottom instead of at the top. The condenser is of an ordinary type with a top and bottom box connected by tubes of small diameter; the exhaust steam enters direct from the cylinder to the upper box, and the water of condensation is removed by means of the air-pump, which is driven by a disc on the end of a crankshaft. The condenser is inclosed in a light cast-iron shell, the circulating water being admitted at the bottom and discharged at the top, the level of the overflow being such that the upper box of the condenser is always covered by water. The condensing water may be contained in a large tank as shown in Fig. 2, in which case the water circulates continuously through the tank and round the condenser; or the discharge level at the top of the condenser may be fitted with an overflow pipe, and the condensing water may be run to waste, a continuous supply being necessary for this purpose. The engine itself has also been modified since it was first shown at Shrewsbury. Owing to the increased height of the firebox, the crankshaft is brought closer to the cylinder, and the length of the connecting and piston rods is reduced. The crosshead guide, which is crossed in one with the boiler, is cylindrical, and the crosshead is of the form indicated in Fig. 2. The regulating valve is placed at the side of the cylinder casing instead of on top as formerly, and controls the admission of steam in the manner shown in Fig. 3. A blow-off valve is placed on the top of the boiler in such a position that any escaping steam passes up the chimney, which should not be less than 10 ft. high. The arrangement for automatic regulation will be understood by inspection of the perspective view and of Fig. 3. A horizontal governor is placed on top of the cylinder, and is driven off a disc on the crankshaft; the travel to and fro of a sleeve on the governor shaft is communicated through a vertical lever to the spindle of the regulator valve, which is opened or closed more or less according to the position of the lever. In its present form the Davey motor is a thoroughly efficient machine, and on account of its simplicity, the absence of trouble it involves, and the absolute safety attending its use, it is in all respects adapted for domestic use. The consumption of coke is comparatively small—about 6 lbs. per horse-power per hour—and the engine can be easily adapted to any of the miscellaneous cases where small powers are required. As an illustration of this we may refer to one installation in which a 2-horse engine of this type is employed to drive a dynamo which supplies current to seventeen 20-candle lamps. Motor and dynamo are

placed in a small shed 6 ft. by 9 ft. and a hopper boiler feeder is placed outside the house, holding enough gas coke for the day's firing. One charge is sufficient to maintain the lamps for six hours, but after the engine has stopped sufficient heat is left in the boiler to supply a heating coil connected with it all night. The consumption of fuel for this service is 120 lbs. of coke per day.—*Eng.*

THE PATENT LAW.

Sir Henry James, the late Attorney-General, is of course a high authority on legal matters. But we are not quite able to follow the view taken by him in a letter to a correspondent which appeared in our last issue. According to the statement made to us, it appears that an inventor forwarded to his patent agent "three provisional specifications" for improvements in steam engines, and was informed by him that as they were quite distinct it would not be possible to include more than one under the same patent. Under the old law, the agent stated, there would have been no difficulty in including all under one patent, but he added that the new law was very strictly construed in this particular.

Thereupon the client addressed a communication to the late Attorney-General stating that as one who took an interest in the passing of the new Patent Laws on the grounds that inventors were justly entitled to a more economic law, he was more than surprised that the new law admitted of a construction the effect of which was to burden inventors with expenses from which they believed it had entirely relieved them. He did not think inventors, or any one interested in Patent Law, understood when the new law was passing through the Lords and Commons that it could, or would be, constructed in the way represented to him, and he hoped that it arose from some extra official diligence in the Patent Office, and not that the Act really intended that each item of improvement of the same machine should be under separate patents.

To this Sir Henry James replied that the patent agent was labouring under a mistake as to the supposed change in the law effected by the new Patent Act. The Solicitor-General and himself had issued regulations then in force in the Patent Office, and the effect of which was that the rules as to the inclusion of more than one invention in the same patent remained the same as they were before the new Act was passed. So long as these regulations were in force there would be no ground for the apprehensions expressed in the letter addressed to him.

Now, whatever may be the theory applicable to the case, we are prepared to show that under the new law the practice has certainly not been uniformly in strict accordance with the suggestion that no alteration in the law as affecting the point in question was effected by the Act of 1883.

Prior to the coming into operation of that Act the granting of patents was regulated by the Patent Law Amendment Act of 1852 and rules from time to time made thereunder. The Act itself (unlike the Act of 1883) was silent as to what might be included under a single patent. But the rule of the law officers dated December 12, 1853, was in these words: "Every application for Letters Patent, and every title of invention and provisional specification, must be limited to one invention only, and no provisional protection will be allowed or warrant granted where the title or the provisional specification embraces more than one invention."

The examination of provisional specifications was carried out nominally by the law officers, but actually by their clerks, and was quite as efficient as the present examination, though far less costly. Under the old practice a single patent would be allowed to cover, for example, improvements in ordnance, firearms and projectiles. The features protected might include improvements in the mode of building up large guns, improvements in the construction of the breech mechanism of small arms, and improvements in the construction of projectiles, besides other features. It was a common thing to include under one patent, improvements in breech-loading firearms and in cartridges.

Under the new law an application for a patent for improvements in firearms and cartridges designed for discharge by electricity, had to be divided. The Comptroller maintained that the specification contained the subject-matter of more than one invention, and he went so far in the first instance as to require that four patents should be applied for instead of only one. The invention was one in which obviously a suitable cartridge was necessary in order that the gun should be operative, because a circuit had to be completed before the discharge would be effected. Therefore in order to produce the result aimed at, namely the discharge of the projectile, the cartridge formed an essential. However, notwithstanding this fact, which was repeatedly urged upon the authorities: and notwithstanding the innumerable precedents, the Comptroller insisted upon a division of the case into two.

In other words, whereas under the old law protection for fourteen years would have been obtained for the entire invention at a cost in Government fees of £175, the cost under the new law will be £308.

The Comptroller in giving his decision said it was a rule that an improvement generally applicable to small arms, and an improvement in small-arm cartridges, could not be considered as a single invention, and therefore such improvements were not allowable in one specification. The improvements of the one were not necessary for the efficient working of the other, and moreover the general nature of the improvement made it applicable to all members of the same class. The only exception to this rule would be where a *special* improvement in the firearm required an unusual formation of the cartridge, or where a cartridge was specially adapted for use in a particular firearm. There seemed to him to be no reason for departing from this general rule in the case of electric small arms.

In another case an alternative arrangement for distributing steam in an engine had to be withdrawn from an application for patent, and had to be made the subject of a separate patent.

In contradistinction to this, it may be mentioned that under the old law a single patent was allowed to include improvements in steam boilers and other apparatus applicable to the heating and evaporation of liquids, parts of which improvements were applicable also to other purposes; and that in another case a single patent was allowed to include an improved construction of steam fire-engine, and also a boiler in various forms applicable for stationary and other purposes, and in part applicable also for cooling fluids. Indeed innumerable examples could be given to prove how much more liberal was the practice under the old law than it has heretofore been under the new.

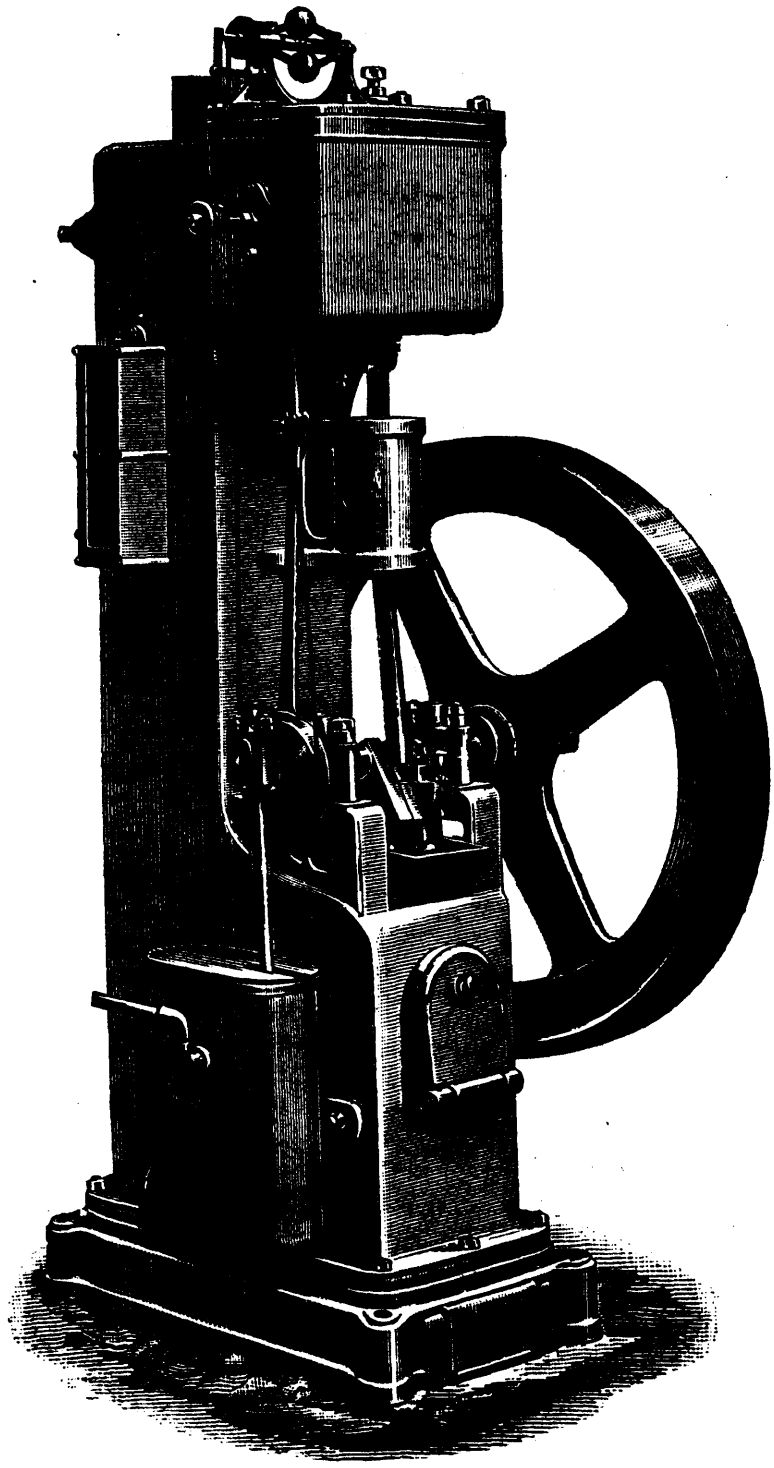
As it would seem that the law officers have exercised considerable control in the matter, it becomes evident that even if in point of form the letter of Sir Henry James is correct, yet in point of fact the effect of the practice under the new law is to make it more costly than it was under the old law to protect a given amount of invention.

What may be the particular regulations to which Sir Henry James refers in his letter it is not possible to say. He does not state when they were made, nor does he say in what terms they are framed. Possibly they are secret rules of recent date, which have not been, and are not intended to be made public. If some enterprising member of Parliament would move for copies of the regulations in question, considerable public benefit would probably result.

Whatever may be these regulations it is certain that the new law expressly provides that every patent shall be granted for one invention only, although, on the other hand, it is not competent for any person in an action or other proceeding to take any objection to a patent on the ground that it comprises more than one invention.

An eminent authority in a treatise on the new law states in a footnote that a patent may still be obtained for an invention consisting of several parts, where the parts are so worked as to produce an improved result by their joint or successive operations. So far as we can see the only reason that can be urged in favor of limiting the subject matter of a single patent is that the State may get as much as possible out of the inventor's pocket. A single invention may comprise many features each in itself new, and there may be a valid claim to the whole in combination, as well as subsidiary claims to sub-combinations and to each of the several features separately. But under the old law it was the practice to allow the applicant to go much further. In describing his invention, and the separate parts, he was permitted to show that he claimed to apply them, not only to the main purpose constituting the object of his invention, but also to other and different purposes. Why then should he be, as he undoubtedly is, denied this privilege under the new law, if it be true, as indicated by Sir Henry James, that it is a mistake to suppose there has been a change under the new law? In view of the sharp lessons the authorities have received it is possible they will hereafter be disposed to adopt more liberal views. We should not be surprised to find under

THE DAVY DOMESTIC MOTOR.



THE DAVY DOMESTIC MOTOR.

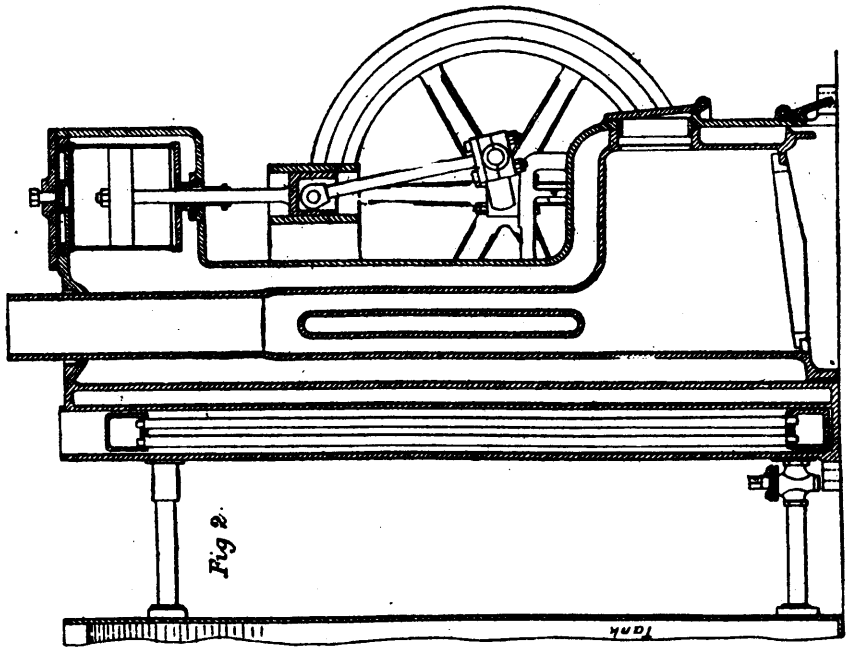


Fig. 2.

Fig. 4.

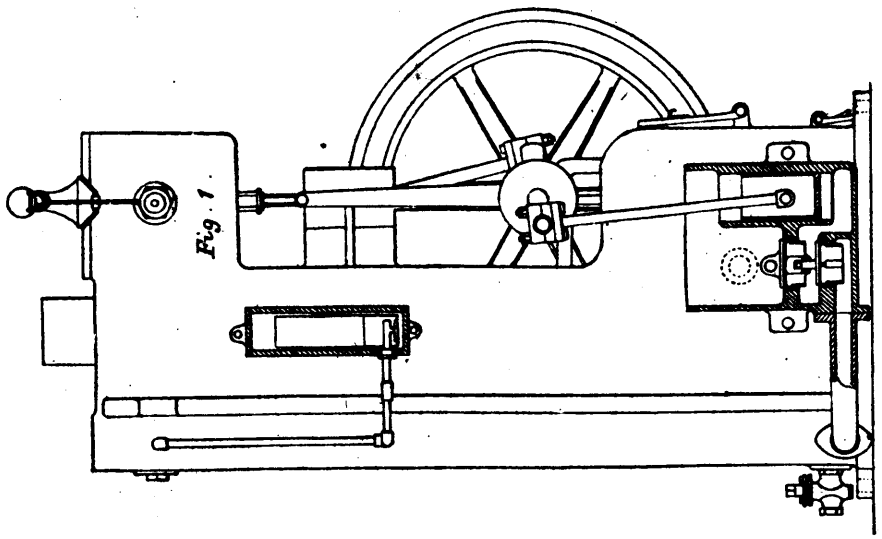


Fig. 1.

a single patent, say in respect of a novel bicycle, a general combination that is new, and comprising, say, a wheel and a lamp that are novel. Although, from one point of view, this is not strictly a mechanical combination, yet the parts are used together for one main purpose, and perhaps might be regarded as one invention. Assuming such a case to be allowed, as we believe it now would be, the inference would be that so long as all the parts are claimed only as applied to one particular object they may be included in a single patent. But, according to the present disposition of the authorities, if the applicant in the hypothetical case under consideration, should apply to protect the individual parts as applied separately for other purposes, his application would not be entertained as for a single patent. Here, then, is a departure from the practice under the old law, and it means that to obtain in such a case full protection for fourteen years the inventor must, under the new law, pay £462 for stamps, instead of only £175 as under the old law.—*Eng.*

"THE TORPEDO SCARE."

Hobart Pacha has had reprinted in pamphlet form his interesting article which appeared in "Blackwood" under the above title. He has also added a few pages in which criticism is said to be answered. "The criticism answered" department consists simply of dubbing all who do not agree with his theories as "rabid torpedists." It appears, however, that "many who are of different opinion (to that of the writer of the article) are mentrained during the last few years as torpedo experts." Now, these are just those who are most capable of judging of the probable value of torpedoes and torpedo boats in warfare, and if they are, as it appears, of a different opinion, it seems to us that it should settle matters so far as it can be settled by the light we have at present. Certainly an English officer "trained during the last few years" as a torpedo expert is a far higher authority than the ex-Turkish Admiral with such obsolete experience as he may have gathered from the rude operations of the Russians and Turks during their last war. The late Board of Admiralty are, however, fortunate in having so popular a man as the dashing ex-blockade-runner and enemy of the Russians for their apologist for what is considered by many to be one of their most serious breaches of faith, viz., the neglect to provide the country with an efficient torpedo-boat flotilla.

With the second part of the writer's essay, so far as he advocates the more extended use of stationary torpedoes, we quite agree; although we hardly think that if the country adopted the course advocated and trusted to these engines alone for torpedo defence, we should be always able to enforce the policy of "Hands off." We quite recognise the immence importance of having estuaries and channels thickly sown with sunken mines of all descriptions, and since Messrs. Latimer, Clarke, & Co., have taken the matter up, it is a branch of warfare the efficiency of which is likely to be much advanced. But mines can be counter-mined or in other ways destroyed, and an active enemy might do it an hour or two as much damage as it would cost days to make good. Hobart Pacha brings forward the instance of America in support of his view.

"How well America knows the value of torpedo defences! How quietly she looks on, while all the world are arming to the teeth! She, too, says, 'Hands off! beware the torpedo mines on my coast!' She builds no big ships, she makes apparently no preparations for a row, but she is ready." The admirable course of instruction of Newport and Willets Point has undoubtedly placed the United States in a position to quickly put navigable channels and approches to her harbours in as efficient state of defence as can be accomplished by mines and other obstructions; though we always thought that geographical position was the great comforting element in an American's estimate of future possible invasion. But are the people of the United States so complacently satisfied with the absence of a fleet as Hobart Pacha would have us suppose? The defenceless State of the United States coast is a more constant theme with American naval officers than even our own Admiralty shortcomings are with English officers, and so far as our experience goes there are very few intelligent and patriotic Americans who do not view with shame the state of their Navy. In the last official report of the Secretary of the United States Navy, the compiler says "Common prudence demands that immediate steps should be taken to remedy the defenceless condition of our coast and harbours."

We would also call attention to the excellent report of Lieutenant Very, United States Navy, on this subject. As the evidence of America has been cited we will quote another passage which bears on the subject from the secretary's report. We must first explain that an Advisory Board, composed of some of the ablest officers in the United States Navy—and higher testimony to their ability it would be difficult to give—had been convened to report generally on the state of the Navy, and amongst other subjects on torpedo boats. This body had advised that 100,000 dols. should be appropriated for the purchase of the right to use the Whitehead torpedo, and that a certain number of torpedo boats should be built. The passage to which we refer runs as follows: "The (Navy) Department, in adopting substantially the recommendations of the Board, would call special attention to the necessity of developing the means of attack and defence by torpedo boats, and the importance of entering in this country upon the construction of what has become one of the most complicated of navals weapons, and yet one of the most inexpensive means of defence—for fifty torpedo boats may be built for the cost of one ironclad."—*Eng.*

THE RIVALRIES OF RAILWAYS AND STEAMSHIPS.

Steamboat men familiar with the rivalry that is carried on New York between the Steamship companies running from New York to San Francisco, or rather we should say between steamship companies and various railways having "through" rates or running powers, will be pleased to note that at last we have got to the reliable data. The stratagems and devices to divert traffic by agents not only in America, but in the United Kingdom and on the Continent of Europe generally are alike ingenious and cunning. We might give a number of amusing examples perhaps known only to the initiated, but space will not permit. But as the master is one of very considerable business importance, as well as one in dispute in shipping circles, we have gone to the trouble to get a few figures which may be implicitly lied upon, and which may be kept at hand for reference' here after. Our autority is Mr. Commissioner Fisk and should any commercial reader want more elaboration, that courteous gentlemen will no doubt supply him with any further details he may ask for, provided they are to be used for a legitimate commercial purpose and for the benefit of all. The bare outline of a very patient investigation is simply this, viz., that so far as the railways are concerned (and it must be borned in mind that the west ward-bound traffic interest hundreds thousands of European investors in United States railway property), the traffic is carried by the New York central in the proportion of 78 per cent. Erie 65 per cent. Pennsylvania 5.8 per cent. Baltimore & Ohio 0.4 per cent. West Shore 35 per cent. Delaware, Lackawanna & Western 2.8 per cent. Now we come to the steamship service, and in one magnificent. bound the Morgan line rushes to the fore with 73.1 per cent. defying competition. The other lines are not in the race, as is shown by the Mallory line only taking 0.1 per cent and the cromwell line a quantity which, cannot be expressed for useful purpose even in tractions of a figure. The general result is this, that if we take railways we get 3,551. 19 tons, with a percentage of 26.8 per cent. and on the other hand, for steamships the figures stand for tonnage at 9,699.50, and the percentage at 73.2 per cent. Thus a grand total is brought out of 13,250.69, of which the steamers have more than the lion's share. The figures and facts given above are not only interesting as affecting the particular freights to which they refer, but have a very wide significance which those acquainnted with freight mysteries and the thousand and one almost inexplicable mysteries connected therewith will fully understand. —[*Liverpool Journal of Commerce.*

—Cork Tree forest abound in countries bordering on the Mediterranean, though the finest quality is found in the Spanish peninsula. There the cork-tree is cultivated especially for its bark, the gathering of which is an industry in which whole communities are engaged. The bark is composed of two concentric layers. The interior is a fibrous tissue, called the mother or tanner, while the exterior is a spongy, elastic substance, the corkwood of commerce. The cork harvest occurs in summer when the tree is in full sap. Circular cuts are made in the bark with a hatchet, while a vertical one is also made. The two edges are then raised and the handle of the hatchet used to strip them down-ward. A tree is not unbarked until it is 20 or 30 years old.

20,080 FEET IN A SECOND.

GREAT SPEED GIVEN TO PROJECTILES—SEVEN PIECES OF BOILER IRON PIERCED.

A little man with a dark mustache, who stood in the sand at Sandy hook, dived one hand into his coat-pocket suddenly and fished out a metal cartidge two inches long. It was packed with powder, and had a hole through the center from end to end.

"If you lit that," he said, "it would fizz away harmlessly, just like a Fourth of July flower-pot. Watch what it does when I let it off in this gun-barrel.

A common smooth-bore, breech-loading gun barrel, that the man had bought in town for $2, lay in the sand. It was just four feet long, and had a bore five-sixteenths of an inch in diameter. In front of it, resting right against the muzzle of the barrel, was a little square target. It was made of nine sheets of boiler-iron screwed together tightly. Each sheet was one quarter of an inch in thickness. The little man fitted the cartridge in the breech, and right ahead of it laid a thin rod of tempered steel. It was nine inches long, and weighed nine and one-half ounces.

"There is nine-tenths of an ounce of powder in that cartridge," he said as he got into a bomb-proof on the sands, "and here she goes."

He yanked a string that was attached to the gun hammer. There was an explosion and then a thud. The little man came out from the shelter of the bomb-proof and picked up the little target. He got a hammer and a wedge and pried it apart. The steel rod had been forced straight through seven thicknesses of the boiler iron, then it had been turned up and broke off. The broken piece was wedged between the last two boiler plates. The topmost inch of it had penetrated the fiber of the iron perpendiculary. The little man gazed at the ruin of the target in admiration.

"That beats the record all hollow," he cried exultantly. "The best that anybody has been able to do hertofore with a cartridge of that size is to drive a steel projectile through an inch of boiler iron. It would burst the gun to put it to such a test with a cartridge of ordinary make.

He dodged behind the bomb-proof again and tried it with an ordinary coarse-grain cartridge. There was a big explosion when he yanked the string, and through the peep-holes of the bomb-proof the spectators saw the gun barrel blown to flinders. The little man fished up another of the new fangled cartridges from his pocket and said:

"This thing was invented by the man who invented the multicharge gun. The idea consists in the character of the powder used and in the boring of a hole through the middle of it after it has been packed in the cartridge. The superiority of the cartridge over anything that has heretofore been gotten up in the same line is the immense power it imparts to the projectile and the great reduction of the strain usually caused upon the gun by the force of the explosion necessary to fire a projectile. These results are secured by arranging the powder so that the force generated at the moment it is ignited will be comparatively small, and will increase continually until the whole charge is consumed. This arrangement starts the projectile gently at first and then imparts to it gradually increased motion, and equalizes the strain upon the walls of the gun. To accomplish this, the powder, which is of very fine grade, is packed in the shell in a solid mass, and then perforated with the central hole, so that when it is ignited by a primer it will throw a stream of fire downward through this perforation. The stream of fire ignites the powder along the internal walls of the perforation, and as this perforation is comparatively small, but as the combustion proceeds the fire surface continually increases until the entire mass of the powder is consumed. By properly proportioning the size and shape of the powder cake relatively to the projectile to be used, and to the length of the barrel through which it is to be driven, the force exerted upon the projectile by the powder may be regulated practically at will, and so as to do the most effective work in any given case."

Can this principle be applied to cannon as well as small arm? was asked.

"Certainly," the little man replied. "All that is necessary is to pierce the solidly packed powder longitudinally with a number of holes instead of one, and then make corresponding holes in the head of the shell, and arrange the head so that the holes can communicate with each other. This can be secured by the introduction into the powder-cake perforations of a number of tubes projecting rearwardly from the cartridge head, so that they will rest against the breech lock of the cannon, and leave a space between the lock and the cartridge head. The construction insures the instanteous and simulantaneous ignition of the powder perforations at their head. It is essential that the powder-cake be hard and dense so that the fire can not penetrate into it but will burn only on its surfaces—that is, as distinguished from cakes made of gangular powder, which, though solid in form, are ganguiar in structure, and burn in all directions through their mass. This method will maintain the maximum pressure uniform all the way to the muzzle, and overcome the inertia of the projectile, instead of applying a maximum pressure suddenly before the inertia of the heavy projectile is overcome, and suffering a reduction of velocity thereby,

"We haven't tested the cartridge in a cannon yet," the little man said, but with small arms we have propelled a projectile 20,080 feet per second, and that beats record for speed, as the perfortions of the boiler-iron plate beats the record in overcoming resistance."—*New York Sun.*

UNIVERSAL AND RADIAL DRILLS.

In accompanying illustrations we give a description of the "Universal" and "Radial" drills manufactured by the Universal Radial Drill Company, of Cincinnati, Ohio.

In Fig. 1 is shown the Universal. The column which carries the arm, driving gear frame, etc., is bored and fitted over a stationary stump has sufficient length of bearing to prevent colum from swaying, and is provided with an adjustable pivot bearing upon an elastic diaphragm in the column, which, when the bolts in the flange at the lower end of column are slackened, takes the weight of the machine off the flange bearing, and allows the column with arm, etc., to revolve easily the entire circle. For ordinary drilling the bolts in flange need not be tightened, but when extraordinary rigidity is required a partial turn of the wrench will bind the column fast to the sole plate. The sleeve which carries the arm and gear frame is fitted snugly to the column and may be raised and lowered by power, and is provided with clamping bolts. The table has both horizontal and vertical faces, and is provided with T slots. The arm and spindle frame have swivels that will revolve the entire circle—so that a horizontal line of holes may be drilled at any angle parallel with each other by adjusting the angle of the arm, traversing the saddle on the arm and a vertical line may be drilled at any angle by adjusting the angle of the spindle frame, and moving the arm vertically to any point desired on the column. A hole may be drilled vertically downward, vertically upward, or at any angle within the range of the arm.

The counter shaft consists of a frame with horizontal shaft and T and L pulleys, and a pair of cut miter gears to connect with vertical shaft at center of top of column.

The spindle, feed screw and elevating screw are made of machinery steel and the feed worm is made of the best tool steel and hardened, all thrust bearings are provided with phosphor bronze washers.

All gears are cut, and the bevels and miters in spindle frame are made of cast steel and cut.

Has power feed and back gear.

Every machine is belted and tested before leaving the shop.

Fig. 2 represents the Radial drilling machine. This machine will drill or bore a number of holes parallel with each other—vertically downward—anywhere within the range of the arm.

The spindle is geared with unusual power, has quick return and is counter-balanced. Well adapted for heavy boring.

The column which carries the arm, driving gear frame, etc., is bored and fitted over a stationary stump, bolted fast to the sole plate, the stump has sufficient length of bearing to prevent column from swaying, and is provided with an adjustable pivot bearing upon an elastic diaphragm in the column, which, when the bolts in the flange at the lower end of column are slackened, takes the weight of the machine off the flange bearing, and allows the column with arm, etc., to revolve easily the entire circle. For ordinary drilling the bolts in flange need not be tightened, but when extraordinary rigidity is required a partial turn of the wrench will bind the column fast to the sole plate. The sleeve which carries the arm and gear frame is fitted snugly to the column and may be raised and lowered

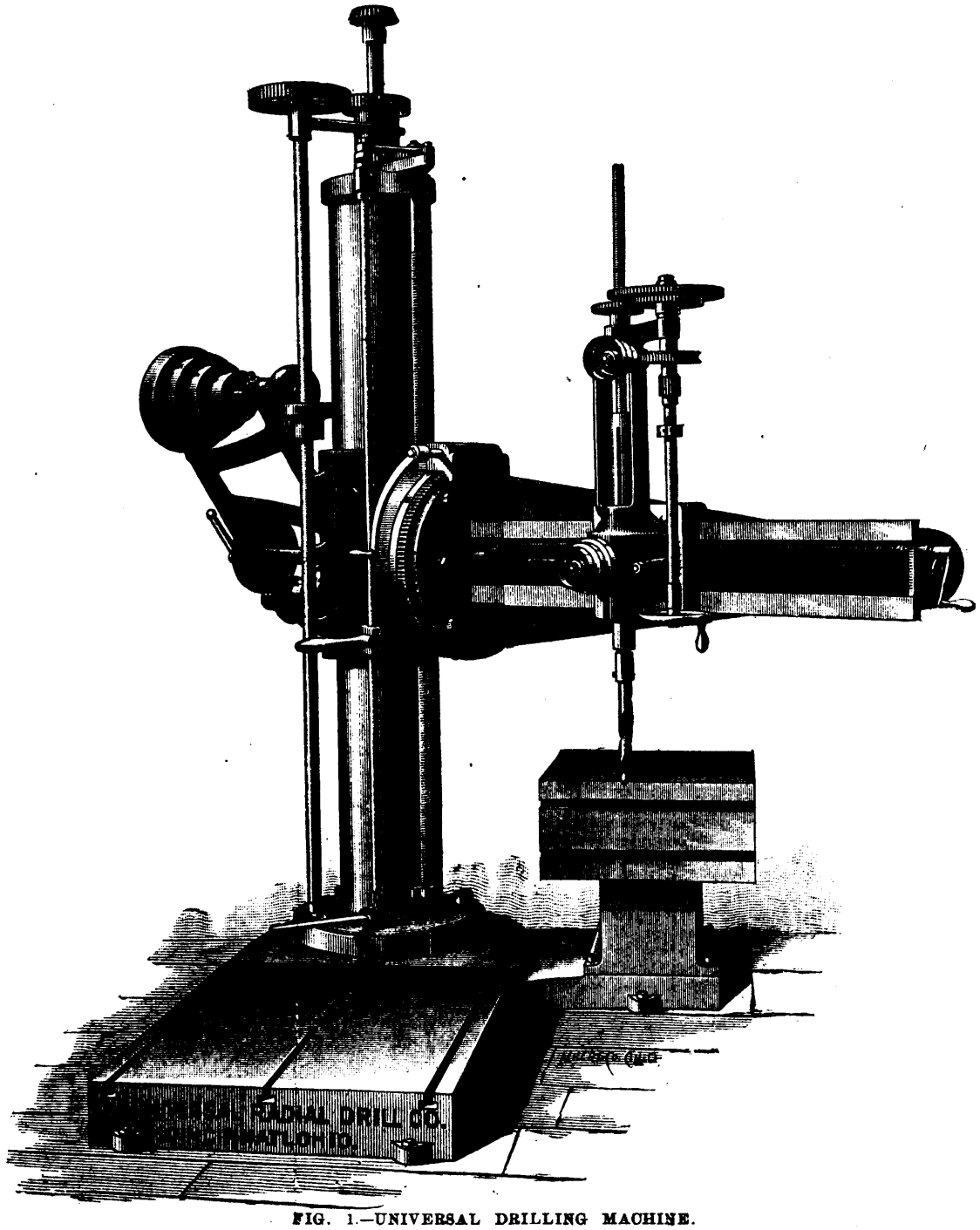


FIG. 1.—UNIVERSAL DRILLING MACHINE.

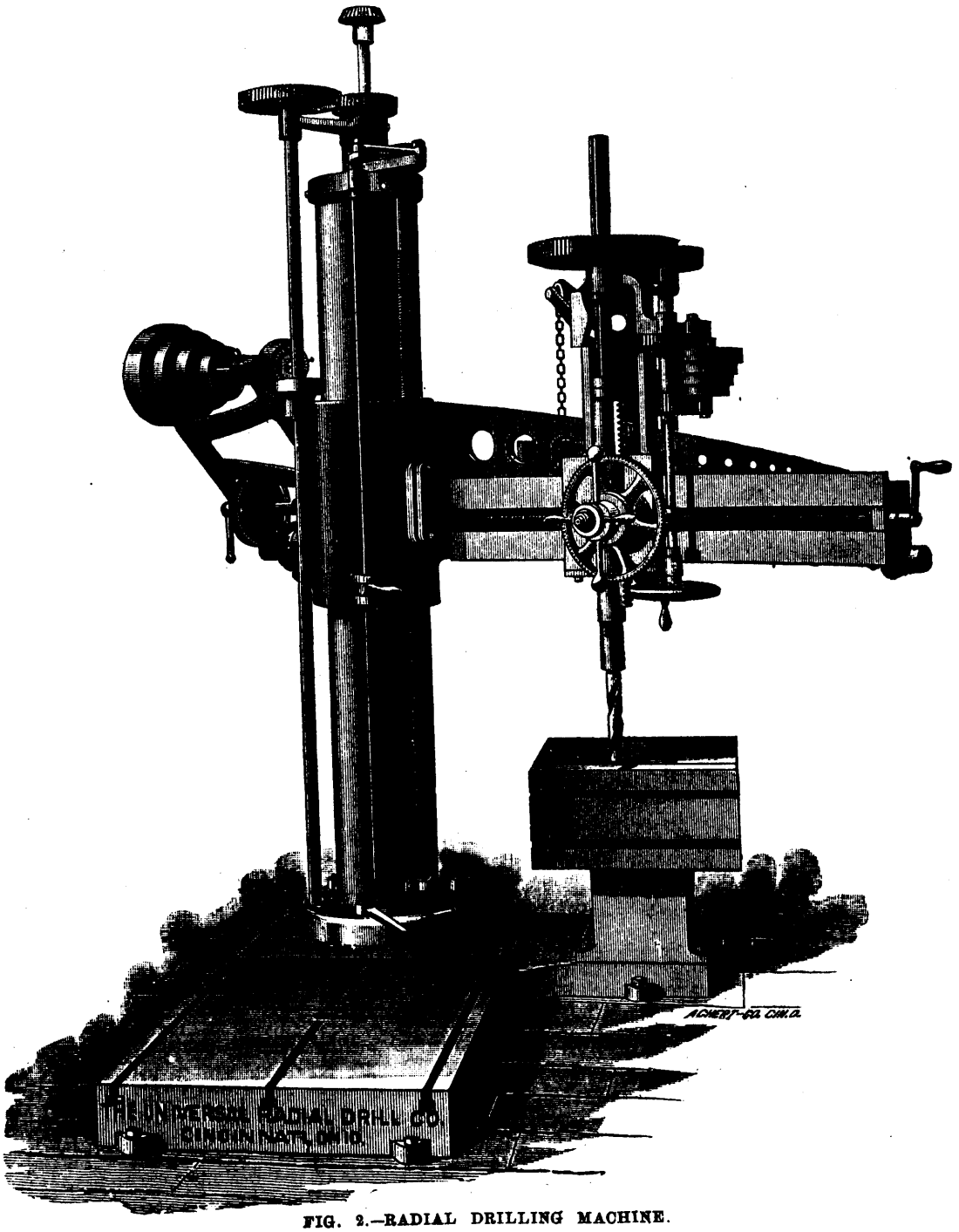


FIG. 2.—RADIAL DRILLING MACHINE.

by power, and is provided with clamping bolts. The table has both horizontal and vertical faces, and is provided with T slots.

The counter shaft consists of a frame with horizontal shaft and T and L pulleys, and a pair of cut miter gears to connect with vertical shaft at center of top of column.

The spindle, feed screw and elevating screw are made of machinery steel, and the feed worm is made of the best tool steel and hardened, all thrust bearings are provided with phosphor bronze washers.

Machines are made and kept in stock with columns of length specified on the catalogue, but may be made to order any length not to exceed eleven feet.

ENGINEERS IN AUSTRALIA.

In connection with the subject of the recent inquiry by a Select Committee of the Legislative Assembly of New South Wales, into the purchase of rolling stock, etc., for the Government railways and tramways of the colony, to which we referred in our issue of April 10th, there is one feature of the case which—as illustrative of the treatment to which officials in the public service of the Australian Colonies are exposed—calls for special notice, not only in the interests of those now in the Works Departments of these colonies, but of those younger members of the profession who may contemplate entering the service, and to whom it is of importance to know beforehand the conditions under which they would have to work.

If the railways and other important engineering works in those countries were private undertakings, the condition of things we are about to notice might be passed over as of minor importance, and as certain to be speedily corrected by the working of the well-established commercial principle—that to secure the services of upright and able officials fair and proper treatment of them is essential; although it is hardly possible to conceive that a state of things so opposed to the true interests and credit of any commercial undertaking could have occurred under the administration of any private or public company.

But as the railways and other important engineering works in our Australian possessions are in the hands of Governments invested with the status attaching to their being integral parts of the British Empire, whilst, at the same time, the officials on whom devolves the duty of carrying on the work, hold their appointments by commission from the Governors, for the time being, of the respective colonies, as representatives of the Queen, acting under the advice of the Executive Council of each colony, these officials are public servants of the State, whose character and welfare are of general public interest and concern. Any improper treatment to which they may at any time be exposed is, therefore, a fitting subject for public notice.

The instance we are about to deal with is, we regret to say, not an isolated case. The unfortunate state of things which it exemplifies, as existing in the Railway Department of New South Wales, has been of long standing. Nor is it confined to that colony alone. For many years the anarchy and confusion in the Railway Department of Victoria, due to the operation of like pernicious influences, brought its working, as is well known, well-nigh to a dead-lock, and led recently to a special board of management being constituted with the object of placing its administration beyond the control of political parties—a step which it is to be hoped will in due course result in a healthier state of things. The ill-treatment and persecution to which the locomotive engineer of the South Australian railways was recently subjected, which was exposed in the course of the numerous Parliamentary inquiries to which it led, and finally resulted in the re-establishment of the locomotive engineer in his position, and the transference of the then Minister for Public Works to another portfolio, exemplifies the operation of like baneful political influences in that colony; while rumours of acts of injustice to officials of long standing in the Public Works Department of Queensland and other colonies, which reach us while we write, evidence conclusively the widespread existence of the evils to which we refer.

In reference to the case with which we are now more immediately concerned, it will be remembered that one matter which received the condemnation of the Parliamentary Committee of New South Wales, was the ordering by the Commissioner for Railways, with the sanction of the Minister for Public Works, of 200 "dump cars," or side tip-waggons, at a cost of close upon £40,000—to be constructed after the pattern of a sample "car," purchased from an American firm at a cost of £225, which car, together with those supplied to the Government after its pattern, was found by the Committee, on the evidence taken before them, to be "unsuitable for the present conditions of the railway requirements." They also found, "that the officers immediately responsible for the safe and satisfactory character of the rolling stock were not consulted before the contract for the 200 additional cars was agreed upon." The character of the transaction was further indicated, as will be remembered, by the remark of the Committee, that "to make an agreement such as this in the injudicious manner apparent from the evidence, and where such a large expenditure of public funds as £38,000 is involved, is, in the opinion of your Committee, a most objectionable proceeding. Your Committee find that it was agreed that these cars were to be made in the colony, whereas the different parts are being imported from America and are merely being put together here, which is an evasion of the spirit of the agreement."

As may readily be imagined, a transaction open to such condemnation necessitated some explanation on the part of those on whom rested the responsibility for the giving of the order; and it is in consequence of the course taken by the Minister and the Commissioner for Railways, in attempting to explain away their share in the transaction by throwing responsibility on the officers of the Locomotive Department, that a case of improper treatment of Public servants has, as it seems to us, arisen which calls for public notice and condemnation. This opinion is based on an examination of the evidence taken before the Committee, which has just been published in full, and in regard to which we do not hesitate to say that no one can rise from a careful reading of it with any other impression than that the officers of the Locomotive Department were placed in an entirely false position by the course followed by the Minister and the Commissioner in the matter.

In order that the relations and responsibility of the parties to the transaction may be the better understood, it may be well, in passing, to state, that the Minister, under the official title of "Secretary for Public Works," is political head of the railway and other works departments of the colony, and, as such, is a member of the Cabinet and of the Executive Council. As ultimate and responsible head of the Public Works—without whose authority no important act in connection with the departments under his control can take place—one would reasonably expect that all matters which were worthy of his personal attention would be done in the most formal and business-like manner, and that to him, of all persons, every official in those departments would naturally look for justice and fair play.

The position of Commissioner for Railways is a peculiar one. At times the office is vested in the Minister for the time being. Sometimes in the under secretary for Public Works. At other times, as at present, it is held by a salaried officer in a distinct and separate office. By the Railway Act the Commissioner for the time being is constituted a "Corporation sole," to sue and to be sued on behalf of the Government. He is also invested with statutory powers to execute railway contracts, or agreements, on its behalf. He is further invested with administrative control over the various branches of the Railway Department, but his functions in this respect are practically limited to the "existing lines," or, in other words, the lines opened for traffic—the construction of new lines being, as they have been from the first, under the immediate charge and direction of the Engineer-in-Chief for Railways. In virtue of the powers vested in him under the Act, the Commissioner is, of course, in a position to exercise control over the terms of contracts for materials required in the working and maintenance of the railway, but it would be expected that, in contracts for rolling stock, at all events, he would be careful, as a matter of common sense and fair play, to allow the technical officers responsible for its proper construction and safety the opportunity of freely expressing their opinions and making suggestions, with the object of enabling them properly to supervise and control the execution of the work, before binding the department to important contracts of that kind, and so avoid placing the engineers in the invidious position of having to interpret agreements drawn up in vague and impracticable terms.

As disclosed by the evidence, both the Minister and the Commissioner were desirous, for various reasons, which they elaborated before the Committee at considerable length, but,

as seems to us, with little cogency, of placing in the hands of the firm of car-makers in America already referred to—whom the brother of the Colonial Treasurer (or Finance Minister) represented as local agent when the sample vehicle was purchased—an extensive order for these vehicles. A report had, however, been received from the acting locomotive engineer—the locomotive engineer being then absent from the colony on leave—in reference to the sample vehicle, which was not favourable to its adoption for traffic purposes. It was not unnatural therefore that the Minister should desire, before taking further action in the matter, to fortify his position by a personal examination and trial of the sample waggon. A meeting of the officers of the Railway Department was accordingly convened, though, apparently, in a somewhat informal manner, to attend the minister on the occasion. No expression of their opinion appears, however, to have been invited either by the Minister, or by the Commissioner, either then or subsequently, as to the result of the trial and examination. Yet, notwithstanding this, the circumstance of their having been present was advanced by the Minister, when called upon by the Committee for an explanation of the transaction, as a reason for holding the locomotive officers responsible for the defective construction which the evidence disclosed as existing in the waggons supplied.

The informal nature of the meeting is shown by the answer of the Minister to a question asked by the Committee. The question and answer were as follows :

"Do you know whether they" (the locomotive officers) "were asked to examine the car personally ?"—"They were not specially asked to make any examination, or to give any report, or to advise in any way ; but they were present, and were freely conversing with me, and I consider it was unnecessary to ask the question. Had our positions been changed, I should have felt it my duty to have pointed out to my chief any defects that I observed."

Such an avowal on the part of the Minister at the head of an important Government department as to the happy-go-lucky way of conducting business at the public expense is certainly remarkable, and it is hardly consistent with the honour and position of a "minister of the Crown" to seek to throw upon the technical officers of the department the onus of the situation caused by his own act, and by the neglect either of himself or of the Commissioner, to obtain in a business-like and official manner the opinion of those officers before entering into the contract. Neither was it becoming of the Minister to call as a witness against his fellow-officers (as it appears from the evidence he did) the engineer of another branch of the Railway Department in support of his (the Minister's) contention that the locomotive officers had evaded their duty in not volunteering an expression of their opinion on the occasion. Such proceedings are not calculated to contribute to that harmonious working of the department which is so essential to the proper and safe conduct of a railway, and we cannot but think that any engineer imbued with a proper sense of what was due to his posision or to his fellow-officers would allow himself to be made a party to such a proceeding. The Minister, however, feeling no doubt that his expression of opinion would, if unsupported, have little weight under the circumstances, thought proper to call to his aid the witness already referred to, who appears to have been in attendance on the Minister on the occasion, but who, nevertheless, as not belonging to the locomotive branch, seems to have thought himself not only free of responsibility in the matter, but even at liberty to criticise the conduct of his fellow-officers. In justice to both the Minister and his witness, we give the question and answer verbatim as follows :

"Would you consider that any officer present who saw anything that was decidedly deficient would fail in his duty unless he called attention to it ?"—"Certainly ; I know the acting locomotive engineer in speaking of the dump car—of the under carriage particularly—drew attention to the style of it and pointed out how simple and good it was, and that it was all that was necessary for a car of that description to carry goods."

At a subsequent meeting the chairman of the Committee, having read the above question and answer to the acting locomotive engineer, asked if he desired to make any explanation and received the following reply :

"Any officer of the department would naturally call attention to anything defective or dangerous, but I had already done that in my minute of April 17, 1883, as I have said before, and if I had done so again on that occasion I should have been offensive ; I consider I should have been forcing my views on the Minister. I would have run the risk of being checked ; in fact I have been checked for doing my duty in that particular respect."

We leave it to our readers to form their own opinion as to whether there was or was not, in the circumstances, the neglect of duty contended for by the Minister, but, either way, we are of opinion that no stronger evidence could be afforded of the false position in which the technical staff are placed, or of the unsatisfactory relations and want of confidence existing between them and the individuals for the time being in power as the outcome of the pernicious influences at work.

As regards the Commissioner's share in the matter and the part he took in endeavouring to fasten upon the locomotive engineers responsibility not warranted, as seems to us by the circumstances, we need only quote one answer given by him to a question put by the Committee as to whether any officer in the Locomotive department was referred to, to say if the sample car was safe, before the order for the 200 additional cars was given. The Commissioner's answer on that point was as follows :

"I was particularly careful, in making the contract, to stipulate that the cars supplied should be to the satisfaction of the locomotive engineer—that all its details as regards its draw gear and its buffer arrangements should be in strict accordance with the requirements of our locomotive engineer. If it should turn out that the stock has not been supplied to the satisfaction of the engineers—if they have any doubt as to the stability of the draw gear—it will be their duty to bring it under my attention, and I shall call upon them to show cause why they did not provide for the due stability of all these working parts."

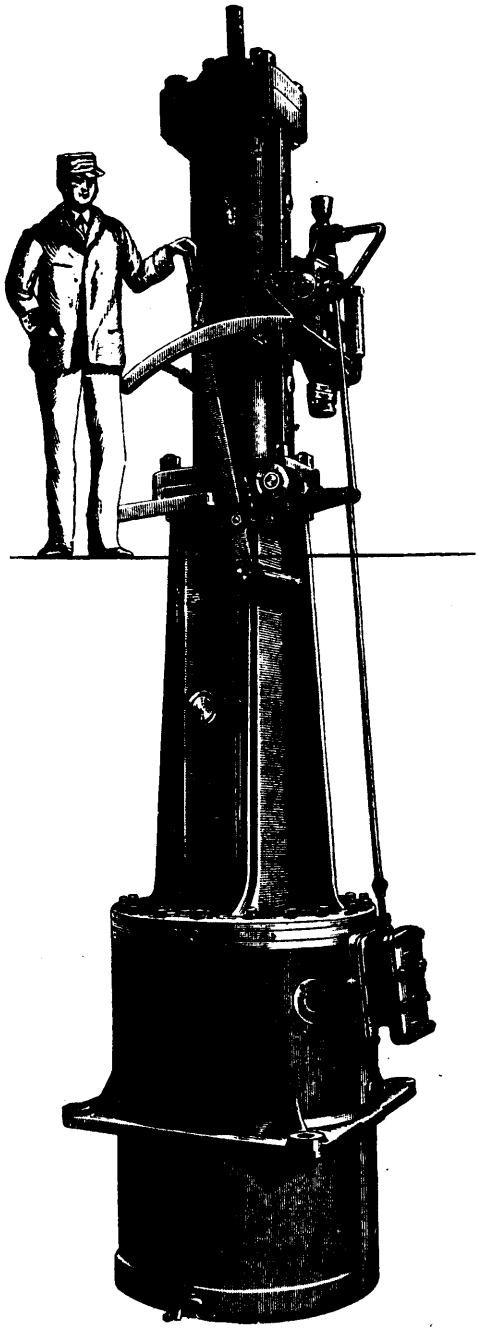
But as, in reply to the next question put by the Committee, the Commissioner admitted, although in somewhat halting terms, that the officers concerned had not been specially made aware, prior to the giving of the order, of his desire to have the additional vehicles manufactured, and that provision for the proper connection of the bodies to the wheels was "not embodied in any formal document between the Government and the contractor," but was left to a "general stipulation"—taken in conjunction with the fact that the vehicles were constructed in America beyond the observation of the locomotive staff, and merely put together in the colony—we fail to see how the opportunity was afforded the engineers for "providing for the due stability of the working parts," for which the Commissioner desired to hold them responsible. This portion of the case is, however, only in keeping with the rest of the transaction, and affords additional evidence of the false position in which the technical staff are placed when a non-professional man, in the position of the Commissioner, attempts to deal with such matters.

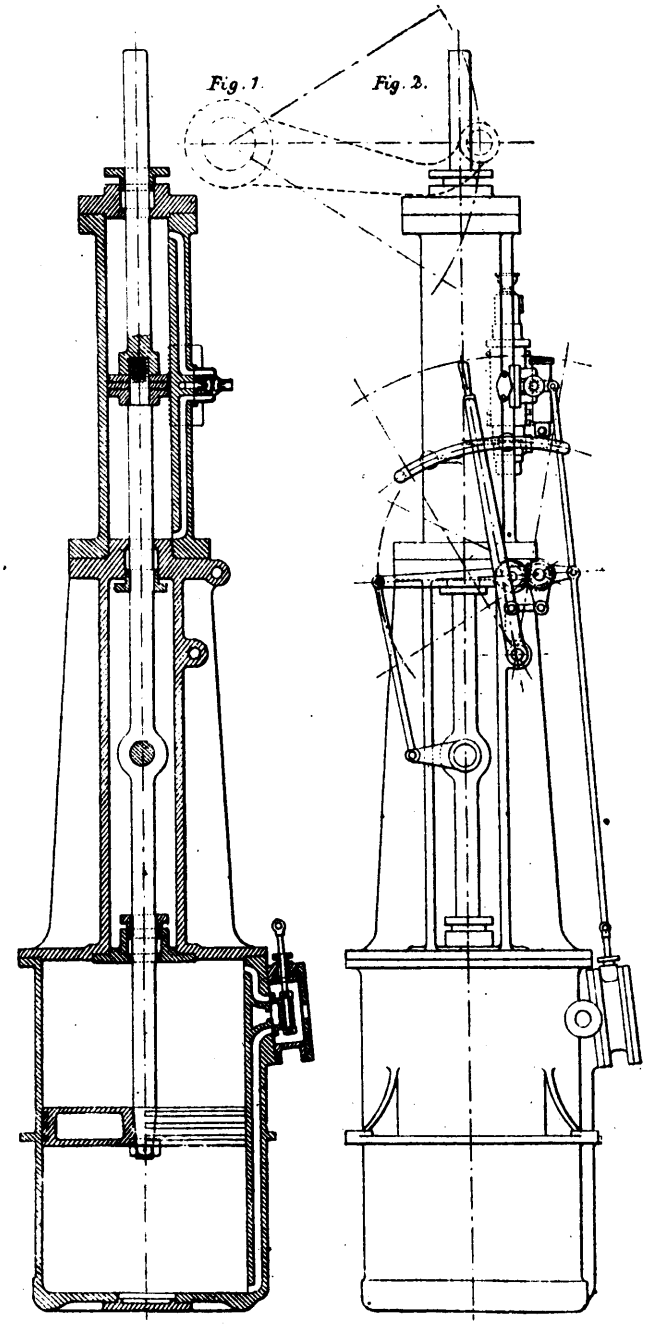
Further comment is unnecessary, and we need merely remark, in conclusion, that, in view of the unsatisfactory conditions which are characteristic of the public service of the Australian colonies under existing political influences, the Governments of these colonies need not be surprised if they fail to retain in, and to draw to, their service men of character or standing in the profession.—*Eng.*

—THE new dredge City of Paris, built for digging out the Panama Canal, arrived at Aspinwall on the 28th ult. in town of the steamship "Portia". She will be immediately put to work.

—A curious invention especially designed for navigating the Nile, but which is applicable to other rivers, has been brought out by Messrs. Yarrow of Vickburg. The object of the invention is to notify the Pilot of the existence of sand-banks or rocks lying directly in his pathway. The invention consists of two poles projecting about fifty feet ahead from the post and starboard sides at the end of which are suspended two vertical iron rods. The bottom extremities of these come about one foot below the level of the boat itself. Attached to each of these two vertical iron is a wire rope which passes inboard, and is connected with the whistle on the boiler ; and the gear is so arranged that immediately this indicator touches a rock or sand-bank it instantly causes the steam whistle to blow. This plan in the first instance draws the Pilot's attention to the fact, and also points out to him on which side of the steamer the sand-bank or rock exists, so that it gives him warning in which direction to steer.

STEAM REVERSING ENGINE.





THE FRENCH DISPATCH TORPEDO BOAT LA BOMBE.

STEAM-REVERSING ENGINE.

We illustrate a steam and hydraulic starting and reversing engine manufactured by Messrs. W. H. Allen, & Co. of York street Works, Lambeth, and of which Messrs. Allen and Mr W.L. Williams are the patentees. This is one of the largest that has ever been made for marine work, and demonstrates to what enormous proportions marine engines have arrived, the starting engine having a cylinder 32½ in. in diameter by 42½ in stroke. The principal feature of this engine is the automatic gear for controling the lever. By its aid the links of the main engines follow exactly the motion of the starting lever. If this be put completely over, the links will go into full gear, either forward or back- ward as the case may be, while if the lever be fixed at any intermediate points the links will take up a corresponding position. The means by which this is accomplished will be understood on reference to the engravings. The starting lever is pivoted at its end to the framing, and is connected by a short link to an arm or crank on a small weigh-shaft which at its opposite extremity carries an arm which works the valve of the steam cylinder. The first crank is not connected directly to the shaft, but conveys its motion to it through a train of spur gear, consisting of four wheels. Two of these are on the weigh shaft, and two are on a stud on a lever centred on the shaft. Calling these wheels respectively Nos. 1,2, 3, and 4. No 1 is fixed to the arm and is loose on the shaft; it gears with No.2 which together with No. 3 to which it is fast runs loose on the stud in the lever; No. 3 gears with No. 4 which is keyed to the weigh shaft, Nos.1 and 3 are the same size, and likewise Nos. 2 and 4. When the man puts the lever over a certain distance the motion is communicated through the train of wheels to the weigh-shaft and thence to the steam valve. Immediately the steam piston commence to move its motion is communicated (Fig. 2) to the lever which carries the wheels. No. 2 wheel is in gear with No. 1 which being fixed to the starting lever is incapable of motion; the former therefore, rolls over it, rotating on its axis, and carrying No. 3 wheel with it. No. 3 causes No. 4 to rotate, and in this manner the weigh-shaft is moved in such a direction and such a speed that the steam is cut off when the links have travelled the required distance. The starting engine is locked at that point by the hydraulic cylinder above, the valve of which is connected to the steam valve. For reversing the engines when the steam is down, an hydraulic hand pump is fitted on the hydraulic cylinder and being connected with upper and lower part of the hydraulic cylinder, enables a man in charge to reverse the engine by hand power.

One of the great difficulties that have always existed in starting engines has been leakage of water from the hydraulic cylinder, this is overcome by the atachment of a small accumulator which is seen on the right hand side of the hand pump and consists of a leather piston kept down by a powerfull-spring, by means of which the pressure is maintained in the hydraulic cylinder and any leakage is made good immediately.

Messrs. W. H. Allen & Co. have supplied a large number of these starting engines to the principal steamers afloat, the one illustrated above being for the steamship, " Ireland, " which has been built by Messrs. Laird Brothers, of Birken head, and is the largest paddle steamer in the world

These starting engines are not confined to marine work, as they have been supplied for steel rolling mills and steel works generally—*Eng.*

THE ELECTRIC LIGHT FOR WAR SHIPS.

The Italian cruiser "Giovanni Bausan, built and armed by Sir W. E. Armstrong, Mitchell & Co., Newcastle-on-Tyne, and commanded by H. R. H. the Duke of Genoa, left the Tyne on her official speed trial on the 11th May, and during a prolonged trip of over six hours' duration, maintained the exceedingly high mean speed of considerably over 17½ knots per hour.

The vessel which, with her powerful armament of Armstrong guns and torpedoes, is probably the most redoubtable cruiser in existence, is fitted throughout with the electric light.

Two gramme dynamos driven direct by Brotherhood 3-cylinder engines, supply the required current, and together with 32 1-horse power secondary batteries, manufactured expressly for ships' use by the Electrical Power Storage Company and enclosed in teak boxes instead of the usual glass cells, are placed in the after torpedo chamber, where are also fitted an ammetre, a voltmetre, and a switch-board controlling the connections between the dynamos and accumulators and also the *nine* distinct circuits into which the electric lamps are divided.

The incandescent light circuits, seven in number, are as follows :

	Lamps.
A. Passages, deck-houses and captain's cabin	44
B. Cabins and mess-rooms	45
C. Coal bunkers	19
D. Engine room	21
E. Stoke holds, fan rooms, and hydraulic engine room	29
F. Torpedo room	7
G. Magazines and steering gear	11

making up a total of 176 lamps, all of which are of the Elison 8-C. P. 51 volt pattern.

In addition to the division of these lamps into seven circuits at the switch-board, all the cabin lamps are fitted with individual switches.

The ship is also fitted with two search arc lights, of 20,000 C. P., placed on the forward and after gun loading stations respectively.

The ordinary practice on board is to start the dynamos to charge the accumulators during the afternoon, keeping them running during the evening until the cabin circuit is switched off, when the dynamos are stopped, and the accumulators serve to maintain the passage lamps throughout the night.

The accumulators are also employed to maintain a portion of the incandescent lamps when the dynamos are feeding the search lights, and are, moreover, a very useful reserve in case of it being necessary for any reason to stop the engines, or when only one or two lamps are required for any special purpose.

The leads are arranged on the double wire system and are throughout enclosed in wood casing.

The entire fitting up of the installation has been performed by the builders.—*Electrical Review.*

A NEW PROCESS FOR TOUGHENING STEEL.

The French Société d'Encouragement have had under prolonged examination a process, invented by M. Clemandot, for working steel. The process is described by the *Revue Imdustrelle* as consisting in heating the metal until it acquires a sufficient ductility, and then subjecting it to a high pressure during cooling. In this way a modification of the structure of the metal is produced, and the material acquires properties analogous to those developed, by tempering. Similar processes have been tried in France, but only upon the same principle that is to say, by operating upon the metal while yet in a state of fusion. M. Clemandot, on the contrary, takes steel already made, heats it simply to a cherry red, and submits it, by means of a hydraulic press, to pressures of from 1,000 to 3,000 kilos. per square centimeter. After having allowed the steel to cool between the two plates of the press, it is withdrawn with all its new qualities perfectly developed, and does not require any further treatment. The result of the process is to impart to the steel a fineness of grain, a degree of hardness, and a notable accession of strength to withstand rupture. This alteration is most considerable with highly carbonated steel, and in this respect the metal is made to resemble tempered steel, without being in all points identical with it. The cause of the alteration in physical condition is ascribed to the rapid heating and no less rapid cooling of the metal. When the red hot steel is first strongly compressed, to conversion of the mechanical energy into heat serves to raise the temperature of the entire mass, at the same time that the particles of the metal are more closely cemented together. This effect is followed by a rapid cooling, due to the contact of the plates of the hydraulic press with the surfaces of the metal. The close pressure materially increases this conducting effect of the cold metal.

A stag has been recently completed for a lead smelting works at Pueblo, Cal., which is 319 feet in heigh and 10 feet in diameter in the clear from the foundation up. It rest on 16 feet of smelter slag, which was poured in a liquid state in the ground 16 feet deep, and allowed to cool and solidify. On top of this, and above ground, is a second foundation, 16 feet high, made of brick. The stack proper, which is 287 feet high, is made of iron and lined with fire-brick. It is the largest stack west of the Missouri River, and when completed was painted red.

THE FRENCH DISPATCH TORPEDO BOAT LA BOMBE.

According to the new classification adopted by the French navy, the torpedo boats are divided into several classes, viz. :

1. The torpedo cruisers of from 1,240 to 1,260 tons.
2. The dispatch torpedo boats, of from 320 to 380 tons.
3. The torpedo boats for deep water, of 50 tons and upward.
4. The torpedo coasters, which are again divided into two classes, those of the first class being of 30 tons and those of the second class 25 tons.

Finally, in the fifth class may be included the vedette torpedo boats, of 25 tons, which, in spite of their slender build, or rather because of their slender build, can render great service for the defence of the coasts.

The annexed cut represents La Bombe, which has just been launched at Havre, and which belongs to the second class, that of the dispatch torpedo boats. It was built at Havre by the "Societe des Forges et Chantiers," which firm has just built, for the Ottoman Government, two torpedo boats which are really remarkable.

Eight torpedo boats similar to La Bombe, are now included in the official list. They are: La Couleuvrine, La Dague, La Dragonne, La Fleche, La Lance, La Salve and La Sainte-Barbe. But of the eight, only La Bombe has been completed. This vessel measures 196 feet 10 inches, from stem to stern, and draws 5 feet 10 inches of water. It is made entirely of steel, and care has been taken to make the hull as light as possible, and at the same time strong enough for the navigation of the high seas. The dispatch boats of the Bombe type are furnished with two engines, each acting upon a screw, and developing 1,800 horse power. The speed attained is almost 18 knots. They have three masts, and are provided with all the latest improvements for handling torpedoes, with apparatus for electric lighting, etc.—*L'Illustration.*

AMERICAN vs. ENGLISH-BUILT IRON SHIPS.

In an interesting interview with a reporter of the N.Y. *Evening Post*, a member of the iron shipbuilding firm of Cramp & Sons, Philadelphia, says he does not think the iron shipbuilding business in this country is more depressed than other manufacturing interests. Being asked if his firm would accept a contract from the Government after the recent opinion of Attorney-General Garland in the Dolphin case, he replied that they would, without the least hesitation, but that they would not guarantee anybody's work except their own, meaning that they would not agree to build vessels on plans, specifications and models furnished by the Navy Department, and guarantee a certain result. They would guarantee results, but must be left free to build according to their own plans—of course under reasonable conditions as to size and class. Under any conditions of divided responsibility, they would not make any guarantee whatever, and would refuse a Government contract, or any other.

Mr. Cramp accounts for the present status of the shipbuilding trade in this country by saying that capitalists have thought it better to put their money into railroads, than into the construction of ships. He further says that his own firm (and presumably any of the six large shipbuilding concerns situated on the Delaware river) would guarantee to build iron ships, *quality for quality*, for the same money they would cost in England, or anywhere else. He says the idea that American ships cost more than English-built vessels, comes from the fact that when an American wants a vessel built, he gets a price from the shipbuilders on the Tyne for what is called "a tramp"—the very poorest sort of boat that can be turned out, and such as the best builders of England do not attempt to build. The price is 20 per cent. below what a first-class boat would cost here, and consequently it is said that ships can be built there just that much more cheaply. He also says the crack boats of the lines running between this country and Europe are not equal to boats that could be had in this country for the same money. The boats are owned abroad, and, therefore, foreign-built boats are naturally given the preference in buying, though boats could be had here that would run more economically and cost no more. A number of the Inman, Cunard, and White Star boats, built abroad at enormous expense, have either proved to be failures or enormous coal-eaters.

Mr. Cramp's remarks suggest the supposition that perhaps, one of these days, some of the crack transatlantic lines will be willing to try what American iron shipbuilders can do for hem.

TECHNICAL EDUCATION AND APPRENTICESHIP.

In a paper read by Mr. Robt. Cunynghame before the Society of Arts, on Technical Education, the writer said :

"It is, therefore, incumbent on the friends of technical education to consider how it may be most economically carried out; and I believe it will be found that the solution of this question lies, not in attempting to replace workshop training by classes or lectures, but rather to supplement it by theoretical instruction. * * *

"Now, I think that all attempts at technical education will be imperfect that do not, to a certain extent, deal with the apprenticeship question. It is in the workshop that the artisan must be really formed—just as the barrister must be trained in chambers, or the doctor in a hospital. At the same time, what the university is to the advocate or medical man, the technical school should be to the artisan; only, however, with this difference, that it is generally necessary that while he is learning, the artisan should be also working, and that his technical instruction should go on contemporaneously with the workmanship employment."

Speaking of the bad influences brought to bear upon apprentices the author says :

"To counteract the evil I have spoken of, there appears to me no more useful plan than to form youths' institutes. The duties of the officials of these institutes should be to see to the apprenticing of boys, encouraging them to enter such trades as offer good prospects, and endeavoring to guide their choice. In all cases a month's trial without pay should be insisted on, and free liberty given to master and boys to refuse the proposed contract at the end of the time. There is no fear that under such conditions a boy will desire to change too often. At such institutions lists should be kept of masters desiring hands, and of boys desiring to learn trades. The character of the masters should be carefully investigated with a view to ascertaining whether they are fit and proper persons, or whether they have lately been bankrupt, and are likely not to be able to fulfill their engagements. Moreover, the boys should be periodically inspected, a monthly report being given by the master respecting their conduct; and, on the other hand, steps taken to compel the masters to stand fairly by the contract."

INVENTORS AND MANUFACTURERS.

Sometimes a really meritorious invention is brought too soon, that is, before conditions are favorable, for its reception. It used to be extremely unpopular, and equally unpleasant, to express a belief that the earth was other than a stationary body. Because it was true did not count anything against the fact that people did not believe it. So sometimes an inventor sees further than he can bring others to see, and suffers by finding his invention fall flat. Men's minds move faster than formerly, and there is some hope that the unfortunate inventor may live to see his views adopted; otherwise his invention will, in the future, be re-invented and some one curious in such matters, or particularly interested in this especial one, will establish a clear case of piracy against the last inventor, who probably never heard of it before.

Again, an invention may be good and needed at the time, but for lack of ability, financial or otherwise, it may not be pushed before the public as it should be. It does not follow because an invention that is not rejected outright does not become prominent or popular, that it is worthless, or even because it does become prominent, that it is of much value.

What is true of inventors is true in some degree of manufacturers of machinery. Machines that in time become popular are often introduced at a good deal of trouble and expense. Many become discouraged trying to bring something meritorious into use, seeing its utility themselves but unable to make others see it. Just how far to go in the direction of trying to create a demand is not easy to decide upon. Sometimes in the case of something altogether good, it may be created quickly; sometimes only at the end of discouraging waiting, and much trouble and expense.

— THE contract for stonework on the new public building at Council Bluffs, Ia., has been awarded to J. M. Rice of Austin, Ill., at $49,893.

PUMPING ENGINES AT WHITACRE.

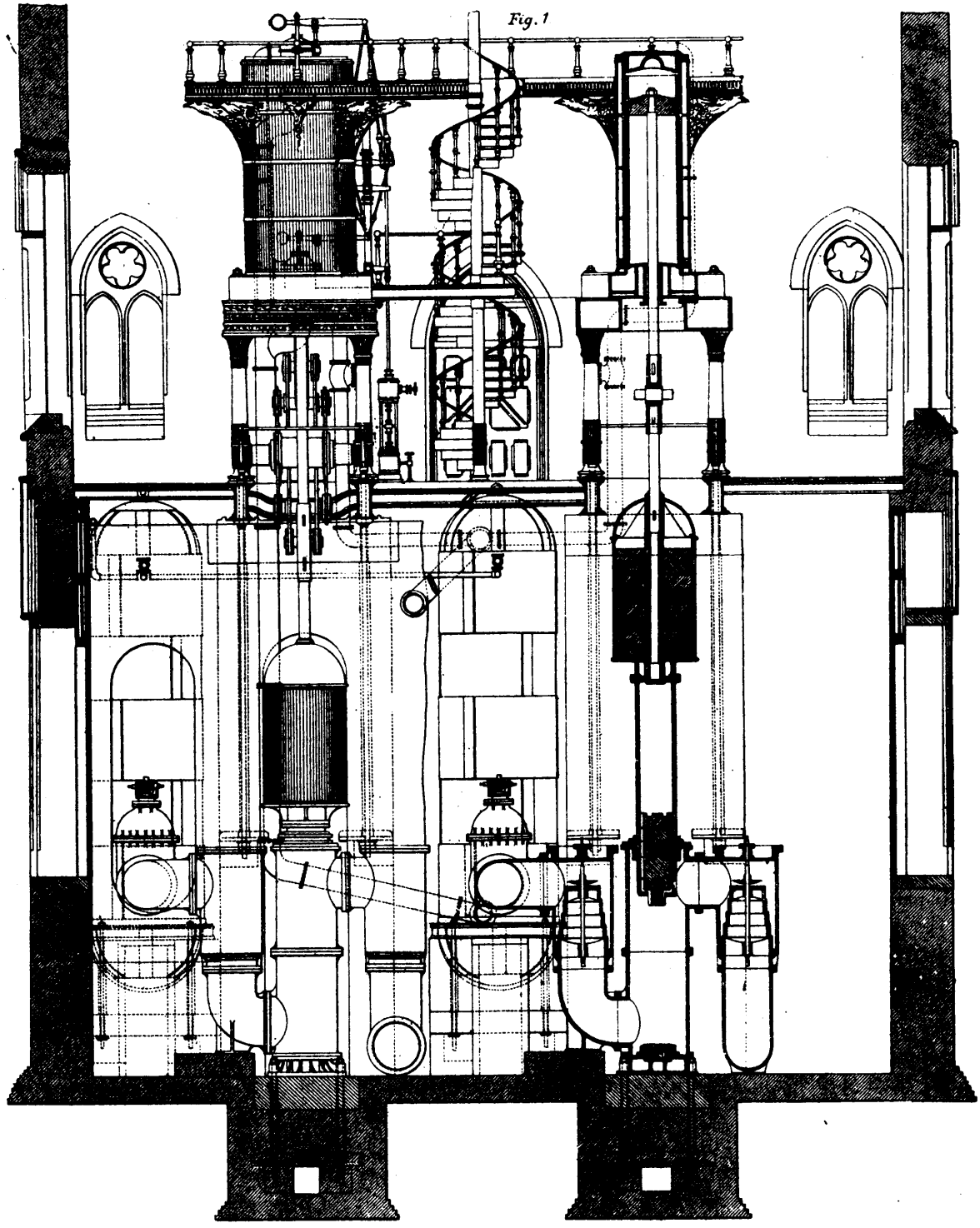
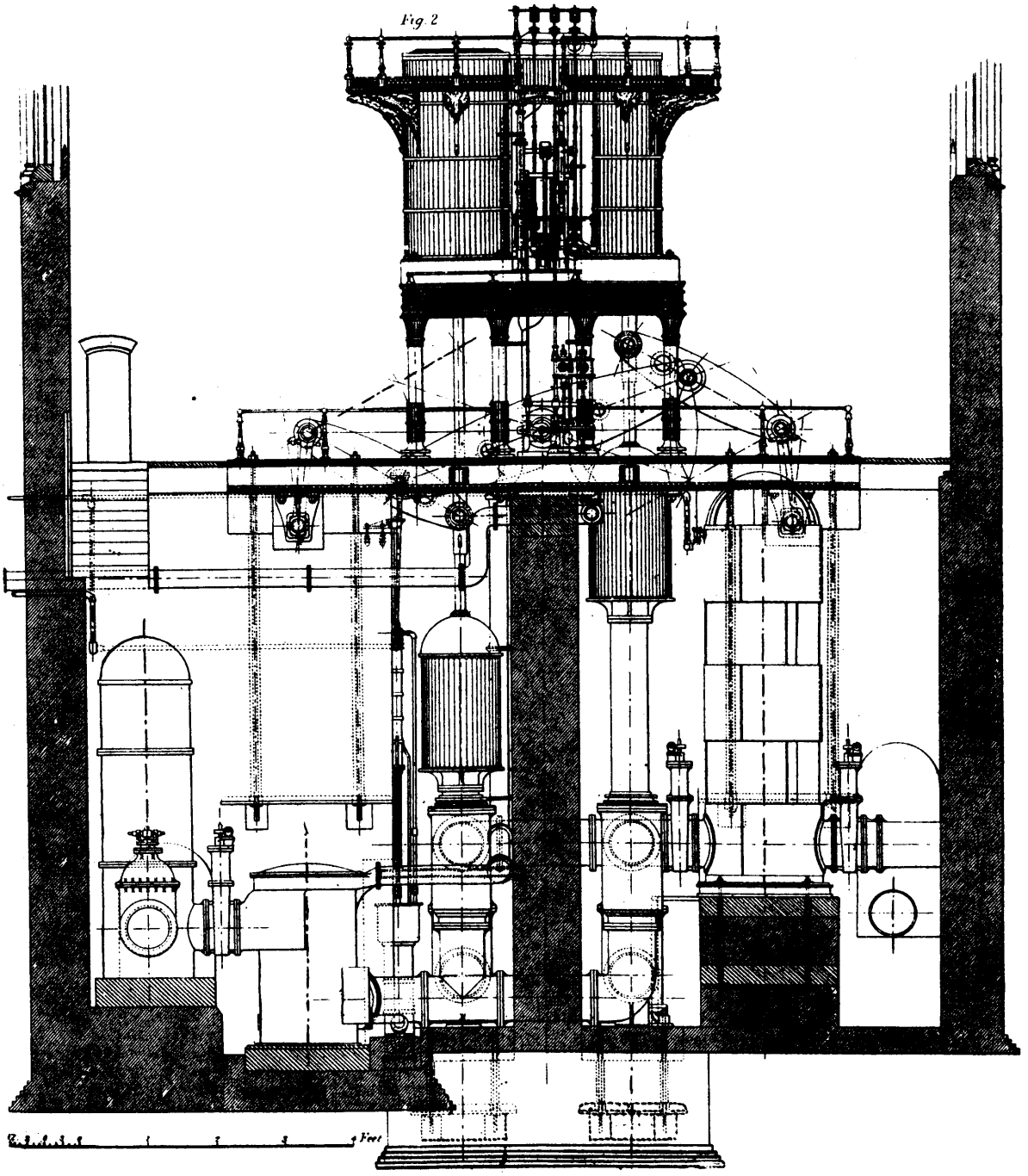


Fig. 1

PUMPING ENGINES AT WHITACRE.



THE ISLE OF WIGHT STEAM FERRY.

The works at Langston Harbour, near Portsmouth, and at Brading, in the Isle of Wight, designed to effect the transport of trains of railway vehicles bodily across the Solent, were completed on Wednesday last, and on Thursday the appliances which have more than once been used provisionally during the execution of the works, were pronounced ready for regular traffic. We give drawings of the full details, and it should be stated that no claim is laid to mechanical novelty—their merit lies in the ingenuity in which commonplace mechanical arrangements have been applied to achieve in a simple way an exceedingly useful purpose. Railways existing on the mainland and in the Isle of Wight, with their lines coming down to the seaside, the problem to be solved was how to transfer simply, cheaply, and expeditiously from the railways to the deck of seagoing vessels, railway vehicles without disturbance of their load. Once upon the deck of the steamer, supposing only she be adapted to the carrying of a heavy deck load, the transport is simple enough—the thing is the loading and unloading, and to be useful this must be accomplished by means more expeditious and less costly than the ordinary method of handling and transhipment. The distance to be traversed between Brading and Langston is between 10 and 11 miles, 6½ miles are in the open sea, the rest in landlocked harbours, which on the island as on the mainland have been judiciously chosen as the places of arrival and departure. On both sides the process of loading and unloading goes on in perfectly still water, and on both the mechanical arrangements are the same. The amount of structural work on the island was rather less than that necessary on the mainland, owing to somewhat less favourable conditions at Langston. It goes without saying that on both sides there is direct physical connection with the railway systems. At Brading all the railways in the island are communicated with, while at Langston access is obtained to the Hayling Island branch of the Brighton and South Coast Railway, which at Havant has a junction with the London and South-Western system—to London by the direct Portsmouth line as well as to Southampton and the west of England.

At Langston the railway skirts the sea. Alongside of, and parallel to, the railway and upon the foreshore, an embankment has been built about 700 yards in length, and of width varying from 30 to 40 yards. The side or sea face of this embankment is sloped and pitched in the customary manner for its entire length, save 300 ft. at the extremity, where a wharf is formed suitable to the use for loading and discharging of ordinary seagoing craft. From the end of the embankment a sloped timber jetty projects, commencing at the rail level and descending by a gradient of 1 in 8, to 4 ft. below the natural bed of the sea. From the top to the bottom of this slope are laid eight ordinary permanent way rails, four of which constitute two running lines of the standard gauge, and along which, as presently explained, the railway vehicles pass, and four laid close, and parallel to each of the running rails. These latter act as check rails, but fulfil also a more important purpose to be described.

In carrying the waggons on board the steamer they are placed upon two lines running from stem to stern. In discharging and loading them, the vessel approaches the sloping jetty stern on, bringing the parallel rails upon her deck into line with the rails laid upon the sloping jetty. It follows that when the tide is high and covers the greater part of the slope, the level of the steamer's deck approaches the level of the top of the jetty; when the tide is low, the steamer approaches at a lower level and a considerable part of the slope is exposed; but neither at high or low tide can the stern of the steamer be brought sufficiently near to the fixed slope to admit of waggons passing from the one to the other. There is always a hiatus which must be bridged. The four extra rails above mentioned are useful in this connection. They carry the moving bridge or cradle, which passing up and down the sloping jetty in the varying states of the tide, connect the ship, at whatever height her deck, with the rails on shore.

In Fig. 2 of our drawings the cradle is shown in position for loading the steamer at low water. In Fig. 5 it is shown on a larger scale as at medium tide; the dotted fragment of the drawing indicating the position at dead low water. The cradle, which is supported on 20 wheels, resting five on each of the four rails of the jetty, is of timber with wrought iron attachments and cast-iron wheels, the movable drawbridge being balanced so as to be well within the power of a single man. It is moved up and down the slope by means of drawing engines, Fig. 9, which also drive two horizontal drums 3 ft. in diameter, by means of which waggons are lowered on to and drawn up from the deck of the steamer. The drawing engines are a pair of ordinary winding engines of 60 horse power. Attached to the drawing machinery is a movable shunting capstan for economizing locomotive power in the station yard. The steamer shown in the perspeative view, and in Figs. 2 and 3, is of iron and of great strength, her dimensions being: Length, 130 ft., breadth of beam 26 ft., horse.power 150 nominal, draught loaded 5 ft. 9 in. She has the steam steering gear of the Harrison type.

The deck arrangement is noteworthy, from the position of the lines of rails. What would in an ordinary railway be the 6 ft. space, is 4 ft. 8½ in. It follows, therefore, that in the event of there not being a sufficient number of waggons to occupy the two outer lines of rails, the load may be placed amidships on the centre line, and so contribute to the steadiness and trim of the vessel at sea. The process of loading and discharging may be briefly described. On the approach of the ship, with her cargo aboard, the person ashore in charge of the engines and cradle observes the state of the tide, and, knowing the draught of water, adjusts the cradle by lowering it or raising it to the required level. On the vessel coming into position, the drawbridge, which is raised and depressed by crabs worked from the gantry, is lowered on to the steamer's prow and made fast there. Ropes, which are ready on the drawbridge connected with the winding gear, are then hooked on to the coupling chains of the foremost waggons, and on signal being given the whole train is drawn out at one operation. The time occupied in unloading is regulated by the speed at which the engines are run, and this may be fast or slow according to the condition of the tide and other circumstances. At high tide, when the deck of the steamer and the cradle are nearly level with the rails at the top of the slope, the process of discharging may last some 30 or 40 seconds, At dead low low water, when the slope is at its maximum of steepness, a slower speed is advisable, and the time occupied may vary from 2 to 4 minutes. The loading, which is accomplished on a similar principle. requires rather more caution. The waggons being drawn to the verge of the slope by steam shunting gear attached to the winding engines, are then allowed to run on to the deck by their own gravity, checked and regulated by the ropes attached to the drums.

When the project was first mooted, doubts were freely expressed as to the sufficiency of traffic to warrant an establishmhnt of this kind. Recently, however, doubts on this subject have been resolved, and it is now anticipated that difficnlty is more likely to arise from redundancy than deficiency of freight. The present carrying power, judging from the traffic that is already offering, is likely to require augmentation. Already inland coal traffic is tendered for conveyance fully up to the carrying power, and other branches of traffic to which the system lends itself if presented in the quantity that seems probable, can only be accommodated by an additional vessel. As some indication of the need for improvement which the Transit Company supplies, we quote from an official source a brief description of the plan which the new arrangements supersede. Speaking of goods seeking delivery at the Isle of Wight the writer remarks:

"At Portsmouth, where the first handling and delay occurs, everything must be unloaded at the town station and take turn with Portsmouth town goods; then follows cartage through the town to the quay, and two more handlings occur here in unloading the carts and shipping.

"Arrived at Ryde the goods aremoved again for carriage to the station (through the town of Ryde), and once more there n loading into railway waggons.

"At Ventnor, or other destination, the reverse process occurs, and after two more handlings and another cartage, the consignee is at last reached, and it is well if he has nothing to complain of in the condition of his goods.

"Since arriving at Portsmouth there have been seven separate handlings, three cartages, a risky water passage, and a railway journey, Although the railway company's responsibility continued throughout, their actual control ceased at Portsmouth, when possession was transferred to the Isle of Wight agents or carriers."

In the future, by contrast, vehicles loaded in London will go direct to their railway destination with no more disturbance to bulk or change of vehicle than is involved in a railway journey between London and Birmingham. The whole of the costly and cumbersome terminal services at Portsmouth and Ryde will be avoided.

The plans and local installations are from the design of Mr. Samuel L. Mason, of Edinburgh, who was also the originator of the scheme. He has closely followed the arrangements of the North Brilish Company at Burntisland, of which he had experience when formerly general manager of that company. The work has been financed and constructed by him, the resident engineer being Mr. William Gregory, C.E. Mr. Stroudley, C.E., of the London, Brighton, and South Coast Railway Locomotive Department, constructed and erected the machinery.

It is in great measure due to the enterprise of the Brighton Board, to their manager, Mr. J. P. Knight, goods manager Mr. Stainforth, and to Mr. Spencer Balfour, M.P., that the Isle of Wight is secured the possession of an economic means of communication of great promise and capability. The Brighton Company have, we are informed, entered into agreement by which they adopt the new route for the whole of their traffic, under conditions which give assurances of financial success.—*Eng.*

AMERICAN VS. SWISS WATCHES.

Several of the largest watch factories in this country have their representative agents in Chicago. The American watch industry a few years ago was in its infancy, and its rapid growth and development is one of the marvels of the day. Illinois has two or three watch manufacturing establishments, and in this city the manufacture of watch casings is an important industry. The time has gone by when an imported watch, even a Jorgenson, is considered indispensable as an accurate timekeeper. American watches are admitted to be as "faithful chroniclers of the passing time," as any watches in the world. In speaking of Swiss watches Consul-General Cramer, writing to the State Department from Berne, remarks that since 1882 the export from Switzerland to the United States of watches and materials has suffered a steady decline.

The reason therefor is not because the Swiss watches are less good now than formerly (they still maintain "a good report"), but because of the rapid development of the same branch of industry in the United States during the past eight or ten years. American watches, in beauty and quality, successfully compete with Swiss and Jorgenson watches, not only in the United States, but also in Europe, and even in Australia.

The advantage the Swiss watch manufacturer has over his American colleague is the cheapness of labor. The advantage which the latter has over the former is that he, with his perfect tools and machinery, is able to produce a larger number of watches during a given period of time than his Swiss colleague, for the latter has much of his work done by hand labor.

While Consul Cramer does not wish the Swiss watch manufacturer and his employes to suffer from want of market for their articles, nevertheless, the interest every American citizen should feel for the success of the various industries of his country induces him to say that if our people would patronize to a larger extent than heretofore this particular home branch, much money would remain in the country and many more mechanics and laborers would find employment. It is not likely that American watches will find a market in Switzerland, but, with judicious enterprise and management, a market may be found for them in France, Germany, England, Austria-Hungary, Russia, the Danubian Kingdom and Principalities, and European Turkey, to say nothing of Australia and India.—*Western Manufacturer.*

PROGRESS.

From 1784 to 1884 is only a century but it embraces almost all the inventions which we find so useful in daily life. Even many inventions once deemed indispensable, but now being rapidly superseded by others, were born within this century. It was only in 1784 the first mail coach was seen and yet "the Wild Irishman" and "the Flying Dutchman" express trains travelling a mile a minute, have become a household worlds the world over. The first fire balloon was sent up in 1784, and to-day monstrous developments of the idea are being used in warfare. A century ago the oil lamps, so familiar, were unknown; candles would not burn without snuffing; the wax candle even, was unknown and gas for illumination was uninvented. Since then gas is being abandoned for illumination but applied for heat and cooking purpose as fuel saving inventions. The flint and tinder were the means of obtaining a light until as late as 1827 when the matches we value so lightly were indented. Really good locks and the manifold adoptions of the spring, were all discovered during this century, the locks of the past being clumsy and easily disarranged contrivences. Labor saving machinery almost every branch belongs to this century; and in agricultural machinery the inventions have received their great incentive through the abundance of land and scarcity of labor upon this continent. Photography too, has placed within the means of the masses a priceless boon—the facility of preserving correct impressions of their relatives features—and strengthened the hands of justice in tracing criminals. This wondrous invention belongs to this century also. So on we might proceed with an astonishing list embracing every branch of science, and affecting every walk of life.

FOURTH OF JULY

An Oration on Independence Day by Bill Nye.

FELLOW-CITIZENS,—One hundred and nine years have now passed since our forefathers declared all men to be free and equal, and began to hold out inducements for the oppressed of other climes to come here and help us kill off the indians.

It has been a great success. It has been thoroughly demonstrated to a dying world that all men are fully equal to all other men, if not more so. We point with pride to day to our broad lands, our luxuriant national debt, and our steadily increasing Mormons. We have only a few more Indians to wipe out, and then the oppressed foreigner will have it all his own way.

The men who declared themselves free and independent 106 years ago are now no more. Yielding to the great nervous strain incident to a red hot campaign, they finally pined away and died. As forefathers we can never successfully supply their places, and their untimely death has cast a pall over this otherwise joyous occasion.

To day from ocean to ocean America rejoices. From the humid Atlantic to the moist Pacific the mighty cannon thunders forth a nation's exultation, and the smaller cannon is gathering in its harvest of thumbs. This is an annual holiday and great national thumb carnival.

We rejoice that the idea of freedom suggested itself to our forefathers. Otherwise we would all be in Canada to-day. Now only a part of us are there.

Let us not speak lightly of Canada for some of our largest moneyed men are there. While we would not care to be a part of Canada it is a good province to smuggle into or smuggle out of. It is a good place to stroll into after banking hours, while the Board of Directors are in session.

One hundred and nine years ago the king of Great Britain made the great mistake of his life. I only regret that he did not live to see it as we see it to-day. Had he been less overbearing toward the infant colony, the yong man of America would have been drinking alkali water in Egypt to-day. We could have fought the heathen all over the globe, and left our shoulder blades to bleach in any clime which we might select.

Had the royal tyrant so tened a little toward the struggling settlements in America 109 years ago, he could have borrowed our navy to-day if he would agree to take good care of the worms and return them in as good order as he found them.

But he decided to do differently and to-day he must take the bitter consequence. Kings are not always right. They frequently get left. Of all the many kings whom I have known personally, and with whom I have been thrown more or less, there are only four or five upon whose judgment I could rely during a great crisis.

That is the reason I very rarely go to a crowned head when I am in trouble.

I seek out some tender-hearted and unselfish pawnbroker; and tell him all.

There is one cloud, fellow citizens, which I see with my prophetic eye, just climbing the distance horizon of our National existence. Sooner or later it will darken the brighest day for us Is it the leprous Chinaman or the great unlaundered Mormon? I hear you ask. Is it the spoil system under which one half of the people will always be happy and the other half accursed. Is it the kiln-dried, fire-and-burglar-proof, wormless American dried apple pie which is now invading our happy homes? Is it the baleful simoom breath of New England rum, which would eat out the vitals of a stone quarry and go back the next day to inquire for the old nitro- glycerine cans.

Ah! no fellow-citizens; a thousand times nay. It is this: If our republican form of government holds together for ninety one years more, we would have to celebrate again, and it

THE ISLE OF WIGHT STEAM FERRY.

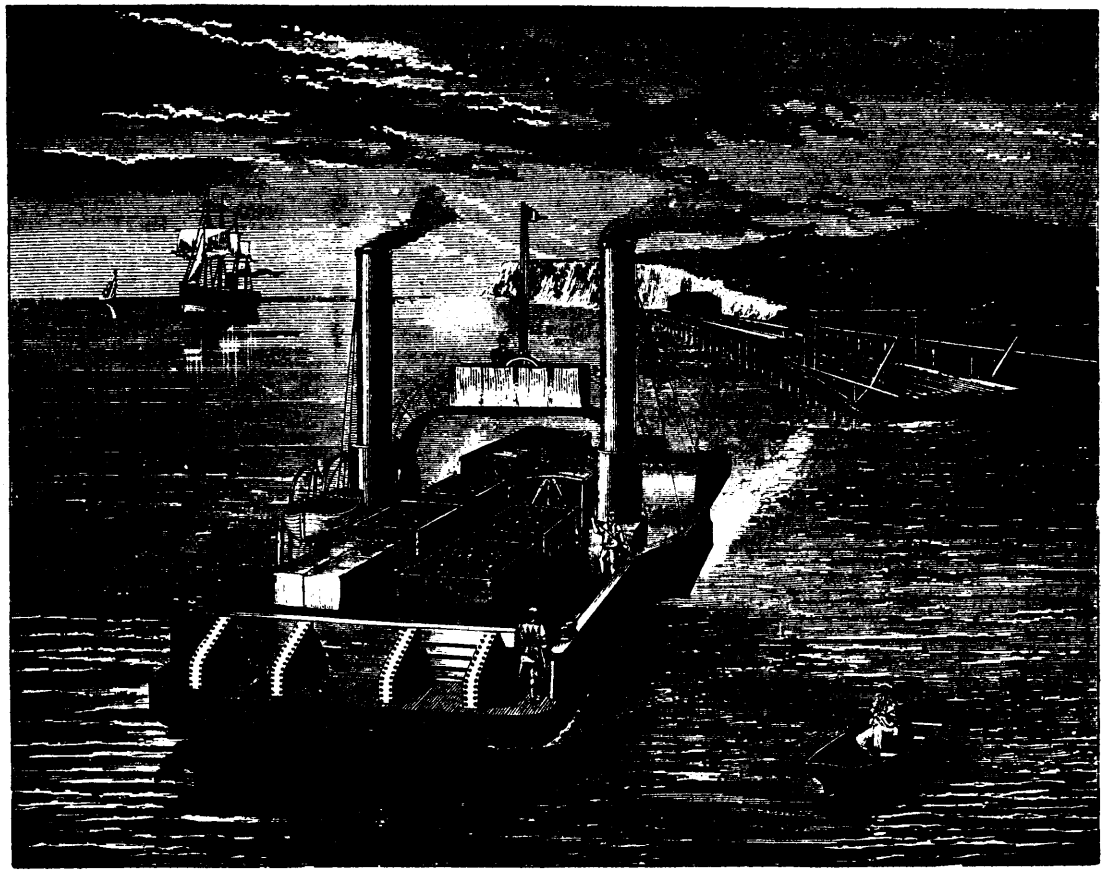


Fig 1.

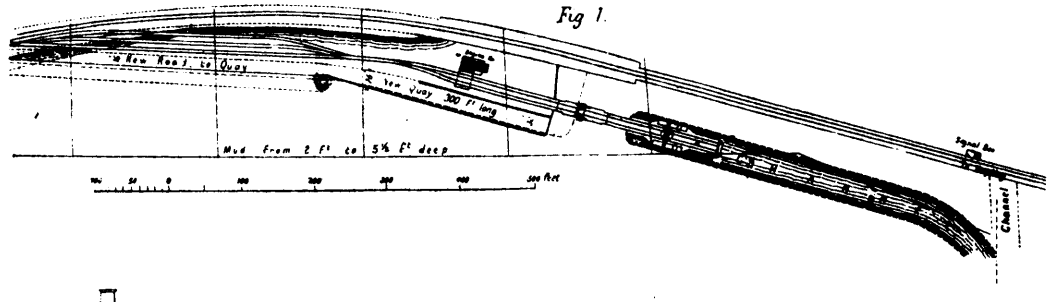


Fig. 2.

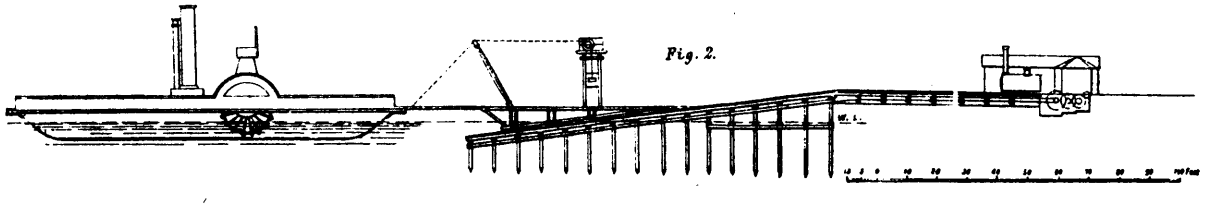
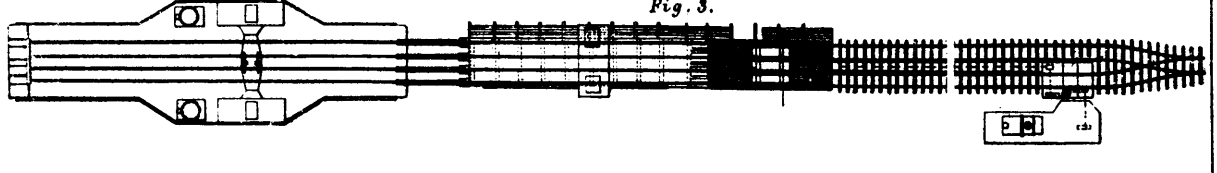


Fig. 3.



THE ISLE OF WIGHT STEAM FERRY.

Fig. 5.

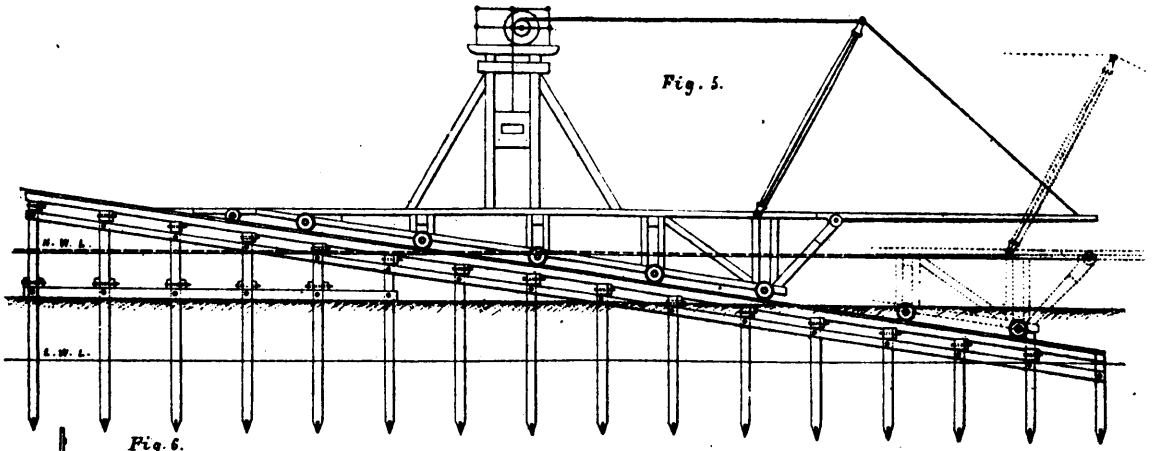


Fig. 6.

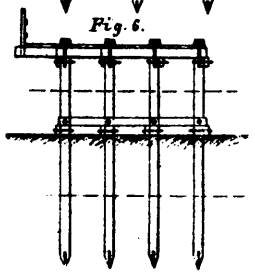
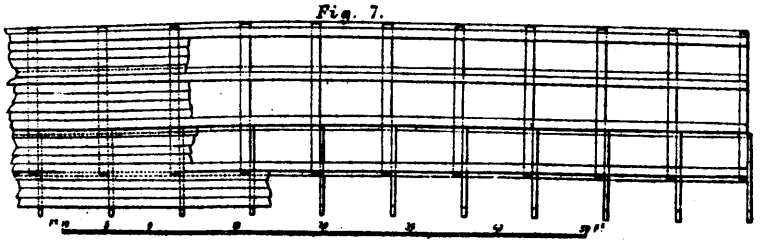
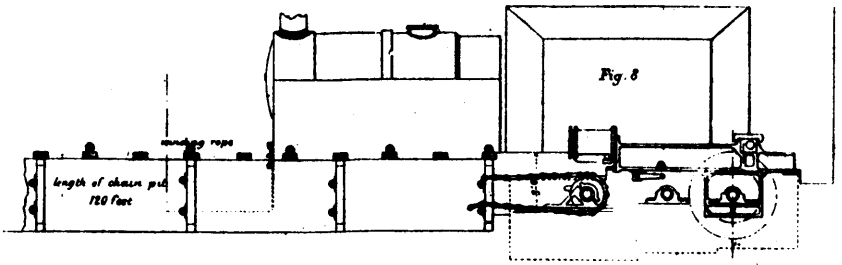


Fig. 7.





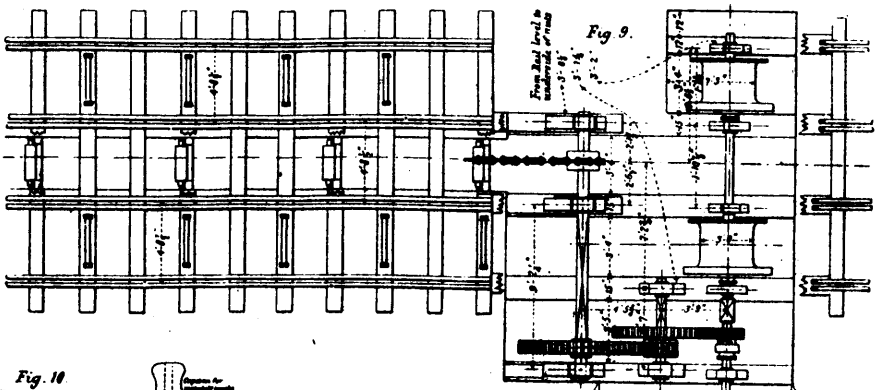
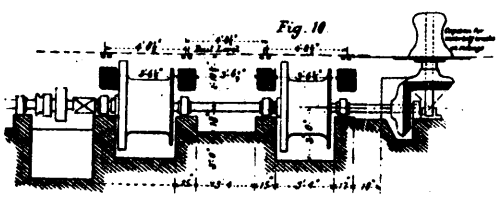
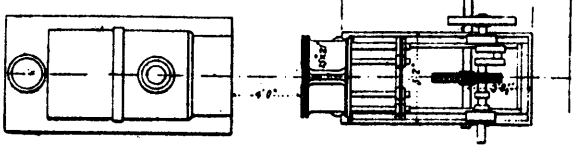


Fig. 10





makes my head ache to think about it. If the feeling of remorse which shows itself the succeeding day after a centennial celebration becomes intensified with each succeeding century, I hope that the 5th day of jnly 1976, I shall be out of town.

I cannot close this brief oration, fellow-citizens without an earnest appeal to you all to be nobler and better men. Of course if you are women this will not be expected; but we can be good citizens by that time, perhaps, and I earnestly exhort all those within the sound of my voice to be loyal and law-abiding. By all means be industrious, do not wait for me, but form habits of industry at once which will cling to you through life. I am convinced by what I have seen of its effects that it is a good thing. Rise early and go about your duties joyously, and, when the morning meal is prepared and all are gathered about the festive board, come and rap gently, and in a low tone of voice, on the door of my boudoir.—*Bill Nye in Indianapolis Sentinel.*

MACHINERY DESIGNING.—XII.

BY OBERLIN SMITH.

In writing this article upon cams I will, as before intimated, enter into more detail than with some other well-known mechanical constructions, both on account of their intrinsic importance and because they are not usually treated of at any great length in engineering books. Even the exact definition of the word seems to be somewhat obscure, some authorities meaning by the word "cam" the whole wheel from which motion is derived, while others speak of the lugs or projections only. Webster's Dictionary defines the cam as "a projecting part of a wheel or other moving piece, so shaped as to give an alternating or variable motion, of any desired velocity, extent or direction, to another piece pressing against it by sliding or rolling contact." Many of the standard mechanical authorities say nothing about this subject, while others dismiss it in a few words. Cams have been used in some form or other away back almost to prehistoric times, and are perhaps more useful than any other one mechanical device, for the reason that by their use a simple rotary motion can be converted into a reciprocating motion of any desired amplitude, and of any speed, either uniform or variable, in one or both of its directions. They are especially valuable in the case of accurate automatic machinery, where a great many combinations of motion are required in one machine, all of which must have a definite relation to each other in regard to time as well as motion.

The principle of any cam is, of course, nothing more nor less than that of the inclined plane, and its simplest form is shown in Fig. 17, where the sliding block C, moving first left and then right in the line *a a*, as indicated by the arrows *l r*, respectively, elevates and allows to fall its follower F, sliding in the line F *f*, by means of the projection *t*. It is evident that, when C moves left, F will move up as shown by the arrow *u* and that when the descending plane is reached it will move down, as at arrow *d*, providing gravity or the pressure of a spring or some other force is present to depress it. Assuming that the velocity of C is uniform, it is evident that F will rise uniformly, and with the proportions shown, will fall uniformly, but at a faster rate than it rose. If C is made as in Fig. 18, with a concave curved surface substituted for the inclined plane F will obviously rise with an accelerated velocity, while in Fig. 19, where the curve is convex, its speed will decrease. These drawings both provide for a uniform downward movement. In Fig. 20 is shown an inclined plane to give an upward movement and a vertical plane for a downward. This shape is evidently impracticable in actual use, as the descent of the follower would have to be infinitely fast if it really follow the cam. Such a member, however, is used in such well-known constructions as trip hammers, stamping mills, etc, where a rapid descent is desirable rather than the smoothness obtained by a cam motion proper. Such a device as has just been described may fitly be called a sliding cam, and its peculiarity is that, on account of its reciprocating motion, the motion of the follower must be always repeated in reverse order alternately with the primal motion. The sliding cam is not, therefore, practicable in cases where the follower's upward and downward motion are different, and must be repeated in regular succession. Strictly analagous to the sliding cam is the oscillating cam, shown in Fig. 21, where the parts are marked with the same reference letters and where the cam C oscillates upon an axis, *a a*, instead of sliding in a straight line, as in Fig. 17. In effect it is merely the sliding cam bent into the arc of a circle. If it be a convex arc, as here shown, the inclined planes, of course, become convex surfaces, but still give a uniform speed to the follower. It is obvious that a concave oscillating cam, with the inclines made concave to suit, would be just as practicable as the one shown. These oscillating cams possess the same feature, before referred to, of repeating the motions of the follower in reverse order.

In Fig. 22 is shown a rotating cam which, if moving at a uniform angular velocity, will effect the follower during one revolution precisely as in the cases of Figs. 17 and 21, but will give a uniform succession of such movements, without repeating them backward, if allowed to continue revolving. Its rotation is supposed to be to the left, as shown by the arrow at *l*. Of course the surface of C in this case is nothing more nor less than the surface of the straight cam, Fig. 17, bent around into a complete circle.

It is evident that the motions given to F in Figs. 17 and 21 might be produced if C moved in some other direction than a straight line or a circular arc respectively, but such a case would rarely occur in practice. An instance, however, where such a device might easily be applied would be in the case of a pitman, one end of which is moving in a circle and the other in a straight line, but all other points of which are moving in other curves, somewhat analagous to ellipses. It is obvious that a cam surface might be applied to the side of a pitman, either between its cross head and crank, or, indeed, upon the end of it produced beyond the crank, although this is a device that I have never happened to see used.

In general practice, then, we have sliding cams, oscillating cams and rotating cams. An ordinary instance of the former can be seen in almost any steam hammer, where the ram is fitted with an inclined groove to work the steam valve. A still more common use of sliding or oscillating cams is seen in ordinary door locks and latches, in which case, however, the inclined part is oftener upon the follower than upon the cam itself. It will not be necessary to treat further of these devices, as they can be constructed upon precisely the same principles as can rotating cams, and these principles will be explained further on. The last-mentioned device will hereinafter be spoken of simply as a cam, and, following the general practice in our shops and drafting-rooms, I shall speak of the whole wheel, including its various inclines and projections, as simply a "cam," the dictionaries to the contrary, notwithstanding. Where necessary, I shall speak of any definite projection, like *t*, as a "tooth" or a "cam-tooth," as the case may be. It is very difficult, however, as in many other departments of mechanical nomenclature, to make such definitions exact. One would hardly know what part to call a tooth in such forms as are shown in Figs. 25 or 26, where the projection extends all the way around the cam. Perhaps as good a practical definition as any for the word in question would be "a rotating wheel, carrying two or more inclined planes which actuate a reciprocating follower by sliding or rolling contact." If it be objected that the inclines are not necessarily planes, we may answer that any curved surfaces, such as are shown in Figs. 17, 18 and 19, may be considered as being made up of an infinite number of short inclines, each at a different angle to the line of motion of C.

We will next consider other directions of motion for the follower in relation to a cam's axis than that shown in Fig. 22, where F is supposed to slide in an axial plane, but a radial direction, and where the primal form of the cam surface is cylindrical or made up of elements parallel to those of a cylinder. In Fig. 23 is shown a cam, C, revolving uniformly upon an axis, *a*, which will give precisely the same motion to F as will Fig. 22, and F's line of motion may still be in an axial plane, but parallel to the axis *a*, instead of perpendicular to it, as in Fig. 22. In Fig. 24 is shown a cam tooth, *t*, mounted upon a conical surface instead of upon the side or end of a cylinder, as in the two previous figures. The motion of F will be as before, and may still be in the same plane, but its direction will be at an angle some other than a right angle to the axis. Although this is shown as an external conical surface, it is evident that an internal surface might just as well be used, as also might an internal cylindrical surface in place of Fig. 22. The use of conical cams is, however not very frequent. There are, however, cases where it is convenient to place them upon a shaft which must, for some good reason, run in a direction inclined to the follower's line of motion. In general, the form shown in Fig. 22 may be called an "edge-cam," and that in Fig. 23 a "side-cam," and it may here be said that all the constructions shown in this article may be classed in general

as single acting cams, the follower being returned to position by some outside force.

In Fig. 25 is shown a follower, F, whose line of motion does not intersect the axis of the cam, but is placed at some distance to one side thereof. To produce the same motion as before the contour must, of course, be modified to suit the position of this line. In Fig. 26 is shown a cam which is circular in contour, but whose center is not coincident with its axis of rotation, *a*—that is, it is an ordinary eccentric. Such a cam as this will of course, move the follower exactly the same as if it were driven by a crank with a pitman of infinite length—that is provided the end of the follower is made flat at right angles to its line of motion and of a width exceeding its stroke, all as shown in the diagram. In Fig. 27 is shown the ordinary heart-shaped cam, which gives a motion somewhat similar to the last named, but with more sudden changes at the times of reversal.

In Fig. 28 is shown a follower which is in the form of a lever instead of being a slide, as in the other diagram. In this case too, the contour of the cam must be modified to suit the arc *f*, which replaces the straight line incident to a sliding follower. Although the term "follower" may not be in very general use I have here adopted it as a convenient and suggestive name for any member of a machine which is driven directly by a cam, whether it slide, as in Fig. 22, or oscillate about a center, as in Fig. 28, or whether it move in any other line than here given, as it might be, were it guided by irregular sufaces or by swinging levers at its different ends. The two forms here shown are, however, almost universally used in practical work.

In Fig. 29 is shown a cam which, starting at the zero point *o*, will move its follower out for a short time, then hold it at rest during the passage of *s'*, then out again at *o'*, then at rest again at *s''*, then in at *i*, then at rest again at *s'''*, then in at *i'*, then at rest during the passage of *s* to the starting point at *o*. Owing to the lack of words of a definite meaning, describing the teeth, inclines, corrugations, jams, lugs, horns, spuds, or whatever they may be called, upon the surface of the cam, I have sometimes in my own practice used the system of marking shown in Fig. 29, where *o* stands for the first time going out, *o'* for the second time, etc. The various *i's* stand in the same manner for "in," and the *s's* for "stay." The general term for the irregular surface of the cam would, according to this method, be the "ins and outs." This is not offered as an ideal system, but as a makeshift which, upon further trial, may prove useful enough to adopt as a standard in any drafting-room where it is well enough liked. It is applicable to the various forms of cams already mentioned, but in the case of double-action cams the direction of the follower, whether in or out, would have to be indicated upon the drawings.

So far we have with one exception been considering followers whose bearing surfaces upon their cams were theoretically knife edges. Of course this will not work in practice, and said edges must be somewhat rounded to an approximately cylindrical or flat form. This change of shape modifies the form of the cam in the same way as does the insertion of a roller in the end of a follower, the action of which will be presently described. In the practical laying out of cams it is usually not necessary to go very far into the mathematics of the subject, as the "mechanico-graphical" method referred to in a former paper is generally the easiest, and the shape of the cam can readily be made to accommodate itself to any kind of a follower surface which may rest upon it.

Wherever practicable (unless, indeed, the pressure is very light and the speed moderate) the follower should be furnished with a roller, preferably of as large diameter as convenient, and not too heavy, which roller is almost as necessary to reduce friction and wear as are the wheels of a carriage in substitution for a sleigh upon snowless ground. In Fig. 30 is shown a roller, R, resting upona cam, C, with a dotted line, C', representing the path of the axis *a'* of the roller relatively to the cam. It is evident that this dotted line is the real cam—that is, it is the shape which directly determines the motion of *a'*, just as does the contour of C, Fig. 22, determine the motion of F by means of its sharp edge at its lower end. A little reflection will show that C is not a reduced duplicate of C', but that all points in its surface are thrown in radially from like points upon C' by the amount of the radius of R—that is, in the case of *a'* sliding in a straight radial line. In Fig. 31 is shown an effect that may be produced by using too large a roller, where the reduction in size of C' to suit the radius of the roller has made the cam impracticably sharp. Even if the point at P could be perfectly sharp, the sharpest possible shape that could be obtained at P' would be an arc of a circle with the radius of R. Thus it will be seen that there is a practical limit to the suddenness of reversing the motion of a follower, dependent upon the relative size of the cam and roller, and upon the sharpness of edge which will be durable upon the cam. The remedy for such trouble as is shown in Fig. 31 is found in making the cam of larger diameter, and perhaps the roller smaller.

With a given diameter of cam, rotating a given speed, there is, of course, a limit to the velocity at which the follower can be driven, based upon the fact that if the inclined plane is too steep the side stress and the consequent friction upon a follower driven upward by it becomes so great as to preclude its practical use. This angle (marked 45° in F. 18) should, in the writer's opinion, never exceed that figure where it is upon the "driving" side of a cam tooth, and a greater angle, say 60° or more, is still better. Of course upon the "following" side it can be much more acute, providing the follower is pushed down fast enough to stay in contact with the cam, and not possess the fault, which many followers have in real life, of moving sluggishly on account of being pushed by springs which are too weak, or, of an attempt to make gravity work faster than nature designed it should. Such followers are apt to strike very unpleasant blows upon the cam at a point where they were intended to-glide smoothly. With a curved incline upon a cam, as shown in Fig. 22, the contour should not be at any point less than 45° with a radial line which may be struck from the axis through such point—that is, upon the driving side, as before said. Whenever it is found that the desired speed of motion necessitates a less angle than this, the only remedies are either to make the cam rotate faster or to enlarge its diameter, so that it may have a greater suface speed.

Note.—In the article preceding this, in June *Mechanics*, on page 164, second column, 2½ inches from the top, immediately after the word "Philosophy," the following was unfortunately omitted: "Of course a much more complete and scientific analysis of this whole matter may be found in the works of Reuleaux upon Kinematics, and many new ideas may be obtained by an inspection of his cabinet of models at the Gewerbe Akademie, in Berlin." This awkward mistake made the writer appear to say that models of the "507 mechanical movements" referred to had been brought to Cornell University, instead of the Reuleaux models, as intended.—*Mech.*

---

14 x 20 Ft BORING AND TURNING MILL.

We illustrate herewith a new boring and turning mill recently brought out by the Niles Tool Work: of Hamilton Ohio.s

This machine has been designed to meet the wants of shop whose occasional needs require a machine to turn work of 20 ′ diameter or more. For the ordinary requirements of these shops a mill to swing 14′ is ample, put at the same time it is important when the need arises, they can operate on much larger work. The purchase of a mill 20 ′swings involves a very large outly, too large an investment in one machine for the amount of work there is to do. Constructed as this mill is the additional investment to enable it to operate on large work is but little greater than the necessary investment in a 14′ mill and hence does not tie up a large amount of money for machinery to meet an occasional want.

This mill is a 14′ boring and turning mill, provided with extention bed-plate and power apparatus for moving the housings and entire upper works back so as to take in work over 14. ′ diameter. The mill is exceedingly well arranged for this purpose. All the movements required are made by power and the changes from 14 ′ to 20 ′ can be made very quickly.

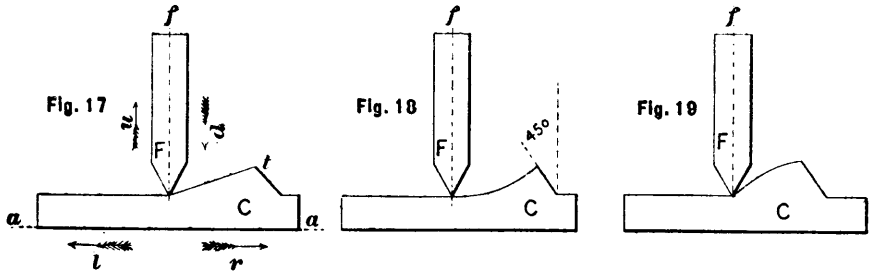
The mill is made very strong and substantial and has ample power to carry two good cuts at the extreme swing 20′ The extension bed-plate can be made for any required swing 20 ′ however is as large as is usually required.

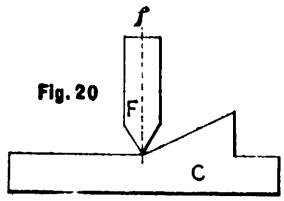
The machine as illustrated, is built to take in work 5 ′ high, but this can be increased if desired, mills having been built to take in work 10 ′ high. Table is 10 ′ diameter. The driving cone has nine steps and is strongly back geared, affording 18 changes of speed. The boring bars have 48″ traverse.

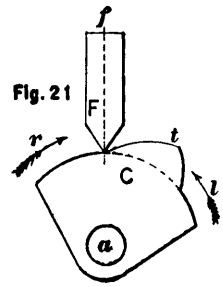
They are counterweighted and have quick return. The bars are counterweighted by a single weight, arranged so that the strain is always directly through the axis of the bar. This device is patented and is an important feature of the Niles mills.

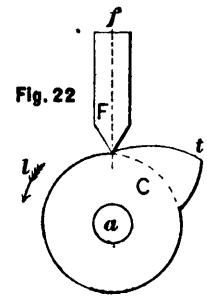
The bars are easily and quickly handled and undue wear in the bearing prevented. Each head has quick hand traverse by rack and pinion. The bars may be set over to operate at any angle. They are brought exactly to the center of the mill, so

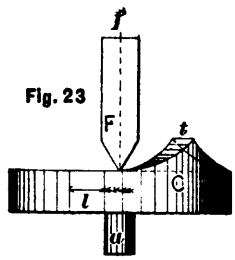
MACHINERY DESIGNING.

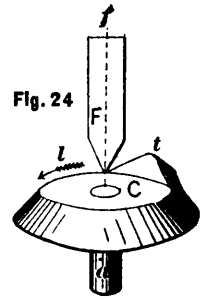


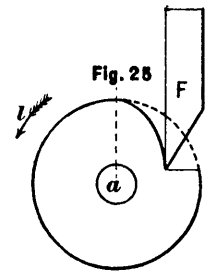


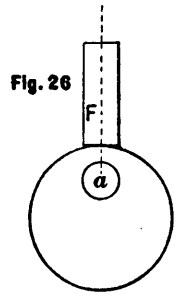


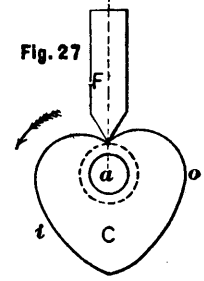


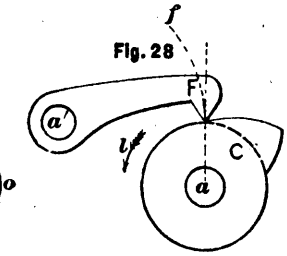


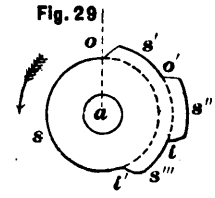


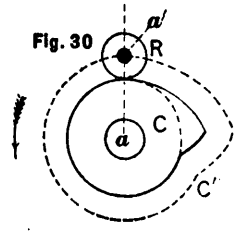


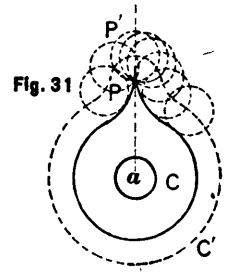


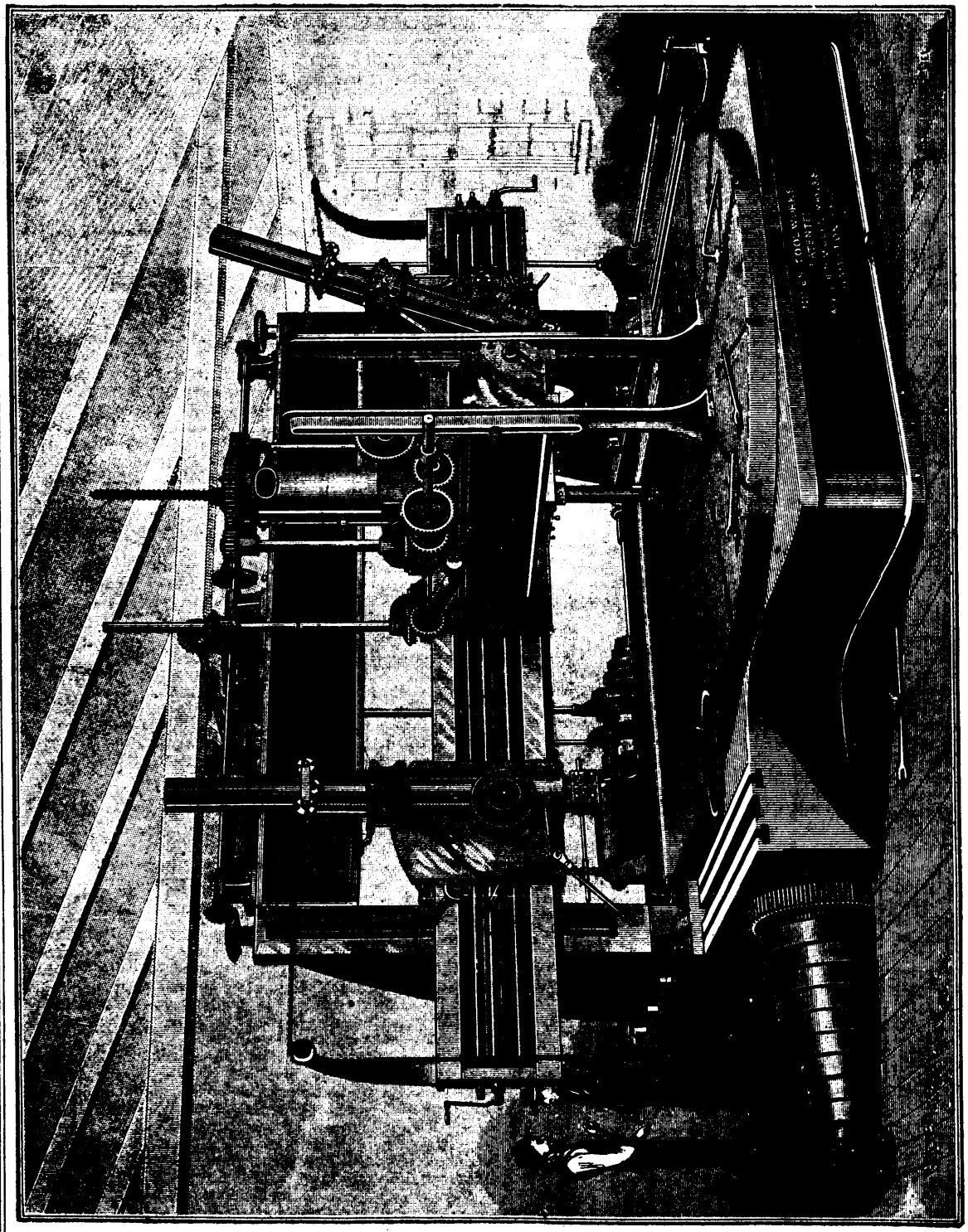












14-30 BORING AND TURNING MILL.

that double end cutters may be used for boring. The feeds are operated through their improved friction disk, the construction of which is patented. The feeds have a wide range, and may be changed instantly to any degree from zero to their limit.

The table is very heavy and is driven by heavy spur gearing cut from the solid. It is free from all the lifting, chattering tendencies of bevel geared machines. The table is provided with a masive spindle of considerable length. This form of structure is the result of much experience with machine having no spindles at all, or only short ones. The spindle runs in bearings adjustable for wear, and is carried at the bottom by a steel step adjustable in height by the small screw and seen at the front of the base.

When the weight of the parts are thus carried by the steps the machine moves freely but solidly, and is thus used for the lighter kinds of work. There is an anular bearing under the outer edge of the table, and when very heavy pieces are to be worked, the step is relieved and the table allowed to seat upon this outer bearing. Thus adjusted the machine works with all the steadiness of the heaviest planer, and all the precision of the accurate lathe.

Heretofore the difficulty in mills of this kind has been the lack of facilities for boring, when the upper works are moved back to take in work larger than the ordinary swing of the mill. For this purpose a very efficient attachment to this machine has been devised, by means of which the boring may be done while turning, and the devise can also be used for key-seating.

It consists of a rail attached to the center of the cross-slide of the mill carrying a head with boring spindle. This attachment is driven independently of the mill itself, consequently the table of the mill can, be run at the proper speed for turning large diameters, and at the same time the boring spindle can be driven at the proper speed for boring, simultaneously. The boring head can be brought close up to the-cross slide of the mill so that it can be used on all diameters. The boring and key-seating attachment is provided with the necessary feeds, operated by power, and every appliance to make a complete machine. It has ample power for boring holes up to 20 ″ diameter. A boring and turning mill arranged in this manner is capable of a very wide range of work.

The great range of work that a boring and turning mill is capable of performing is not fully appreciated by some who are not sufficiently familiar with its uses. Many are deterred from considering the purchase of these machines, looking upon them as involving a heavy investment upon a tool not often used, as a matter of fact, the boring mill never stands still. A 12 ′ mill will work on small work, of the kind to which it is adapted to such an advantage over a lathe as to justify its use, regardless of the large work of which it is capable. Numerous small pieces bolted to its remarkably convenient table can be simultaneously faced off with a facility not to be found in lathes planers or shaping machines.

Almost anything that a lathe can do, and much that it cannot do can be done on these improved boring mills, and usually in a much shorter time and in a more satisfactory manner. The time gained in the mere matter of setting unwieldly and irregularly shaped pieces will alone foot up to handsome profit in favor of these machines. Every machinist is acquainted with the anoyance of fastening work of this class to a vertical face-plate, and, should on account, of this expense (from loss of time and extra help) be kept, it would even then far exceed the usual estimate."—*Chicago Jour. of Com.*

—Work has been begun at Krasnovodsk on a ship canal to connect the Caspian Sea with the transcaspian Railway.

Iron Paint.—A recent german invention, composed of pulverized iron and linseed varnish, is intended for covering damp walls, outer walls, and, in short, any place or vessel exposed to the action of the open air and to the weather. Should the article to be painted be exposed to frequent changes of temperature linseeed oil varnish and amber varnish are mixed with the paint intended. for the first two coats, without the addition of and artificial drying medium. The first coat is applied rather thin, the second a little thicker and the last is rather a fluid state. The paint is equally adapted as weather-proof coating for wood, stone and iron; nor is it necessary to previously free the latter from rust, grease etc, a superficial cleaning being sufficient. This paint will prove a valuable auxiliary to manufacturers.

STEEL TAKING THE PLACE OF WROUGHT IRON.

Few people not actually engaged in the metal trade are aware of the wonderful strides made by steel in recent years. In fact, steel is wholly taking the place of wrought iron. Steel is simply a mixture of iron and carbon, the quantity of carbon ranging from 0·25 to 0·02 per cent. of the mass. It is not only stronger and for almost every purpose better than wrought iron, but it is cheaper.

Its first victory over wrought iron was obtained in England, where steel rails for railroads were found to be much better than iron in several ways. They did not wear away so rapidly under the wheels, and they were able to stand a greater strain. The first Bessemer steel plant in this country was started in 1867. Its product was used for making rails; and the total amount for that year was 3,000 tons. For a number of years the Bessemer steel was almost wholly devoted to that purpose, the high price at which it was sold making it unprofitable for other uses to which wrought iron was put. Steel rails brought $160 a ton in 1867. But after the panic of 1873 prices came down, and in 1875 the rails brought $75. The hard times of 1879 lowered the price, in spite of combinations among owners, and in 1883 steel rails sold for $40 a ton. Since that time the price has fallen steadily, and a recent price list puts the price of rails at $29, and of steel slabs, ready to be rolled or forged into any shape, at $28 per ton.

The result of these low prices is that bridges are no longer made of iron. Steel beams have taken the place of iron in the fireproof buildings. Steel ships are built instead of iron ships. Steel boilers replace iron boilers. Steel rifles replace the old cast iron cannon. Wherever tensile strength is required, steel is used.

The use of steel in beams and girders for houses and bridges was a natural sequence of its use in railroad tracks. But the use of this steel has not been confined to railroads and steamships. The big tin plate factories in Wales began to experiment with steel instead of iron about two years ago. Tin plate contains about 93 per cent. of iron and 7 of pure tin. The steel plate was found to be cheaper, and the articles made of steel tin plate were superior. For making tin dishes without seams or soldered joints, the Siement process steel plate is not only superior, but it is about the only kind that can stand the spinning process. This country now imports 240,000 tons of tin plate annually, and it is all made of steel plate with a tin coating.

One field in which steel has not yet wholly displaced iron is the manufacture of nails. The plates from which nails are cut can be rolled from steel ingots as easily as from puddles iron, but the steel plate is harder to cut, and the cutters charge a little more for the work. The plants engaged in making steel nails are limited in number, and the price of steel nails is higher than that of iron. The steel nail is smoother, stronger, and handsomer, and has made its way in spite of the higher price, but the difference in price is rapidly dwindling, and will, no doubt, soon disappear altogether. In November, 1884, the Wheeling manufacturers charged thirty cents and the Troy men twenty-five cents a keg more for the steel nails. Quotations during the last of February this year were $2.10 per keg for steel nails and $2 for iron. The profit to the manufacturer of the steel nails is much greater on account of the smaller cost of the plates, and the only thing that prevents the iron nail makers from using steel plates entirely is that it takes money to change the plant, and after the great depression of the past two years money is not overabundant among iron manufacturers in any branch of the trade.

A curious outgrowth of this improvemrnt in the manufacture of nails is the action taken by the trades unions in the West at the instigation of the puddlers. By the old puddling process of making iron plates for nails, the pig iron was melted in a grate furnace, and a small army of men stirred up the melted mass with long rods until the impurities were burned out and the iron became pasty insteady of liquid. By the new process the melted pig iron in a big pear-shaped kettle is sujected to a powerful blast of air, which is forced up through it from the bottom until the impurities are burned out. Then another small amount of melted pig iron is poured in, and the mixture is ready to be cast into ingots. By the old process, twenty skilled men could turn out fifteen tons of nail plate in a day, while by the new process four common laborers and one skilled mechanic can turn out from 150 to 250 tons in a day. Naturally, the puddlers must lose their occupation. They have induced the Contractors' and Master

Carpenters' Association of Wheeling to boycott the steel nails and all union builders will be asked to boycott them also.

There is one thing that has not yet been successfully made of steel, and that is a propeller shaft for a steam ship. Experiments were made in England, and after considerable money had been lost, the attempt was abandoned. Then the wise men who were going to rebuild the American navy took up the abandoned idea, and ordered steel to be used in the shafts for the new cruisers. John Roach objected, but the Advisory Board insisted, and Roach gave the contract to other parties. The Dolphin got her shaft, and started on her trial trip up the Sound, and after a short trip the shaft broke. Then the plans of the other cruisers were altered, and it is said that the change has involved a fatal weakening of the sterns of the new commerce destroyers.—*Sun.*

HIGH AND LOW SPEED ENGINES.

A few years ago the discussion between the advocates of high *vs.* low speed for steam engines was warm. At present we hear but little of it. It is apparent that both sides to the controversy have come to the conclusion that the truth was not all on one side ; a very satisfactory conclusion. If it has been demonstrated that engines at high speed have given exceptionally good duty, it has also been shown that remarkably good results have obtained at low speed. By speed reference is had to number of revolutions ; both sides to the controversy have always agreed upon the economy of fairly high piston speed. The truth seems to be that there is room for both high and low-speed engines, and that while in one instance one is better, in another instance the same is true of the other. Both types have their field, although it is not very clearly defined. This appears to be the verdict not only of intelligent engineers, but of steam users as well, and as such it will undoubtedly stand, at least until radical changes are made in steam engine construction.

THE RUSSIAN OIL WORKS.

The Russian oil region covers an area of over 14,000 square miles, with forty-two oil wells in one district, over a hundred in another, and four hundred in a third, while there are still richer regions waiting to be developed to produce still greater results. One spouting will produce 2,000,000 gallons a day. The oil is found in places at a depth of a hundred feet, and no well has gone below eight hundred and seventy-five feet. Three Swedish brothers and a few Americans and Russians who have been in America have introduced method and system, pipe lines, oil carrying barges and steamers, tank carts, refineries, joint stock companies, railroads, and now produce 800,000 tons of crude and 200,000 tons of refined petroleum, and are rapidly finding new markets.

HOW TO SPLIT A SHEET OF PAPER.

It is one of the most remarkable properties of that wonderful product, paper, that it can be split into two or even three parts, however thin the sheet. We have seen a leaf of the *Illustrated News* thus divided into three parts, or three thin leaves. One consisted of the surface on which the engravings are printed, another was the side containing the letter-press, and a perfectly blank piece on each side was the paper that lay between. Many people who have not seen this done might think it impossible ; yet it is not only possible but extremely easy, as we will show. Get a piece of plate glass and place on it a sheet of paper ; then let the latter be thoroughly soaked. With care and a little dexterity the sheet can be split by the top surface being removed. But the best plan is to paste a piece of cloth or strong paper to each side of the sheet to be split. When dry, violently and without hesitation pull the two pieces asunder, when part of the sheet will be found to have adhered to one and part to the other. Soften the paste in water and the pieces can easily be removed from the cloth. The process is generally demonstrated as a matter of curiosity, yet it can be utilized in various ways. If we want to paste in a scrap book a newspaper article printed on both sides of the paper, and possess only one copy, it is very convenient to know how to detach the one side from the other. The paper when split, as may be imagined, is more transparent than it was before being subjected to the operation, and the printing ink somewhat duller ; otherwise the two pieces present the appearance of the original if again brought together. Some time ago the information of how to do this splitting was advertised to be sold for a considerable sum. We now impart it to all our readers gratuitously.—*Paper Trade Journal.*

IMPROVED FORM OF COLBY COUPLING ATTACHMENT.

With the present form of the Miller coupling, cars cannot be uncoupled on curves, which fact often causes trouble and delays in separating and making up trains.

To obviate this serious difficulty, the improved form of the Colby Coupling attachement, shown in the annexed cuts, has been made and applied to the locomotive tenders of the Boston and Albany, and other railroads, with perfect success.

The improvement consists of an adjustable block *C*, so placed in the extended arm of the back casting that when the train stands on a curve the block can be pulled out, allowing the hooks to be separated, and the cars drawn apart.

In adapting the improvement to passenger cars, a small casting holding the adjustable block, takes the place of the old guard or "boot" (as it is generally termed) as shown in the cut. The adjustable block *C* is loosely dovetailed into the casting, and is allowed to so bottom that it can never pinch nor stick so as to cause trouble in getting it out. The details drawings show it as arranged on the Boston & Albany railroad, of which road, at Boston, the inventor, George H. Colby, is master mechanic.

THE NATIONAL PROTECTIVE TARIFF LEAGUE.

The protectionists' club lately organized in New York has changed its name to "The National Protective Tariff League." It is intended to be active in spreading information regarding protection to American industry, particularly among the working people. The organization is non-partisan in politics, admitting Democrats as freely as Republicans. The methods proposed are substantially those which have been so effectively carried out by the Cobden Club in England, and by its affiliated organizations in this country—to organize throughout the country in every election district in the large cities, and, so far as possible, in every county town, local clubs, the formation of which will be encouraged by the central organization, which will supply current publications favoring protection, pamphlets and speeches illustrating and explaining its operations, with occasional lectures or discussions which shall have the effect to awaken and maintain such interest in the subject as will keep these local organizations not merely alive but active.

Miscellaneous Notes.

AN apparatus for showing under the microscope the combustion of metals by the passage of the electrict spark through them has been exhibited to the Royal Society of London.

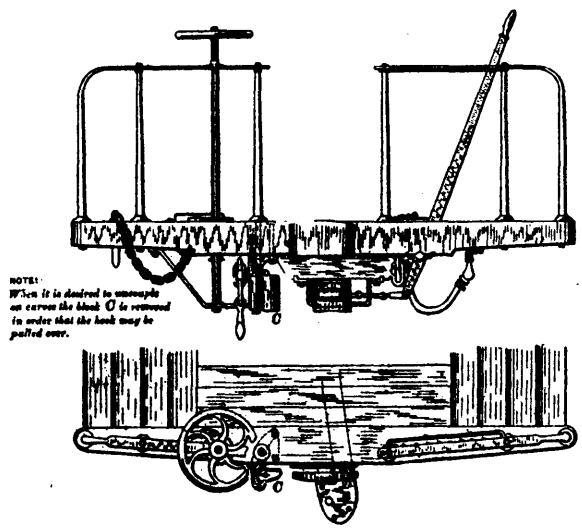
THE PANAMA CANAL.—London *Engineering* says : We learn that within a few months the first nine or ten miles of this canal will be opened to light draught vessels. This run will extend from Colon to above Gatun.

—THE Committee of British House of Lords have unnanimously passed the Corporation Tower Bridge Bill, with the scheme of which, including architectural, engineering, and working details, they expressed themselves satisfied. *Engineering.*

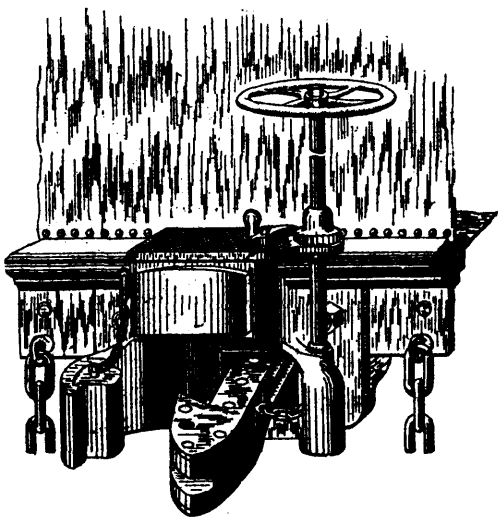
SOUTHERN EXPOSITION, LOUISVILLE, KY.—The Southern Exposition, of Louisville, Ky., bids fair to make another successful season this year. It will open August 15 and continue until October 24. A large amount of energy has been devoted to making the Exposition attractive in many details, and improvements in several directions will be seen by the visitors.

THE Davy apparatus for making Bessemer steel, by blowing pig iron in an ordinary foundry ladle, has been attracting a good deal of attention. A plant to produce one ton at a blow, or, say, 100 tons per week, can be put on waggons at Sheffield for £500. The steel is produced, we are informed, of any temper, and at its little cost in the ladle for casting as by the ordinary Bessemer plant.

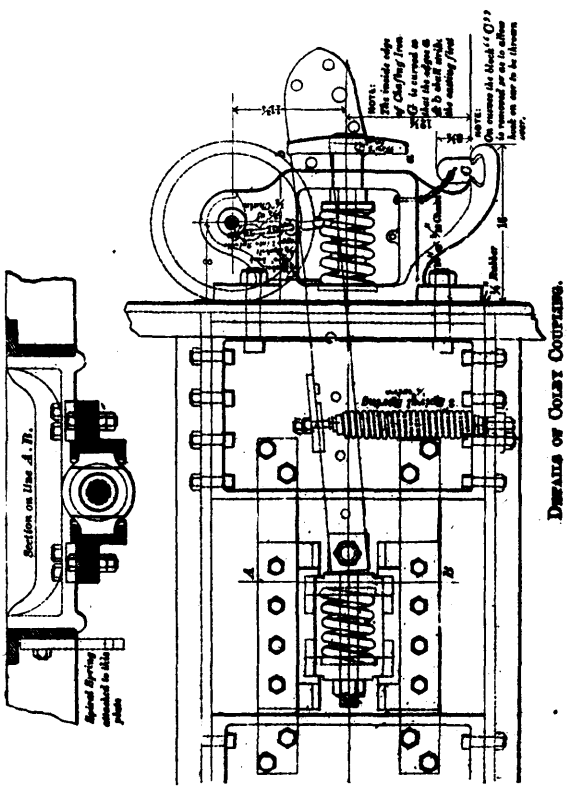
COLBY COUPLING.



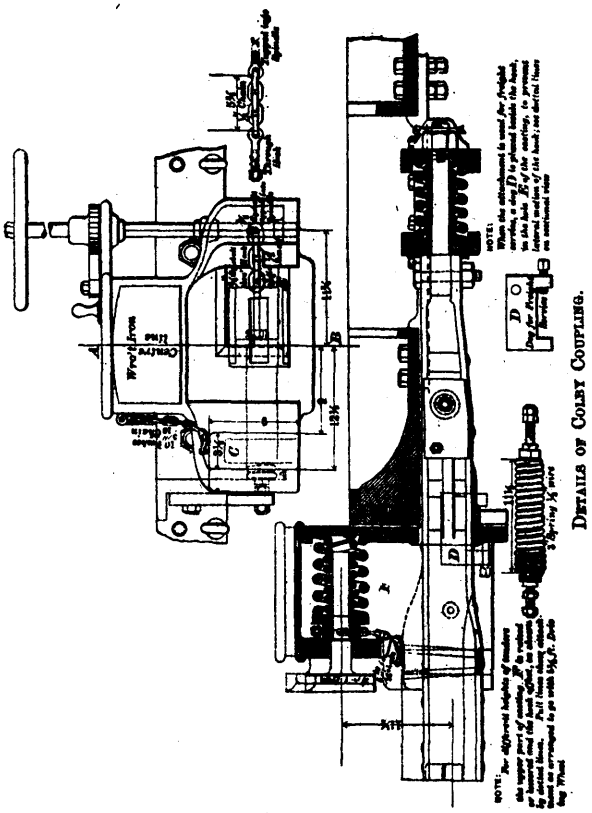
COLBY ADJUSTABLE GUIDE BLOCK FOR MILLER COUPLING.



COLBY COUPLING ATTACHMENT FOR LOCOMOTIVE TENDERS.



DETAILS OF COLBY COUPLING.



DETAILS OF COLBY COUPLING.