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TORONTO WATERWORKS.

The water works department of the city of Toronto, Ontorio, seems to be in a very unsatisfactory state, notwithstanding the vast amounts of money which have been spent and still being spent on it. How Toronto, with such a fine location, contiguous to Lake Ontario, should be so circumstanced, it is difficult to imagine or explain.

It seems that this department has been bungled from the very beginning, and instead of the citizens profiting by the sad experience of the past, they are unaccountably clinging to a similar policy, which, to say the least of it, is quite unworthy of the Queen City of the West and inconsistent with a go-ahead progressive people.

The citizens of Toronto must either be a careless, long-suffering people, or held in political aldermanic bondage, otherwise such a deplorable state of affairs would not be permitted by any ordinary free and enlightened community such as they are. The water for city purposes is obtained direct from the Lake Ontario by means of pumping; and in this alone we believe the correct plan has been adopted—notwithstanding all that may be said at present in favor of bringing water from Lake Simcoe, by Granby, a distance of about 40 miles.

The methods and appliances in detail for the procuring of a suitable supply of water direct from Lake Ontario in most respects appear to be singularly defective and innefficient, while in point of economy they are ruinous in the extreme.

How long such a state of matters will be allowed to continue it is impossible to say, because at present there are no indications of carrying out reform or even improvement, excepting the one fact that the present Mayor and some few members of Council, among whom is included the Chairman of Water Works Committee, seem desirous of investigating matters with a view to elaborate a scheme for the better control and management of this most important department.

We sincerely trust they may be successful and that they will be honestly supported in Council in rectifying matters before it is hopelessly too late.

Part of the scheme is to appoint a water works' superintendent and manager, which in most other cities seems to work well. We believe if an energetic and conscientious gentleman, possessing practical knowledge and experience with professional engineering ability, is appointed, a very marked improvement would gradually show and far more than pay for the extra outlay of a few thousand dollars.

If any other considerations than the above should influence and enter into the appointment of a water works' manager, the results will be disappointing and wrecked by non-fulfillment.

With a constantly changing Council it is impossible to keep the official machinery in a high state of efficiency, without having able and conscientous heads in each department, and the water works department requires more professional ability than most people imagine. There should be no rule of thumb, work and guessing, but facts, figures and calculations rather than dogmas ought to prevail.

The present pumping appliances have hardly capacity enough to cope with the growing demands of the city, and the winter which has just closed confirmed the wisdom of a former Council's action in contracting for the immediate construction and erection of new pumping engines.

The absolute necessity and importance of having at once additional pumping power was more than fully established during the cold spells of January and February, 1885.

The new engines contracted for are being built by a local engineering firm to designs made up and furnished by a mechanical engineer in Cleveland, Ohio, in conjunction with the engineer in charge of pumping station and the contracting engineering firm in Toronto.

With such a combination the citizens are led to expect good results, and pumping engines of no inferior merit, not only as regards pumping the desired quantity of water, but distributing it to the citizens at a greatly reduced cost over the present ones in use, which are now well known to be extremely wasteful in regard to coal.

We hope the supporters of the designs adopted will not be disappointed, and that the citizens will not have reason to regret the help extended to these supporters, because, if so, they will have nobody but themselves to blame.

The testimony secured by appointing experts to report previous to letting contract, was decidedly unfavorable to the adoption of these very designs and we have it from one of the best authorities that the engines and pumps combined, when supplied by contractor, will be a failure, in point of efficiency and economy, in contrast with what might easily have been obtained from the same local contractors by their following other and much better designs.

A great deal of newspaper controversy was indulged in about the time of awarding contract, and the chief champion of the present designs was one of the local evening newspapers, and no doubt its reasons for so doing were best known and understood by itself, even though unintelligible to many.

Perhaps the supporters of the present engines may find it a harder task to convince the public that the new pumping engines are in every respect all that should be desired.

We do hope that Toronto will not allow itself to retrograde in matters of civic works of improvement, but a calm and candid survey leads to the conclusion that not even yet do appearances direct that way; so that Toronto will have to grin and bear her burdens for some time to come.

STEAM BOILER AND ENGINE ECONOMY.

The subject of efficiency combined with the necessary durability and economy in the use of steam appliances have received in Canada of late years much more attention and consideration than formerly.

When it is considered that heat is the great force operating on, and acting through agents, and that same is derived chiefly and directly from coal or other fuel, it is not to be wondered at, because Canada, especially Ontario and adjacent territory, is unfortunately deprived of coal-fields and have to draw all her supply from the eastern provinces or the United States, frequently paying a high price.

We refer chiefly to the manufacturing centres and not to the lumbering districts where cheap fuel can be had in the shape of the sawdust or other refuse of the mill—the latter are fortunately self-supporting in the matter of fuel and in this respect Canada is as highly favored as any country.

But such Cities as Montreal, Toronto, Hamilton, London, etc., have to spend enormous sums for the necessary suitable fuel for general manufacturing purposes. Although a good deal has been done and still being done in the matter of economy in the use of steam power, there is still room for a more general adoption of the best and most economical appliances from the very furnace and boiler up to the exhausting of heat into the air from the chimney and exhaust pipe of steam engine.

Were the science of heat better understood and not so indifferently treated its importance and value to Canadian manufacturers would be more than fully established. In some moderately small factories and manufacturing concerns of which Canada has, perhaps, more than her proportion, the saving in the coal bill alone has by strict adoption of economy been the only profit obtained to the concern and yet parties are found who do not believe in the economy of one apparatus over another contenting themselves with the notion that steam is the same no matter how it is obtained and afterwards used.

We would state here that the science of heat is one of the most subtle and difficult sciences there is and requires for its full knowledge a large share of the highest mathematical skill.

We believe it would pay parties contemplating steam application to confer and consult with some recognized expert or firm of consulting engineers and thus secure satisfaction without the worry and after trouble of loss and failure.

The horizontal tubular boiler generally adopted in Canada, we think, everything considered, is the best and most preferable design. It only remains to have it constructed of proper material and well arranged in all its details, to be amply strong and well made for the uses to which it may be put.

The setting of boiler in brickwork is not the least important, while the arranging of grate bars, furnace details, flues, etc., require great care and experience. Next comes the fittings and attachments to boiler proper, the nature and application of these very much determine the durability and safety. Quite as much as the furnace setting, flues, tubes, etc., determine the efficiency of the boiler to evaporate the maximum quantity of water for the minimum of fuel burnt and consumed in grate bars of furnace.

Assuming the boiler to be in satisfactory condition for generating steam, let us go further by assuming its connection with a steam engine. The first point to be watched is to have area of main steam pipe large enough to supply at boiler pressure enough quantity when engine was its maximum at its highest speed for ordinary purposes one-tenth the area of steam cylinder of engine will be enough while the steam ports in cylinder need not be much less than this and the exhaust not greater than one and a half.

The principle which regulates economy in the steam engine are many and quite sufficient, also the regulator of power to speed, but, we propose to return to these and do them some justice in a future article.

To prevent rust, dissolve one ounce camphor in one pound of melted lard; take off the scum, and mix in as much fine black lead as will give it iron color. Clean the machinery, and smear it with this mixture. After twenty-four hours, rub clean with a soft linen cloth.

During the past year a new market has opened in Australia for California fruit, especially the dried article, canned goods and apples. During the past season an average of 10,000 boxes of apples per month have been shipped by steamer from San Francisco to Sydney. The fruit is carefully wrapped in white paper. The Australians do not like large apples, but want medium-sized. There are but few ports in Australia where they will allow apples from foreign countries to land. This is consequence of local legislation, and is intended to prevent the introduction into the country of the codlin moth and other fruit pests.

MACHINERY vs. MOSLEM.

The prelude to the last act of the bloody drama which Britain and the Mahdi are now playing in the African Soudan is nearly ready for the boards, and it is reserved for American mechanics to play it.

As a necessary step to the subjugation of the fierce Arab tribes who are ranged under the banner of the Moslem pretender, the British Government has determined to lay a pipe line, for the purpose of conveying water for its troops, across the 280 miles of desert between Suakim and Berber, after the manner of the oil pipe lines in successful use in this country.

Manifestly delays and experiments could not be risked in an enterprise upon the speedy success of which so many lives and such important political consequences depend. For the mechanical appliances needed to carry out the proposed plan, the British Government was therefore forced to apply to the American mechanics who were familiar with the problem. The contract for a number of pumping engines adapted to the work has been awarded to an American firm, Henry R. Worthington of New York, and the Brooklyn works of this firm are working night and day toward its fulfillment. Four engines have been already shipped, and the firm have also offered to furnish the four-inch wrought-iron pipe required, at the rate of fifteen miles per day, while confident of their ability to furnish twenty miles per day. It is believed the necessities of the case will require the pipe contract also to be awarded in this country, notwithstanding the efforts of British competitors to secure it.

The pumping engines used are of the Worthington duplex type, non-condensing, and calculated to work under a pressure of 1,000 to 1,500 lbs. per square inch, and have a delivery capacity of 150 to 200 gallons of water per minute—a much less capacity than that of the American oil-pipe lines being required.

Whatever difficulties the British soldiers may encounter in maintaining their foothold in the Soudan, pending the construction and completion of the pipe line, and the narrow-gauge railroad, which is made possible by it, and is presumably likely to follow it, there can be no doubt of John Bull's ultimate ability to whip the Mahdi, now that he has called in the aid of American machinery and American mechanics.

Of the possible ulterior consequences, political and commercial, which may in time follow this move, it is needless now to say much. If the pipe line and railroad accomplish the desired military result, and are preserved, as is probable, for the purposes of peace, important commercial consequences may ensue, the accounts of travelers seeming to agree that in the Soudan region, the desert once passed, lies an immense country, fertile, well-watered, and especially adapted for the cultivation of cotton.—*Ex.*

ANCIENT CHINESE TELEPHONES.

At a recent meeting of the Royal Asiatic Society in Shanghai, a paper by Dr. Macgowan was read on the subject of the early use of telephones in China. This paper, being very brief, we give it in its entirety:

It detracts nothing from the merits of the ingenious physicists who have conferred on mankind the boon of the telephone, that its principles are familiar to uncivilized peoples, several of whom are in possession of rudimentary telephones. It was, I opine, when the Chinese were in their youth that they constructed the rudimentary instrument a specimen of which I herewith transmit for the Society's museum. It consists of two bamboo cylinders, one and a half to two inches in diameter, and four in length; one end of each is closed by a tymyanum of pig bladder, which is perforated for the transmitting string, the string kept in place by being knotted. This rude instrument is styled the "listening tubes," and is employed for amusement as a toy, conveying whispers forty or fifty feet. It is unknown in many parts of the empire, Chihkiang and Kiangsu being the only provinces (so far as I can ascertain) where the listening tube is employed.

Besides this toy, Chinese ingenuity produced, about a century and a half ago, the "thousand mile speaker." The implement is described as "a roll of copper, likened to a fife, containing an artful device; whispered into and immediately closed, the confined message, however long, may be conveyed to any distance; and thus in a battle secret instructions may be conveniently communicated. It is a contrivance of extraordinary merit." The inventor of the "thousand mile speaker," Chiang Shun-hsin, of Huichou, flourished during the reign of Kang-hsi, A.D. 1662-1772. He wrote on occult science, astronomy, etc. The above account of his invention was taken from his works by the author of a Fuhkien Miscellany. At that time—reign of Kien Lung—there was no longer an instrument of this description in that province. It seems to have perished with the ingenious scientist who contrived it.

Here is a fine opportunity for the organization of a new telephone company, with a legal department to hunt up the lost evidence, and take a whack at the Bell telephone monopoly. Doubtless many heathen Chinee might be found glad to testify they had often used the old telephone in talking from the Great Wall to Pekin, and further if necessary.—*Ex.*

A SUNKEN CONTINENT.

This was the title of a very interesting lecture recently delivered by Captain William Churchill, in which he sought to show by the records of deep-sea soundings and from archæological remains that the Pacific islands are only the remnants of a submerged continent, whose mountain peaks and lofty heights are all that remain above the surface of the ocean. He dwelt at length on the subject of a Polynesian antecedent civilization as revealed through ancient implements, statues, and sculptured stone slabs found on a few of the groups, more notably the Feejees. The studies of zoophytes and coral formations taken from a depth of 2,000 fathoms and more also confirmed this belief of the subsidence of the pre-historic continent. On Pitcairn's Island, and also on Tahiti and Tonga-Tabu had been found remains which showed the existence of a long-forgotten tribe. At Tonga-Tabu a monster trilithon is to be seen. It is composed of gray, volcanic stone, with neatly-dressed edges. It is 10 x 12 feet square, and stands twenty feet out of the ground. It is surmounted by a huge kava bowl. Captain Churchill considers this relic to be of great archæological value. He described the implements and metals in use by the natives of several of the groups before the advent of the white voyagers, and said that iron and steel were unknown to them before their discovery by civilized persons. Captain Churchill gave a minute description of monolithic statues of stone and sculptured wood found on Easter Island. The monoliths were found standing in rows of five or six, only a few feet apart. They were hewn from volcanic rock and were either very crude in workmanship or else they had suffered from the ravages of time. One row of these statues was quite well preserved. Each of them was ten feet high and they represented human heads and bodies, with a cap or other head covering on the top. These were the same statues seen and described by Capt. Cook in his works on travel and discovery. A finely sculptured hand of a dancing girl and some polished wooden slabs, on which were numerous hieroglyphical figures in long rows, had been discovered in an ancient and half-ruined stone house on Easter Island. This was the only relic of a native written language ever found in the Pacific Islands.

A POWERFUL NEW EXPLOSIVE.

A story comes from Huntingdon, Pa., that a man from an Eastern city has been experimenting there with a new explosive compound, which he calls nitro-petrolene. In one experiment a solid rock, of which 1,600 cubic feet, estimated to weigh 85 tons, were exposed, and drilled to a depth of six feet, and a glass-tube seven-eighths of an inch in diameter and ten inches long, filled with the explosive, was introduced. The remainder of the operation was precisely the same as in blasting with dynamite. Nearly half of the exposed part was broken into fragments that a man can handle, some of them being thrown to a great distance, and it was shattered and loosened for many feet under the mountain side. A sound white oak tree, three feet in diameter, was perforated to the heart at a distance of eight feet from its roots, and a small glass ball, containing the compound, was inserted and exploded. The body of the tree was split into kindling wood, the roots were torn from the earth, and not two of the limbs within thirty feet of the ground remained together. A rifle, when charged with the new compound, embedded a bullet in a tree twice as deep as when charged with powder. The substance is in liquid form when made, but may be solidified by mixing it with another substance which is, itself, combustible and is entirely consumed in the explosion. As to its chemical composition no information can be obtained, except that suggested by its name.

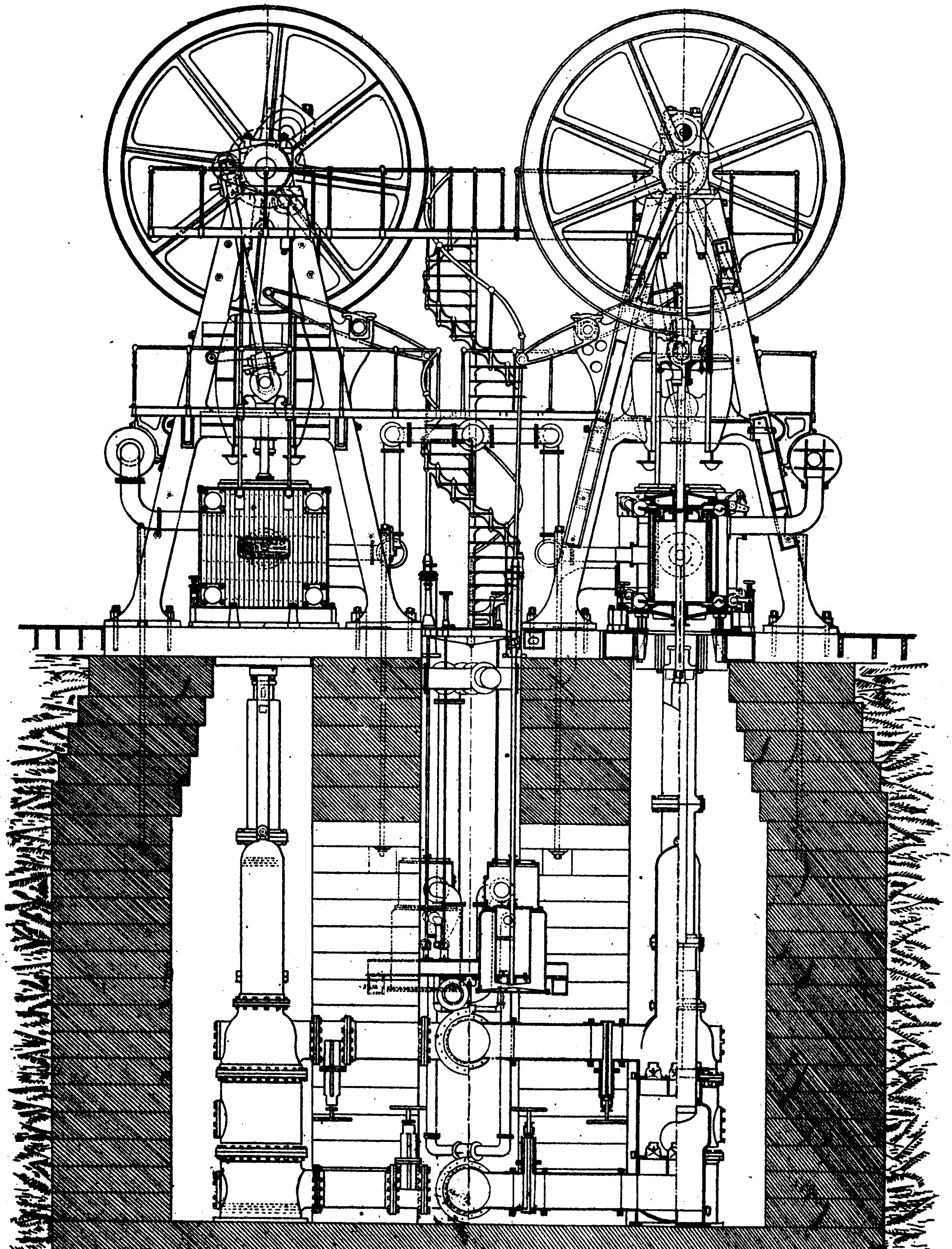


FIG. 1. END ELEVATION OF BOTH ENGINES.

REYNOLDS PUMPING ENGINES, AT ALLEGHENY, PA.

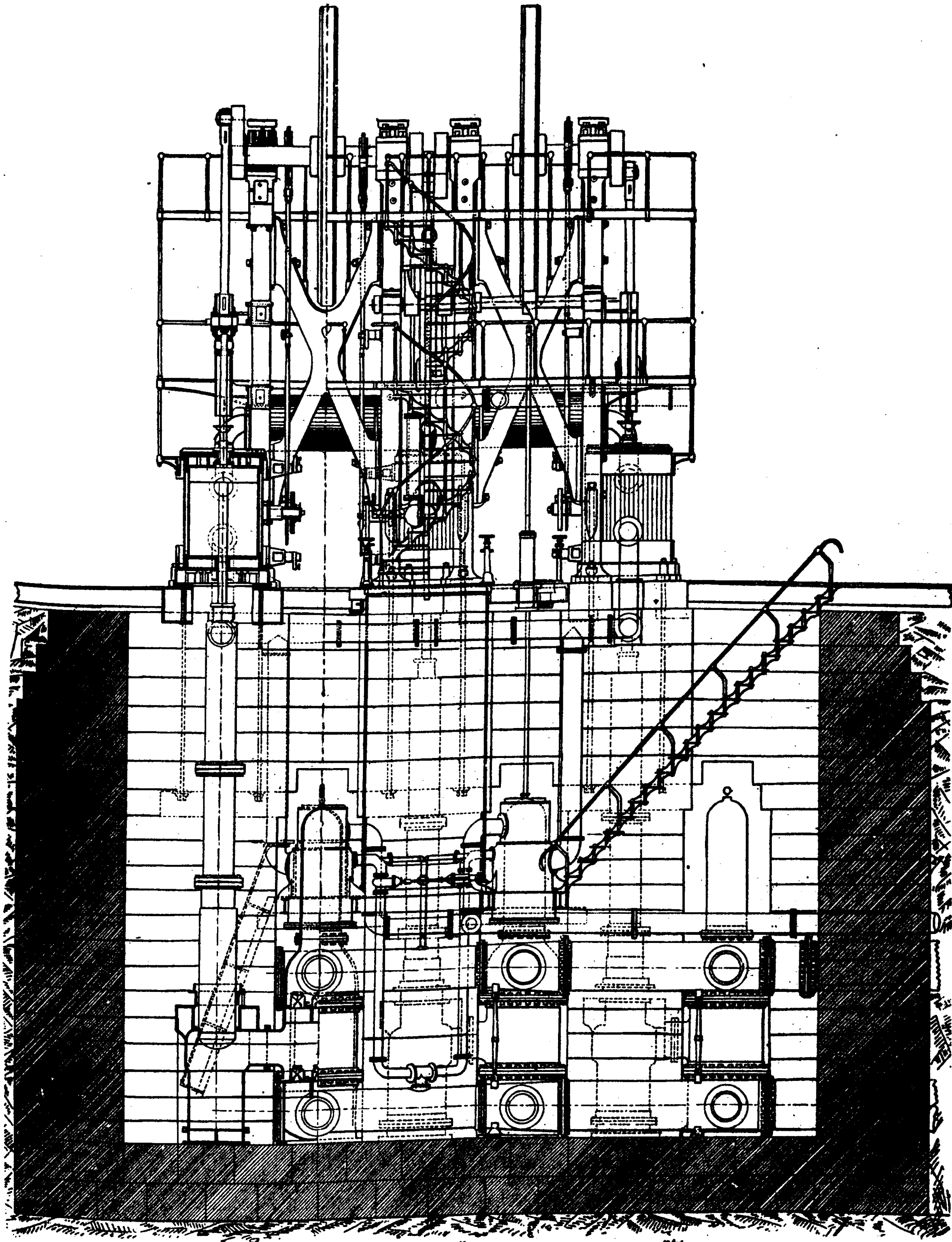


Fig. 2. Side Elevation of one Engine.

REYNOLDS PUMPING ENGINES, AT ALLEGHENY, PA.

REYNOLD'S PUMPING ENGINES AT ALLEGHANY, PA.

We are indebted to the *American Engineer* for the accompany illustrations and description of the above engines.

These engines, two in number, are vertical, three-cylinder compound, rotative machines, built by Edward P. Allis & Co., of the Reliance Works, Milwaukee, Wis., from designs by Mr. Edwin Reynolds, general superintendent of the Reliance Works. Each engine is of six million gallons capacity in twenty-four hours, at a plunger speed of 120 feet per minute, and they are alike throughout. Taking water from one central horizontal suction pipe, situated between the two sets of pumps, they deliver into a horizontal force main located directly above the suction pipes.

FIFTY TON FLOATING GRAIN ELEVATOR.

The elevator illustrated has been constructed for use in the harbour of Dunkerque, France, to the order of Messrs. L. Dewulf Cailleret et Fils, and is made for discharging grain in bulk from ships into barges for transit inland. As will be seen from the engravings, the machinery is contained in a wooden tower which is erected on a strong barge. A condensing engine of 15 nominal horse-power is fixed in the hold to drive the gear, and is supplied with steam from a Cochran boiler. Two outside elevators (Figs. 1 and 2) are suspended on universal joints from the outer end of a strong steel shoot or trunk of ∩ section, the inner end of the trunk being hinged on a shaft *a* which is mounted on rollers, and traverses a curved roller path *b* from back to front of the tower. In the trunk is an india-rubber carrying band, running over terminal pulleys *c d* at either end. This band is driven from a pulley *e* below the deck in the centre of the tower, and as the curve of the roller path is struck from the centre of this pulley, the band is driven equally well at all points of its traverse. The outside elevators are driven by this band, through Ewart's patent drive chain. In consequence of the varying draught of ships and barges, it is of course necessary that the elevators should have a certain vertical range, and from this it follows that at times the band will form a considerable angle with the horizontal line both up and down; special arrangements are therefore needed for putting and keeping the grain on the band. This is most effectually done by means of (1) a feed apparatus *f* which lays the grain on the band at the same speed at that which it is travelling, and (2) by means of inclined carrying rollers *g*, which give a trough-like shape to the top side of the band. The carrying capacity of the band is also thus increased and waste is entirely prevented.

The trunk and elevators may be moved horizontally or vertically while the machine is at work, being under the complete control of one man on the deck, or when out of use may be run back and completely housed inside the tower as shown by dotted lines at *h* (Fig. 2). In the tower are fixed four of Pooley's automatic weighing machines, a Barnard and Lea's separator or cleaning machine, two internal elevators of ordinary construction, an exhaust fan, a sack hoist, and all the necessary gearing for hoisting or lowering the trunk or racking it in or out.

Having now described the machinery, a few words are necessary to explain the way in which the grain is dealt with. After being raised from the hold of a ship and brought into the tower by the outside elevators and band, it is passed through the largest of the weighing machines, which is capable of weighing the maximum quantity the machine can deliver; it then falls into an elevator bottom and is raised to the top of the tower, passes through the separator, and after being cleaned is weighed again in the smaller machines. From these it may either be received in the sacking hoppers and sacked, or be again elevated to a convenient height and thrown out into barges alongside. The machine is capable of discharging grain at the rate of fifty tons per hour, and at a much lower cost per ton than is possible by hand labour.

The builders, Messrs. Spencer & Co., of Melksham Foundry, Melksham, Wilts, make a speciality of this class of machinery for discharging vessels or warehousing corn, and have supplied it to several leading firms of merchants and millers both at home and abroad. It is constructed under Gillett's patent.—*Eng.*

THE brain is the palest of all the internal organs, and the heart the reddest. Whatever cames from the brain carries the hue of the place it come from, and whatever comes from the heart carries the heat and color of its birth-place.—*Holmes.*

THE CONVEYOR.

Very little appears in print about the conveyor. There are several reasons for it. One is, that every one familiar with the mill is expected to know what a conveyor is like, and how constructed. The other reason may be assigned to the prevalent practice of neglecting such objects that are simple in their very expression, and that do not bespeak for the writer superior knowledge in order to elucidate his theme.

To despise little things is surely a great mistake. When rightly endorsed, the most gigantic structure of any kind is but a combination of simple parts. Piece by piece, and day by day the additions are made, and at last the work is completed, in its fullness eliciting admiration and wonder. Visitors to a modern well-equipped mill invariably express astonishment at the net-work of contrivances and the bewildering array of machinery. The millwright and the miller look at the scene with different eyes. They know how from a small beginning the simple parts, by gradual and systematic progression, developed into an intricate but perfect whole.

Even if simple, the conveyor plays a very important part in the mill. In some instances the elevator can be made use of to do the work that is done with the conveyor, but not without extra expense and at the sacrifice of room and convenience. The bolting chest, however, could not dispense with the conveyor at all. The fact that in many cases three are preferred to two conveyors, under each reel, gives evidence of how well the conveyor is appreciated in this one particular. At the present time especially, when every vacancy in the mill must be filled with machinery, and the material carried to and from these localities, is the conveyor found to be a valuable contrivance for the purpose. The new mill, of course, does not need as many conveyors as the same sized old mill, which has been remodelled. To the majority of the machines the product is spouted direct from the elevator. When all the machinery is arranged according to a well executed plan, the use of so many conveyors can be avoided. Though the conveyor, like the elevator, is indispensable in the mill, too many are an annoyance and a great inconvenience.

The wooden conveyor is the first to claim attention. This conveyor was introduced as an improvement upon the drag-belt. For general mill use nothing better can be substituted. The wooden shafts with wooden flights are preferable in bolting chests and for all the products of the wheat. Especially when the conveyors may in the course of time, be made to empty at different places is the wooden conveyor the most desirable. With little trouble the flights are changed, and the material in transit is conveyed a different direction. No conveyor shaft should ever be fitted into the box, unless it has the flight holes bored both ways. At the time the conveyor is made, there may be no reason for doing so, but when the conveyor is once in the bolting chest, or out of easy access somewhere else in the mill, considerable effort and work is often required to change the flights, and it frequently occurs that a change is imperative where least anticipated.

The two sizes, ten and twelve inches, are most commonly used. The ten inch box measures about eight inside, and the other about ten. The twelve inch box is probably the most used. For a mill over one hundred barrels capacity, and for bolting chests over fourteen feet in length, the twelve inch box will be found best adapted in capacity. The conveyor that is working full under ordinary circumstances, is too small for the place. Allowance should be made for the maximum load. While it is always better to err in the direction of surplus capacity than otherwise, it is ludicrous to see a small bolting chest with an immense conveyor under it. Where there is no possibility of using a large conveyor, there is nothing gained in placing anything except what can be properly utilized. For a twelve inch conveyor the shaft should be four and one-half inches, and the flights two and one-quarter inches, thus giving one-half play on all sides. If the conveyor is constructed perfectly true, and the shaft sections not over six or eight feet in length, the shaft could be made heavier still, without reducing the size of the flights. The less material can lodge in the conveyor box, the better for the product of the entire mill. To keep the mill free from bugs and worms, conveyors should be so accurately constructed that their contents are continually being disturbed and replaced by new stock. If there is not too much space between the heads of the flights and the sides and bottom of the conveyor box, the conveyor will keep clean enough to not become infested with infested with insects. Millers are often puzzled as to where the bugs and worms originate in the mill, especially when the mill is kept scrupulously clean. An examination of the conveyors may reveal the source of the trouble. Frequently a conveyor is not used its whole length, and no flights driven on the part where not needed. There is more or less dust occasioned by the product coming into the conveyor, and bythe action of the shaft, so that an accumulation of material will soon take place in that part of the conveyor which is not used. In a comparatively short time this material begins to mould, and is converted into a veritable bug and worm nest, and as these make their way into the other part of the conveyor, they are carried into the reels with a regularity that is surprising. Every conveyor should have its full complement of flights, so that the box cannot fill up anywhere.

What kind of gudgeons should be used, depends a great deal upon the size of the conveyor shaft. The winged gudgeon is, beyond a doubt, the most suitable. A shaft under four inches in diameter, if of soft wood, will give the least trouble with winged gudgeons. Flanged gudgeons can perform the desired surface, providing the shaft is sound, and of sufficient thickness. Light conveyor shaft's with flanged gudgeons will give way, when worked to a high capacity, especially if driven with a tight chain or belt. On a short,ten inch conveyor, by using the winged gudgeon, the shaft can be made three inches, from good timber, and the flights, in this case, could be as large as in a twelve inch box. A flanged gudgeon could hardly be put on this shaft and give as good results as the other.

The iron conveyor is highly to be recommended for grain, and for those places about the mill where there is no possibility that any extensive changes in the course of the conveyor will ever be made. Easily driven, durable and convenient, they can be adopted in many situations with profit. The same sized box has a much larger capacity than the wooden conveyor, because the diameter of the shaft is so small. The iron conveyor can also be run at a higher speed than the other, comparatively, because the diameter, from outside to outside of flights, is much less than in the wooden conveyor of the same capacity, and therefore not so liable to throw the material. Besides, the iron conveyor has one continuous smooth surface, while the wooden conveyor has not.

The speed of conveyors can be varied according to the material they handle and the place they occupy. The wooden conveyor in the bolting chest at the speed of twenty-eight is accepted generally as the most satisfactory. Higher speeds in flour chests can be adopted, but only in case the cut-offs openings are amply large; otherwise the conveyor may carry over. The great mistake with the majority of conveyors is that the slides are too small, and even when opened the openings are closed from a failure of the material in the bottom of the conveyor to drop through. Of course the miller should see to it when he draws a slide, that the conveyor is emptying properly. Seventy-five is about the maximum speed of an ordinary wooden conveyor, while some iron conveyors handling grain, of the larger sizes especially, have been driven up to the speed of one hundred and fifty. Instances are often met with in the mill where even a high-speeded wooden conveyor could be made use of with advantage. For example, a conveyor empties at but one place, and that out of the side of the conveyor. This conveyor at a high speed is not as liable to choke up as at a slow speed. Some millwrights consider it impossible to tap a conveyor at the side and not have the spout shutting up continually. The fact of it is, if a few important conditions can be secured, a spout to the side of the conveyor is more preferable than one under it. The conveyor should run fast, the flights from both ends of the conveyor empty at the opening, two sets of flights, opposite each other, for throw-outs, at the mouth of the spout, and an opening large enough for any emergency. No greater annoyance can be imagined than a clogging spout underneath the conveyor that is placed but a few inches from the floor. The chances are that such a conveyor will often make the mill busy when there seems to be no occasion for the rush.

Wooden conveyors should always have hard wood ends and well-fitted bearings. The end pieces should be never less than two inches thick. Oil holes should be large enough so that they can be kept open. Conveyors outside of the bolting chest should not be closed at the bottom with one piece. Tongued and grooved boards put on parallel with the ends of the conveyor, and fastened with screws and not with nails, make the best bottom for the conveyor in every particular. A conveyor is frequently placed overhead, almost tight to the next floor. It becomes necessary to change the flights and make a new exit for the material. Obstructions at each end prevent the removal of the conveyor shaft. One has a choice between two disagreeable tasks—tear part of the mill down to get out the conveyor shaft, or dissect the conveyor, often terminating in its partial destruction, when the whole has been put together with nails. Had the bottom been put on as above suggested, the removal of a few screws would have rendered any change whatever easy of execution, and when accomplished, the conveyor would be none the worse for it. The cant-strips on the inside should, therefore, always be fastened with screws inserted from the outside. The millwright will then be able to make an opening into the conveyor for a spout, without boring into nails or sawing them in two. The use of screws in place of nails will add very little to the cost of the conveyor, but the well-being of both conveyor and miller is thereby often largely enhanced. Frequently millwrights are to be met who seem to have an innate aversion to the use of screws. In looking over a new mill recently, in which the millwright work was the best of its kind, we found even the lid of all the spouts nailed on. As the spouts were all made of hard wood, a brisk time with chisels, hammers and saws may be anticipated before everything is in the usual running order.

To conclude the subject, and have nothing to say about doors into these sides of those conveyors to which access can be gained in no other convenient way, would be neglecting the mention of an improvement that millers must regard as absolutely indispensable. Some mill-furnishers have provided the lower conveyor in the bolting chest with lids, or doors, but the upper conveyor is still closed firmly on all sides. Hardly in one case out of ten is there sufficient room on either side of a bolting chest to take out the conveyor shaft. Hence, in order to change the flights, the cloth must be removed from the reel, and the unfortunate conveyor repairer is swung into the chest between the ribs of the reel, and in this uncomfortable position must make the necessary alterations. The fire hazard of a tight conveyor cannot be overlooked, the danger from this source must urge the adoption of an automatic door which recedes the moment an undue pressure is caused on the inside. A conveyor in a bolting chest is not perfect, except it be provided with convenient side doors, and these secured with suitable fastening. What the writers consider a suitable fastening will be given in some future issue.

In the past, these little conveniences that can be attached to the conveyor, were not so grievously missed, because the conveyor was not hampered by machinery on all sides; but under the present circumstances the mill builder who can furnish the conveyor which the exigencies of the day demand, will not only receive the approval of the intelligent miller, but his orders as well.—*Harry S. Klingler, in Millwright and Engineer.*

BITUMINOUS *VS.* ANTHRACITE COAL.

The use of bituminous coal for steam making purposes has increased so largely during the last years or two, that the anthracite coal companies have determined to increase their allotment for the year 1885 one million tons, with the special view of competing with bituminous coal for the supplying of large manufacturers. The total allotment of thirty million tons previously agreed upon seems likely to be excessive, and the proposed contest between the anthracite and bituminous coal producers for the trade of steam users can, therefore, hardly fail to result in lower prices, to the manifest advantage of users of coal for steam making purposes. The Pennsylvania Railroad Co., which recently refused to enter the anthracite combination, is extensively interested in the mining and transportation of bituminous coal, so that the coming war is likely to be of imposing dimensions.—*Ex.*

A NEW method for getting up steam in a steam boiler is, first simultaneously circulating and heating the water in the main boiler before the fires are lighted in the furnaces by a current of steam from the supplementary boiler, whereby the water is drawn from one part of the main boiler, heated and discharged into water, and has become so uniformly heated as to greatly lessen the liability of strain due to unequal expansion by the heat of the fires.

FIFTY-TON FLOATING GRAIN ELEVATOR.

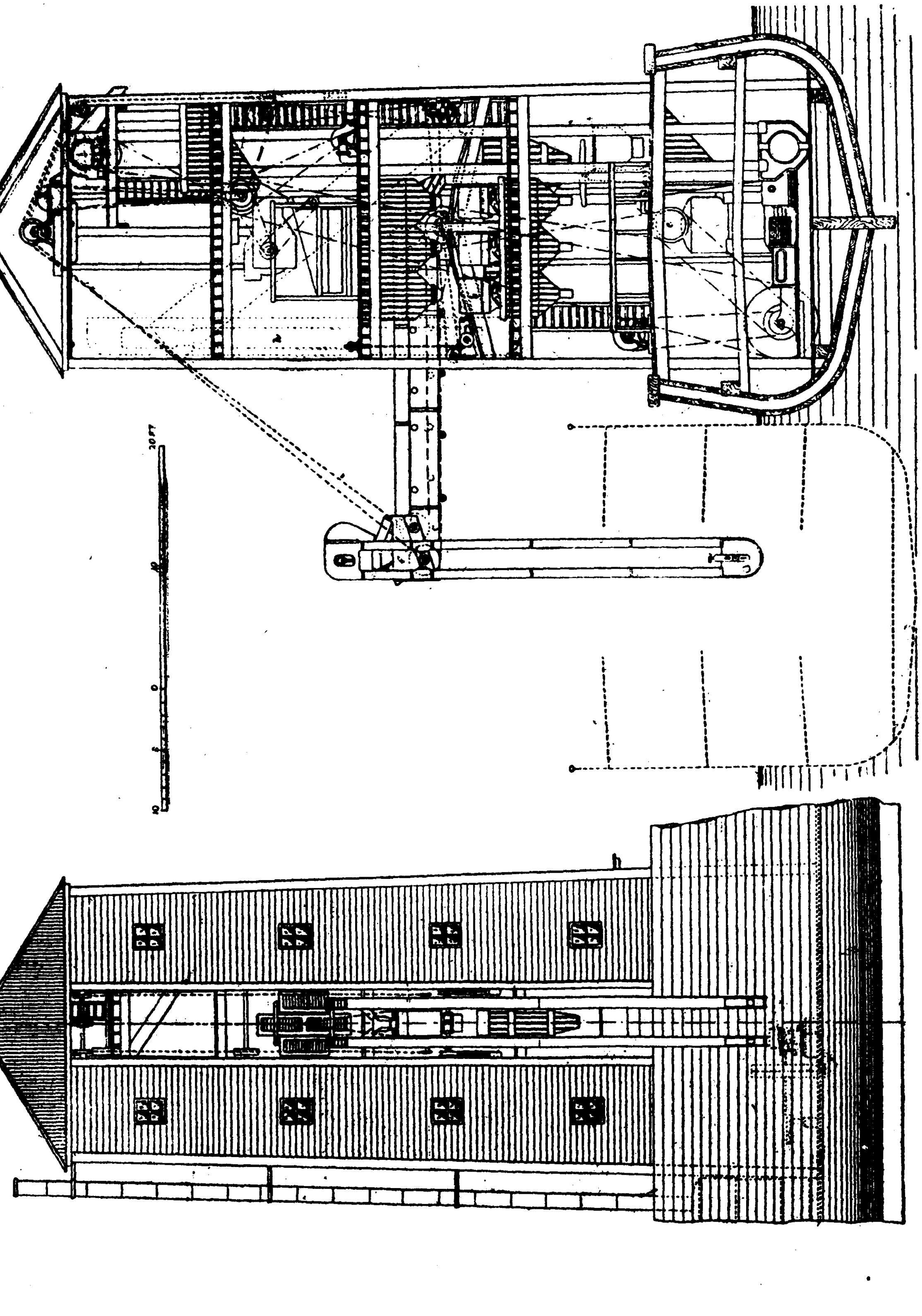


Fig. 1. Fig. 2.

FIFTY-TON FLOATING GRAIN ELEVATOR.

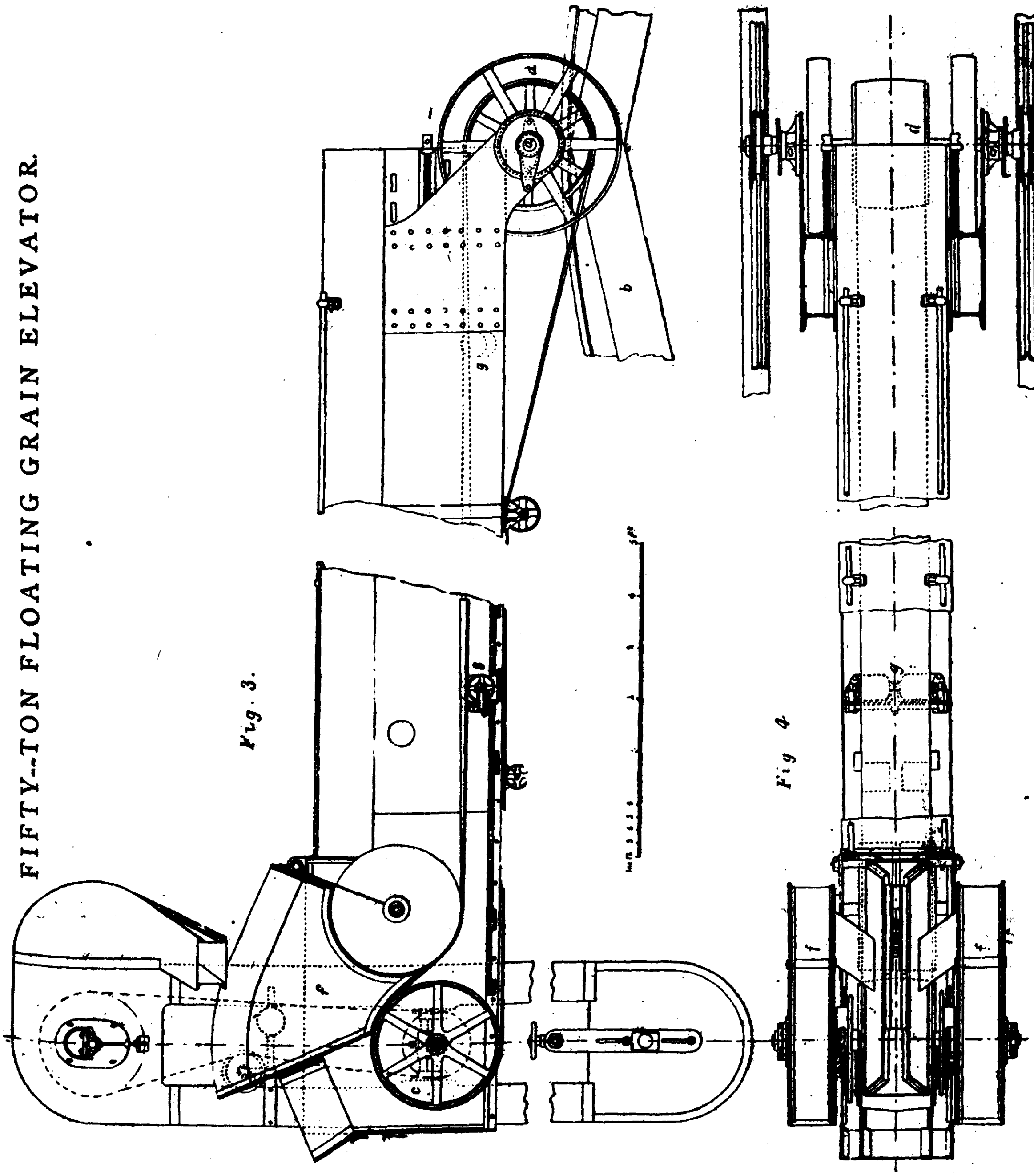


Fig. 3.

Fig 4

THE NICARAGUA CANAL.

A SCHEME OF GREAT COMMERCIAL IMPORTANCE TO THE UNITED STATES.

Thousands of miles saved.

One of the chief concerns of the United States just now is the scheme of constructing a ship canal through Nicaragua. A treaty for this purpose has been negotiated with that country and only awaits the ratification of our Congress. The advantages of this canal to the United States, Europe and the whole world are incalculable ; They are about the same as were set forth in favor of the Tehauntepec ship railway in an article in this journal in November. It is said that the construction of the canal present no extraordinary engineering difficulties. The entire length of the route is 181.26 miles: Of this distance only 61.74 miles will be canal proper. The rest is river water and lake navigation. There will be four dams in the San Juan river, and three short canals around the three rapids which obstruct the navigation of the river, the entire length of which will be 3.51 miles. The length of the canal from the lake to the Pacific Ocean at Brito is 16.33 miles, but in this distance there will be 10 locks and a summit level of 134 feet to be overcome. The cut at the summit will have to be that depth, but this will not be more than a mile in length. The maximum depth in nearly five miles from the lake will be 108 feet and for one-half this distance the cut will be an average of 20 feet. Quite extensive works will be required to make a good harbor at Brito, and considereble dredging will have to be done at Greytown. This harbor 20 years ago was deep, with an easy approach, but it has filled up with sediment carried down the San Juan river. All this sediment, comes, however, from below the point where the canal leaves the river, and by closing the old mouth of the stream the silt deposit will be stopped. It will require five years to complete the canal and the cost, it is said, ought not to exceed $65,000,000 ; the work can probable be done for $45,000,000. This was the estimate of Mr. Childs, one of the most capable engineers of his time made, after a careful survey of the route, though another estimate by another man is $100,000,000,

The Nicaraguan route has many adavantages over that of Panama, where the French are at work. The cost of construction will be a great deal less. It will require many years more of labor and millions upon millions to complete the Panama canal. The digging of the canal is the least of the engineering difficulties to be overcome. An enormous rainfall at certain seasons has to be provided for, in order that the resulting floods may not destroy the canal. Very extensive and exceedingly expensive works will have to be constructed at the Pacific terminus to overcome the tidal difficulties. Of course, with modern improvements in machinery and mechanical appliances, with modern engineering skill and an abundance of money, the Panama canal can be built. But after it is built it will not be available, as the Nicaragua route will be, at all times to sailing vessels. The trade winds do not prevail off the Atlantic Panama coast as they do further north, off the coast of Nicaragua. Moreover, the distance to and from Greytown to all our Atlantic as well as all European ports is much less. It is in the direct line of the ship routes, while Panama is far to the south. The sea route from New York, and also from Liverpool, passes between the island of Cuba, and the coast of Hayti, and the Harbor of Greytown is not far south of due west of this passage.

Admiral Ammen, who has given this subject much attention, believes that the cost of the canal, when the work is executed in the best manner, will not exceed $65,000. Admitting the maximum cost to be $82,000,000, he says that 1,000,000 tons would be a low estimate of the annual tonnage passing through the canal, while in half a century it would be five times that amount. The grain product exported to Europe from the Pacific coast now exceeds 2,000,000 tons, while the vessels partly laden with iron and coal, used partly as ballast, going through the canal for cargo, would not be less than 1,000,000 tons. To this would be added the traffic from Japan, Northern China, the Phillippine and Sandwich Islands, the Islands of the South Pacific, New Zealand and Australia. This would make 5,000,000 tons in sight as soon as the canal is opened. With canal dues at $1 per ton, deducting $1,000,000 for maintenance and towage, he concludes that there would be found $4,000,000 for dividends, or a small fraction below 5 per cent. on $82,800,000, the maximum cost of the canal after doubling the engineers' estimates. He believes that the canal would develop an enormous traffic to the North Pacific coast in timber.

The treaty provides that the United States shall build the canal within ten years and that there shall be perpetual alliance between the United States of America and the Republic of Nicaragua, and the former agree to protect the integrity of the territory of the latter. A strip of territory two and one-half English miles in width, the middle of the strip to coincide with the centre line of the canal, and also a strip two and one-half miles wide around the southern end of the lake where the lakes is used as a water course for the canal, as well as a strip two and one-half miles wide along the river, where the river is used as a part of the canal, shall be set aside for the work and owned by the two contracting parties. No custom house tolls, or other taxes or impositions of any sort or kind, shall be levied by the Government of Nicaragua upon any vessels passing the canal, their cargoes, stores, passengers, crews or baggage, or for unloading, loading, docking, or repairing vessels. All the proceeds of the canal and its accessories, including a railway line and a telegraph line, which the United States shall build, shall be applied, first, to the maintenance and improvement, if found necessary, of the works, including the salaries of the board of managers and all officers and others employed. The balance shall be paid to the two Governments in the following proportions: To Nicaragua one-third, and to the United States two-thirds. It appearing that the financial condition of Nicaragua is prosperous, that the Republic is without incumbrance of debt, and that the Government finds it necessary to finish as soon as possible certain railway within the Republic, to extend its telegraph line, and to improve the navigation of the river San Juan, which enterprises will be of aid to the canal and favorable to its speedy construction and successful operation, the Government of the United States agrees to loan to the Government of Nicaragua the sum of $4,000,000 to be applied to the above enumerated projects; and the right is given the United States to keep Nicaragua's share of the canal tolls until the debt and interest are paid.

President Arthur, in commending this treaty to Congress, says that from New York to San Francisco by this route for sailing vesels the time is ten days shorter than by the Panama route. The canal would unquestionably be immediately renumerative. It offers a shorter sea voyage with more continuously favoring winds between the Atlantic ports of America and Europe and the countries of the East than any other practicable route, and with lower tolls, by reason of its lesser cost, the Nicaraguan route must be the inter-oceanic highway for the bulk of the world's trade between the Atlantic and the Pacific. By piercing the Isthmus the heretofore insuperable obstacles of time, sea and distance disappear, and our vessels and productions, will enter upon the world's competitive field with a decided advantage of which they will avail themselves. When to this is joined the large coasting trade between the Atlantic and Pacific states which must necessarily spring up, it is evident that this canal affords even alone an efficient means of restoring our flag to its former place on the seas. Such a domestic coasting trade would arise immediately, for even the fishing vessels of both sea-boards, which now lie idle in the winter months, could then profitably carry goods between the Eastern and the Western states.

Weeks of steam voyage, or months under sail, continues the President, are consumed in the passage around the Horn, with the disadvantage of traversing tempestuous waters or risking the navigation of the Straits of Magellan. A nation like ours cannot rest satisfied with such a separation of its mutally dependent members. We possess an ocean border of considerably over 10,000 miles on the Atlantic and Gulf of Mexico, and including Alaska, of some 10,000 miles on the Pacific. Within a generation the western coast has developed into an empire, with a large and rapidly growing population, with vast, but partially developed, resources. At the present rate of increase, the end of the century will see us a commonwealth of, perhaps, nearly 100,000,000 inhabitants, of which the West should have a considerably larger and richer proportion than now.

The political effect of the canal will be to unite closer the states now depending upon railway corporations for all commercial and personal intercourse, and it will not only cheapen the cost of transportation but will free individuals from the possibility of unjust discriminations. It will bring European grain markets of demand within easy distance of our Pacific, and will give to the manufacturers on the Atlantic seaboard economical access to the cities of China, thus breaking down the barrier which separates the principal manufacturing centers of the United states from the markets of the vast population of Asia, and placing the Eastern states of the Union, for all purposes of trade, midway between Europe and Asia. In point of time the gain for sailing vessels would be great, amounting from New York to San Francisco to a saving of 75 days; to Hong Kong of 27 days; to Shanghai of 34 days, and to Calleao of 52 days.

THE SONNEBULA, OR FOG WHISTLE OPERATOR.

The Board of Trade requires that when a steamship is under way in a fog, sound signals shall be made at intervals of not more than two minutes to warn ships in the vicinity of the need of cautious movement. As the signalling has often to be kept up for hours, and even days, it becomes an irksome and monotonous duty, and is sometimes intermitted, either from carelessness or forgetfulness, and this perhaps at the critical moment when in the immediate proximity of another vessel. To avoid all danger from this cause, and also to relieve the watch, Messrs. Durham, Churchill and Co., of 23 Leadenhall street, London, have introduced a mechanical fog-whistle operator, which they call the Sonnebula. The object of the apparatus is to produce in regular succession intervals of sound and silence, following each other with perfect regularity and without care or attention on the part of the crew. The sonnebula is not the cause of the sound—that is furnished by the existing horn or whistle—it merely turns the steam on and off, replacing the hand of the man upon whom this duty formerly fell. It can be adjusted to give intervals of any length within limits, and at the same time it can be instantly thrown out of action, and the sound can be hand-regulated just as if the apparatus did not exist.

To render the action clear we give a perspective illustration and two detail views. It will be seen that the apparatus comprises three cylinders, two of which are steam cylinders controlled by one valve, while the third acts as a cataract. As this latter part controls the lengths of the intervals we will describe it first, the great value of the instrument depending upon its regularity. The piston works in a cylinder filled with oil, which is alternately forced from end to end through a passage containing two valves. These two valves are adjustable; the first is of the ordinary non-return type and has its lift regulated by a screwed spindle provided with a handwheel; the second might be more correctly described as a cock, and consists of a pipe closed at the end and provided with openings by which fluid can enter and leave its interior. By raising or lowering this pipe the area of opening for the inlet of the fluid can be adjusted with great nicety. Now supposing the cataract piston to be moving towards the left it will force the oil before it into the valve chest and through the cock just described to the other end of the cylinder. When the motion of the piston is in the opposite direction the oil has no longer to pass through the cock to gain the upper division of the valve chest, but raises the valve, and flows through the larger opening thus afforded. This arrangement is adopted because the sounds are never nearly equal in length to the periods of silence, and consequently, as the motions of the pistons correspond to the times of silence and sound respectively, one is always made at a much greater speed than the other.

In line with the cataract cylinder is a steam cylinder, the piston of which is upon the same rod as the cataract piston, and transmits to this latter its motive power. The steam is distributed as follows: the valve is worked by two pistons upon one rod; each is a separate cylinder open at one end to the steam chest. The opposite end of each cylinder can be put in communication with the external air by a valve which is raised by the main piston when it reaches the end of its stroke. As the parts are shown in the figure, steam is entering the right-hand end of the cylinder, and will continue to do so until the piston arrives at the end of the stroke and raises the valve, which is connected by a passage, shown in dotted lines, with the left hand subsidiary cylinder. This is full of steam which has leaked past the piston, and immediately it is exhausted the steam in the steam chest forces the subsidiary piston forward, reversing the main valve, and admitting steam to the left-hand end of the main cylinder. The main piston then begins its backward travel, and at its termination a like series of operations occurs. Thus a continual reciprocation is maintained, without the use of any external moving parts.

Upon the main cylinder there is mounted a vertical cylinder, which in the sectional view is shown moved through 90 degrees to bring it into the plane of the section. The office of this cylinder is to open the valve of the whistle, the connection being made by a cord. It receives its steam directly from the main cylinder, through passages clearly shown in the engraving. As soon as steam enters the left-hand end of the main cylinder it also enters the upper end of the vertical cylinder, forcing the piston at once to the bottom and holding it there until the distributing valve is reversed, when the vertical piston is immediately raised. Thus, while the main piston is always moving, either rapidly or slowly, the vertical or whistle-operating piston, makes quick strokes with intervals of rest between them.

Should it be desired to suspend the automatic action, either for the purpose of listening, or to give a prolonged or varied blast, the valve can be manipulated by the hand lever shown in the perspective view, and can be held over either way, or moved backwards and forwards as desired.

The Sonnebula has already had a wide and most successful trial. It has been fitted on vessels of the Cunard, Allen, White Star and Beaver, and other lines, and the commanders have testified to its advantages. The Board of Trade also states "that the officers who have seen it report that it works satisfactorily."—*Eng.*

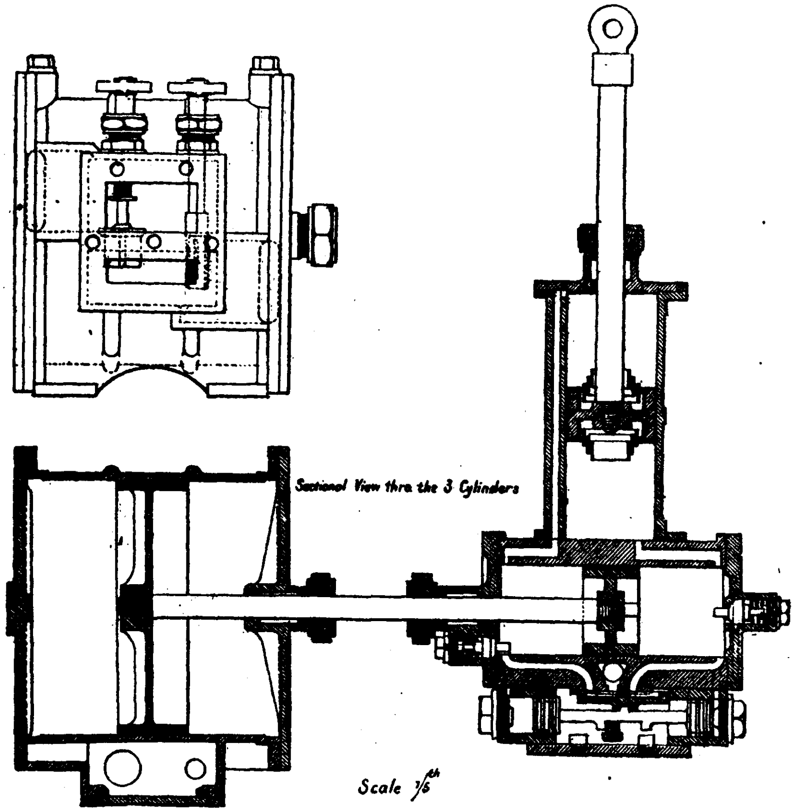
THE "OTTO TWIN ENGINE."

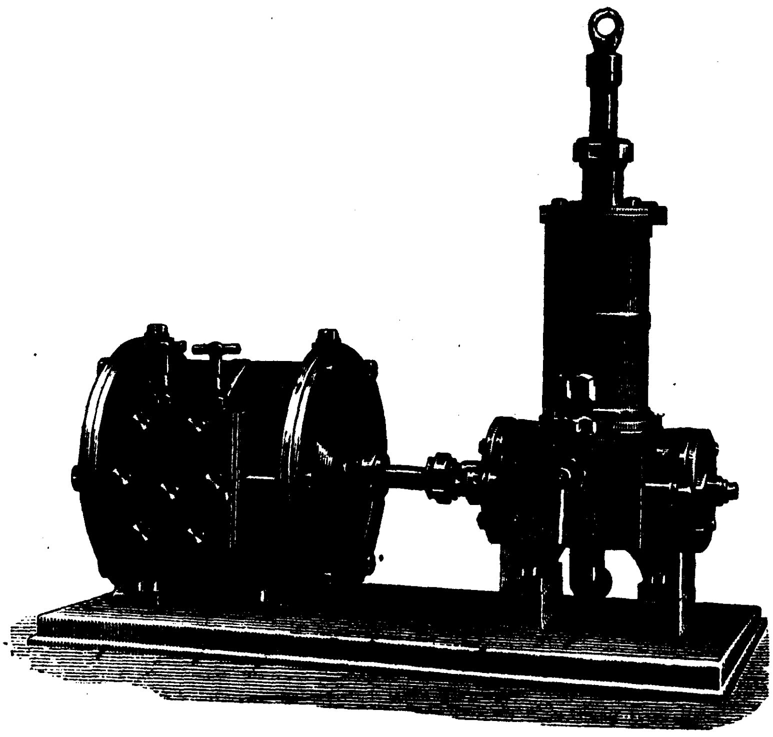
Messrs. Schleicher, Schumm & Co., of Philadelphia, in order to comply with the constantly increasing demand for higher power gas engines, have lately put upon the market a modification of the "Otto" gas engine, an illustration of which we present to our readers in the accompanying cut, which they designate as the "Otto Twin-Engine." It is manufactured in sizes over fifteen horse-power only. The engine is noteworthy for its symmetrical arrangement. The pulley being placed centrally between the main bearings, will naturally be better prepared to resist the strain of the belt, than if overhanging on one side next to the fly-wheel, while the use of the cranks disks also in proximity to strong bearings held by a solid frame, are preferable for the double crank shaft. The gear-shaft of the engine is moved by a gear wheel and pinion placed between the right hand fly wheel and pulley and extends through the frame. It gives motion to the slides by means of a crank pin at its extreme end and between the frame and the casting, connecting both cylinder heads, it causes the sleeves and cams to operate the gas inlet as well as the exhaust valves. The governor receives also motion from this shaft.

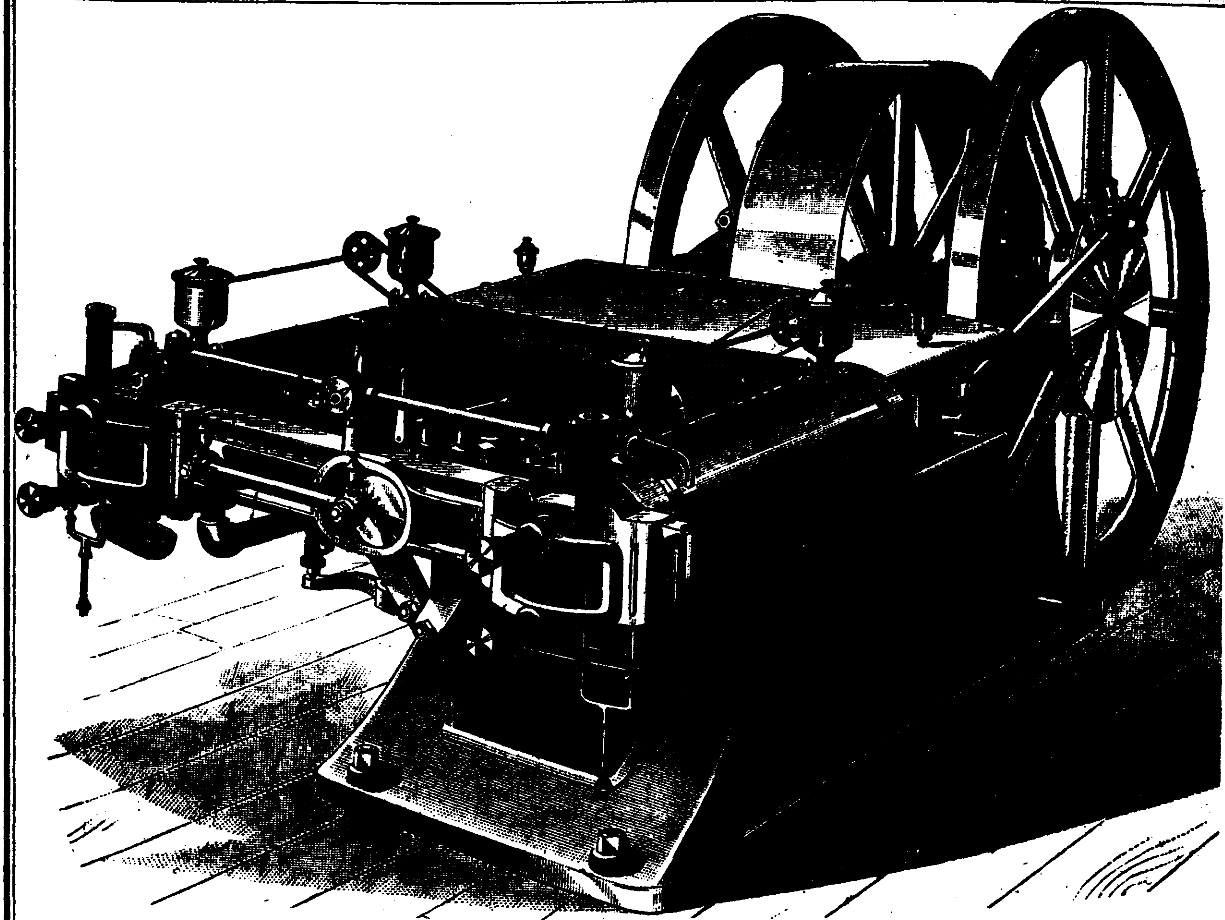
The engine is so constructed that either one or two cylinders may be run by simply shutting off the gas leading to one cylinder. Where loads vary within large limits this may offer advantages. The object of the combination of two cylinders in one machine, is to obtain an impulse every revolution when fully loaded and to insure thereby steadiness in running. Gas engines have been built claiming on account of this feature high regularity—but the functions of compressing the gaseous mixture and expanding it after igniting were divided in them between two cylinders in a manner to make one the exclusively working and the other the exclusively compressing cylinder. When running under partial load, the arrangement has the same effect as is experienced with compound marine engines when the governor begins to regulate. The gas is cut off from the pumping cylinder, while the working cylinder receives, *regardless of the governor's action*, the charge last admitted to the compressing cylinder and thereby speeds the engine up, after the governor has cut off. The speed of the engine is similarly retarded when the governor drops so as to admit a charge of gas—this charge having to pass through the pump before it acts in the engine. In the Twin engine referred to, this is avoided as there is no charge to be admitted to working cylinder after the governor has cut off the supply.—*Ex.*

SOUTH African ostriches are laying eggs so abundantly that only a small proportion can be hatched. One gentleman says "that he had 300 eggs lying in his camp last week. Several have been sold on the Graaff-Reinet market for culinary purposes at 9s. per dozen. This ought to bring pancakes, puddings, and omelettes within the reach of all, for one ostrich egg is, on the average, equal to two dozen hen's eggs. The incubator may be considered exploded. It is known to have filled the camps with Cape chicks of impaired constitutions or deformed bodies; and, now that the rage for buying ostrich chicks at high prices, irrespective of 'antecedents,' is past, the incubator is stowed away with the old lumber."

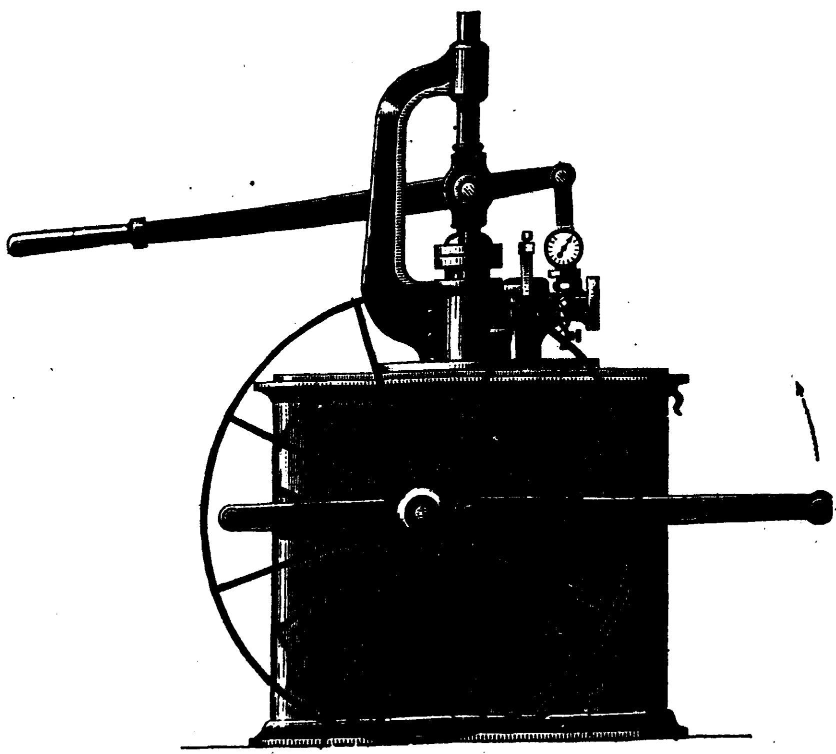
THE SONNEBULA OR FOG WHISTLE OPERATOR.







"OTTO TWIN ENGINE."



Test Pump for Boilers.

SUPERHEATED STEAM.

It seems a little remarkable, says the London *Engineer*, that in the pursuit of economy of fuel engineers have abandoned superheating. Years ago its value was well understood, and the superheater was found in almost all ships pretending to have good engines and boilers ; but the boilers which in the present day are fitted with true superheaters may be counted almost on the fingers. The reason why superheating was given up is to be found in the fact that the thing was overdone. We have heard of instances in which the steam was so much heated that it would scorch paper, and did carbonize and ruin the piston-rod packings. No amount of saving in fuel could compensate for this. Another objection to superheating lay in the fact that it appeared to exert a species of solvent effect on the cast iron of port faces, the edges of the ports becoming in time so brittle and soft that they could be dug out with a pen-knife. We have reason to think, however, that, although superheating was a failure 10 or 15 years ago, it need not be a failure now, the conditions under which it can be employed being much more favorable than they used to be. What we are about to say on the subject is not intended to apply solely to marine engines, but to all steam engines which are intended to be economical.

The conditions of application are more favorable than they have been, first, because more is known about superheating than was known, and there is consequently less chance of it being overdone ; and, secondly, the use of very high pressures has led to the production of better castings than those previously made. Again, asbestos and metallic packings are now available, which were unknown before ; and, lastly, mineral oils can be used as lubricants instead of the tallow which alone was at the service of the engineer as a cylinder greaser. Twenty years ago, when Mr. Adams first tried to use very high pressures—150 pounds to 160 pounds—on the North London Railway, great trouble was experienced from the cutting of the cylinders. The high temperature of the steam, 370°, volatilized or carbonized the oil, and the metal appeared to be attacked in much the same way as though superheated steam was used ; but after a few trials a mixture of irons was found and a system of casting adopted which got over the difficulty, and pressures of 160 pounds are now freely used without any inconvenience. If we assume that 350° is a safe temperature, then it follows that steam of 85 pounds with a temperature of 328° might have 25° or thereabouts of superheat imparted to it without the least danger. Indeed, we may go further than this, because the steam is certain to be cooled down the moment it enters a cylinder, so that a greater degree of superheat would do no harm. The advantage to be derived from the use of a superheater is twofold. In the first place, it will send dry steam, not a mixture of steam and water, into the engine ; and, secondly, the superheat will tend to prevent cylinder condensation. Before any of our readers can understand the advantage to be derived in this way, however, they must realize the loss caused by the use of wet steam, or rather by the presence of moisture in a cylinder.

The great foe to economy of fuel is cylinder condensation. If perfectly dry steam could be used this condensation would be reduced to a minimum, because dry steam, like any other gas, conducts heat very slowly. If the walls of a cylinder were always dry, then the cooling influence of a condenser would be hardly felt, for reasons which may be easily explained in a few words. If a surface is wetted and submitted to a vacuum, the moisture will evaporate freely, taking up the heat necessary for evaporation from the surface on which it rests. If the vapour is continually drawn off, as by the air pump of a condensing engine, the evaporation and absorption of heat will be intensified, as may be easily shown by a simple experiment. Sulphuric acid is extremely greedy of water ; if some be placed in a saucer under the receiver of an ordinary air pump, and a watch glass containing water is placed near it, also under the receiver, as soon as the pump is worked and the pressure reduced, vapor will be given off by the water and immediately seized by the acid ; and so much heat will be carried off in this way that the water will quickly be frozen if the watch glass rest on a bit of wood or other non-conductor from which it cannot get heat. Just the same action takes place at every stroke in a steam engine, and the amount of loss will be measured for one thing by the quantity of moisture in the cylinder.

Ordinary saturated steam is a very different thing from a permanent gas. It is in what chemists call the critical condition. Its molecules are in unstable equilibrium, and the least deprivation of heat causes condensation. When steam is superheated it acquires different properties. Among others it is much more mobile. Mr. D. K. Clark has pointed out in his treatise on the locomotive, that engines with outside cylinders always have more back pressure than engines with inside cylinders, because, the outside cylinder being cooler than the inside cylinder, the steam is wetter than the exhaust more sluggish. Smaller ports and passages will do with gaseous than will suffice with saturated steam. It must not be forgotten that steam is considerably increased in volume by superheating. The late Dr. Siemens found that steam of 212°, superheated, but maintained at atmospheric pressure, augmented rapidly in volume until the temperature rose to 220°, and less rapidly up to 230°, or 18° above saturation point ; from thence it behaved like a permanent gas. Ordinary saturated steam may be made gaseous by superheating it from 10° to 20°. According to Regnault, the total heat of gaseous steam is about 2½ per cent. greater than that of saturated steam.

It is well known to most engineers in the present day that a portion of the heat contained in steam is converted into work, so that even in a perfect non-conducting cylinder, if such a thing could be had, some steam must be condensed. Now it so happens that working steam will always give up its superheat before anything else, and therefore it is quite possible, theoretically, to work an engine without any cylinder condensation whatever, the whole of the heat converted into work being derived from the superheat. Such an engine would work with maximum economy. Let us assume that .3 pound of steam per minute developes 1 horse-power in a given engine ; the total quantity of heat in it will be, let us say + .3 = 354.3 units, of which we may suppose that 324 are due to the fuel, the temperature of the feed-water being 60°. A horse-power represents only 42.74 units per minute. The specific heat of saturated steam is .305, that of gaseous steam is .475, under constant pressure. If we take the latter figure, then it would be necessary to superheat ⅓ pound of steam by 90°. If its pressure were 85 pounds, its temperature while saturated would be .328°, and 328 + 90 = 418°, which would be too high for ordinary use, corresponding as it would to a pressure of about 420 pounds on the square inch absolute. The whole of the work would, however, come out of the superheat, and if the cylinder had a very thin liner, and was jacketed with superheated steam, it is more than probable than an extreme degree of economy would be attained. Although we do not assert that it would be desirable to push superheating so far as this, we would earnestly impress upon steam users the importance of adopting some arrangement by which dry steam may be admitted to the cylinders of the engines ; even a steam-trap fitted on the steam pipe near the engine will be useful. It is not as generally known as it ought to be that all Lancashire, Cornish and locomotive boilers supply steam which contains from 5 to 8 per cent. of moisture in the shape of insensible priming. Some of this can be "knocked out" of steam by the use of baffle plates ; but in all cases where it is possible some arrangement for drying the steam thoroughly should be adopted.—*Ex.*

PROFESSOR TYNDALL ON ELECTRICITY.

In an instructive lecture on "The Sources of Electricity," delivered befor the British Royal Institution several months ago, Professor Tyndall, among other things, dealt with the properties of hollow conductors, using in the first instance a silver teapot. He charged with electricity a brass ball held by a silken thread, lowered the ball into the open teapot, then showed that the teapot contained no electricity inside, but plenty outside, especially at the end of the spout. If a little boy could be put inside that teapot, he explained, no electricity would be found there. Faraday once made a little house of laths ; it was 12 feet square, and covered with tinfoil. While he was inside that house not a trace of electricity could he find there with the most delicate instruments, while the house was in communication with a most powerful battery, and giving strong sparks outside.

Professor Tyndall next spoke of the influence of points, saying that one experimentalist had determined the sharpness of thorns by their action upon electricity. He electrified a great insulated paper tassel, thereby causing its long strips of paper to diverge, and the distant as well as the near approach of a needle point made the strips fall together again ; this, he said, explains the principle of the lightning conductor. He exhibited a lightning conductor with several points tipped with platinum; from his little experience he was inclined to think that one point to a lightning conductor was as good as many; still it might be right to have several. The conductors should have a good earth connection at the bottom, and not be put but 2 inches into it, as a builder did on one occasion. The Board of Trade has a lighthouse on the north coast of Ireland in which the bottom of the lightning conductor was once led into the sold rock at the base; he wrote to the authorities, after an accident to the structure from lighting, saying that they invited the lightning to strike the lighthouse, and that the bottom of the copper rod should have been connected with the sea. The best discharger of electricity is a flame; it is more efficient than metal points. A wind flows from electrified metal points, the air being made self-repulsive. He then put some water with the chill off in a flat glass cell and dusted a little lycopodium on the surface of the liquid; the wind from an electrified point made the particles self-repulsive, and their eddies were exhibited in magnified form upon the screen by the aid of the electric lantern. The electric mill, in which vanes are driven round by the wind from an electrified point, was next exhibited.

The electrophorus, he said, was decovered by Volta, to whom a statute has been erected in the market place at Como, because of the great honor in which that early electrician is held, not alone in Italy, but all over the world. He then brushed the rosin and wax-plate of the electrophorus with the catskin, brought the conducting disk down upon the plate, and showed how a spark was obtained from the latter. A sheet of vulcanized india-rubber, he proved, will do as the plate of an electrophorus; a disk of tin, with a sealing-wax handle, will do for its conductor; so also with a half-crown attached to a stick of sealing-wax. By the latter means he obtained enough electricity to enable the half-crown to attract the end of a freely-balanced lath. He next exhibited the electrical machine of Mr. Whimshurst, who, he said, was connected with the Board of Trade; he was a man who had not tried to make money out of the machine, but had given it freely to the world. Next he explained the principle of the Leyden jar, saying that in 1745 Von Kleist, a bishop of Cammin, in Pomerania, charged with electricity a flask containing mercury; a nail running through the cork touched the mercury; this apparatus, when charged as just stated, gave a shock. In 1746 Cunæus, of Leyden, received shocks from a flask in which water was substituted for mercury.—*Ex.*

HOW A MILL-OWNER LEARNED TO RESPECT THE INDICATOR.

The President of the Fishkill Landing Machine Company relates an instructive incident, showing the manner in which a New England mill-owner acquired a healthy respect for the performances of that, to him, mysterious and over-rated instrument, the steam engine indicator.

The local inspector of the boiler insurance company finding the boiler was getting a little old, ordered its pressure reduced from 70 to 60 pounds, but the mill-owner said it would not do his work at that pressure. Applying to the Fishkill concern for advice, use of the indicator soon snowed them that the old-style engine used in the mill was wasting coal, and that a new engine would permit four or five years' further use of the boiler, at which time replacing the boiler would make the entire plant substantially new. Skeptically pooh-poohing the idea that such a little, new-fangled contraption as the indicator, would tell truthfully what was claimed for it, the mill-owner finally accepted the engine-builders' guarantee, that a certain saving in coal would result, and a Fishkill-Corliss was ordered. Before the new engine was set in place all the coal used in the old engine was, by agreement, carefully weighed for several weeks and a record kept.

A similar record was afterwards kept of the amount of coal required to run the new engine, demonstrating that the latter was effecting a net saving in coal of $12 per day. The mill-owner now figures that the new engine doesn't owe him anything, and the balance keeps on inclining to the right ride of the ledger. He is at present exercised over the query, whether he is more indebted to the Hartford inspector, who first put him on his mettle, the engine-builder who gave him such satisfactory advice, or the inventer of the truth-telling but despised little instrument, or whose pencil, after all, pointed to the right place, viz., his pocket.—*Ex.*

COMPOSITE PORTRAITS.

At the Newport meeting of the National Academy of Science, Prof. R. Pumpelly read a paper "On an Experimental Composite Photograph of the Members of the Academy," illustrating it by photographs of several groups of the members, and also by photographs ef engineers employed on the nothern transcontinental survey.

This paper was in the direction of the experiments first instituted by Francis Galton, and described by him in his book "On the Existence of the Human Faculty." Galton's experiments seemed to indicate the possibility of obtaining type-pictures of different types of different persons and characters.

These pictures are obtained by taking the photographs of a number of different individuals of the type to be compared, in as nearly as possible the same position. These pictures are then photographed on the same negative, being superposed one on the other, and each photograph being exposed for only a very short time, so that the resultant contains and combines all the features which the different photographs possess in common, but eliminates those which are due solely to individual peculiarities. The pictures are focused on the eyes; and since the distance in eye differs in different person, some indistinctness about the borders of picture is inevitable. The mouth escpecially appears to lack decision, by reason of being somewhat blurred; yet on the whole the composite picture is such a one as would be at once recognized by most persons as a fair illustration of such a kind of person as the individuals which compose the class under observation.

It is by somewhat such a process as this, in fact, that Prof. Pumpelly thinks that we usually form a mental image of different types and classes, whereby we recognized for instance, at sight a Chinaman or an Indian.

The pictures of members of the Academy showed in one instance a compound formed from thirty-one individual members. This picture may fairly be taken as a type picture of the average scientist or the ideal intellectual man of the Caucasian type, being composed as it is of individuals the most eminent in America in various lines of scientific research. It shows, as must have been expected, a high and massive forehead, and that well-known though indescribable cast of countenance which we all pronounce at once, without perhaps being able to assign any reason for it, to be intellectual, so that on seeing a countenance of this stamp we naturally infer that it is that of a professional man.

It was observed, however, that the faces of three of the persons thus combined differed largely from the average type, and in the subsequent experiments these three photoghraphs were omitted for the purpose of securing greater clearness in the result, notwithstanding that the exposure of each picture to the camera was only two seconds, out of the total exposure of sixty two seconds for all, so that the peculiarities of individual pictures would make only a very feeble impression on the combined photograph. The remaining twenty-eight pictures, then, were divided into two groups, and classified, according to the department of science most affected by the members, into sixteen naturalists and twelve mathematicians.

On combining the mathematicians into one group and the naturalists into another, it was seen that, with apparently the same height of forehead, the mathematicians have a broader, and the naturalists a slightly narrower, forehead than the average.

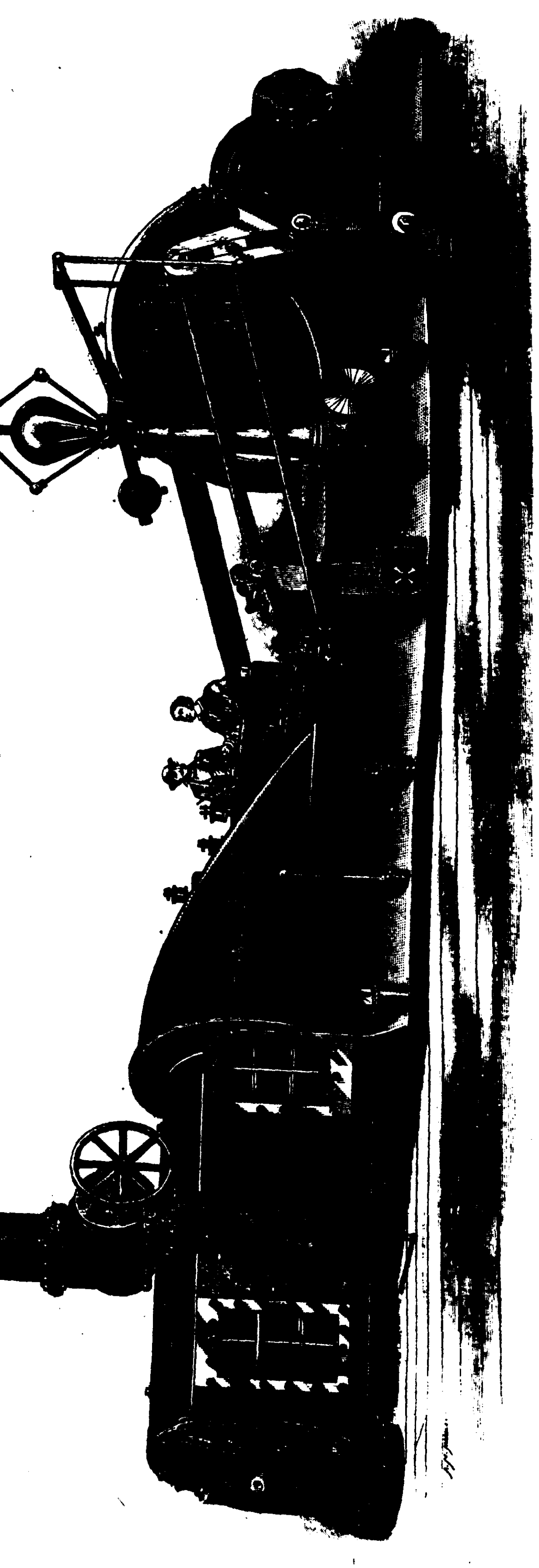
Prof. Pumpelly spoke at some length of Galton's experiments, by which he has obtained type-pictures of burglars and of other classes of criminals, of engineers, of persons suffering under certain form of disease, such as consumption, of family groups, etc.

He intimated that it was his intention to prosecute these inquiries in the direction of composite profiles, which he expected would produce some startling results. He regarded this as a method of much value in anthropological work.

Major Powell stated that the same method has been applied to obtain a composite photograph of crania at Washington, but without success.

Other members of the Academy, however, indorsed Prof. Pumpelly's views.

Prof. Peirce thought it particularly desirable to obtain a composite photograph of musicians, and also of mathematicians who were devoted exclusively to mathematics, remarking that the members of the Academy represented were not of that exclusive mathematical type which he regarded as a very peculiar one.—*Ex.*



PORTER-ALLEN ENGINE.

PORTER-ALLEN ENGINE.

The engraving of the Porter-Allen Engine, represents the one built for the Lackawanna Iron and Coal Company, who have kept it in constant use for about a year in one of their mills at Scranton, Pa., where it is driving, through direct connection—that is to say, without intermediate gearing of any kind—a "three high" train of 36 inch rolls for rolling steel ingots blooms.

As can be seen from the engraving, this engine is massive, and admirably calculated to withstand the enormous strains it is subjected to, which are occasioned by the shocks which the peculiar kind of work required of it gives rise to.

The engine has a cylinder with a bore 44 inches diameter, and a stroke of 5½ feet. It was started at 45 revolutions per minute, but is of suitable proportions to work well at 70 revolutions, at which speed, and with 80 pounds' steam pressure, the engine will develop over 2,000 horse-power. At present however, it is worked up to little more than half the power it is capable of developing.

The following extract from a letter from Mr. W. F. Mattes, chief engineer of the Lackawanna Iron Company, gives particulars respecting this engine's performance and the capacity of the train it is attached to, which are interesting:

"The steel ingots rolled, when intended for 60 pound rails, are 12½ inches square at top by 14½ inches square at bottom, by 6 feet long, and are reduced to blooms 7 inches square in 12 passes. We have never blown sufficient steel to discover the ultimate capacity of the train, but it probably would be reached in the neighborhood of 5,000 tons per week. With 65 pounds boiler pressure the engine develops ample power, and the regulation under the abrupt changes from zero to full power is very satisfactory."

Some of the principal proportions of the engine are as follows:

Space occupied—Length, 45 feet; width, 22 feet. Diameter of flywheel, 30 feet; diameter of crank disk, 8 feet; diameter of crank shaft, 25 inches. Greatest width of bed plate, 7½ feet. The nearly flat top of the bed is about 6 feet wide for a considerable part of the length.

The total weight is 140 tons; and the weights of some of the heaviest parts are:

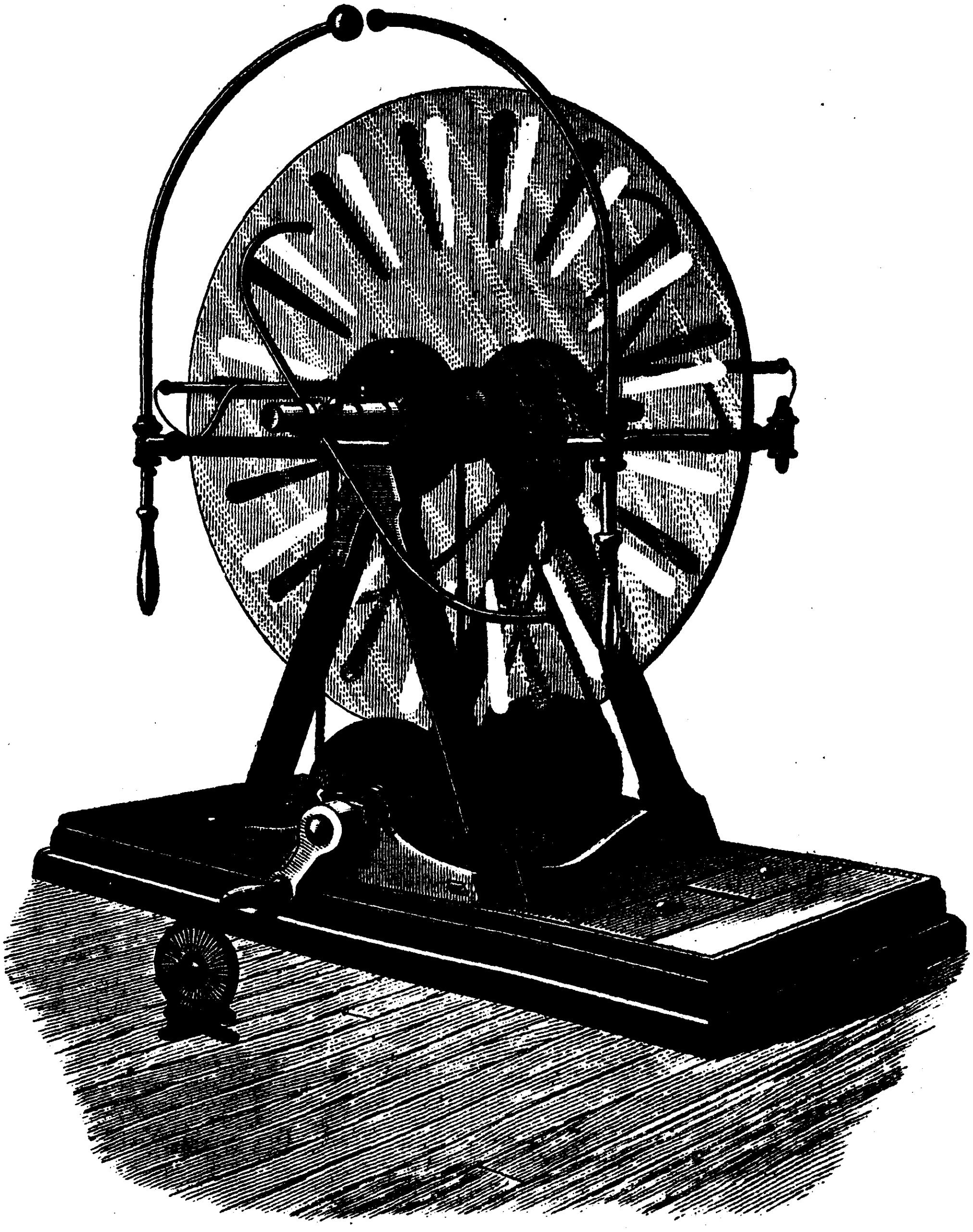
Flywheel, 48 tons; bed plate, 24 tons; cylinder, 14 tons; shaft, 12 tons; crank, 5½ tons; outer pillow block, 7½ tons.—*Ex.*

THE UNITED STATES makes one-fifth of the iron and one-fourth of the steel in the world. Of the gold supply this country furnishes one-half, and of the silver, one-third. The United States represents 36, Great Britain 33, and all other nations, 31 per cent. of the mineral industries of the world.

KEENNESS OF SIGHT.—At a recent meeting of the Society of Arts in London, a paper was read on the subject of aids to the eye-sight. Dwellers in towns, it was remarked, rarely looked at a distant object, and the townman's eyesight is hopelessly inferior to that of the average Scotch forester.

THE Edison Central Station in New York for the distribution of electricity for incandescent lighting has been in continuous operation for two years and a half, with the exception of a stop of about two hours. The use of the lamps is less than two and a half hours per day and the operating expenses 1⅞ cents per lamp per day. The price charged is on the basis of gas at $2 per thousand, and during the year 1883, the station earned 3 per cent. on the investment.

Dr. Colier, the State geologist of Indiana, has been experimenting on the changes in the scructure of even the best iron. He finds that iron bars and bolts subjected to vibration were "rotten." Inserted in immovable rocks they were found to be fibrous and strong. The examples of these changes are to be sent to the Stevens Institute of Technolgy, where an investigation of this subject has been in progress for several years.



THE WIMSHURST SEVEN FOOT DUPLEX ELECTRIC MACHINE.

TEST PUMP FOR BOILERS AND PIPES.

We herewith illustrate a force pump specially designed and manufactured for the testing of boilers and pipes by hydraulic pressure. In a great many shops where the testing of boilers and pipes has to be done, the appliances for performing this important work are of the crudest and most perfunctory character. The consequence is, that valuable time is often wasted in doing an operation which ought merely to be the work of a few minutes, and when it is done the record is worth very little. A convenient pump like that here shown soon pays for itself in the saving of workmen's time effected. The pump cylinder is made of cast iron, the lever of wrought iron, and the valves of steam metal. Two pistons are used, one working within the other, the larger piston being applied in filling up the boiler or pipes, while the small one comes into service when the point of testing is reached. Changing the action of the pistons is done by simply moving a wrought iron pin. The pump is mounted on a sheet iron tank which is fitted with wheels and frame that carry it readily to the points where the testing is to be done.—*Ex.*

A GREAT ELECTRIC MACHINE.

We illustrate a machine which has just been completed by Mr. James Wimshurst, one of the consulting engineers to the Marine Department of the London Board of Trade, in his own private workshop, and which is, undoubtedly, the most powerful and efficient electrostatic machine in existence. This apparatus, says *Engineering*, has been constructed for and presented to the Science and Art Department at South Kensington by Mr. Wimshurst, the cost of the raw material being defrayed by the Department.

The diameter of the circular plates of the great machine is 84 inches, of plate glass three-eighths inch in thickness, and weighing 280 pounds each. Each of these disks is pierced at its center with a hole, 6½ inches in diameter, and is firmly attached to a gun metal boss, 15 inches in length, carrying the disk at one end and a pulley at the other, and which is bored so as to run freely on an iron tube, 3 inches in diameter, this tube being supported at each end by strong oak trusses, rising from a firm base, also of oak, and which is fitted with lockers at each end, for holding spare parts and accessory apparatus. The heads of the two trusses, or A frames, consist of massive castings of gun metal, which are so shaped as to hold the hollow iron tube and the ebonite rod to which the collecting combs and discharging terminals are attached. The iron tube projects at each end beyond the trusses, and to the projecting ends are attached the brass "neutralizing" rods, which terminate in light wire brushes, shown in the illustration.

To the disks, which are well varnished with an alcoholic solution of shellac, are attached, at equal angular distances apart, radial sectors of tinfoil, sixteen on each disk. These sectors are 19 inches long, and have a mean width of 1·65 inches, thus having an area of 31·35 square inches. There is thus on each plate a metallically coated area of 500 square inches, or a thousand square inches on the two disks together.

The apparatus may in principle be regarded as a sort of double-acting "Nicholson's revolving doubler," the sectors on the one disk acting as inductors on the other, and *vice versa*, and that the extraordinary high efficiency of the machine is probably due to the fact that both plates contribute charges of electricity to the collecting combs, and that the sectors on the one disk act as inductors and as carriers respectively to those on the other when they approach the best positions for those respective actions to take place.

The collecting combs are attached to the discharging terminals, as shown in the engraving, by interchangeable brass rods, some being straight, while others are bent, so that their positions with respect to the horizontal diameters of the disks may be varied within a range of about 16 inches, that is to say, between about 8 inches above and 8 inches below the horizontal diameter. The discharging rods or terminals are constructed of brass tubes, 1¼ inches in diameter, and are fitted with terminal balls of different diameters, which are also interchangeable. The distance of these balls apart—and therefore the striking distance of the spark discharge—can be varied by the glass handles with which the discharging rods are fitted at their lower ends, and as these handles have their attachment in a hinge joint, they can be used as levers wherewith to turn the terminal rods around a vertical axis, and thus to vary the distance between their upper ends.

The two disks are rotated in opposite directions by the lower drgiving gear, shown in the figure; this consists of a horizontal spindle fitted with a winch handle at each end, and carrying a pair of oak pulleys which are connected respectively to the two pulleys aatached to the disks by endless cords, one of which, being crossed, causes one disk to be rotated in the opposite direction to the other; and as the height of the bearings of the lower spindle is adjustable, the driving cords can always be maintained perfectly tight.

The principal characteristics of this form of electrostatic machine, and to which its exceptionally high value as a laboratory instrument is due, are (1) that it is readily self-exciting in almost every condition of the atmosphere; (2) that the polarity of the apparatus never changes, as it is so liable to do in other forms of induction machines; (3) that the charge is very large compared with the area of the glass employed in the disks; and (4) the small cost at which the machine may be constructed.

Although the great machine which we illustrate in this notice was working in a workshop in which there was a steam engine and boiler at work, and consequently with a considerable quantity or water in the atmosphere, and although it was closely surrounded with lathes and shafting and other metallic conducting bodies, not only did it pick up its charge even before a complete revolution was made, but kept up a constant stream of discharge sparks between its terminals of over 14 inches in length. The results have already proved far more satisfactory than was anticipated before it was tried, but when it is set to work at South Kensington, where it will be under far better conditions for developing its full powers, still higher results may be expected. We may, indeed, congratulate Professor Guthrie and the science schools generally on this new acquisition to the physical laboratory, which must prove a most valuable instrument for experimental research.

Mr. Wimshurst has in his laboratory what is probably the largest collection of the most powerful electrostatic induction machines in existence, having worked for several years in perfecting this class of apparatus. We have in the illustration introduced (partly to serve as a comparison of size and partly to illustrate a very interesting and typical form of the apparatus) a sketch of what is perhaps the simplest and the cheapest electric influence machine ever constructed. This little apparatus consists simply of two disks of varnished glass, 12 inches in diameter, fitted with tinfoil sectors, and mounted on a spindle, which can be held in the hands, and the disks can be rotated in opposite directions by spinning them with the finger and thumb. When this is done—although there are no collecting combs or discharge conductors—the most brilliant effects can be produced, the whole apparatus literally bristling with electric discharges immediately the rotation commences, and one of the most remarkable and not the least valuable features of this beautiful little instrument lies in the fact that it can be constructed in a good, salable, and workmanlike manner and sold at a very small charge.—*Ex.*

THE WESTON-CAPEN FRICTION CLUTCH.

Of the illustrations on this page, Fig. 3 is a sectional view of a Weston-Capen friction clutch in the form of a cut-off coupling for line-shafting. As applied to a pulley it is shown in sectional view, Fig. 6, and perspective view, Fig. 2.

Referring to Fig. 3, which represents a clutch for coupling the ends of two adjacent shafts, the construction and action of the several parts of the clutch are described in the manufacturer's pamphlet as follows: S^1 and S^2 are the two shafts which it is desired to connect by means of the clutch, power being transmitted from either one to the other, as desired, although it is best, where the case admits of it, to make the shaft S^1 the driver, and S_2 the driven shaft, so that the latter and the parts attached thereto remain stationary when the clutch is disconnected.

The sleeve A, fitting tight on the shaft S^2, and secured to it by the key M and a set screw, serves as a frame or centre on which are fitted and assembled all the other parts of the clutch except the box E, which is attached to and communicates motion from the shaft S^1. The right hand end of the sleeve A consists of a square hub, identical in form with central opening of the *internal* disks shown by Fig. 4, and over which the latter fit and slide.

Beyond this square hub the sleeve A is enlarged into a circular flange, forming the right-hand abutment for the disks.

Sliding over the central portion of the sleeve A, which is there of slightly reduced size and of circular section, is the follower B, which, when thrown forward, to the right, presses on the disks and forces them against the flange referred to, at the other end of the sleeve A. A collar C is screwed on the left-hand end of the sleeve A, and forms the abutment against which the toggles act when applying pressure to the disks. The two abutments being thus attached to the opposite ends of the sleeve A, the re-action of the end thrust between them is entirely absorbed by the sleeve, and is not transmitted to either shaft. The collar C is also utilized to effect the adjustment of the clutch by screwing or unscrewing it on the sleeve A. It is slit longitudinally at one point, and its ends drawn together by the set-screw P, which, when loosened, permits the collar to be turned for adjustment and when tightened locks it securely in place.

A second series of disks, of the form shown by Fig. 5, and designated as the *external* disks, are placed alternately with the internal disks and by their peripheries engage with the box E.

The external disks are thus compelled to rotate with the box E, but, if not frictionally engaged with the internal disks, communicate no motion to the other parts of the clutch. The internal disks, on the other hand, engage by their centres with the sleeve A, and rotate with it, but have no direct connection with the box E. If, however, the two series of disks are forced together by the follower B pressing against them and forcing them toward the flange at right-hand end of the sleeve A, thus gripping the entire stack of disks between the two pressing surfaces, the two series of disks are locked together by frictional engagement and rotate in unison as one solid piece.

In order to obtain the longitudinal pressure required to lock the disks together two or more toggles are employed, as shown in Fig. 3. One end of each toggle is pivotted to a projecting boss on the adjusting collar C, and the other to a similar projection on the rear of the follower B. The toggles have a positive action in *both directions*, so that they not only force the follower B forward when applying pressure, but also positively withdraw it when the pressure is released. The toggles are connected by the grooved sliding collar F, operated in the usual manner by a forked lever. The toggle action dispenses with all need of any end pressure on this lever, so that, excepting at the mere moment of transition from one position to the other, there is no friction and consequently no wear upon either the collar F or the forked lever which actuates it.

When the clutch is in engagement and is transmitting power all of its parts are rigidly locked together and revolve in unison without friction, noise, or loss of power. When disengaged one of the shafts is at rest, and the other, preferably the shaft S_1, is in motion. To provide the proper bearing between the stationary and the moving parts the right hand end of the sleeve A is provided with a long hub, having a bronze bush G fitting nicely on the shaft S^1, and within which the latter runs, the frictional contact being thus between the iron shaft and the bronze bushing. Special provision is made for the proper lubrication of the journal thus formed, as well as for the other part, of the clutch which require lubricating. When a clutch is disconnected, so that one portion is at rest and the other in motion, the bushing G thus receives all of the resulting friction and wear, and it is so constructed as to admit of easy replacement in case of wear, by which means the proper alignment of the parts is easily and accurately restored.

As shown in Fig. 3, the grooved collar F is in the forward position and the toggles depressed, thus forcing the friction disks into contact and locking all the parts of the clutch in engagement, so that the motion of the shaft S_1 is transmitted through the box E, the disks D, and the sleeve A, to the other shaft S_2. In like manner, if the latter be the driver, motion will be transmitted in the reverse order through the clutch to the other or driven shaft S_1. The position of the several parts when the collar F is retracted and the toggles elevated, so that the clutch is disconnected, is clearly shown by Fig. 6.

Fig. 6 shows the clutch as applied to a pulley, its purpose being to effect the engagement or release of the pulley and shaft, as desired. Referring to Fig. 6, S is the shaft to which it is desired to connect the pulley H by means of a clutch, power being transmitted either from the pulley to the shaft or from the shaft to the pulley, as required. In this case the several parts of the clutch are identical in all respects with those of the cut-off coupling shown by Fig. 3, and already fully described, except that the hub of the box E is lengthened and is turned to fit into the hub of the wheel or pulley H, which latter is bored to fit accurately over the extended hub of the box and is then secured thereto by the key N and a set-screw. The collar I, fastened by a set-screw in the usual manner, is then secured on the shaft in the position shown, and serves to preserve the longitudinal position of the pulley H and its attached parts. As shown in Fig. 6, the collar F and their toggles are in their retracted position, thus withdrawing the follower B and releasing the disks, so that the clutch is disengaged and no power will be transmitted through it. It will thus be seen that the clutches shown in Fig. 3 and 6 are identical in all essentials, and that the same device, with slight modification, is available either for a cut-off coupling for shafting, or as a friction clutch for pulleys.

The construction and action of the several parts, although requiring a somewhat long description to explain clearly, are few in number and simple in operation. All of the parts are of metal, no wood or other soft material being employed. The clutch is entirely free from collar friction or end-thrust, and runs without noise or loss of power. The friction surfaces are all flat sheet metal, of great durability and easily and cheaply renewed. The adjustments are very simple and quickly made The working parts are all assembled upon a central sleeve, and do not require to be taken apart in order to fit the clutch in position, so that it can be easily and quickly applied. It embodies all of the essentials of an efficient and durable clutch, and avoids features which have been found unsatisfactory and liable to rapid wear.—*Ex.*

SIMPSON'S GEAR MOULDING MACHINE.

The advantages of a machine for moulding all classes of gears —spur, bevel, and miter, mortised or worm, in all forms and in all sizes—are too well known to need comment. The use of such a machine will save a large outlay in patterns, and enable the use of a gear best suited to the purpose, instead of making a compromise, which is often done to save the price of patterns. The engraving presented herewith represents a machine for the purpose named.

In using this machine the moulder simply adjusts the index pin to a series of holes on index cylinder, corresponding to the number of teeth required. The diameter is easily adjusted by turning the handle on end of the spindle arm, which moves the tooth block carriage to any desired radius; stops are then adjusted so as to preserve the radius while the wheel is being made. By a quadrant slot on tooth block the latter may be turned so as to describe any angle required on the face of the wheel—spur, bevel, or miter—as the case may be. When teeth on the tooth block are rammed up the moulder moves the spindle arm around until the pin enters the next hole, when the tooth block is again lowered until the stop on the square shaft brings it to its proper place. The same operation is repeated until the gear is completed.

Everything about the machine is plain, simple, and straightforward; no worm wheel or compound gearing about it to bewilder with their complexity. Any mechanic with only limited mechanical ability can easily understand the machine and learn how to work it almost at the first glance.

The holes on index cylinder are accuarately spaced and drilled on machines specially made for that purpose. Through this agency the gear to be made must leave the sand with special accuracy.

The machine, we are informed, has been tested by experts, and its operation fully endorsed.—*Ex.*

THE bayaderes of India, who possess the most perfect figures of any women of any country on earth, have a much more healthful and charming device than any Europeans. Their corsets are formed out of the bark of a Madagascar tree, on a principle which permits them every freedom of movement in breathing and in any form of exercise. These are wonderful productions of ingenuity. The colour resembles the skin to a remarkable degree, and the material is so fine that the most delicate touch will hardly distinguish it from human flesh. Once made, these corsets are seldom removed, the bayaderes even sleeping in them. They thus preserve astonishingly beautiful figures to an advance age, without pain or discomfort to themselves, while we, who boast ourselves intellectual and civilized, torture with out beautifying ourselves.—*Ex.*

THE WESTON--CAPEN FRICTION CLUTCH.

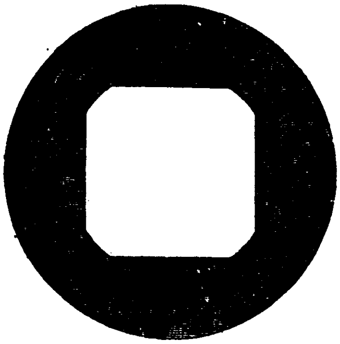


Fig. 4—Internal Disk.

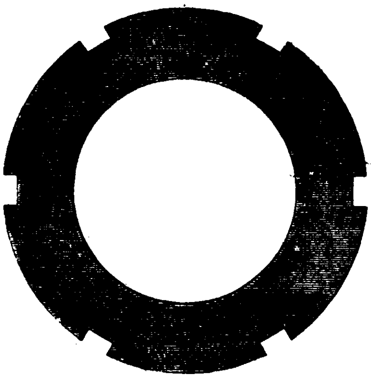


Fig. 5—External Disk.

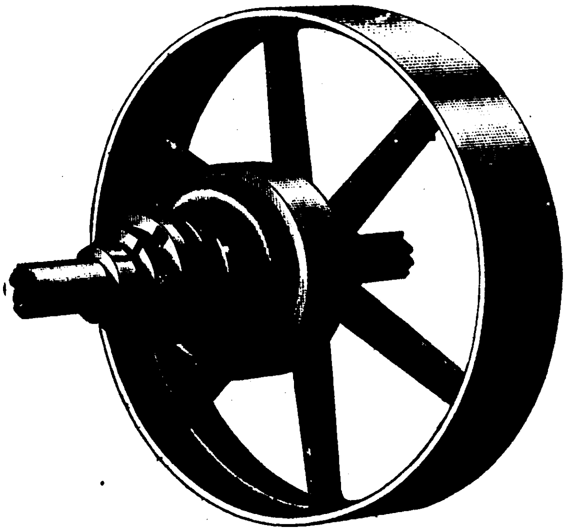


Fig. 2.

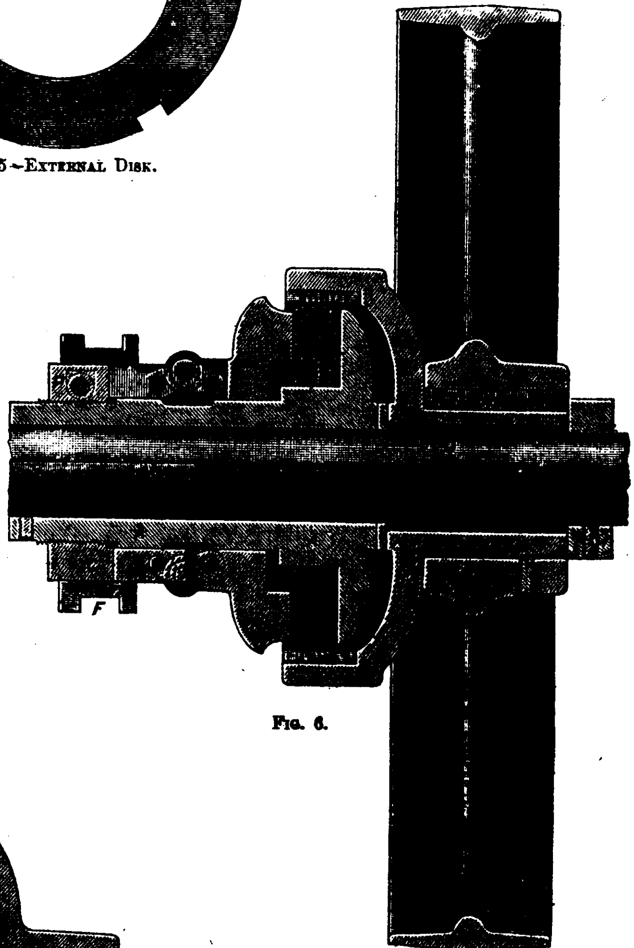


Fig. 6.

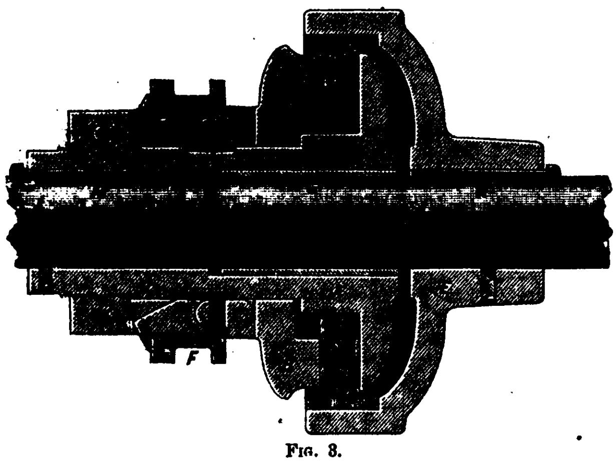
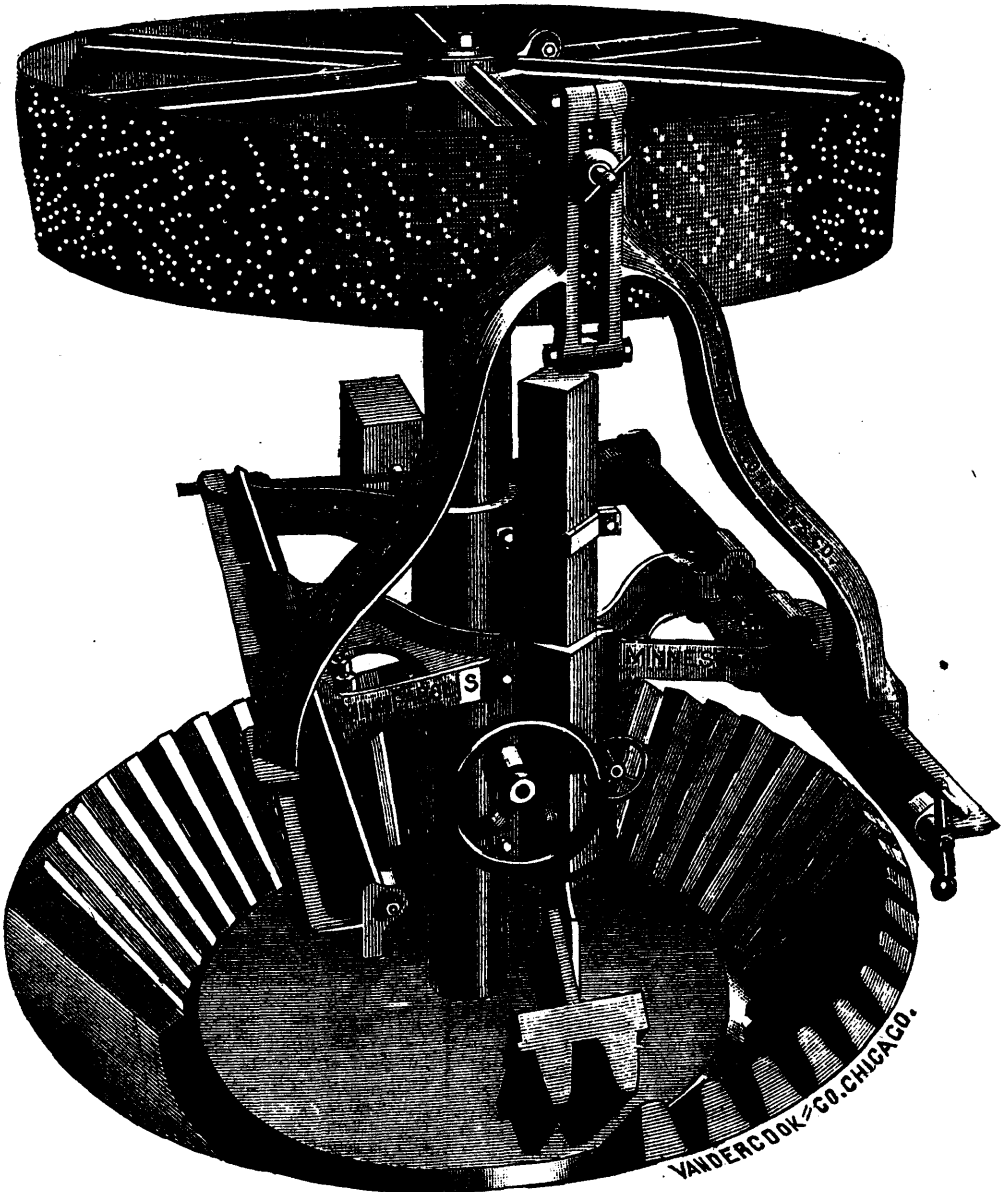


Fig. 3.



Simpson's Gear Moulding Machine.

DOMES OR NO DOMES.

Mr. Wm. Lachlan, a gentleman well posted in matters pertaining to European locomotive practice, contributed to one of the late issues of the *American Journal of Railway Appliances* an interesting letter on domes for locomotive boilers. As the relative advantages of such boilers with and without domes have at times been very freely discussed, his remarks showing the tendencies on some of the European railroads cannot fail to be of interest. We quote:

Opinion is much divided in England as to the advantages of domes on locomotive boilers. On the Great Western Railway all broad-gauge engines built or rebuilt since 1846 have boilers without domes. The narrow-gauge engines built about 1862 were built without, but subsequently a large number of passenger and freight engines were built with domes. However, since 1875 nearly all passenger engines have been built with flushed topped boilers, and without domes, and all new boilers are built in this way, the locomotive superintendent, Mr. Dean, clearly preferring domeless boilers. On the Bristol and Exeter Railway all the broad gauge engines were built without domes; in fact, these engines resemble the G. W. R. stock. The Great Northern Railway has probably the largest number of domeless boilers, no engines with domes having been built for this road for many years. There are probably not more than 30 engines on it with domes, and these are tank engines or old engines different from the standard types, and when any of these require new boilers they always are made to conform to the pattern of the standard stock.

The South Eastern Railway is now building nothing but domeless engines, all engines requiring new boilers being altered to the new pattern. This line as far back as 1851 had some 25 enignes without domes, some of which are still running; and I can remember two or three of the boilers thus built still in active service on engines running fast passenger trains as recently as 1881, the old boiler barrels of 1851 having then done 30 years' good work. The Glasgow and South Western Railway has no domes on its engines; in fact, the boilers are preferred without. The Lancashire and Yorkshire Railway having such a very mixed lot of engines, and so many different types, has probably as many engines without as with domes, but recently domes appear to be gaining ground. The North British Railway has several domeless engines. At one time domes were the exception rather than the rule; now they are probably nearly as many of the one type as the other. There are a few isolated cases of domeless boilers on the Great Eastern, London and North Western, Caledonian, London, Chatham and Dover, and North Eastern Railways, but they are all stray types, and not in conformance with the standard patterns of those companies. As for the exclusive employment of domes, the following railways in England may be quoted: The London, Brighton and South Coast, London and South Western, Midland, Manchester, Sheffield and Lincolnshire, Tilbury and Southern, and the Metropolitan and Metropolitan District railways. In France domes were not much in favor from 1848 to 1860, but are now used almost exclusively. Very few of the old French "Crompton" engines had domes, and their boilers have certainly done wonderful service. In Switzerland a large number of engines built recently have no domes. In Germany domes are the rule; there are, however, a few old engines to be there met with that are without. In Belgium large domes are the rule. In Holland, as nearly all locomotives are imported, they resemble the types of the counties in which they were built.—*Ex.*

THE HARDENING OF STEEL BY PRESSURE.

The many trials to harden steel by pressure have usually led to the metal being first heated, and when it has attained the requisite degree of softness being subjected during cooling to a considerable pressure. Clemandot has stated that by his process, as above described, the same properties are obtained as by the usual method of hardening. There is (according to Stahl and Elsen) a greater fineness of grain obtained than in the case of steel allowed to cool naturally, a higher degree of breaking strength and greater hardness being likewise arrived at, provided the steel used for various qualities is sufficiently highly carbonized. It resembles steel hardened by immersion in water, without, however, being identical with it. Two different and almost simultaneous physical effects take place; a forcible and lasting condensation and a rapid cooling of the steel. The latter circumstance (brought about by the contact of the steam with the stamps of the hydraulic press or with the inserted metal plates) is attributed to the intimate contact with the cooling agent thus effected. The most remarkable consequences produced by Clemandot's process result from the simultaneous operation of these opposing physical actions, corresponding respectively with hammering and hardening by immersion. The pressure need only be exercised upon two opposite surfaces, which should be of a certain extent. It is recommended for the steel to be brought to a cherry red heat, and for the pressure to be brought as quickly as possible to the extreme limit in view, which may be six, twelve or eighteen tons per square inch of surface. The metal-pressing plates should have smooth surfaces. The real difference between this method and hardening by immersion consists in the fact that toward the end of the latter operation an increase of volume is possible, and consequently a diminution of condensation, while the hydraulic press (exercising an active influence during the entire process of cooling) strives to bring back the metal to its original volume and specific gravity, and to prevent the generation of internal tension, such as is known in hardening steel. Experiments have confirmed these theoretical assertions as to the density and resistance of the metal, which becomes much harder without increased brittleness resulting. The effect is greater according as the steel is more highly carbonized.—*Ex.*

A LARGE PRICE FOR A BIBLE.

A Bible was sold at auction in London the other day for three thousand nine hundred pounds sterling (about $19,500). It was knocked down, after spirited bidding by a number of contestants for the book, to Mr. Quaritch, a dealer in rare works, and is believed to be the highest price ever paid for a single copy of any book at auction. It is known to bibliophilists as the Mazarin Bible.

The title is derived from the fact of a copy having been discovered in the library of Cardinal Mazarin in Paris, about the middle of the eighteenth century, and it is generally assumed to have been the earliest printed book. There are said to be eighteen of this edition in existence, one-half of which are in public libraries in Europe.

The copy for which Mr. Quaritch bid such a wonderful price is described in the *Art Age* as "magnificent." It is printed in double columns in type similar to church script, and is "splendidly" bound in blue morocco. The Mazarin Bible is without date, and is variously ascribed to the years 1450, 1452, and 1455. A copy preserved in what used to be called the Royal Library at Paris contains a note stating that it was completed "in binding and illuminating" in the year 1456, which would put the probable date of printing at twelve months earlier. According to the catalogue of the Syston Park Library, the Mazarin Bible is printed with metal types. Typefounders, however, hove differed on that point among themselves, some contending that it was compressed from wooden blocks, others declaring for letters cut in metal, and a third party deciding in favor of cast letters, the last in every material respect like those now in use. But, whatever kind of type may have been employed in producing the earliest printed book, it would, even at the present time, be accepted as a noble specimen of the typographical art.

The printing of the Mazarin Bible is ascribed to Gutenberg, but the fact, we believe, has never been established beyond a doubt. Mr. Quaritch, in an interview with a newspaper reporter after the sale, said that three out of the five copies of this edition of the Bible known to be owned by private parties had passed through his hands, the first being purchased by him when a young man for £590. "The present copy," Mr. Quaritch went on to say, "I have also bought for my stock, and it is purely a speculation of my own. I do not expect to keep it long."—*Ex.*

A General Subway.—It is proposed to build a general subway under all the principal streets of London. The cost of such an enterprise would be considerable, but the benefits derived from it would, in the end, more than pay the cost. The architectural and scientific papers speak approvingly of the scheme.

It is proposed to arrange the fire engines belonging to the Fire Department of Brooklyn, N. Y., to burn crude petroleum, instead of coal. The great advantage expected to be gained is that engines on duty can carry a less bulky and more convenient supply of fuel.

THE NEW CLAYTON DUPLEX AIR COMPRESSOR.

In this issue we give the new Clayton Duplex and Double-Acting Steam Actuated Air Compressors, which are extensively used and enjoy an enviable reputation for economy and efficiency among the mining, tunneling, railway and engineering interests in this country and abroad.

These compressors being duplex, with cranks set on the quarter, admit of the location of the flywheel in the centre of the machine, which adds to its compactness, equalizes the strain—on account of the action being direct—and by this plan a very important defect in the compressors of other construction is avoided *i. e.*, the main journals are thereby removed from the heat of the steam cylinders, which effects a great saving in wear and trouble, and an extravagant use and waste of oil in ineffectual effort to keep them from cutting.

Connecting rods of improved pattern are used ; a heavy rod connects the cross-heads on top, and a distance piece on the bottom serves as a slide and works on a long adjustable guide, and by its use the cylinders are relieved from the weight of the pistons, rods, etc. In these compressors there are no sliding valves, rotary valves, or so-called positive moving valves for the admission of the air, as such valves produce much friction and wear, and can be kept tight a short time only ; all sliding valves are difficult and expensive to repair.

The induction and eduction valves are of the poppet style, and are placed in the cylinder heads, and are so arranged that the valves and seatings can be inserted or removed from the outside.

These valves have slightly elastic disc between valves and seats, which disc takes all the pressure and protects the metal surfaces against wear. The suction valves are numerous, and give plenty of opening for air admission until the cylinders are filled to almost the atmospheric pressure, and are provided with safety stems, or bolts, which effectually secure the valves from falling into the cylinders should the valve stem break, or the nut come off, and the valve can be fastened against the seat until it is convenient to repair it.

The air cylinders are surrounded by water jackets of improved design, and are so constructed as to force the water to circulate along the top to and around the ends of the cylinders in such a way as to equalize the temperature of the cylinders to a uniform degree their entire length.

The builders of these compressors have the sole license to use the patent "Air Governor" for regulating the speed of compressor and the pressure of air on the rock drills, pumps, hoisters, or other machinery ; thus, if 80 pounds pressure of air is required to operate the drills, weight the lever, on air governor, to that pressure ; and should eight drills be working and four of them suddenly shut down, the governor will close off the steam sufficiently to reduce the speed of the compressor to the volume of compressed air required, and vice versa, should four drills be working and four more be suddenly started, the air governor will automatically turn on more steam and run compressor at a speed sufficient to compress air for the additional number of drills.

The great economy and advantage derived from the use of this, and the other improvements above mentioned, is apparent.

The Clayton Air Compressors are built either single or duplex—actuated by steam, belt, or gearing—and in sizes ranging in capacity to run from one to fifty drills ; all sizes being constantly in stock or in process of construction.

These works have issued a new catalogue, giving prices and description of the Clayton Air Compressors, rock drills, boilers, mining pumps, and complete mining and tunneling plants, and copies of same, estimates and general information will be cheerfully furnished on application to the Clayton Steam Pump Works, near New York and Brooklyn Bridge, Brooklyn, N. Y. —*Ex.*

About the most remarkable piece of engineering work that has come under our notice lately was a steam boiler set in sandstone. The blocks of stone were neatly dressed, and the work looked very fine outside, but the furnace, and the pier supporting the back end of the boiler, seemed to be in about the same condition that the eggs were in at a certain hotel where a guest ordered them poached, and the waiter strongly advised him to have them scrambled, "for," said he, "them aigs ain't very fresh, boss, and dey *look* better scrambled !"—*Locomotive.*

HYDRAULIC SHEARING MACHINE.

The illustrations represent a new form of hydraulic shearing machine, designed and constructed by Messrs. Anderson and Gallwey, of Cremorne Works, Chelsea, for the rolling mills of Messrs. Jose Goffin and Co., of Clabecq, Belgium.

The machine is designed to cut plates of 1½ in. thick, and by the arrangement of the framework, plates of great width and of unlimited length can be operated upon. For this purpose the frame is formed of two horizontal cast-iron girders let in to two end castings, between which a distance of 11ft. 6 in. has been allowed. The main cylinder, which is shown in action in the detail view, is cast in one with the top girder, and is bored out to receive the ram, which is secured to a crosshead carrying the shear blade and sliding in guides.

The ram is U-shaped in longitudinal section, in order to allow a second cylinder to enter the hollow thus formed. This latter cylinder receives the "draw-back" ram, the upper end of which is fixed in a small crosshead rigidly connected with the crosshead carrying the blade, by means of two tie-rods. The smaller ram is always in direct communication with the pressure water, and is therefore continually tending to draw the upper shearing blade away from the lower fixed blade. The pressure water is admitted to the larger ram and exhausted therefrom, through two mitre valves the spindles of which pass right through the valve box. These valves are forced down on their seat by the combined action of the pressure of the water and of two spiral springs. The lower ends of the spindles bear on two eccentrics on a shaft running the whole length of the machine, and to this shaft levers for operating the valves are attached at intervals. The levers are connected by means of chains with hand rings in the way shown, and as they can be shifted to any position on the longitudinal rod, the machine can be worked from any point in its length. Upon pulling one of the chains the eccentrics on the shaft open the pressure valve and close the exhaust.

When the ram has completed its stroke, a counter-weight on the shaft brings the eccentrics into their former position, closing the pressure valve and opening the exhaust, when the pressure on the smaller ram draws the crosshead and the upper blade back. The machine is also provided with automatic tappet gear, by means of which the stroke of the ram can be adjusted to any length between ½ in. and 6 in. ; the consumption of water being in direct proportion to the length of stroke.

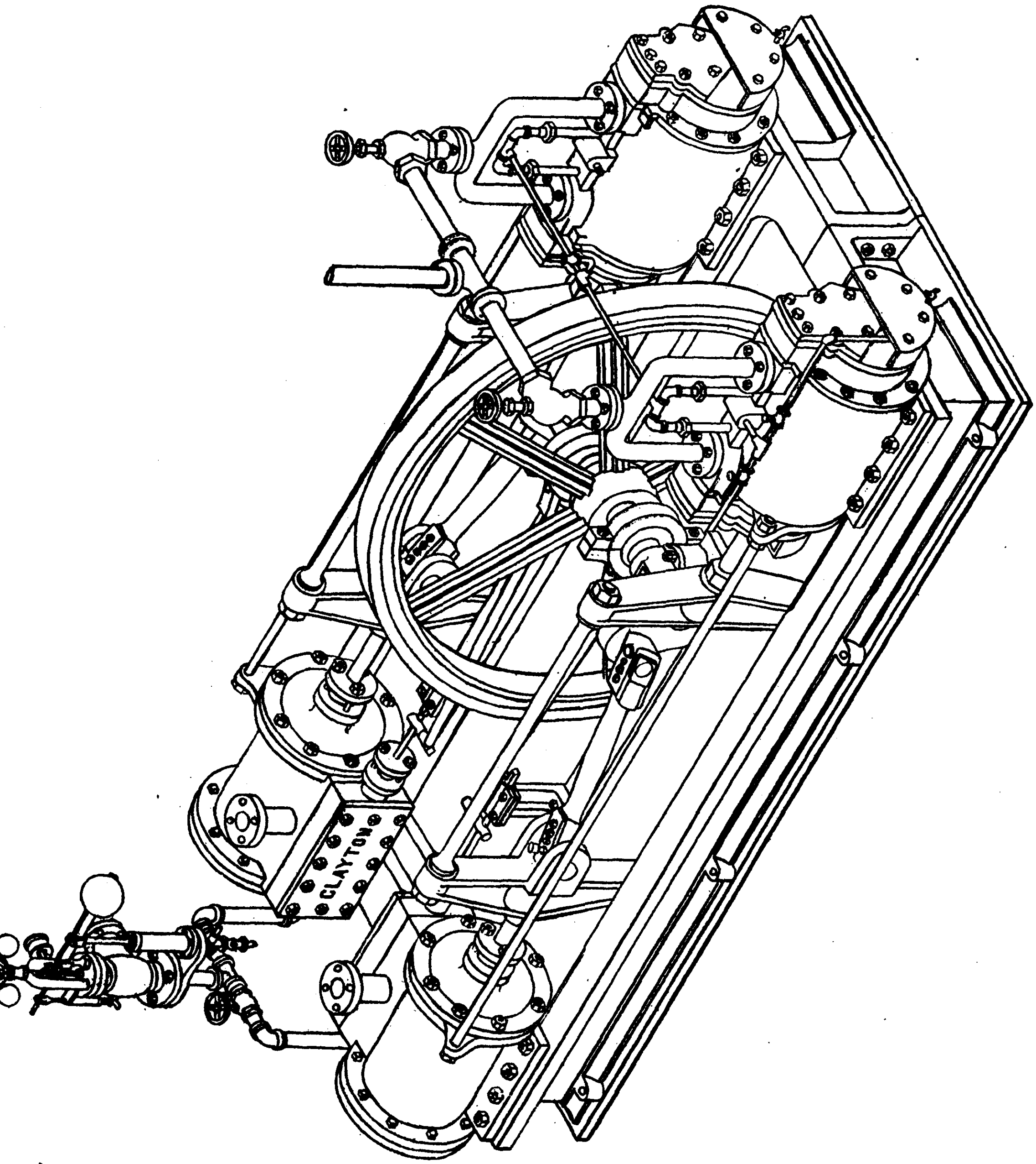
Although the shears have to cut very wide plates, the length of the blades is only 2 ft. 6 in. ; this gives greater facility in straight cutting and also allows a curved line to be followed.

Special attention has been devoted to the minor details of construction, in view of the requirements of rolling mill proprietors and bridge and boiler makers, to whom the improvements introduced into the machine will doubtless recommend it—*Eng.*

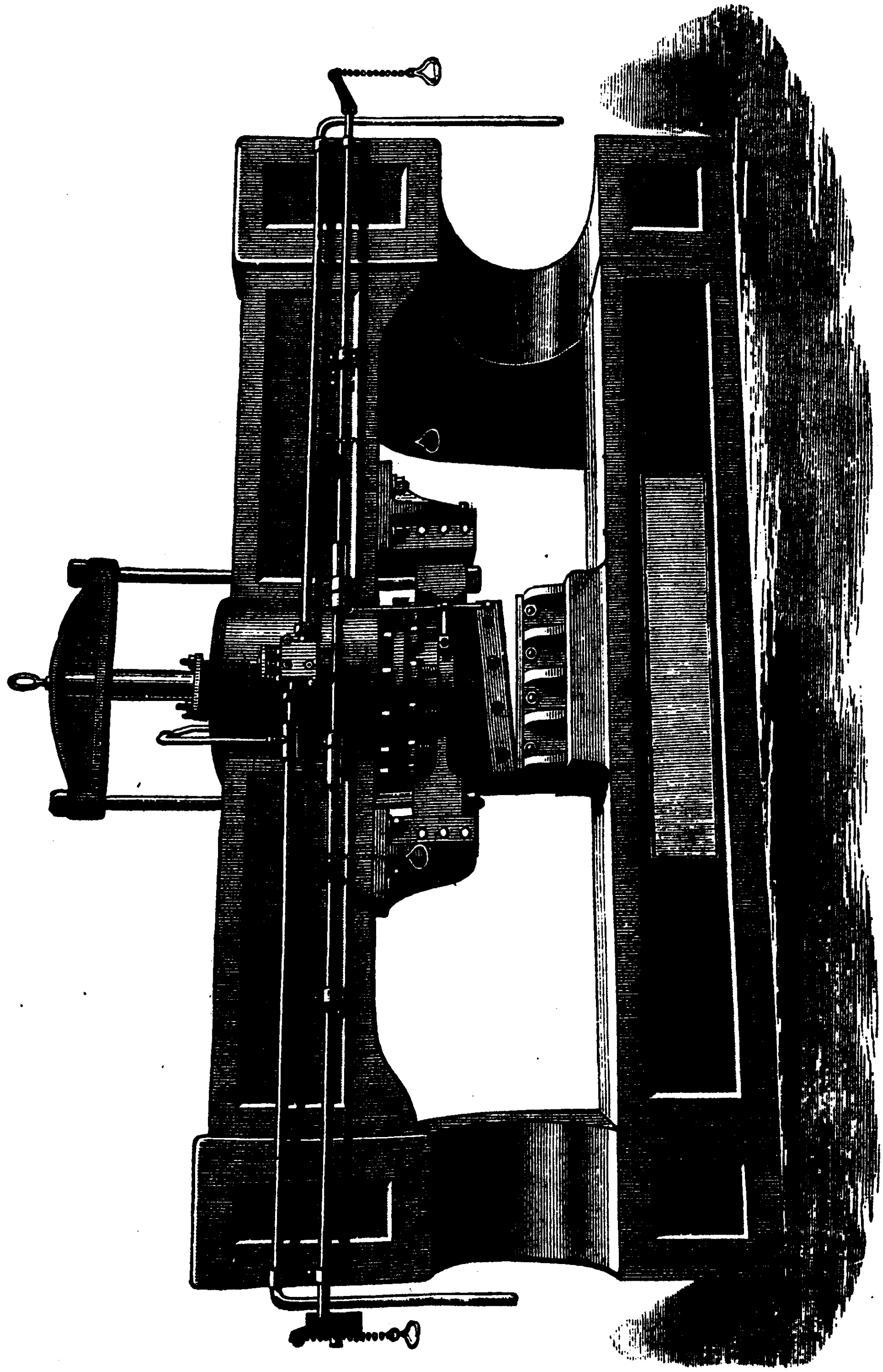
SCALE IN BOILERS.

In the experience of the steam user there is probably no one cause more prolific of danger or more wasteful of steam power than scale in boilers. The great saving in fuel and time is evident when it is known that a scale one-fourth inch thick requires an extra expenditure of 60 per cent. more fuel. Scientific experiments show the conducting power of scales as compared with iron is as 1 to 35.5 ; consequently, to raise water in a boiler to any given heat, the fire surface of the boiler must be heated to a temperature in accordance with the thickness of the scale. To raise steam to a pressure of 90 pounds, the water must be heated to 320 degrees Fahrenheit. In a clean boiler of one-fourth inch iron this may be done by heating the external surface of the shell to about 325 degrees. If one-half inch of scale intervenes between the shell and the water, such is the non-conducting power that it will be necessary to heat the fire surface to about 700 degrees, almost red heat. This excessive heat causes the oxidization of the metal, and it becomes granular and brittle, and is liable to bulge, crack, or otherwise give way to the internal pressure, with the dangerous results which follow such conditions.

After long and exhaustive experiments, looking to the destruction and prevention of scale, the Ohio Scale Solvent Co., of 29 Glen Building, Cincinnatti, Ohio, now confidently offer their scale solvent with the assurance that it has no deleterious effect upon the iron, and that it will entirely remove



CLAYTON DUPLEX AIR COMPRESSOR.



HYDRAULIC SHEARING MACHINE.

all scales that have formed in the boilers, and will completely resist the formation of any new scale, by holding the mineral salts in the feed water in a sludgy sediment until it can be blown out through the mud drum or otherwise. With this preparation the difficulty of using the hard water of wells or from other sources is entirely overcome, and the increased safety in the use of boilers and great economy in the consumption of fuel is assured, thus saving the additional cost of repairs and extra time and labor in cleaning out, and also saving valuable time of employés frequently lost by delay. This solvent is a dry powder which will not deteriorate by exposure to the weather. It is mixed thoroughly in a bucket of warm waterand administered at the man-hole, safety valve, through the feed water pump, or any other convenient manner, and costs only from two to five cents per day for each boiler.

ABOUT EMERY.

Emery is a sub-variety of corundum, which is found in rhombodial crystals, and is colorless or colored, being met with in all degrees of transparency. Its degree of hardness is 9. corundum is found as a precious stone (ruby or sapphire), as ordinary corundum of brownish color, and as emery in close masses mixed with magnetic iron. On account of these admixtures emery possesses a hardness which is barely half that of sapphire. Its specific gravity is 4.31, and in contrast to other stones of equal hardness it has the peculiarity that when crushed or triturated its smallest particles preserve their capacity of polishing, as they remain sharp-pointed. This proproperty exists in the same degree in no other substance of equal hardness, and is wanting in artificial emery, which, possessing similar hardness, color and weight, is often used for the adulteration of the genuine article.

The best emery is found in the island of Naxos, in clay deposits and also in marble. It is in pieces varying in size from walnut to blocks of several hundred weight. It is often found in veins three feet in thickness, and less frequently in globular shape or large pieces, which are probably the results of volcanic eruptions. At one time Naxos was the only known source of emery, but since then the Levantine or Turkish emery was discovered, which, although of inferior quality to the Naxos article, is yielded in about ten times the quantity. The places where it is found are numerous, but only those near the coast are of practical importance, on account of the difficulties attending transport in that region. The principal locality where emery is found is near the towns of Magnesia, south-west of Smyrna and Aidin, in Western Asia Minor, in the plains of Macander. Deposits of emery also exist in limited quantities in the islands of Samos, Chios and Cyprus.

The manner in which the emery is obtained is primitive, and is about the same in most places. When embedded in clay it is simply dug out; if in marble, the latter is removed by the force of the swelling of pieces of wood, which are placed in position and wetted. When removing emery from the veins alluded to, it is brought to the surface by primitive lifting appliances. Such a shaft is seldom deeper than 65 feet. The smaller pieces are ready for transport. This is effected by heating them in a fire of bushes, and throwing water upon them, by which means they are divided into blocks of about two cwt. The emery is carried by donkeys as far as Syria, from which place it reaches the various commercial centres, such as London, Marseilles, Amsterdam, etc. The leasing of the emery quarries is effected by the Greek and Turkish governments in lots of 2,000 to 3,000 tons, under very stringent conditions.—*Ex.*

THE DISCOVERY OF ENAMEL.

At South Kensington a two-light window in silver stain sets forth the life and labors of Palissy, the potter, says the Magazine of Art. The first light depicts that well known episode of Palissy breaking his tables for fuel. The domestic tragedy is quite prettily conceived. In the centre of the composition stands Palissy, tall and slight, dressed as a gentleman should be, in doublet and hose. His left hand is grasped by a gentle young woman wearing a dress and coif of the fourteenth century, and only faintly recalling the virago whose incessant nagging the potter held to be the worst of all his persecutions. In his right hand the museum Pallisy holds an axe; at his feet are fragments of most substantial furniture, which he contemplates with genteel bewilderment, as though surprised at his great prowess in effecting such a breakage.

Six years before the day on which the little tragedy took place, young Palissy the glass painter had been a newly married man, settled in the town of Saintes, in the fertile province of Saintonge, and near by the famous salt marshes of Marennes. By birth he belonged to the diocese of Agen, where he had learned the noble trade of glass painting. The young artist was a man of rare qualities of mind; he had little book learning, but a great craving for knowledge, though the wisdom he wished for was not to be gained from books in the days of King Francis I.

For the knowledge that Palissy yearned to possess was a knowledge of nature and her ways of the growth of the earth, the formation of the springs, the action and ever changing limits of the sea. So when he grew to manhood, to gain this learning Palissy left Agen and travelled throughout the length and breadth of France, thinking and wondering much of nature and her marvellous ways, and earning his bread by glass painting and by portraiture, in which art he had some skill. At length, after about ten years of wandering, he settled in Saintes, most likely because it was the home of a certain young woman who, perchance, was not a virago until hunger and disappointment, poverty and the loss of many children, had soured her temper. So, in 1540, we find Pallisy settled in Saintes, a man who from his writings we may judge to have been looked up to by his fellows; an intelligent artist, a local leader of the reformed religion and a collector of all manner of fossils and curious stones. Anything strange delighted Palissy, and we read in his writings how such an one brought him an ammonite and another gave him an old stone that he had dug out of his garden, and of things that people brought to his workshop for him to look at and explain to them if he could. So when in the year 1540 "an earthen cup enamelled with much beauty" found its way to Saintes, it was naturally taken to the house of Bernard Palissy.

The days of Francis I. seem so civilized and like to our own that it is hard to realize the gulf which in many ways divided them from our times, and it is with ever recurring surprise that we remember that in those days no glazed or enamelled ware of any kind was made in France; that porcelain—not to be made in Europe until nearly two centuries later—had hardly begun to be exported by the Portuguese from their new settlement at Macao; and that any art pottery that was in France was Italian majolica, which was imported in only small quantities and at a very high price. How rare it was we may judge from the fact that Palissy, who in the way of trade had entered many noble houses, had never in all his travels seen such ware till in the year 1540 this enamel cup was shown him. But as he held it in his hand it occurred to him how glass painting was yearly less in vogue, how overstocked the trade, how poor the pay; and that if once he should "discover how to make enamels, he could make earthen vessels and other things very prettily, because God had gifted him with some knowledge of drawing." So from that day Palissy resolved to discover how the enamel was made. In that masterpiece of naive writing, "L'Ariste en Terre," he tells us most simply and powerfully the hardness of his search; that he was as one who gropes in the dark, having no knowledge of clays or of pottery, no conception of the substances of which the enamels were composed and guided only in his search by his knowledge of glass and his long study of nature. This much only he was told; The white enamel was the thing to seek for, since it was the basis of all the others. Palissy set to work to build himself a potter's furnace. Then, taking all the substances he could suppose likely to make anything, he pounded and ground them and making a great quantity of different mixtures and proportions, bought some pots, broke them, and placed some of the powder on each of the potsherds. He then marked each of the fragments, and having written down what compound he had placed on each baked them in his oven.

In this way he worked on for several years, never getting any result; this less because his materials were wrong than because his furnace was not hot enough, and because he was so ignorant of the right manner of arranging the crocks that "if the material had been the best in the world, and the fire also the fittest, it was impossible for any good result to follow." Every compound he had tried again and again; he had used a furnace of his own till his means were exhausted, and too poor to buy fuel, he had begged permission of the pottery a league and a half distant, where he brought his pots, to fire his experiments there, "always with great cost, loss of time, sorrow and confusion."

At last he saw there must be something fundamentally wrong in his way of working and resolved to return for a time to his trade, and "comfort himself as though he were not zealous to drive any more into the secrets of enamels." Fortune, who had so long deserted Palissy, deigned to cast a glance at him; for only a few days after he had resumed his trade, Francois sent commissioners to establish the gabelle in Saintonge and to appoint a surveyor to map out the salt marshes and surrounding district, and Palissy was appointed to this work which employed him for a year with profit to his pocket and ease of mind and time to think over the probable causes of his failures.

On reflection he believed that one reason why his enamels had not melted might well be that the potter s furnace was too cool. So, when his work was finished he built himself such a furnace as is used by glass painters and on his first experiments one of his pieces "began" to melt. Alas! is stopped at the beginning, and though this little success encouraged him to devote two years entirely to the quest he got no better result. At the end of that time he lost hope, his means were exhausted, he was in debt on all hands, and his wife, embittered by her children's want, let him have no peace at home. Wherefore, sadly and reluntantly. Palissy determined to give up the search, and with a heavy, hopeless heart carried his last array of post-herds to the furnace. But now, when he had ceased to hope for it, almost ceased to wish for it, success came and with less than four hours of firing, one of the pieces turned out white and polished in a way which, says Palissy, "caused me such joy as made me think I was become a new creature, and I thought that from that time I had the full perfection of white enamel." So thought the neighbors, so thought Madame Palissy, and there was rejoicing and renewal of love in Palissy's house. There was no question now of giving up the search, money was borrowed, and for six or eight months, though he had never understood his clays, he made vessels and dishes for his enamel. He could afford to pay none to help him; so when the vessels were made he had to carry the bricks for his own furnace, draw the water, temper the mortar and be his own mason. Then came an anxious time—the firing his carefully wrought posts; but at the first baking all went well and the vessels were ready for the enamel. He was now wearied with the toil and mental strain of the last months but the hardest labor was still before him, and a time in which he endured "suffering and labor such as no man would believe." For more than a month he worked night and day, grinding and powdering his enamel. At length the neverending toil was done, the precious vessels put in the furnace, and Palissy, anxious, weary, but full of hope, sat down to feed his fires and to dream of the beautiful white wear he should sell for three or four hundred livres; though of the money Bernard no doubt thought far less than did his poor wife, and the dreams of that day were chiefly of frame and honor and satisfied ambition.

So the day passed, and when night came the enamel had not yet melted; but after so many wakeful nights one more or less signified nothing, and all the night through Pallissy kept up his fires; yet when morning came the enamel had not melted; and this, surely, must have been one of those times of which Palissy tells us that, "to amuse people who came to see me, I did my best to laugh, though within me all was very sad."

So the day passed. Night came again, another night of watching, less hopeful than the first, a night of eager self-deception, of seeing signs of melting where all was hard and dry; and when the third morning broke the enamel had not melted. That day Palissy could not laugh, could not bear that any one should see his agony; it seemed as though his mingled hope and fear must stifle him. Still he piled on the wood, and still the enamel remained as dry powder.

Night came and went in fevered watching, broken by minutes of fevered sleep, of startled waking from dreams in which the fire had gone out; and still the potter, dazed and stupefied, watched on, and the fourth day was at an end. The time now passed like a ghastly dream, till at last, when the sixth night came, Palissy owned to his soul that the enamel would never melt.

By some mistake he must have put in too little of that substance which should melt the others. He must make sure of that; it was not in his nature that he should rest till he found out why the enamel had not melted. So, without letting the oven cool, he ground and pounded a fresh compound, all the time keeping up the fire.

Then, for the first time, he left his shed, rushed into the town, a strange, scare-crow figure, bought a few common pots overlaid them with powder and put them in the furnace. Then he filled the mouths of his oven with wood, and, going to his store for more, found that he had burnt his last fuel.

What could he do? Without fuel the work and hope of years was ruined—the hope of a life; for never again could he go through that toil and expense.

Was his labor to fail? his credit and hope to be destroyed for the lack of a barrow of fuel? Yet where could he get it? His eyes fell on the palings of his little garden: quickly he tore them up, quickly the fire devoured the well seasoned timber.

Frenzy gave Pallissy new energy, new strength; he flew to his house and broke up the chairs and tables, tore up the floors, much to the grief of his wife and scandal of his townsfolk, who said, the kindest, that he was stark mad; the others, that he was laboring to produce falpse money.

At last that second enamel melted and turned out, as Palissy tells us, "tolerably well;" well enough to restore his credit in the town, to give him hope to make other trials, which resulted in disappointment, though he succeeded at last.—*Ex.*

THE STEAM YACHT TOPSY

The use of small steam yachts for pleasure purposes is fast growing in popular estimation in this country. As in a pleasure yacht speed and compactness are important matters, it is essential to get large engine power in small space and weight, which, coupled with good lines on the hull and a properly proportioned screw, will bring about high speed. The old type of marine engine is very generally considered as not suited to the purpose, the weight for a given power being too great from the fact that it is impracticable to get sufficient speed inrevolutions.

The engraving represents the first steam yacht built by the Westinghouse Machine Company, Pittsburgh, Pa. Her dimensions are 34 feet 6 inches over all and 5 feet 6 inches beam. The engine is a 5 feet x 6 inches Westinghouse marine; boiler plain vertical, 8 feet diameter and 4 feet high, with 1 inch tubes 20 inches long; double cone and stack. The screw is two-bladed, 28 inches diameter and 28 inches pitch. The pitch of screw is much below the usual practice, being made to correspond with the high speed of the engine, which, with 80 lbs. boiler pressure, is from 375 to 400, and with 120 lbs. upwards of 500 revolutions per minute. In a trial over a measured mile this engine has propelled the boat at a speed of twelve miles per hour, which it is believed will be increased to fifteen when (as is the intention) a 6 feet engine is put in in place of the 5 feet. The engine exhausts into the smoke-stack or into a keel condenser at the option of the engineer.

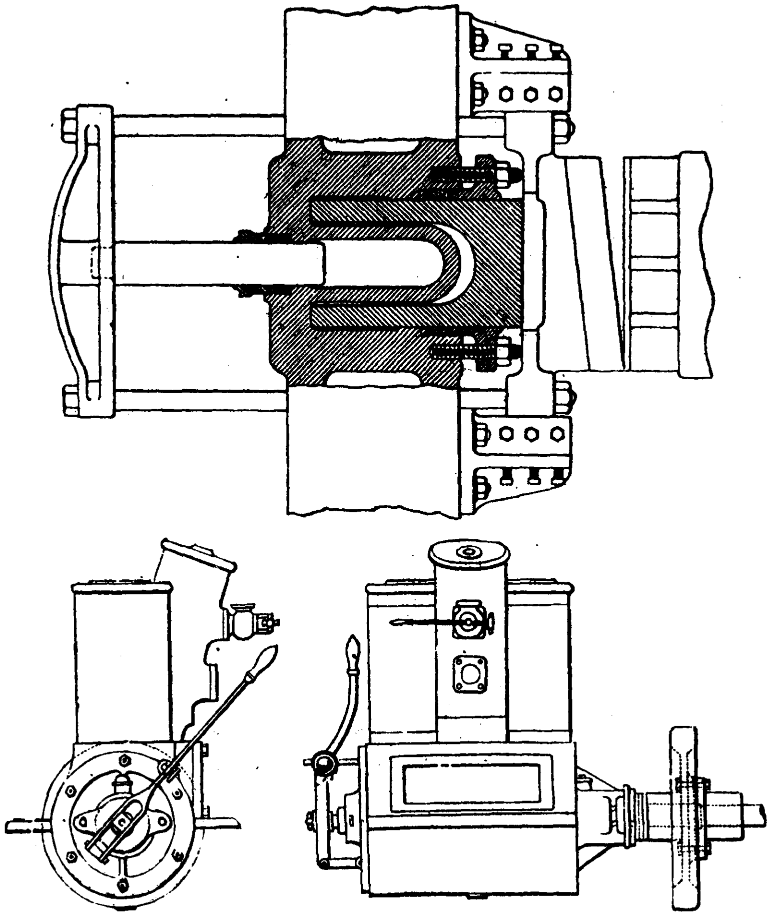
The boat is supplied with underneath tanks throughout, the tanks being divided into compartments and used for adjustable water ballast. An ejector, the suction of which reaches down into the keel condenser to the stern post, provides for entirely freeing the condenser of accumulated water before starting, thus enabling the boat to be started from the dock much quicker than would otherwise be possible.

The small outline cuts represent the Westinghouse engine as adapted to marine purposes, which, we are informed, has during the past season has been applied to a number of launches for various purposes, for which its high rotative speed particularly adapts it.—*Ex.*

STATE'S SECTION LINER.

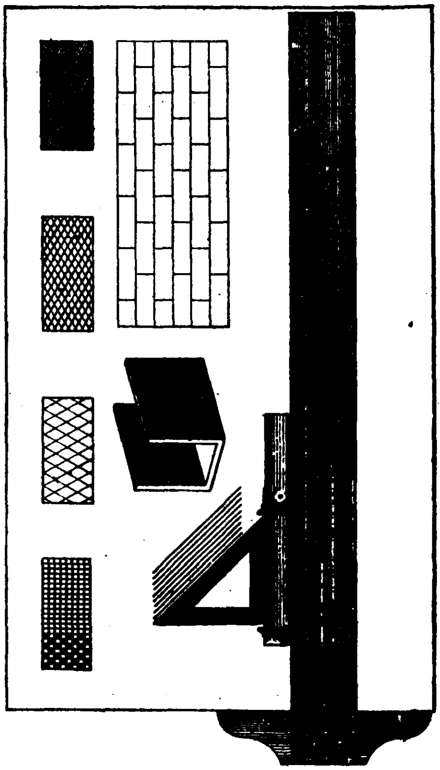
The engraving represent a new section liner, for the use of draughtsmen, as well as some of the uses to which it may be put. It consists of a bar provided with two gauge stops, one of which is stationary and the other movable. It is easily adjusted to any triangle, and is operated by holding the liner and angle under the left hand, drawing a line, and then holding the angle and sliding the liner along until the gauge stops. The metallic parts are nickel-plated, and the bar of mahogany is ten inches long.—*Ex.*

Sir Andrew Fairbairn, M.P., Chairman of the Committee of the Yorkshire College of Science, has contributed £1,000 towards the expenses of a new building as an engineering department. Sir John Hawkshaw has started a fund for the endowment of a professorship of engineering at the same college by a donation of £1,000.



Outline of Westinghouse Engine Adapted to Marine Purposes.

The Steam Yacht Topsy.



STATE'S SECTION LINER.

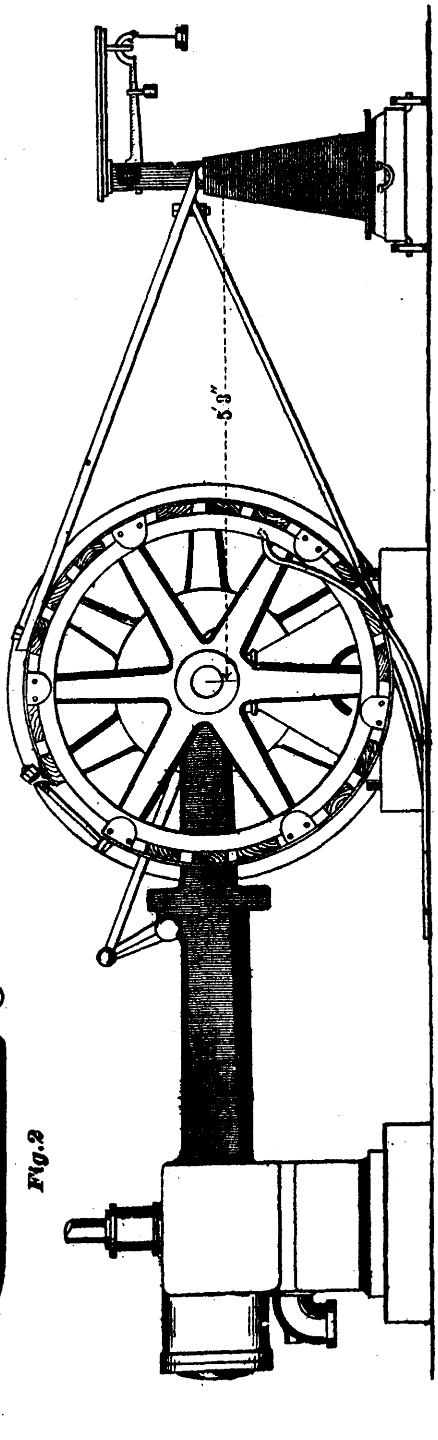


Fig. 1

NEW PRONY BRAKE.

NEW PRONY BRAKE.

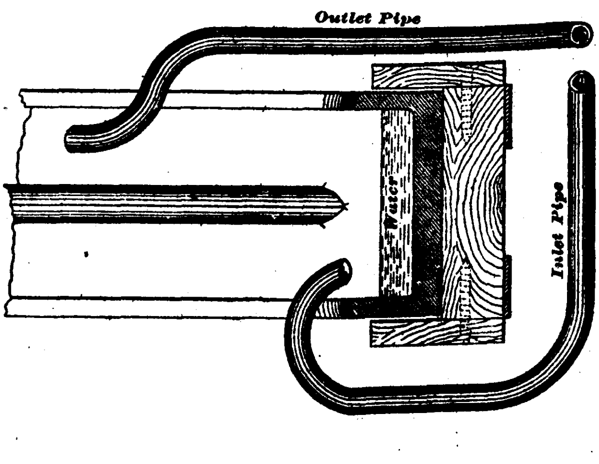


Fig. 2

NEW PRONY BRAKE.

At the recent fair of the American Institute, two students from the Stevens Institute—Messrs. Mitchell and Aldrich—made a partial test of the Straight Line Engine then on exhibition, and the Prony brake used embodied some features we had not seen before, and we herewith produce a cut of it from a sketch furnished us by the Straight Line Engine Company.

It is of the ordinary belt kind, with blocks of pine wood bound to the face of the iron pulley by two leather bands, though band iron hoops are better, as the stretch of the leather calls for more constant attention. It will be seen that the force exerted to overcome the friction between the pulley and the friction blocks is transmitted to the platform of an ordinary scale, by the end of one of the arms resting on the top of a small roller, supported by the stand set on the scale.

The top of the roller is level with the center of the shaft, and just five feet three inches from it, and when once set the radius will not vary, however much the brake blocks may wear. The circumference of a circle, whose radius is five feet three inches, being 33 feet, the distance selected is one that saves many figures in calculating the results; for, instead of multiplying by 33 feet. and then dividing by 33,000 to arrive at the horse-power, it is only necessary to divide by 1,000. Thus, all the figures that are necessary is to multiply the number of revolutions by the pressure on the platform and divide by 1,000, the weight of the stand and levers having first been counterbalanced.

The pulley is made as shown in Fig. 2, with a flange on each side projecting in about two inches, forming a circular trough, into and out of which a stream of water is kept flowing. The water enters through the inlet pipe, fixed to deliver the water on one side of the arms in the direction the wheel is turning, and the outlet pipe, scoops out the water after it attains any determined depth. Just before stopping the water is shut off, and the outlet pipe crowded out, until it comes in contact with the inside of the pulley, so that nearly all of the water is removed, and splashing prevented when the wheels come to rest. Pieces of salt pork, secured between the blocks, furnish a constant supply of grease, increasing as the temperature of the pulley increases. With this brake, the pulley of which is 42" × 7", a test of 30 or 40 horse-power may be made, and continued for any length of time.

In the test mentioned one or two points were brought out in regard to the engine. First, the great accuracy with which the speed was controlled, there being a variation of but two revolutions both by a change from no load to 55 horse-power, and with a variation of several pounds in the steam pressure. The engine tested had an 8" × 14" cylinder, was run from 230 to 232 revolutions, and the steam pressure ranged from 60 to 80 or 90 pounds. The friction as determined by deducting the work recorded by the brake, from that shown by the indicators, varied from 100 per cent. when running light to $4\frac{8}{10}$ per cent. when doing 55 horse-power of work. In fact the actual work required to run the engine was very nearly constant, being $\frac{1}{16}$ of one horse-power less at 35 horse-power than at 6 horse-power and 55 horse-power. This condition, Prof. Sweet argues, agrees with his theory that the compression was, as it ought to be, viz.: just what will arrest the reciprocating parts and start them back, relieving the crank pin and bearings of all the friction possible while the engine is passing its dead centers.

It is a common thing to recommend the use of the indicator, but its work combined with the Prony brake, or some other means of determining the amount of actual work performed, becomes far more valuable, and had we some ready means of determining the actual amount of steam used, or perhaps we should say the character of the steam used, both the indicator and the Prony brake would settle points in engine construction and economy much more conclusively. To determine the amount of water used it may be measured, as it is pumped into the boiler, or condensed as it leaves the engine, but to determine how much of it goes into the engine in the form of steam, and how much as water, is not so easy, as the present known methods are not so uniform under like conditions as to give confidence in their accuracy.—*Ex.*

LIEUT. GREELY has accepted the invitation of the Scottish Geographical Society to address its members when he visits Great Britain; but he could not fix an approximate date, as he had not yet finished his official report of the Arctic expedition.

THE BALL ENGINE AND GOVERNOR.

This is a view of an automatic cut-off engine, designed for heavy duty, long continuous runs and high speed when necessary, built by the Ball Engine Co., of Erie, Pa. The starting point or first requirement of an engine of this kind is a rigid frame, having sufficient metal so distributed as to receive all strains without deflection or vibration. This frame possesses this quality, it is said, in the highest degree. Absolute alignment is obtained by a special system of construction, and the self contained form of the engine insures the continuance of these conditions. The very large wearing surfaces used are additional guarantees of continued alignment. They also result in cool, quiet running and long life of the engine. No expense or trouble is spared in the construction of this engine. Every detail receives the most careful attention, and the most skillful men are employed, who follow a rigid system of working to gauge, and this work is inspected with regard to quality and not quantity. The wearing surfaces are all scraped by hand to surface plates, and the steam joints are done in the same manner, no packing being used. The valve and valve seat are submitted to the same process. This scraping of the valve is repeated when testing the engine until the valve shows no leakage under full boiler pressure. These engines are especially adapted to electric lighting which requires perfection in design and workmanship, and the best attainable economy and regulation. In meeting the greatest possible requirements for an engine, it makes it an easy problem to meet the wants of all others where the duty is less exacting. In the regulation this engine can be absolutely held to speed under full changes of load, or when the character of the work is such as to make it desirable, the governor is adjusted to accelerate the speed when the engine is loaded. This is an advantage in saw mills and many other kind of work, but particularly in electric lighting when separate engines are used for each dynamo. When so arranged, the governor is adjusted so that the standard speed is only reached when the full number of lights are burning, and as lights are turned out the speed decreases. Their system of governing is believed to be as near perfection as it is possible to get. The theory of this governor is based on the logical principle that if a varying load requires a change of steam supply, this change should be the direct result of the load and should exactly correspond with it. In other words, the governor of a steam engine should not depend upon the very variation of speed which it is intended to obviate for its motive power to act, but should recognize the variation of load, thereby becoming a weighing machine—the result of this weighing producing a corresponding change in the steam supply, thus making it possible to keep up an absolutely uniform speed. Comparing this system with the old one, we see that with the old systems the supply of steam is in proportion to the speed, but with the new system the supply is in proportion to the load and the speed is constant. The process of governing may be briefly described as follows: Suppose the engine to be started without any load. As the speed approaches the desired point the weights of the governor acquire centrifugal force sufficient to overcome the springs, and they move outward, cutting off the steam and retaining the engine within the prescribed limits of speed. Now, if work be put upon the engine, the usual process is for the momentum of the engine to be overcome, reducing its speed until the loss of centrifugal force in the weights allows the springs to draw them in to a position that will admit the necessary amount of steam to meet the load, and if still more load be added the speed is reduced still further. In the case of this governor the addition of load does not overcome the momentum of the engine, but acts directly on the weights, drawing them into a position that admits the necessary steam. When load is thrown off the weights are immediately released just in proportion to change of load. In this way the conditions of load are communicated directly to the steam valve without going through the engine, and the change of load on the belt is met by a corresponding change of steam in the cylinders the two being simultaneous. The successful operation of this new force, producing, as it does, a result so long sought and never before obtained, is a matter of no small importance in the development of the steam engine, and particularly so since the demand in this particular has of late been so exacting. The Ball Engine Co. will be pleased to send their catalogue, describing minutely the action of the governor and the different sized engines they build, to any one who will make application to them.

Engineering Notes.

THE Fishkill Landing Machine Co. at Fishkill-on-the-Hudson, N.Y., have issued a circular, giving illustrations which show the best arrangement of horizontal tubular boilers, with a list of such sizes as are commonly used. These boilers are constructed of either iron or steel, wholly or in part, as may suit the views of purchasers. On all sizes about 36 inches in diameter, the lateral seams of shell and flanges of dome are doubly riveted; and when desired, the bottom of shell may be made in two courses, with only one girth seam over the fire. The edges of sheets are planed bevel for caulking, and particular attention is given to laying out and punching the holes for rivets, so that when the sheets come together, the holes may be "fair," and receive the rivet without the use of drift-pin. Special care is taken in the arrangement of the tubes, to obtain the greatest amount of heating surface consistent with large liberating area, ample steam room, and free circulation. The heads above and below the tubes, are thoroughly secured by long "crow-foot" braces of Ulster iron, well fastened to the shell of boiler. Every boiler has a man-hole either in the dome-head or top of shell, and usually, in the larger sizes, an additional man-hole in the front tube-head below the tubes, with the head re-inforced by a wrought iron ring riveted around the opening. A hand-hole is located in every back head, and another in the front head of the smaller sizes of boilers, and all man-holes and hand-holes are supplied with suitable plates and guards. In ordinary cases heavy cast iron supporting brackets are riveted to sides of boiler, to rest on side walls; or when preferred, wrought iron suspension stirrups may be used in their place. An angle-iron arch is fastened to back head of boiler to support arch of brick work for back connection. Their boiler shop is supplied with the latest and most approved tools; only the best brands of iron or steel plates and lap-welded tubes are used; the work is done by skilful mechanics under the supervision of one of the best practical boiler-makers in the country; and, when completed, every boiler is tested by water pressure, and proved tight before shipment.

The cause of practical education, the "learning by doing" principle, is making somewhat slow but very sure progress, and this is a matter in which every manufacturer is interested. Much has been written of late antagonizing the recent remarks of Rev. E. E. Hale, on the subject of half-time schools, but while he offers no relief for the fault, he finds he states a truth when he says that children who devote their whole time to obtaining book knowledge are but half educated. The remedy, however, in the present state of society, can not come in turning the children into the streets one-half the time, but must come by introducing real practical work into our school course of instruction in some way. Probably no cast iron rule for this reform can be laid down, as the circumstances and conditions must be so very different in different parts of the country, and in different towns and cities even in the same section. The school boards say the fault is not with them, but with the parents and the changed conditions of society, but while that may largely be true, it is much easier for the schools, with a perfect organization, to be adapted to society than for individual members of society to adapt themselves to the schools. How can a man who is employed in some mercantile or manufacturing establishment, and living in a tenement house, find useful and instructive employment for his boy one-half the time, and even if he could, how could the boy comply with the present school rules and pursue such employments? There is no question as to who must institute any reform that comes, and there seems to be little doubt but the reform is to come surely and with increasing rapidity when once fairly started. The Kindergarten method of instruction has for fifteen years been very gradually and very solidly gaining a sure hold in the hearts and minds of our best informed primary educators and it will stay and become the foundation on which will be builded a grand system of practical education all the way up to the colleges. A minister, a lawyer, a merchant, is a better man in his place if, with his literary attainments, he also has such a knowledge of affairs and practical work that he can grasp such subjects as he comes in contact with in all their details. The Milton Bradley Co. of Springfield, Mass., have been the pioneers in the manufacture of the material for the Kindergarten works, as also in the publication of cheap and useful guidebooks, and they are now giving special attention to extending the same principles with the primary and grammar grades of the public schools. They have a good exhibit of their material at New Orleans, which is said to be attracting much attention, and they have furnished the government with such material as it needs in its practical educational exhibits, in which Gen. Eaton is much interested and to which he is giving his personal attention in the arrangement and perfecting of the early details and, later, it will be under the special care of his competent assistant, Lynden Smith, Esq. All the state exhibits have given special attention to Kindergarten work, and everywhere is seen encouraging signs of the rapid growth of interest in the practical side of education. But it still remains for the manufacturers, who are most directly interested in this matter, to encourage their school boards in a properly regulated advance in this direction, till every student has the privilege of learning something of the business and work of practical life.

Miscellaneous Notes.

A NEW shrapnell shell for 100-ton guns has been invented by an Italian admiral. At 30 yards from the cannon's mouth the shell bursts, throwing forward 75 smaller projectiles, which in their turn burst into a fan-shaped shower of balls and fragments of metal with terribly destructive effect.

ON the Prince Edward Island Railway recently, engine No. 7, hauling one baggage car and three coaches, ran 3,336 miles with 1072 bushels of coal, which is equal to a consumption of 32 bushels per 100 miles; and engine No. 21, hauling the same number of cars, ran 3,168 miles with 1066 bushels, being 33 bushels per 100 miles.

A CARPET which had covered the floor of one of the chambers of the mint at San Francisco, for five years, was recently taken up, by order of the authorities, cut in small pieces, and burned in pans. The ashes were then subjected to the process employed with mining dust, and the amount realized from the daily deposits of the precious metals used in coinage during that period, was $2,500.

THE money kings have an evident mania for all kinds of watered stock. J. Gould's aquatic luxury, *Atlanta*, requires ten tons of coal per day, and costs $5,000 per month for fuel, provisions and crew. William B. Astor's magnificent steel yacht will cost the neat little sum of $350,000. Poor souls, they are really forced to curtail the wages of their employees, in order to meet their expenses.

A LONDON scientist says that the highest velocity that has been imparted to shot is given as 1,626 feet per second, being equal to a mile in 3.2 seconds. The velocity of the earth at the equator, due to rotation on its axis, is 1,000 miles per hour, or a mile in 3.6 seconds; and thus, if a cannon ball was fired due west, and could maintain its initial velocity, it would beat the sun in its apparent journey around the earth.

ALL kinds of ingenious contrivances have been brought forward at different times for the detection of fire-damp in mines, but most of them have been of a very complicated nature. The last of the series, however, is so simple that it seems astonishing that no one thought of it before. A child's india-rubber ball with a hole in it is squeezed flat in the hand and held in the place suspected of fire-damp while released, and allowed to suck in a sample of the air. The ball is now directed toward a safety lamp, and again squeezed, when the tell-tale blue flame will show if it contains any inflammable vapor.

THE *British Medical Journal* suggests a danger to horses at public drinking troughs. It believes that glanders are spread among horses in this way, and recommends a stand-pipe and bucket as the safest and best arrangement for watering animals in cities. It is more comfortable for the horse, who has not to strain his neck against the collar to reach the water, the water is fresher and more palatable, and there is far less danger of its being contaminated with dust, dirt, and the germs of disease.

A French officer of engineers has conceived an idea for enabling vessels upon the high seas to communicate with the shore by means of the existing submarine cables. He proposes that these cables shall be supplied at convenient intervals with short branches, the free ends of which shall be buoyed in such a manner that passing vessels, provided with the necessary batteries and with a key by which to obtain access to the wires, may telegraph home. Experiments to test the feasibility of the scheme are about to be begun, and several branches are being attached to the cable which connects Algiers with Marseilles.

BALL ENGINE AND GOVERNOR.