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LIGHT TRAMWAYS FOR THE NORTH WEST.

In our March number we took occasion to urge the importance and necessity of Tramways in rural districts and for opening up outlying districts and referred especially to the value of their adoption in our great North West country.

Since writing the article circumstances have more than confirmed the desirability of putting the Tramway method into practical shape.

Our North West Rebellion has abundantly demonstrated the absolute necessity of some such suitable communication between our main line and the districts outlying and at present unfortunately so isolated.

We consider the scheme well worthy the attention of the Government and capitalists and believe it to be a political, military, and commercial necessity.

The English Government have lately admitted a similar conclusion in their Soudan and Egyptian campaign and it remains for Canadians to at once put a system of things in operation. This would bind all our Territories together as a unit.

OUR REBELLION.

The capture of Riel has in a measure broken the resistance of many half-breeds and Indians, but it is still a question to what extent the Rebellion will be carried on by other tribes of warlike Indians.

The serious fighting which General Middleton and his troops had to go through was evidence enough that the Rebels had planned and calculated on a long and stubborn resistance if not upon a successful issue.

The Battle of Batoche will, undoubtedly, notwithstanding its death roll, adorn the pages of Canadian History in favour of our gallant General and volunteers.

It is to be hoped that the Government of the day will mete out justice speedy and effective to all those who have plunged the country into needless war and expense with all its attendant loss of valuable life.

One of the results of the present campaign will be to make Canadian's feel more confidence in their own strength and at same time, show that Fenians can have no hope or business this side of the border.

The present trouble more than demands that we ought to sustain a well equipped and efficient standing army of not less than 3000 men, because it is notorious that smart young men have been taken from the ordinary walks of life, to quell every little disturbance that crops up.

In addition to an increase of mounted police it is now quite evident that more effectual methods will have to be employed to preserve the safety of settlers and the different supplies and stores situated all over our North West Country.

Although the rebellion will retard immigration and settlement for a time, we think on the whole it will do good to Canada in proving her strength and importance.

Canada ought now to provide herself with all the appliances of modern warfare and especially those appliances suited for Indian tactics.

THE USES OF GLUCOSE.

Both glucose and grape sugar find extensive applications for a great variety of purposes as substitutes for cane sugar or for barley. The most general purposes for which glucose or starch sugar is used are:

1. For the manufacture of table syrup. This consists of a nearly or quite colorless glucose, with a sufficient addition of cane sugar from the sugar refinery to give it the flavor and appearance of a highly refined molasses. The quantity of cane syrup added varies from 2 per cent. up to 33 per cent.

2. As a substitute for barley malt in the brewing of ale or beer. This is really a substitution of Indian corn for barley, but it constitutes a very imperfect substitute, as the corn, by the treatment employed in extracting its starch for conversion into glucose, is completely deprived of all the nitrogenous bodies and mineral salts which it originally contained. Hence the glucose alone, which is simply transformed starch, is substituted for the entire barley grain, with its great variety of valuable constituents. This is not true, however, of the maltose produced from the entire corn by the action of the malt. This material contains all the soluble constituents of the corn, together with the additional substances which are rendered soluble by the action of the diastase of the malt.

3. As a substitute for cane sugar in confectionery.

4. For the adulteration of cane sugar, to which it is added to the extent of twenty or more per cent.

As a substitute for cane sugar in canning fruits and in the manufacture of fruit jellies.

6. For the manufacture of artificial honey. This is neatly put up in glass jars containing a small piece of genuine honey comb.
7. In the manufacture of vinegar.
8. In the manufacture of liquor-coloring, used in mixing liquors and making artificial liquors.
9. Other more limited applications; in the manufacture of wine; by the baker in making cakes; in cooking; in the preparation of sauces; as an addition to some canned meats, especially corned beef; in the preparation of chewing tobacco; in the manufacture of printers' rollers, and in the manufacture of some kinds of inks.

ICE AND COLD AIR MADE BY MACHINERY.

The proprietors of a great up-town hotel in New York, have thrown off the yoke of the despotic iceman. A large refrigerating plant on a novel principle makes it "a cold day" for the contents of the numerous refrigerators, while the contents no longer possess that unpleasant moistness which the proximty of melting ice induces. The guest with scientific tendencies is not now able to discover fossils dating from the glacial epoch in his ice water, for the ice is frozen from pure water in a carafe or glass decanter, holding about a quart and especially designed for this purpose.

The plant is designed to run on the absorption principle with certain improvements on the Carrè machine which materially increase the economy. Although machines of this description have been in the European market for a year and have been introduced with success in India and Australia, this is the first one built in America. The principle of operation is familiar to all those acquainted with the Carrè machine. In the generator is a quantity of ammonium hydrate, farmiliarly known as spirits of hartshorn. Through a coil of pipe in the generator, steam at a pressure of fifty-four pounds is passed. This is sufficient to evaporate the pure ammonia from the liquid into gaseous form. This gas is permitted to flow into a cooler where it surrounds a coil of pipes containing brine which is caused to circulate through this coil and those in the refrigerating closets. The ammonia gas absorbs a large part of the heat from this brine by expanding in the cooler. The brine thus serves as a conveyor of the heat absorbed from the refrigerating closets and their contents to the cooler, where the heat is in turn absorbed by the ammonia gas. After passing through the cooler the gas goes into a third vessel called the absorber, into which the "weak water," left after evaporation in the generator has been allowed to flow. This water being cooled by radiation, absorbs the ammonia gas and forms ammonium hydrate which is pumped back into the generator and the process is repeated.

This is essentially the method employed in the Carrè machine The main novelty and improvement of the apparatus described is in this, that after leaving the absorber, the ammonium hydrate is not returned dirctly to the generator, but is passed through a cylinder containing perforated trays. The mechanical action of these trays upon the liquid as it passes through them frees about 75 per cent. of the ammonia gas, which is used directly in the cooler; while only the remaining 25 per cent. has to be evaporated in the generator. The plant described was put in at a cost of about $10,000. It requires about 500 pounds of coal a day, and will produce ten tons of ice for every ton of coal consumed.

THE FUEL OF THE FUTURE.

That the gas for heating purposes will eventually drive all other combustibles out of the field in Pittsburg is inevitable. Already the consumption of gas, instead of coal, is enormous. It is estimated that from 15,000,000 to 20,000,000 cubic feet of gas is burned each day in Pittsburg as fuel. Already ten iron and steel mills in the city, and six in other parts of western Pennsylvania are using it in their puddling furnaces and under their boilers. Within three months a dozen more mills will have it in operation, and every other manufacturing firm is eagerly awaiting the completion of the various pipe lines. Six glass factories in the city, and seven in near towns are using it. Every brewery in the city uses it, instead of coal. There has not yet been enough gas to spare for domestic purposes, and only a few dwellings, comparatively speaking, have been able to get it for their stoves and grates. Two of the largest hotels use it entirely in their kitchens. Safety inventions have been made and much of its dangerous possibilities averted. As a result householders are anxiously awaiting more gas. Within an area of fifty miles about Pittsburg at least a dozen small towns have discarded coal entirely, and every dwelling house has gas in its cook stove, parlor grate and bedroom fireplace. Among these places are Butler, Freeport, Clarion, Tarentum, Kittanning, Oil City, Wellsburg, Apollo and Murraysville. There are no ashes to remove, no sooty fireplaces to kindle in the morning. A thumb valve regulates the flame, brick bats in the grate distribute it and retain the heat and it may be kept burning low all night to have the house warm in the morning.

NORTHERN ONTARIO.

THE GREAT LAKES EXTENDING ALONG THE HEIGHT OF LAND. COAL AND IRON DEPOSITS. A DISTRICT OFFERING ADMIRABLE FACILITIES FOR SETTLEMENT.

Three years ago Pagamasing was the furthest point known to the white man in the direction of James Bay in ascending Spanish River. This H. B. Post is on an island in a beautiful lake about 8 miles long by 2 in width. It is the first of a series of great lakes extending along the height of land nearly to the Michipicoten. They form, with a few portages, a continuous route for canoes over a large district of country, and are valuable for their fisheries. Sugar maples occur on some of them, and a farm of potatoes and corn is cultivated by the Indians with good results. The lakes for a long distance empty northward into the West Branch of the Spanish River; and further west into the Mississagua, Garden, Batchewaning, and Moose Waters. Of this lacustrine plateau very little is known, except along the surveys of the C. P. R. Its northern slope is a region of muskegs, sandy prairies, frequent streams, and sharp ridges of sand rock at long intervals. The centre is occupied chiefly by lakes surrounded by fine grooves of timber, and probably abounding in fish and waterfowl. Its southern declivity inclines to clay, and will be found more suited to agriculture than the northern slopes. The rock on the slope is chiefly Huronian, and on the highest altitudes Laurentian much denuded by glacial action. The whole region is

STRONGLY IMPREGNATED WITH MINERALS.

and several clearly defined bands cross the railway. An exploratory line from Nemagosendu to Sault Ste. Marie would be very useful in revealing the true character of the country. In 1882 a party ascended the Mississagua, and struck N-W from Green Lake to the head of the Montreal River of Lake Superior. They traversed a region of rich brown clay, treeless, covered with straws berries, and abounding in clear lakes with large springs visible in their bottoms. The leader of the party seemed to consider it well suited for settlement and the lakes are adapted for trout breeding. It may be years before we know the full value of the land we hold, but the hardy settlers of Bruce Mines region will yet scale the rugged escarpment which binds their settlement to the north and reveal the worth of uplands beyond. The canons through which the Garden, Mississagua, and Spanish Rivers descend are wild and beautiful, and will in time become favorite resorts for tourists. The slope north-ward is very gentle, and all its waters are collected over an extend of 250 miles into one great estuary known as the Moose Waters emptying into James Bay From the head of the Ottawa to the Michipicoten all the streams flowing north converge to the outlet and for a very extensive water system. Long reaches of these streams are navigable and if the land between were occupied by Swedes and Finns the region would soon become valuable. When

THE COAL AND IRON

of that land are made available, and its character better known, it may prove that Ontario has a N. W. of its own, that Mowat Land may possess advantages unknown in Manitoba, and that its mines, stock, and fisheries may prove an important factor in the future resources of Ontario. A survey of the whole region now confirmed to Ontario, which would give a definite knowledge of its resources in land, timber, minerals and fisheries, would bet he means of attracting to its development a large amount of capital and energy which are at present working elsewhere or lying idle. While deeply regretting the check given to progress in the North-West by present troubles, it becomes our duty to call the attention of intending immigrants to the country we have nearer home and with no possibility of Indian or half-breed troubles to annoy. Ontario has homes for a million more as good as the average of the North-West and more easily accessible.

THE CLIMATE.

Owing chiefly to its remote position and partly to its latitude Northern Ontario (Algoma and Nipissing) is commonly supposed to be a very sterile and inhospitable region. The writer, during a portion of five seasons spent in various parts of this district, has tried to obtain reliable data as to its true climate and agricultural capabilities. Briefly, the spring opens about the same time as in the county of Bruce, so far as foliage and grasses are conterned. Owing to immunity from fall frosts, crops are often sowed very late, and often every new settler has some clearing to do in spring before seeding. Hence the general impression that spring is very backward and cold. During the past summer more attention has been paid to gardening, and the results have been quite satisfactory. Tomatoes sown from seed in open air ripened early in September, while oats sown in July were safely harvested in October. The wild grape grows luxuriantly on islands in Lake Nipissing, the plum, cherry, and high bush, as well as marsh cranberry, on its shores; and the usual small fruits abound everywhere. I found the wild plum on the plateau of Archer, 1,350 feet above sea level, also in the Spanish River near Pagamasing; and it is rumoured that it extends to its source. A few patches of potatoes near swamps were touched late in June, but recovered, and did well, while

ALL FIELD CROPS WERE A FAIR AVERAGE,

though very poorly put in, owing to lack of teams and implements in this new region. Grass along the road was magnificent, one head of timothy shown measured 20½ inches, and blue joint on flats is frequently taller than a man. Of the adaptation of climate to successful settlement there can be no doubt, and of the fertility of the soil as little; the only question then is—Is there sufficient soil to be found to repay the search for it? The average of the country I have traversed—between Bruce Mines and Callander—would give in the vicinity of 40 p.c. of arable land, nearly all free from stone, balance solid rock. Some townships average 80 per cent., and form fair settlements, while tracts will only be fit for grazing purposes. The amount of moisture is very suitable for agricultural and grazing; the record at Sturgeon Falls, on Lake Nipissing, for the last year, being, Dec., 1883—Rain, .7; snow, 21.5. Jan., 1884—Rain. .2; snow, 9.3. Feb.—Rain, 0.3; snow, 10.5. March—Rain, 4.05; snow, 2.6. April—Rain, 4.25; snow,—. May, rain, 2.32; June, 2.08; July, 3.30; Aug. 1.07; Sept., 5.04; Oct., 3.96; snow, 2; Nov., 3.11; snow, 5.7; rainfall for the year, 30.11 inches; snow-fall, 49.8. It may be remarked that both rain and snow came very seasonably—that no trains were blocked, and scarce a day in which men could not work in the woods. With these facts in view and that the lowest temperature was —36°, the average of February being +8°, we only reasonably conclude that the region is not only habitable but salubrious.

A REVOLUTION IN TELEGRAPHY.

THE SURPRISING INVENTION THAT MAY SUPERSEDE THE TELEPHONE AND THE MORSE SYSTEM.

A new application of electrical science has been made in Philadelphia that promises to go far towards revolutionizing telegraphy and supplanting the telephone in popular favour. It is nothing less than the discovery of means by which anybody capable of manipulating an ordinary type-writing machine may, with equal ease, rapidity and precision, send and receive messages over a telegraph wire. Should this invention do all that is claimed for it, and, indeed, that it seems fully capable of, there seems to be no good reason why the places of expert Morse telegraphers may not be filled everywhere by girls, clerks, expressmen, station agents and other non-experts, so at once reducing greatly to the public the cost of telegraphy, and increasing facilities by the establishment of telegraph offices throughout the country in places where they have not heretofore been. For reasons best known to the company controlling this most important invention, its operations have until now been kept a secret. The office and operating rooms have been carefully guarded against reporters, and the men interested have been as close-mouthed as if it had been a political mystery, instead of a step in progressive science that they were concealing.

THE NEW SYSTEM.

The distinguishing features of the new system—which takes its name from the inventors, Mr. George M. Hathaway and James H. Linville—are the entirely novel transmitter and receiver employed. Those two instruments, although put near together here upon a table, have between them about a hundred miles of ordinary telegraph wire coiled about the room, through which their connection is made. In point of fact, the transmitter and the receiver are exactly alike, the same machine serving for either use as required. Its front is almost the key-board of a caligraph or type writer, the letters of the alphabet and the numerals standing up on elevated keys. Back of this is a small wheel lying horizontally, upon the circumference of which the letters and numerals are in high relief. Behind this is is a vetical column, around which blank paper is placed, and by a simple mechanical contrivance moved up line by line as desired. The paper almost touches the lettered face of the wheel. A small inking roller, governed by a spring, supplies colour to the lettered wheel. Inside the column is a small hammer that strikes the paper against whatever letter may be directly before it, and so prints it upon the surface of the paper. All that seems simple enough.

THE MYSTERY IS BELOW,

in the intricate and delicate electrical attachments by which variously graduated currents are led over the thirty-eight or forty wires from the keys to the printing apparatus, and at the same time to a connected instrument far away to record both simultaneously and with a perfect accuracy on every key that is struck. The wire connecting the instrument is single, but those graduated currents not only pass along it without confusion, but even meet and pass in opposite directions at the same time. This was fully demonstrated in to day's tests. The touching of a key instantly produced a letter upon the paper of both instruments, and letter after letter followed as rapidly as a skilful type-writer operator could touch the keys until many messages had been exchanged. It was observable that the wheel, when retrogression in the order of the alphabet was necessitated, whirled close back to a fixed point each time, as the wheel of a "gold and stock indicator" instrument does, but it moved with much greater rapidity and so little affected transmission that forty to fifty words per minute were easily sent by a person who was not at all an expert, and received automatically at the other end of the line without errors.

THE DISTINCTIVE ADVANTAGES

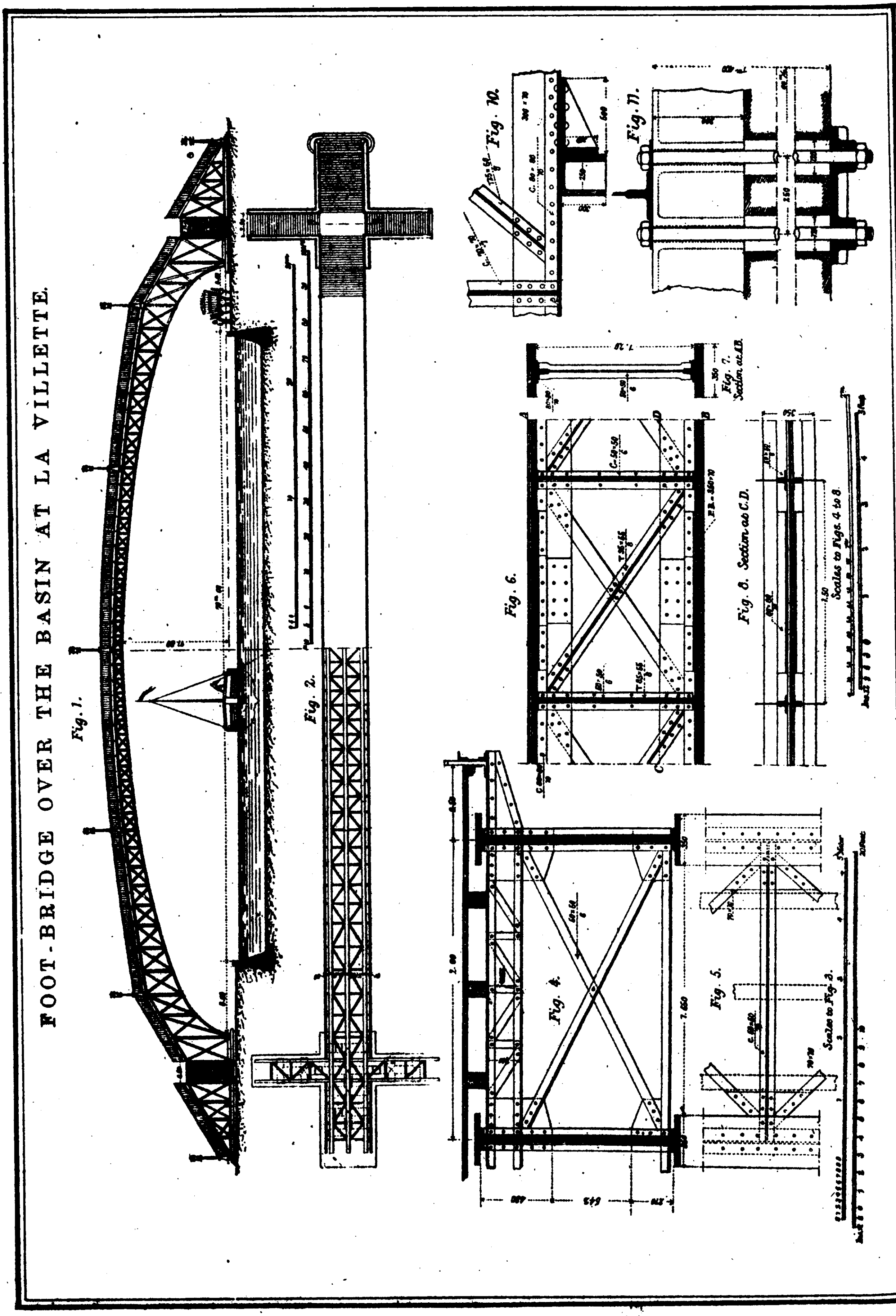
claimed by this system over all other telegraphic, telephonic and type-writing instruments are in its simple and inexpensive construction, and the ease of operating it. Any person who can read can transmit and receive messages through it as correctly as could the most experienced expert using the Morse instrument. It is as rapid as it is accurate, and all messages by it being automatically printed, both at the point of transmission and that of reception, they can be received with safety and reliability in the absence as well as in the presence of the recipient. The recording of messages at both points precludes all questions of errors in transmission. It cannot be read by sound, and is consequently the only method for preserving privacy the electrical communication. It is at once a stock indicator, telephone and type-printing telegraph. For railroads and express companies, bankers, brokers, merchants and all commercial purposes—it being adjustable to any system of wire communication and capable of working with any number of tributaries—it is of inestimable value. It is not a verbal telephone, but will supersede that instrument by silently and rapidly recording all messages upon paper. There are no formidable complications in its construction, end it is regarded by expert electricians as a wonderful achievement.—*N. Y. World.*

COUNTERWEIGHT AND COUNTERBALANCE.

By M. A. Beck.

On this subject you doubtless have room for one more, so I send you a copy of some brown-paper sketches made several years ago, which show the action of counterweight with more or less clearness. The notes adjoining the sketches are as made on the originals, and may be convenient for reference.

Counterbalancing is a matter that can be attained with some


FOOT-BRIDGE OVER THE BASIN AT LA VILLETTE
Fig. 1.
Fig. 2.
Fig. 4.
Fig. 5.
Fig. 6.
Fig. 7. Section at A.B.
Fig. 8. Section at C.D.
Fig. 10.
Fig. 11.
Scales to Figs. 4 to 8.
Scales to Fig. 3.

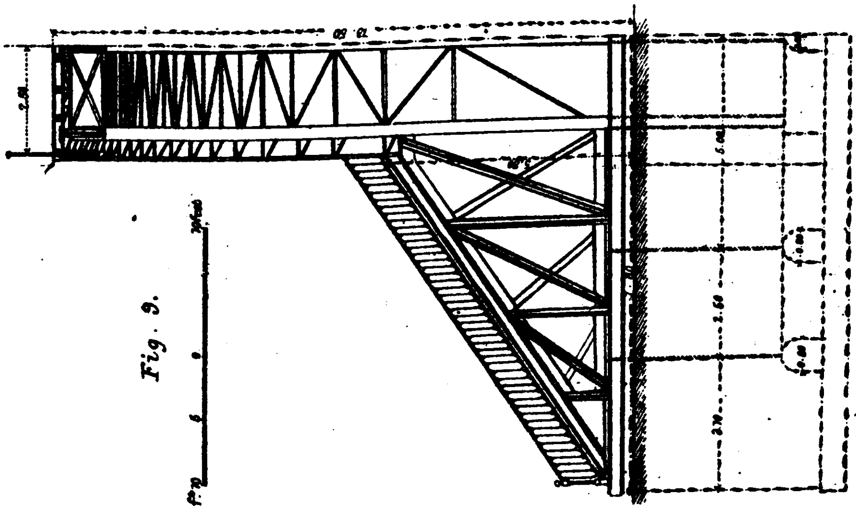


Fig. 9.

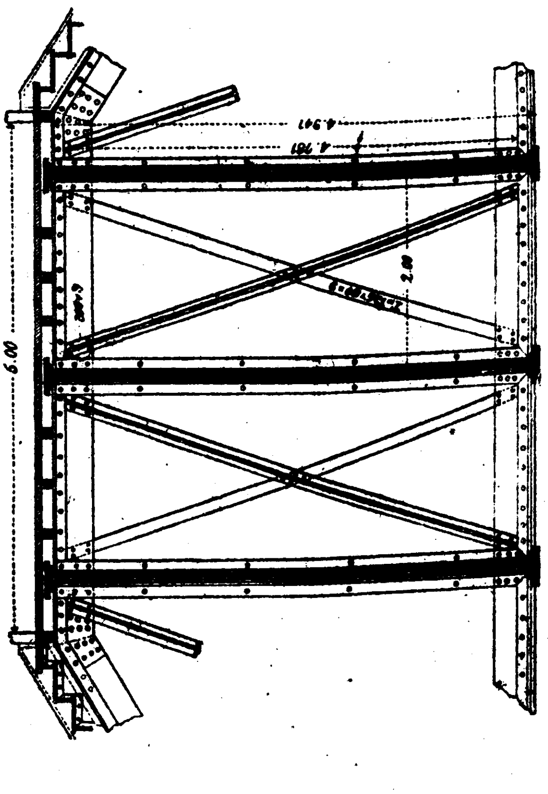
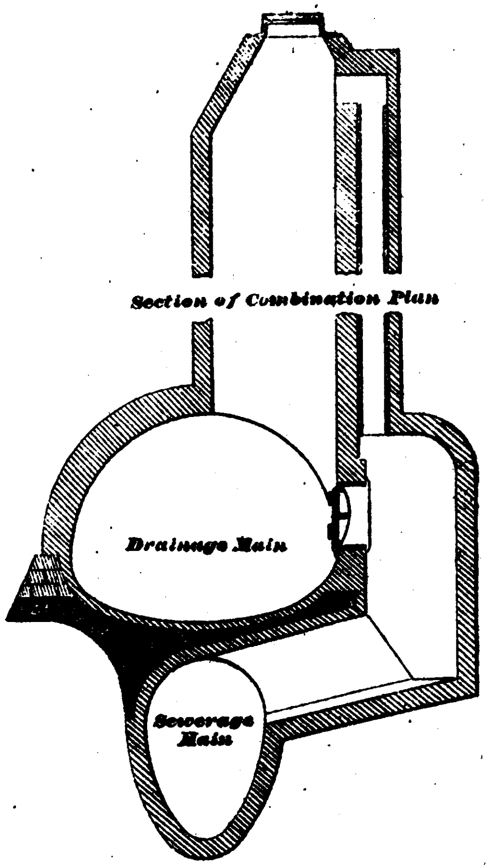


Fig. 3.



Section of Combination Plan

degree of nicety only when pre-determined conditions are adhered to. Any change of load, speed, steam pressure, etc., especially in those automatic engines depending on a single valve for admission and exhaust, will produce disturbance which cannot be counteracted except by altering the weight of the reciprocating parts and counterbalance to harmonize with the effect of a greater or less admission and compression.

It is mainly by the action of the steam in the cylinder that the reciprocating parts of a high speed engine can be properly counterbalanced. The work of counterbalancing is partly, through this elastic medium, transmitted to the frame or non-reciprocating parts, and must be counterweight in a measure by placing its equivalent in effect opposite the crank-pin. The cylinder and frame form the opposite element, on the one side, to the accelerating and retarding force necessary in effecting this balancing; and the requirement of a counterweight, for horizontal balancing, diminishes as the ratio of required accelerating force to the inert mass of frame, cylinder etc., is increased.

In all easy-running engines the tendency of the reciprocating parts and of the counterweight will be in the same direction while the crank is on and passing either center. At these points the counterweight can have no effect on the reciprocating parts, and hence, its centrifugal effort, if sufficient to neutralize the initial accelerating force, would produce all that is needed. But we should none the less take into account the relation between the reciprocating and non-reciprocating masses of the entire engine: "Action and reaction are equal and opposite;" so, if we shoot a wedge between the cylinder head and the piston, and an equivalent in effect of the steam entering, the tendency of the wedge to shoot the reciprocating parts in one direction, and the cylinder, frame, etc., in the opposite direction, will be as the relative masses. At the initial point the horizontal movement of the reciprocating parts is opposed by the main bearing, but the tendency, with proper accelerating force, is there none the less, and (if repetition be allowed), the tendency of the counterweight being in the same direction, its effort should be just sufficient to neutralize the effort made by the frame to move in the direction opposite.

The recoiling effect of compression and admission in the engine is analogous to the action of a cannon. The greater the ratio between mass of shot and gun for any given velocity, the less the recoil; and the greater the ratio between the mass of reciprocating mass of engine, for any given speed, the less recoil, and therefore the need of a counterweight to pull in the opposite direction at the same time.

An engine of the Corliss type, with a simple unbalanced crank, and with cylinder and frame of sufficient weight to secure strength and stiffness, will run quite as steadily as an ordinary high speed engine, with a crank disk balanced in the usual way, to secure good results. Not that balancing at high speed is sovery difficult, but simply because it is difficult to get a builder to construct, or a customer to pay for, an engine with sufficient metal in the framing to secure the same ration between the work of reciprocation and the inertia of the non-reciprocating mass in one case that there is in the other. So long as builders will insist on making light engines, and running the mat high speeds, just so long will we have engines demanding the closest attention and the best of lubricants while they are making an effort to shake, even the unshakable.

In no case should the non-reciprocating mass (the shaft and wheel must be left out) be less than five times the initial accelerating force. Designed in this way, the weight and proportion of the engine will bear special reference to the speed it is intended to run at—the reciprocating mass, in case of high rotative speed, being fixed with reference to crank effort.

Ordinarily, we may make the frame, cylinder, etc., of mill engines of the Corliss type about fifteen times the weight of the reciprocating parts, and secure good results in running.

In counterbalancing, if we place a weight opposite the crank equal to the crank and pin (the reciprocating mass multiplied by the initial accelerating force and divided by the non-reciprocating mass) good running will result, and the main bearing will be free from the abuse commonly received by overbalancing.—*Am. Mach.*

ACCORDING to the Jewelers' *Circular* French clocks represent the highest perfection in the way of decorative clock cases. English clockmakers claim and deserve the reputation of producing the most accurate timekeepers, while to the American manufacturers belongs the credit of making the best timekeepers at the least possible cost.

DR. SANG ON THE FORTH BRIDGE.

We fear that the worthy and venerable secretary of the Scottish Society of Arts must have unintentionally caused a flutter of alarm in the minds of the City clerks and other readers of a recent issue of an evening paper, wherein it was stated on his authority that "from a geometer's point of view" the construction of the Forth Bridge was "inadmissable," because amongst other enigmatical reasons as "no collection of even numbers could make an odd number, there must be either deficiency or redundancy." Commenting on the "elaborate paper which Dr. Sang read in three portions before the Royal Scottish Society of Arts," a leading Highland journal observed: "It is rather alarming to find a scientific man of Dr. Sang's eminence and responsibility, declaring that the Forth Bridge is being built on unsound principles. He would not say it was unsafe, but then his principle is that a structure which is theoretically unsound is practically unsafe, even although by waste or redundancy of material the margin of strength over and above its power to hold itself together may make it practically of use for the purpose intended. The paper will, no doubt, receive attention from scientific men." It is quite possible that it may. Frequenters of the London parks can hardly have failed to notice that guardsmen, for some reason seem to derive a pleasure from watching the evolutions of an undrilled squad of volunteers, and the same touch of nature may no doubt make scientific engineers regard for a few moments with interest the secretary's "Elementary view of the strains on the Forth Bridge due to the shifting load."

Dr. Sang devoted his first evening to proving to the Fellows of the Society that if one end of a balanced double contilever be loaded, a compensating weight must be applied somewhere on the opposite side of the fulcrum, in other words he conclusively demonstrated that if a weight be placed in one pan of a pair of scales an equivalent mass of matter must be loaded into the opposite pan, or balance will not be attained. Applying this principle to the central pier of the Forth Bridge he found that "an amount of ballast must be heaped upon" the central to prevent the cantilever tipping under the possible contingency foreseen by him of the train covering one cantilever only. Had Dr. Sang any knowledge of the subject-matter of his paper or of bridge building of any kind, he would have known that unfortunately the dead weight of steel required for the construction of a 1700 ft. span bridge must necessarily be so considerable that no "ballast" or holding-down bolts could be required at the central pier to balance merely the unequally distributed and comparatively insignificant weight of a train.

The investigation having been advanced so far the first evening, Dr. Sang next directed the attention of the Fellows to the "Geometry of the Cantilever Truss," and on a subsequent evening to the "Statics of the Cantilever Truss," or rather of the central or Inch Garvie tower, which rests on four piers arranged at the corners of a rectangle 260 ft. by 120 ft. In dealing with this part of his subject, Dr. Sang's troubles very quickly commenced. "The tower," said he "cannot terminate in a single point; it would make the bridge stand on three feet. When there were four struts converging, and when some known pressure is applied, thereto, it is *impossible to tell* what share of that strain is borne by each." Again, with a rectangular top, certain struts or ties are "redundant, and *therefore dangerous*. . . . The presence of the other member changes matter entirely; it creates strains rising toward infinity. *Unless the compressions and distensions of the parts be sufficient*, the strains must come to exceed the capabilities of any material. Our minds cannot grasp the idea of infinity; let us come down to finitude," and so on, with a continued repetition of "no one can compute the strains." and "no one can tell," until the bewildered investigator at last frankly confessed that these elements "create an unneeded, an intolerable, anxiety." It is to be regretted that the estimable secretary of the Scottish Society of Arts should have subjected himself to this "unneeded, intolerable, anxiety," but probable the same result would have followed his acceptance of the command of the Channel Fleet or any other important duty outside of his own experience.

Engineers will at once see that the cause of all Dr. Sang's troubles is his ignorance of the fact that the problems he sets himself to solve require for their solution a knowledge of the laws of elasticity, that is to say, of the laws which connect the stresses on a body with the alterations of dimensions the parts simultaneously undergo. His difficulty is the same in kind as that the schoolboy experiences when facing his first quadratic equations, or the farm labourer when asked to sign his name; it is not that the thing cannot be done, but that he does not know how to do it. On some other planet perchance Dr. Sang may find a material which does not extend and compress under stress, and some of his fictions about the Forth Bridge may there become facts. But in this sphere engineers have to deal with things as they exist, and in steel they have a material of practically perfect elasticity within the limits of working stress. So far from its being impossible to calculate the stresses on a rectangular frame with two diagonals, the problem is one which any properly trained engineering student would solve for Dr. Sang, with any required degree of accuracy. Dr. Sang, therefore, should have substituted the phrase "I cannot tell" for "no one can tell," and he should have avoided the use of the word "dangerous" when addressing an Edinburgh audience on questions relating to the design of the neighbouring Forth Bridge.

A knowledge of geometry no more consititutes a man an engineer than the possession of a handsaw makes him a carpenter—it is merely one of the tools with which he works, and an unskilful use of it may do him much mischief. Dr. Sang once touched upon the true fringe of the subject when he said, "unless the compressions and distensions of the parts be sufficient." It is for the engineer, and not the the geometer, to say whether they are sufficient. The latter might be pardoned for imagining that the individual wires of a colliery rope would snap in succession like so many stitching needles in passing over the drum of a winding engine, but the engineer is required to be better informed. In dealing with such a problem as that presented by the Inch Garvie tower resting on its four piers, the engineer would first satisfy himself as to the amount of compression, if any, of the different piers. The foundation in that special case being on solid rock and the piers of solid masonry he would know from practical experience that no unequal settlement could occur. He would further know from the results of thousands of experiments on the extension of steel bars and on the deflection of rivetted girders that the modulus of elasticity might be taken as constant, and with these data he would calculate the stress on any member in the Forth Bridge as exactly as Dr. Sang could that on the string of a plumb-bob. Neither would the engineer experience any difficulty in deducing the stresses if the piers and foundation were of some partially compressible material, for he would ascertain experimentally the limits of the possible unequal settlement of the four piers, and introducing that quantity into his equations he would arrive with the same exactness as before at the stresses on different parts of the structure.

A geometer ambitious to deal with engineering questions like those essayed by Dr. Sang, should first get an engineer to give him the requisite practical *data*, and then himself carefully observe the practical behaviour of such objects as six-wheeled locomotive engines, four-wheeled carriages, and four-legged tables and chairs. He would then realize that questions of elasticity enter into most problems of practical construction and that in this world at least a three-legged stool is not the most generally useful type of structure. A few months hard study would satisfy him there is no royal road to learning, and he would then, if wise, decide to avoid the odium of quackery and leave difficult engineering problems to be dealt with by qualified practitioners.

There is something almost pathetically comic in the spectacle of the venerable secretary of the Scottish Society of Arts suffering "intolerable anxiety" because the central tower of the Forth Bridge has four legs like a table or chair, and further frightening himself by foreseeing "how a builder seeking to strengthen the scaffolding may bolt on diagonal ties and unwittingly prepare a downfall." Neither is the statement "the objectional character of this arrangement seems not to be understood by engineers, I shall take some pains, therefore, to make the matter clear," without humorous suggestion, for it recalls Mr. Punch's militiamen who when out of step with the rest of the regiment, honestly believed that the others were wrong. Unfortunately at least two of Dr. Sang's audience appear to have missed seeing the humorous nature of the consequences which followed the adoption of Dr. Sang's hypothesis of a material of construction which would not change its form under stress, for an Edinburgh paper reports a Mr. Westland to have remarked "no one could say anything against what Dr. Sang had said, his theory was perfectly correct," and a Mr. Reid to have added, "he would be inclined to doubt some of the calculations of some of the people who had to do with the Forth Bridge."

How far an elementary view of the Forth Bridge stresses, or of any other complicated scientific question may prove useful or the reverse, depends of course upon the mode of handling. A tourist may obtain a sound elementary view of the allitudes attained in his rambles by means of an aneroid barometer, but to use the results to correct the levels on an Ordnance map would not be a mark of wisdom. To boil the barometer would be simply a joke: "I make a barometric observation"—said Mark Twain in his "Tramp Abroad"—"to get our altitude. I boil it half an hour in a pot of bean soup the cooks were making. The result was unexpected, the instrument was not affected at all, but there was such a strong barometer taste to the soup that the head cook; who was a conscientious person, changed its name in the bill of fare."

Dr. Sang "boiled the barometer" on three several evenings at the Scottish Society of Arts. As not a single stress or strain on the Forth Bridge is correctly given in the paper, nor could by any possibility be ascertained by the methods therein set forth, we would suggest that following the above precedent, the name "An elementary view of the strains on the Forth Bridge" be changed in the "bill of fare."—*Eng.*

A HOUSE FULL OF ELECTRICITY.

If Benjamin Franklin, the electrician and proverbial philosopher, who snatched lightning from the skies and the sceptre from the hand of Solomon, had been one of the invited guests at the house of E. H. Johnston, in Thirty-sixth St., the other evening, he might have been as astounded as Macauley's New Zealander in the streets of modern London. The spectacle of his kite-led current, as docile as the "slaves of Aladdin's lamp," turning wheels and obeying human wishes in various ways might have overcome the imperturbility even of one who was accustomed to stand before kings. But we have reversed the spirit of his age, when all that was unknown passed for the magnificent. For modern invention has accustomed us to sup on wonders and rise unsated from the feast.

Mr. Johnson is a practical enthusiast. Zeal and knowledge go not tandem with him but as a team. Others have lighted their houses with electricity but he has turned his into a Pandora's box, "a paradise of dainty devices."

A Christmas tree stood on his second floor. Its top nearly touched the ceiling and its roots were set in a hollow pedestal. This tree was hung with tinsel, toys and candle. If the candles on it had been lighted and it had remained still it would have been like other Christmas trees. But instead it kept turning on its base, and six times with every revolution two score tiny electric lights of red and purple and white twinkling out of the evergreen branches. All the evening the six score lamps went through their polychromatic permutations except where the kaleidiscope was stopped to explain its mechanism. It was then seen that the tree was simply an entertaining part of M. Johnson's practical plan of lighting his house by a dynamo machine in the cellar. The same current that supplied a sixteen-candle lamp ran the motor causing the tree to revolve, and also by an automatic device brought into circuit the little lamps, which were enveloped in French tissue paper. "What an attraction for a show window," some one said. "Why not?" replied Mr. Johnson. "Add to the colors and then surround the whole pageant with mirrors and multiply them indefinitely."

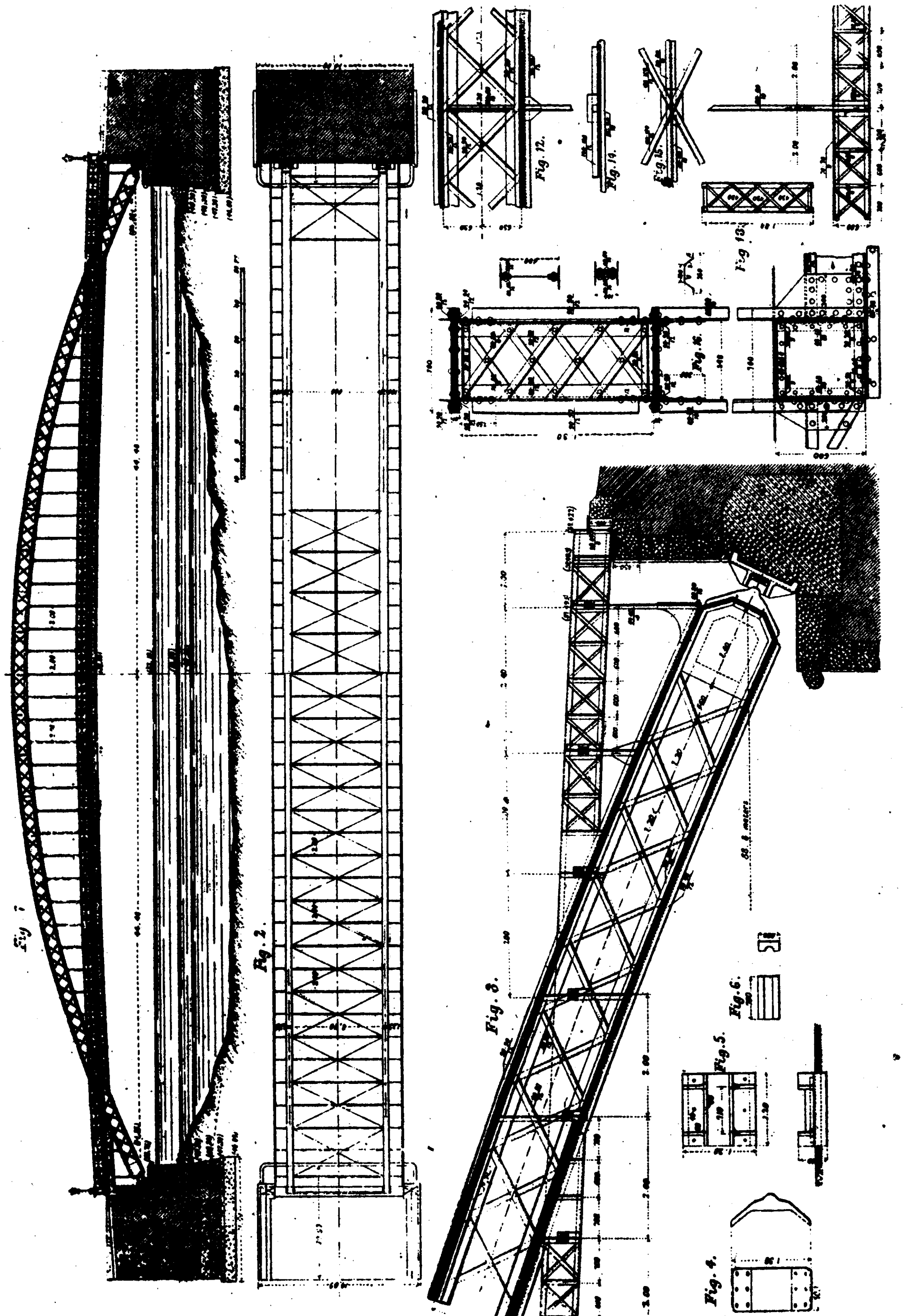
"Your fire looks comfortable to-night," remarked a guest glancing at an open grate that radiated a mellow light. "I call that 'my sellers fire,'" said Mr. Johnson. "You see I have concealed a few electric lamps there in pine shavings. I intend to put them inside of cannel coal covered with isingglass, to make the effect more realistic. We dont't need a fire, as we use the exhaust steam that runs my machine to heat the house."

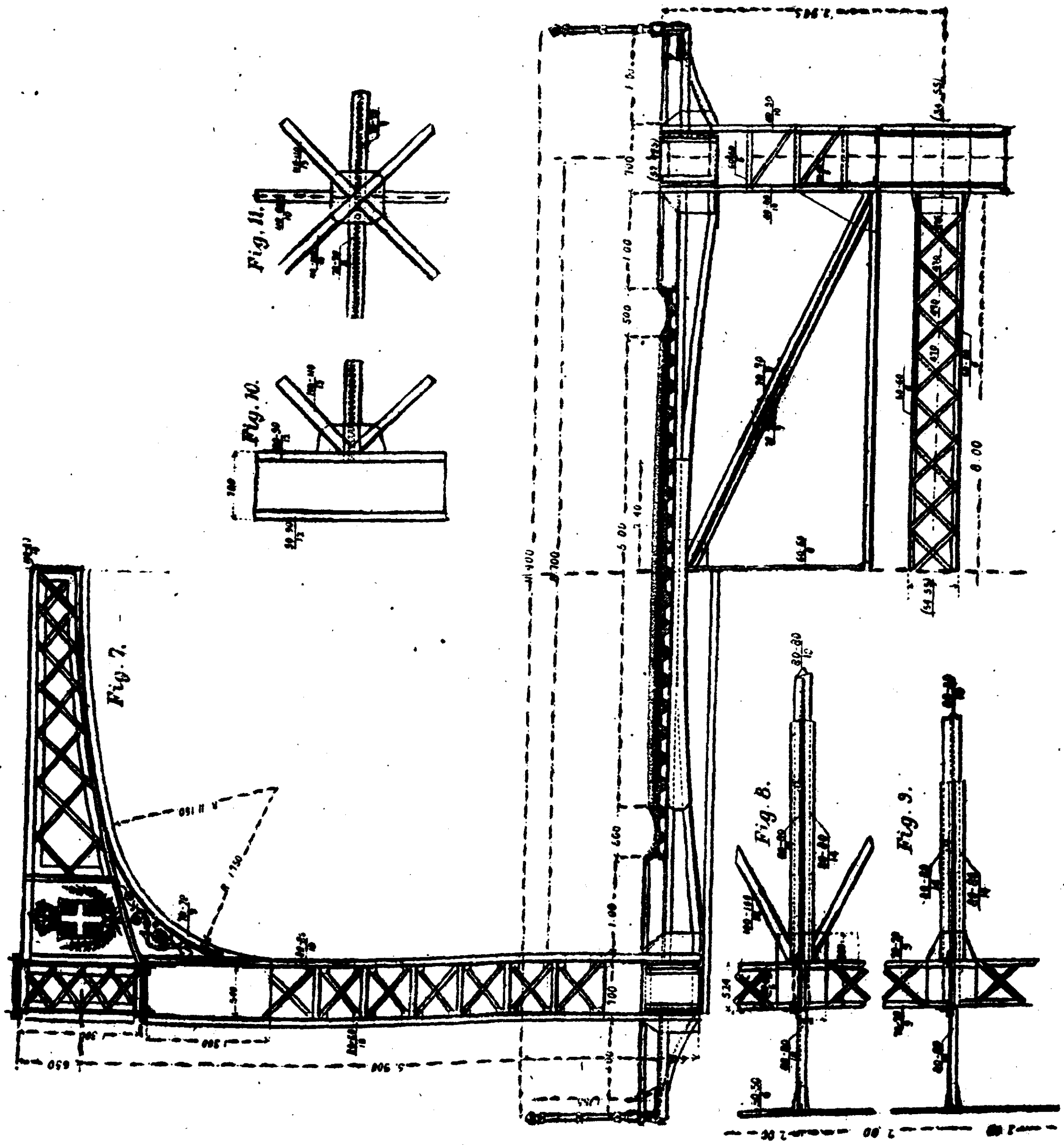
"It is the spectacle of the burning bush over again," remarked a well-read observer. "But more easily extinguished," and the host pressed a concealed button, and the light disappeared.

On the parlor floor he showed various contrivances, as useful as they were ingenious, for lowering the light at will, singly or in groups. "All the wires on this floor run back to the safety catches in the window seat," added Mr. Johnson. "I have thus provided against the possibility of being left in darkness by making each series of lamps on the chandeliers independent of each other."

I want to show you my Landseer by the electric light," he continued. The nearest lamp was unscrewed from its socket

BRIDGE OVER THE RIVER ADIGE AT VERONA.





BRIDGE OVER THE RIVER ADIGE AT VERONA.

and suspended by a wire inside of a tall porcelain vase. The current being applied the picture of an Alpine shepherd surrounded by his dogs was displayed in graphic relief like a cameo. Nothing could surpass the fidelity with which the light revealed the minutest shading of the artist's brush.

"That is the only true way to show a painting," said the host. "No arrangement of light upon a canvass can produce so purely natural an effect. Every artist who sees this is enraptured by it. Billiard players are equally pleased with the lighting of my table," he continued, leading the way to the billiard room in the basement. "These two lamps are adjusted and the light is so reflected from the ceiling that I defy you to find a shadow on the table either under the cushions or the balls. You would suppose that with a thirty horse-power engine nearly under this room some noise or trembling might be perceived. [A few of the more curious went below. Even after entering the cellar the throbbing was so light as to be almost imperceptible.]" "The floors are well cemented, and I have muffled the walls as you see, but the engine runs so smoothly that it might almost be set up anywhere. I run that pump by an electric motor, and keep the upper stories amply supplied with water. As for heat, I have enough steam left over after making my light to heat the house thoroughly. Several of my neighbor's houses are wired for the light, and I intend to supply them with it shortly."

At the lunch table later in the evening, Mr. Johnson was asked to prophesy on the future of the electric railway. "I don't like to prophesy unless I know," said he. "Still my opinion is that within two years one division of the elevated road will be operated by electricity. The problem has been worked out except in its details. To furnish the power in sufficient quantities is a matter of course with the demonstrations that have already been made in electric lighting. But just as in that business there are manifold devices for the regulation and use of the current, the outcome of hard experience, and not to be dispensed with in the commercial sense. Once get the electro-motive force under control and absolute safety is secured. Each section of the track can be so isolated that a collision will be impossible. To light the cars from the same source that supplies their motion is easy. Oh, we are only in the infancy of this science," said the electrician, as he lit his cigar by an electric lighter.—*N. Y. Tribune.*

HOW A "CORNER" IS WORKED.

The speculators in the grain markets often engineer a rise or a decline in prices, almost entirely irrespective of the supply on hand or even of the crop prospects. Corn or wheat will frequently be quoted several cents per bushel higher for one month's deliveries than for other months. The newspaper reports may give the cause of these wide fluctuations as a "corner," a "gamble," or the efforts of speculators. Hence it may interest our readers to know how a "corner" in grain is worked.

Corners in grain are only possible when there is an excess of short sales. And, if one understands the theory and practice of short sales, he can readily understand the working of a corner. In regular business, when a man sells grain he actually has the grain to deliver, but in speculation a man sells what he has not, with the hope of being able to buy and deliver the goods at a cheaper figure. But every bushel thus sold must be brought back at some figure, higher or lower, before the transaction is or can be closed. And right here is where the mischief comes in. In regular business when a man sells anything that is the end of the transaction, but every speculative sales involves another buying transaction of equal size and amount. And this is called "selling short," because in such deals a man agrees to deliver what he does not yet own, and hence he is short or minus that amount of actual stuff and is compelled to buy at some price. He can buy it the next day or he can defer it a month or longer if he chooses. The man who sold September corn short in August, must buy back all that he sold before the close of September, or pay the price difference in money.

During last August or before, an immense amount of corn was sold short in this market for September delivery. The price of corn at that time was thought to be higher than it would be when September came round. Wheat was so low, and the promise of the new crop was so good, that traders concluded there would be a drop of at least ten cents a bushel, and so they all rushed in to secure a part of the prospective profits. And if the market had been let alone they would have come out all right. But after millions of bushels had been thus sold for future delivery, some parties put their heads together and bought up all the cash corn in the elevators and then went into the market and bid up the price, taking all that was offered and still bidding higher for more. Very soon some of the shorts saw the market going against them and began to buy back at a loss what they had previously sold. This, of course, greatly increased the number of buyers and sent the market up faster. After the boom was fairly under way no one dared to sell short any more, and the only corn obtainable after that point was reached was in the hands of the parties who were runnning the deal; hence they were at liberty to put what price upon it they pleased, provided they bought from day to day all the actual corn which came in over the railroads and all the speculative corn offered. The entire corn supply, therefore, was virtually locked up by the parties running the corner.

Those sellers who filled in or bought back what they sold before the price got too high, escaped from the trap set for them with but little loss, but many others got mad and vowed they would not buy until they got ready. The parties running the deal could not force the delinquent fellows to buy until the last day of September, but they could force them to put up margin-money enough to more than cover all the difference in price between the low point and the high. Hence a corner always settles itself after a while into a tussle between the victorious longs and the mad shorts, and in this contest the price can be put up to any figure the first party decides upon. The situation and the deal are entirely at their mercy, and the shorts must eventually settle at the price fixed for them by their antagonists, or appeal to the Board of Directors, to come to their rescue and fix a marginal price, which appeal, in this case, was successful, though it is not always so. Such, in plain and untechnical language, is a brief description of the famous corn corner of September, 1884.—*Chicago Journal.*

NEW SYSTEM OF MILLING IN FRANCE.

The revolution in milling, brought about by the use of rolls in Hungary and America, and the preference shown by bakers for roller flour which, according to inventors, is to supplant stone flour everywhere, is at present a matter of great consideration with French millers. However, the advantages obtained by roller milling are as yet not sufficiently tangible to convince the entire trade, and cause it to adopt that system unhesitatingly. Roller millers have certainly produced flour superior to stone flour, but what is the cost of production, and what the percentage of yield? With regard to color, roller flour is undoubtedly unsurpassable, but it is obtained at the expense of a number of operations, which necessitate various mechanical complication, and a skilled class of mechanics, all of which increase the cost of production. For these reasons, millers are loth to incur the heavy expenses of changing their mills, and would prefer to keep their millstones, which shorten and simplify milling, and which, although they do not produce superfine flour, yield an excellent and medium grade, which comes up to the popular requirements.

If the system of stone milling were ever so little improved upon, it would have nothing to fear from the competition of rolls, for the cost of the former will always be less. To obtain this is the object I have in view, and which I believe I have attained. The success of my system would be a boon to the milling trade, since the only alteration necessary is the preparation of the stones, without making any radical change in the mechanism. The result obtained by the use of rolls, led me to investigate whether the system of stone milling was not open to improvement, and whether the principles introduced into France from England sixty years ago, and improved by us at that time, but which have remained at a standstill ever since, had reached the limit of perfection. The experiments which I have made have convinced me that a marked improvement in color can be obtained by following lines different to those which have been adopted up to the present in the system of stone milling. In the ordinary millstone dress the surface of the stones has a large number of furrows running from the skirt toward the eye. The planes which separate these furrows from each other are called lands. In the latter lines are cut with a pick, and are called cracks.

These cracks have to be put in afresh every eight or ten days, and to do this well is the supreme point of the miller's art. There have even been invented machines in order to attain greater perfection in this. Although the system of furrowing has been in use sixty years, there is no definite theory on the subject. It is made accordingly to the general adopted style, or even according to the phantasy of the miller. The furrows are more or less numerous, wider or narrower, rectilinear or curved, without any precise knowledge as to the advantages possessed by any one of them above the others. I have frequently observed the embarassment of practical men when questioned on the subject of furrowing. The utility is recognized by them, but they are unable to define it, I will endeavor to do so in the following manner:

It is easy to understand that the smooth surfaces of two disks, one of which revolves, would be useless for grinding up and disintegrating the component parts of wheat. The particles squeezed between the two surfaces could not be acted upon by centrifugal force; they would revolve for an indefinite period with the stone, and be flattened out without moving toward the skirt. It is therefore necessary that the pressure exerted on the particles should be interrupted so that they, when under the action of the revolving stone, may move toward the skirt, The duty of the furrow is to interrupt this pressure, as well as to offer hollow spaces over which the stock will travel, then work up the inclined plane of the furrow, and finally be ground between the lands. In this definition, the role of the furrows in the runner is not exactly the same as that of the bed-stone furrows; their chief use is to break the pressure, to propel the stock, to ventilate the working surfaces, and to help to grind by the action of their corrugations. Formerly, French millers used the porous Ferte-sous-Jouarre stones only, without furrows. Their system was that of high grinding, in which there was a space between the surfaces, allowing the stock to follow the action of centrifugal force. The roughness of the stone, assisted by a coarser dress, rather than by pressure broke the wheat. Moreover, when the English system of dress was applied to French stones, the result was a failure. When the English introduced American mills into France, they brought into use "la Ferte" stones of a less porous nature and a system in which the furrows occupied one-quarter of the surface, and the lands three-quarters. In the present system, the custom is to have a large plane surface, and to make the furrows much narrower than the lands, as the latter only do the grinding by means of the careful dress with which they are provided.

The modifications for which I have taken out a patent are based upon totally different ideas; I do away with the land almost entirely and widen the furrows. My millstones have more hollow than plane surface. The hand is reduced to a narrow convex strip. The principles which I laid down, and the data I have followed are as follows: 1. The wheat is subjected to too much friction between the surfaces of the lands, and the result is that a part of the external coloring matter and of the germ is attached from the hull, and discolors the flour. The wheat, when reduced to flour, is subjected to a superfluous frictions which can only lower its quality. 2. The wide furrows in my system are intended to carry the stock to the skirt much quicker, and to discharge it after a small number of revolutions. 3. In the usual system, the stock travels only about 6 centimetres for each revolution of the stone, and takes from six to eight revolutions before being discharged.

In my dress, the stock is held between the stones for barely three revolutions, during which it comes into contact with the grinding portions 120 times. The product contains more middlings: an excellent point, since better flour is made after from the latter, after separation from the bran and purification. The lands are not cracked and are almost smooth. The system of cracking, a matter of so great importance to millers, and to which so much attention is devoted, is prejucial to good grinding. In my system the wheat is crushed by pressure as the points of contact of the two stones, just as in roller grinding it is broke at point of contact of the rolls. The stones clear more quickly on account of the wide furrows; the speed is reduced in order to diminish the pulverization of the bran; and to lessen the friction on the stock, my millstones are smaller than is the present custom.—*A. Dard, in le Meunier.*

CONDITION OF CARBON IN STEEL.

A report of a committee to the English Institution of Mechanical Engineers states that the results of many experiments made appear to warrant the following conclusions in regard to characteristics, recognizable by chemical examination, that are exhibited by different portions of one and the same sample of steel presenting marked physical differences consequent upon their exposure to the hardening, annealing, or tempering processes.

1. In annealed steel, the carbon exists entirely, or nearly so, in the form of a carbide of iron, of uniform composition (Fe_3C or a multiple thereof), uniformly diffused through the mass of metallic iron.

2. The cold rolled samples of steel examined were closely similar in this respect to the annealed steel, doubtless because of their having been annealed between the rollings.

3. In hardened steel, the sudden lowering of the temperature from a high red heat appears to have the effect of preventing or arresting the separation of the carbon, as a definite carbide, from the mass of the iron in which it exists in combination; its condition in the metal being, at any rate mainly, the same as when the steel is in a fused state. The presence of a small and variable proportion of carbide of iron in hardened steel is probably due to the unavoidable or variable extent of imperfection or want of suddenness of the hardening operation; so that, in some slight and variable degree, the change due to annealing takes place prior to the fixing of the carbon by the hardening process.

4. In tempered steel, the condition of the carbon is intermediate between that of hardened and annealed steel. The maintenance of hardened steel in a moderately heated state causes a gradual separation (within the mass) of the carbide molecules, the extent of which is regulated by the degree of heating, so that the metal gradually approaches in character to the annealed condition; but even in the best result obtained with blue-tempered steel, that approach, as indicated by the proportion of separated carbide, is not more than about halfway toward the condition of annealed steel.

5. The carbide separated by chemical treatment from the blue and straw tempered steel has the same composition as that obtained from annealed steel.

HAND-SCREW STEERING GEAR.

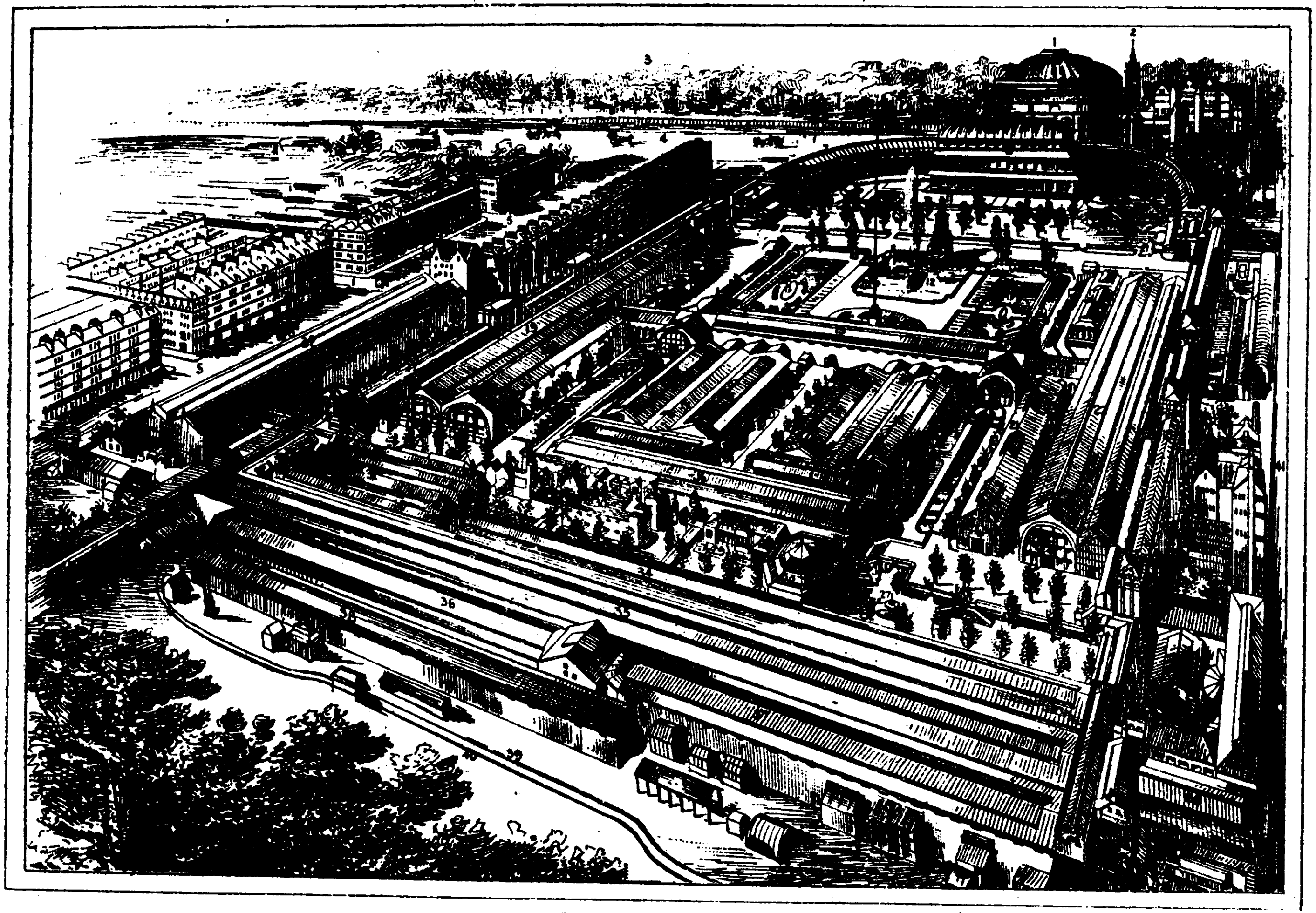
Although steam steering gear is almost universally used on board steamers, it is requisite that the spare gear aft, and which is almost always screw gear, should be of the most substantial character, and also that the means of connecting and disconnecting from the one to the other should be both simple and reliable. To this end Messrs. J. Hastie and Co., Kilblain Engine Works, Greenock, who have had above thirty years experience in the manufacture of screw steering gear, and above ten years in steam steering apparatus, have recently brought out some improvements in steering apparatus, which we now illustrate.

The after steering apparatus is mostly used when the vessel is on a course, and it is also an emergency gear utilized when any accident happens to the steam gear or when the steering chains give way. These breakdowns usually occur at a critical time, and if the vessel is not at once got under control by the after gear being connected, she falls into the trough of the sea; any attempt to connect the after gear at this critical moment is apt to result in another breakdown, owing to the violent oscillation of the rudder under the action of the waves. To obviate this danger Messrs. Hastie used a frictional brake of a peculiar kind, which we illustrate above, and which controls the rudder effectually in a few seconds without shock, and does not interfere, even in the case of old vessels, with any existing apparatus.

A is a cast-iron or steel brake made either a sector or a complete circle, and attached to the ordinary steering quadrant B. The lower part of this sector is by preference grooved circumferentially, as shown at C, and has a corresponding wood piece D fitted into it, the ridges of one surface fitting into grooves of the other. This wood is cased between the plates of a lever E, working from the fulcrum F. The lever is operated by a screw, which is actuated either by a rod inserted in holes in the boss G or by a ratchet H, one or two strokes of which put the bearing surfaces either in or out of contact. The grooved surfaces are of great importance in obtaining a firm grip, as with the same pressure on the screw the grip is many times greater than with the flat surfaces of a wheel, the result being that the necessary holding power is obtained with proportionately less lateral pressure on the rudder stock. The quadrant form of brake fulfils in this application all the conditions of a complete wheel, without any additional space being taken up beyond that occupied by the ordinary quadrant.

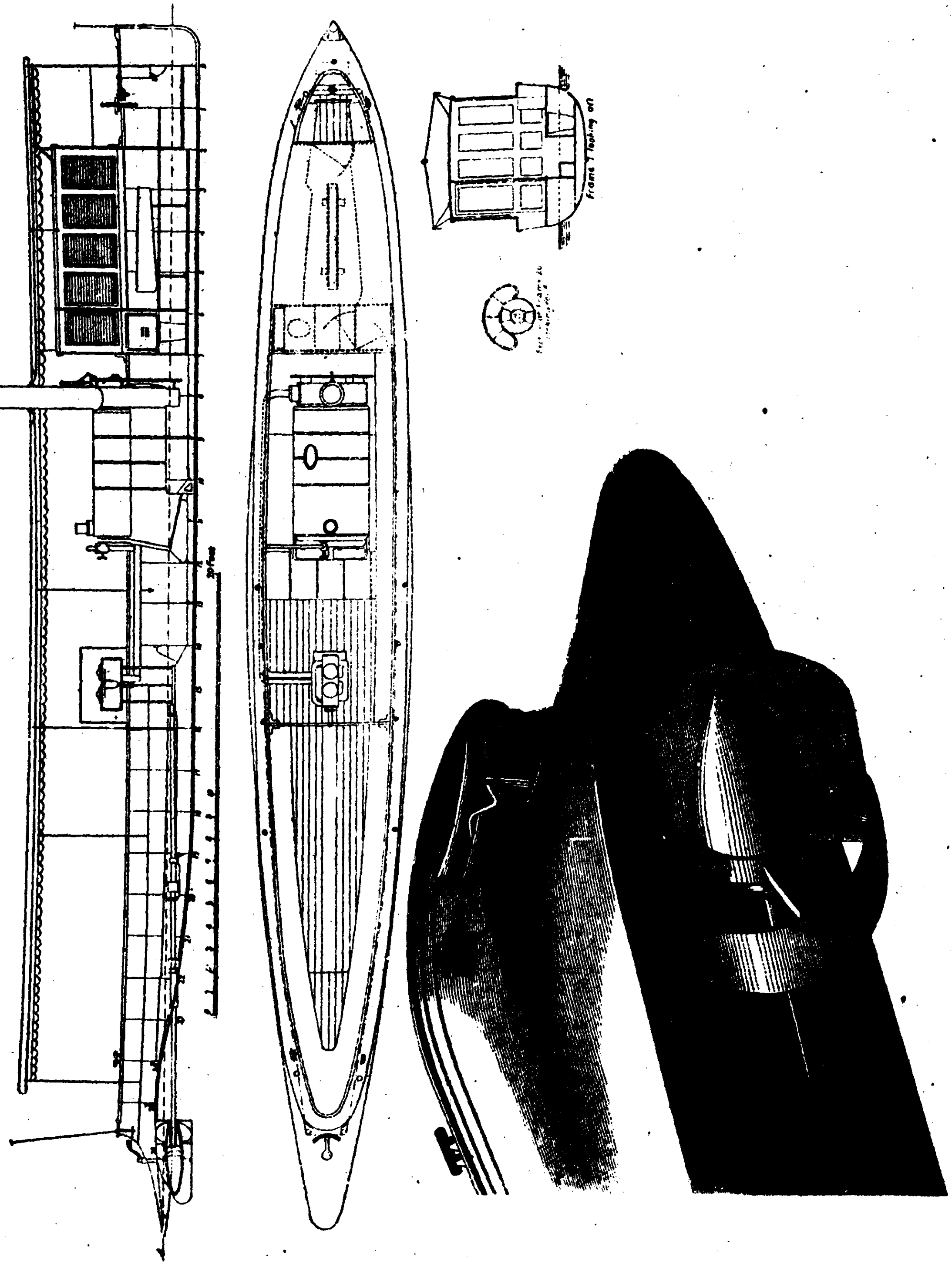
The particular method of working the brake shown on the engraving is only one of many methods available to suit the

BIRD'S-EYE VIEW OF THE INTERNATIONAL INVENTIONS EXHIBITION.



REFERENCES.

1. Royal Albert Hall.
2. Albert Memorial.
3. Kensington Gardens.
4. Kensington Gore.
5. Queen's Gate.
6. Conservatory.
7. West Quadrant.
8. East Quadrant.
9. West Refreshment Pavilion
10. East Refreshment Pavilion.
11. Prince Consort Memorial.
12. Fountain.
13. Central Gallery.
14. } West Central Gallery.
14. }
15. } East Central Gallery.
15. }
16. South Central Gallery.
17. West Arcade.
18. East Arcade.
19. West Gallery.
20. West Annexe.
21. East Annexe.
22. East Gallery.
23. Smoking and Refreshment Rooms.
24. Cheap Dining Rooms.
25. Conference Hall.
26. Principal Entrance.
27. Fountain.
28. Water Pavilion.
29. H.R.H. Prince of Wales's Pavilion.
30. Old London Street.
31. Machinery for Electric Lighting.
32. Queen's Gate Annexe.
33. Queen's Gate Entrance.
34. } South Galleries { North Court.
35. } { Middle Court.
36. } { Dining Rooms.
37. } { South Court.
38. Kitchens.
39. Electric Railway.
40. Pneumatic Railway.
41. Exhibition Road.



SHALLOW-DRAUGHT STEAMER WITH GUIDE-BLADE PROPELLER FOR THE NILE.

requirements or peculiarities of each particular ship. It can also be arranged for working by the foot of the man steering by the after hand gear.

One of these brakes was applied to the rudder of the Peninsular and Oriental Company's last new vessel, the "Chusan," and was severely tested at sea with such satisfactory results that it has been specified to be applied to the vessel now building for that company by Messrs. Caird, of Greenock. Messrs. Hastie have also devised a safety guide for use when the steam steering gear is in operation, and when of course the hand gear must be disconnected. The disconnection is usually effected by removing the taper pins J which join the large screw nuts K and the connecting-rods. These connecting-rods I, being then free, move by the action of the crosshead, which works in conjunction with steam steering gear, and are apt to come in contact with the screw nuts referred to, and break down the gear. By the new arrangement the connecting-rods and pins, when removed, work in the slot M of the safety guide, where they can do no damage, and where they are available at any moment should an accident happen to the steam gear requiring the connection of after hand screw gear. In large vessels slide blocks are fitted into the guides.—*Eng.*

THE LANE SECTIONAL BOILER.

Messrs. Howard Lane & Co., of Palmerston Buildings, E. C., shown the Lane sectional boiler, of which we give an engraving, and they also exhibit at the same stand a small boiler under steam with an engine, dynamo, and electric light, arranged to illustrate their system of illuminating the interior of steam boilers. This boiler consists, as will be seen, of a number of inclined wrought iron tubes arranged in vertical rows, each tube being closed at its lower end and fixed at its higher end to a connecting casting. This casting is divided into two parts by a partition, and within the main tubes already mentioned are smaller tubes, the front ends of which are fixed on the partition just referred to. Referring to our illustration, in which the direction of the water current is shown by arrows, it will be seen that the water descends on the front side of the partition just mentioned, enters the inner tubes, and is conducted by them to the rear ends of the main tubes, it then returning to the front through the annular spaces between the inner and main tubes and raising up to the collecting drum, where it is discharged through a curved hood, which throws the water downwards, allowing the steam to be seperated from it. The arrangement of the setting of the boiler is very clearly shown by our illustration, and will require little description. It will be seen that the front part of the fire is covered by a firebrick arch, which tends to promote completeness of combustion, while the inclined tubes carry screen tiles, as shown in the detail view, Fig. 2, which deflect the escaping gases and cause them to pass partly round each tube, delivering them directly under the tube above.—*Eng.*

CEMENT TESTING MACHINE.

Of the two testing machines exhibited by Mr. V. de Michele, of 14 Delahay-street, Westminster, one is new patent automatic cement testing machine, invented by him, and of which we give an engraving. Some of our readers will be familiar with a machine bearing Mr. V. de Michele's name, which has been extensively used, the principle of this machine being that a strain was applied through the medium of the cement briquette at the short arm of a bent lever to lift the long arm which was weighted. When the leverage was so increased as to be too great for the cement to sustain the briquette broke. This machine was not automatic, the power being obtained by means of a worm and wheel. In the present machine, as our illustration shows, the briquette is broken by the right-hand lever falling and raising as it does so, through the medium of the briquette, the other lever. The weights on the right-hand lever are placed farther from the fulcrum than are those on the left-hand, hence the automatic motion which is kept most completely under control by means of the small oil cataract shown in section. The handle can be set to break a briquette or series of briquettes as slowly or quickly as may be desired, but the standard test is that the strain be applied at the rate of 100 lb. per second on the square inch. The machine can be stopped at any period of the stroke, and when restarted applies the strain at the same rate as it did before the stop. A feature in these machines is the new arrangement of index which has been adopted. When the briquette breaks the left-hand lever falls slightly, releasing a spring which has been moving the index up the graduated quadrant and leaving it, marking the strain the cement broke at. The non-automatic machine (the other machine exhibited) is on essentially the same principle as the automatic type, only that the weights are so placed that the levers are in equilibrium at all portions of thestroke; the briquette being broken by the slight constant hand pressure of a few pounds. In this case the oil cataract andgear is, of course, dispensed with and a very simple and efficient machine is provided. The workmanship is of a high class and the machines, being simple, are no likely to get out of order, but to render the automatic machine serviceable, under any ciscumstances, it is provided with two holes in the right-hand lever, one being where the weights are fixed in a non-automatic machine. Thus, in case of any derangement, the toothed quadrant has only to be taken off, the studs holding the weights fixed in the second holes, and the machine is again ready for use. In the same way a non-automatic machine can be at any time supplied with automatic gear should its owner so desire, the holes for the weights being already provided.

BELLAMY'S MULTITUBULAR BOILER.

As an example of large boilers we give illustrations of one for Demerara, and rated by Mr. Bellamy at 40 horse-power.

This boiler is 12 ft. 7½ in. long by 7 ft. 6 in. in diameter, and it is constructed for a pressure of 80 lb. per square inch. It is fitted with one of Fox's corrugated furnaces, 3 ft. 10 in. in diameter, inside, and from this 37 tubes, 4½ in. diameter, extend to the near end of the boiler. From the back chamber thus formed the products of combustion return through 32 tubes, 5 in. in diameter, to the front end of the boiler, where iron smokeboxes are provided, which communicate with the chamber in which the boiler is set. From this chamber the gases finally pass off to the chimney through the flue shown in the section, Fig. 1.

The boiler illustrated has 22 square feet of firegrate area and 738 square feet of heating surface, from which it will be seen that a powerful boiler is obtained within very limited dimensions. The boiler is carried upon two cast-iron standards, filled in with brickwork, and from the manner in which it is set the shell can be readily examined externally. The arrangement of the furnace fittings is worth notice. As is very commonly done in corrugated furnaces, a shield plate is provided below the grate to give a smooth surface, from which the ashes can be readily raked, and this plate has been turned to account to carry the furnace fittings. Thus the firebar bearers, the casting for carrying the bridge, and the dead plate are all fixed to it, and thus all necessity of attaching these parts to the furnace itself—a frequent cause of leakage—is avoided.

In boilers of a large size than that illustrated, Mr. Bellamy prefers to use two furnaces, the general construction being otherwise like that we have just described.—*Eng.*

AN ENGLISH ENGINEER ON AMERICAN MACHINERY.

Mr. Arthur Rigg, C. E., in the course of a paper, read before the Society of Engineers on American engineering enterprise, says:

"Those who commence doing everything which imperfect knowledge considers cheap are little aware how wide-spreading are the consequences of such an opinion being entertained by themselves and communicated to their work people. That idea not only saps the foundations of permanent success, but also poisons the springs of all honest dealing. It acts by the force of an evil example, and consequently depreciates the quality of manufactures. Many of our goods are already nearly driven out of foreign markets in spite of our immeasurable advantages, and are being replaced by the productions of American and foreign countries. If there is much to see and admire in Canada and the United States, there is nothing more worthy of imitation than the system which prevails there to so large an extent, of having the best of everything, whatever it may seem to cost—a system which insures prosperity to trade self-respect to the manufacturer, and one that is consonant not only with the sound principles of political economy, but also with ordinary common sense. Some people seem imbued with an idea that anything said in praise of either American or of foreign workmanship involves an unpatriotic distinction of what we produce at home. This is very narrow view of things, for without having any sympathy with that cosmopolitan philanthropy, which exalts every country at the expense of our own, it is plain that we can never indulge a generous ambition, nor aspire to lead the van of progress, if we shut our eyes wilfully to what goes on in the world around.

"There are no countries from which we can more fairly take example than those whose original inhabitants come from this. America has been peopled by the more energetic of our own race, who now possess a country of marvelous internal resources. By the help of their laws and to their enormous gain, new inventions are eagerly soughtafter, and talent meets great encouragement. There a man does not need to labor for many long years in perfecting an invention, taking the doubtful protection of those statutes of limitation called our Patent Laws, only at last to find his ideas appropriated by another—a pirate who takes undue advantage of the numerous pitfalls by which an inventor is encompassed. And for another reason, it is no wonder that foreign countries get ahead of us, when even their government wisely encourage every new departure, every improvement in existing methods. With them there is little of that nervous timidity about anything out of the beaten track, and none of that provoking interference due to the conceited half-knowledge of those who have learnt enough engineering to meddle with and spoil what they cannot understand. Abroad, engineers are more fully trusted than here, and they are therefore more free to obey the sound maxims. Make sure first of those general principles you intend to apply; then trust them implicitly; and, finally, never be afraid to carry them out.

"The direct adaptation of tools to their intended purpose is very noticeable in all American machinery. In their planing machines, for example, everything is done to facilitate the attendant's labors by numerous little devices. The handles are arranged all ready for his use; and, as the table runs quickly back, its catch strikes against an elastic lever, and so moves the narrow belt with the utmost quietness, and only about half the distance needed for an English machine. Then this action puts a friction pall into gear, and it deliberately advances the tool for another cut. The driving pulleys of these machines are ranged along the side, so they need not be placed across the line of main shafting as with ours, and, altogether, this one example might serve as a text for a long dissertation upon the art of intelligent design, more particularly as contrasted with the clumsy planing machines which satisfy people here. Indeed, at one of our works the proprietor showed the writer an American machine for a different purpose, that was working well and with the utmost silence; while, not far away, was another doing corresponding work, and bearing the name of a large firm in this country. This latter was creating a deafening noise, and seemed as if concentrating its energies upon self-destruction every few minutes. A barbarous design, most appropriately named by its owner, as we left it, 'Brute Force and Ignorance.'

"In setting out manufacturing establishments of the best class in America, one cannot fail to notice that the object kept steadily in view is the need of cheap production with the disadvantage of expensive labor; and to this end the original first cost of machinery is considered of far less importance than any diminution of its productiveness, for that would be a continual drain upon profits. Settling the commercial aspects of any manufacturing concern may not lie strictly within the province of an engineer, but it ought to receive from him an amount of attention equal to its importance. That point where interest on first cost balances annual expenditure can be determined by very simple calculations, for if we assume capital all to be borrowed, and the machinery constantly in full work for fifty hours a week; and further, that a return of 10 per cent. per annum just covers interest, repairs, and depreciation, then it follows that unless an investment gives more than 10 per cent. it is not worth making. All excess over such interest becomes clear profit, and is frequently found enough to justify an opinion that no investment yields so high a return as first-rate machinery fully employed; and this is further illustrated by the old Lancashire saying, that it is always worth investing £1,000 to save the annual cost of one man's labor."—*Am. Mach.*

THIS country sends tower clocks all over the civilized world. In the United States the greatest demand for them comes from the North and West. The prices range from $500 to $5,000. There are a great many new school houses, city halls, court houses and other public buildings erected every year, and the demand is always good.

THE WASHINGTON MONUMENT.

The dedication of this structure, February 22, 1885, recalls the fact of the great engineering skill developed when the plan of the monument was changed and enlarged, whereby it was rendered necessary that the original foundation should be correspondingly enlarged and strengthened to enable it to bear the greatly increased weight. We therefore reproduce the statement of measures adopted for his purpose. The problem was how to get under the shaft. The plan adopted, a larger foundation was to introduce the masonry in three vertical layers about four feet width, having first tunneled under the structure with drifts of the same width and of the required height and length. These layers were connected with each other by dowel stones set in their faces as the work progressed, and with panal depressions in the alternate layers, into which the intermediate layers were molded. The material used in these layers was strong Portland cement concrete, except for a short distance just under the old foundation, where rubble masonary was forced in and wedged up under the stones of the old structure. The tunnels described were excavated in pairs on opposite sides of the monument, in such a way that the strain was equalized. During the course of the work the monument sunk a little, but, owing to the precautions taken, it practically settled squarely or evenly all around, so as not to displace the axis or disturb the equilibrium of the structure. Each of these pairs of tunnels was filled with cement before the next pair was excavated, and thus the work was continued until all the earth within the dimensions given had been tunneled out and replaced with concrete. To lock the old foundation in with the new, and distribute the pressure more uniformly over the new mass, three large buttresses on each side of the structure—twelve in all—were carried from the upper surface the new foundation up to and under the outer portions of the shaft; while to sustain the central portion of the old foundation a leg of concrete was projected under the middle of it, the well in the center being used as a means of access to the portion to be excavated and filled.

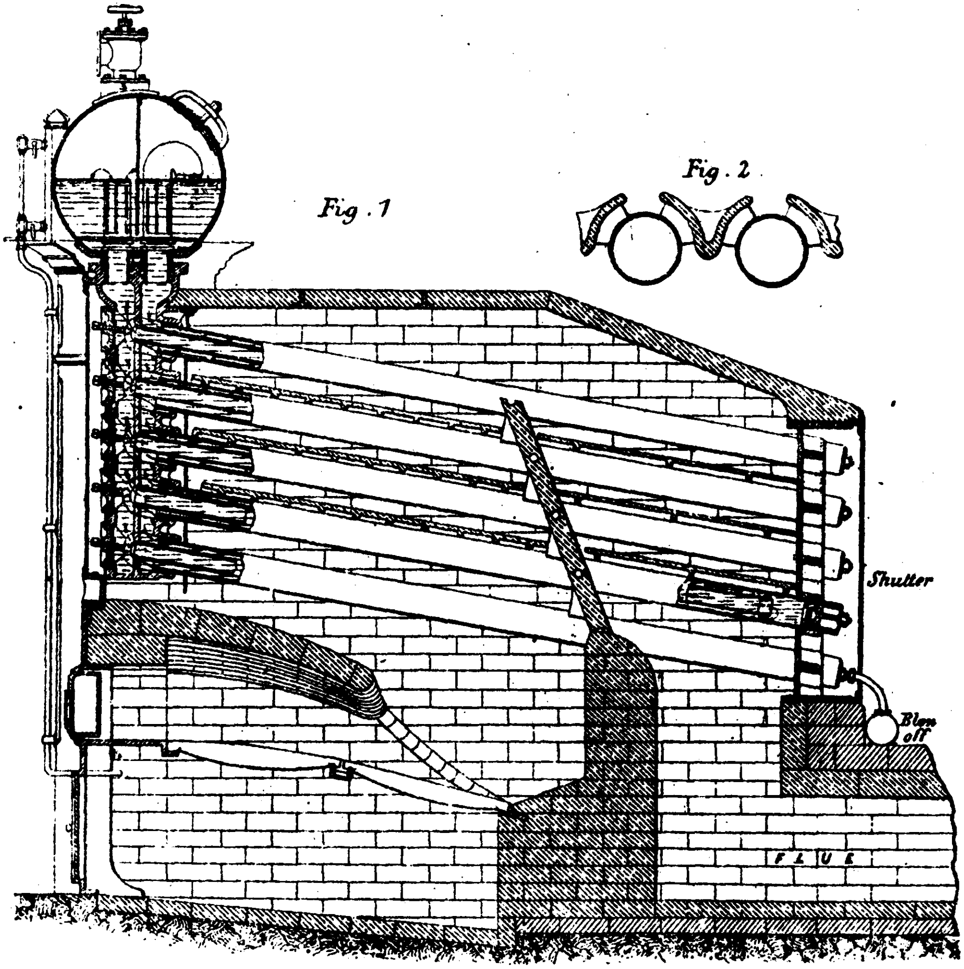
Thus the foundation was deepened thirteen feet six inches, and extended in all directions twenty-three feet three inches. Seventy per cent of the earth under the old foundation was dug away and replaced with a mass of concrete extending eighteen feet within and twenty-three feet three inches without the line of the outer edges of the old foundation. This mass of concrete extended five feet under the outer face of the shaft at its lowest joint, where it rests upon the foundation. This gave a new foundation 120 feet six inches square, and enlarged the area of the foundation from 6,400 square feet to 16,000 square feet. To distribute the pressure of the shaft over the new foundation, the old rubble stone base was torn from under the walls of the shaft and replaced by a concrete underpinning extending out upon the new concrete slab. In doing this fifty-one per cent of the cubical contents of the old stone foundation was romoved and forty-eight per cent. of the area of the shaft undermined. The foundation as completed extends thirty-six feet ten inches below the shaft and six inches blow the permanent level of water at the site of the monument. The total weight of the structure is 81,120 tons.

It is calculated that the pressure upon the bed of the foundation nowhere exceeds nine tons per square foot, and is less than three tons per square foot near the outer edges of the foundation. The shaft, as proportioned, both in dimensions and weight, is entirely stable, as against winds that would exert pressure of one hundred pounds or more per square foot upon any face of the structure.—*Ex.*

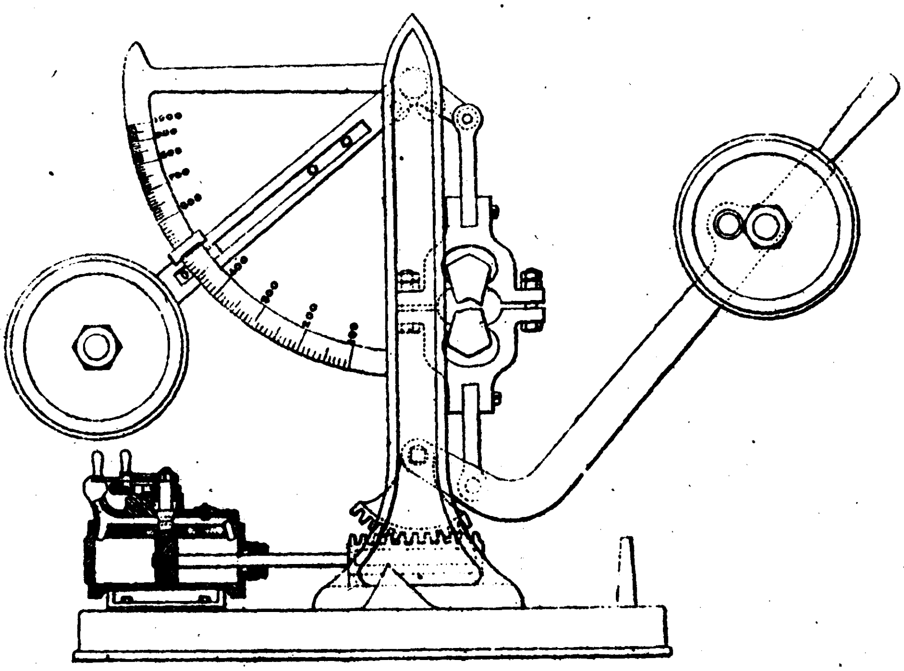
GLYCERINE FROM DISTILLERY DREGS.

"We are getting an excellent article of glycerine out of distillery dregs now," said a manufacturing chemist, "and soon as the fact gets to be generally known the refuse of the worm of the still will be worth more than it ever was before. Glycerine is a constant product of the alcholic fermentation of saccharine matter, and all fermented drinks contain quantities of it. In the distillation of liquids containning alcahol the glycerine does not free itself from the 'mother,' or dregs, not being volatile like the alcohol. The glycerine is taken from the mother liquor by the ordinary chemical methods, and superheated steam is then brought to act in the residuum, which removes the impurities and leaves a choice quality of glycerine."—*New York Sun.*

EXHIBITS AT THE INVENTIONS EXHIBITION.

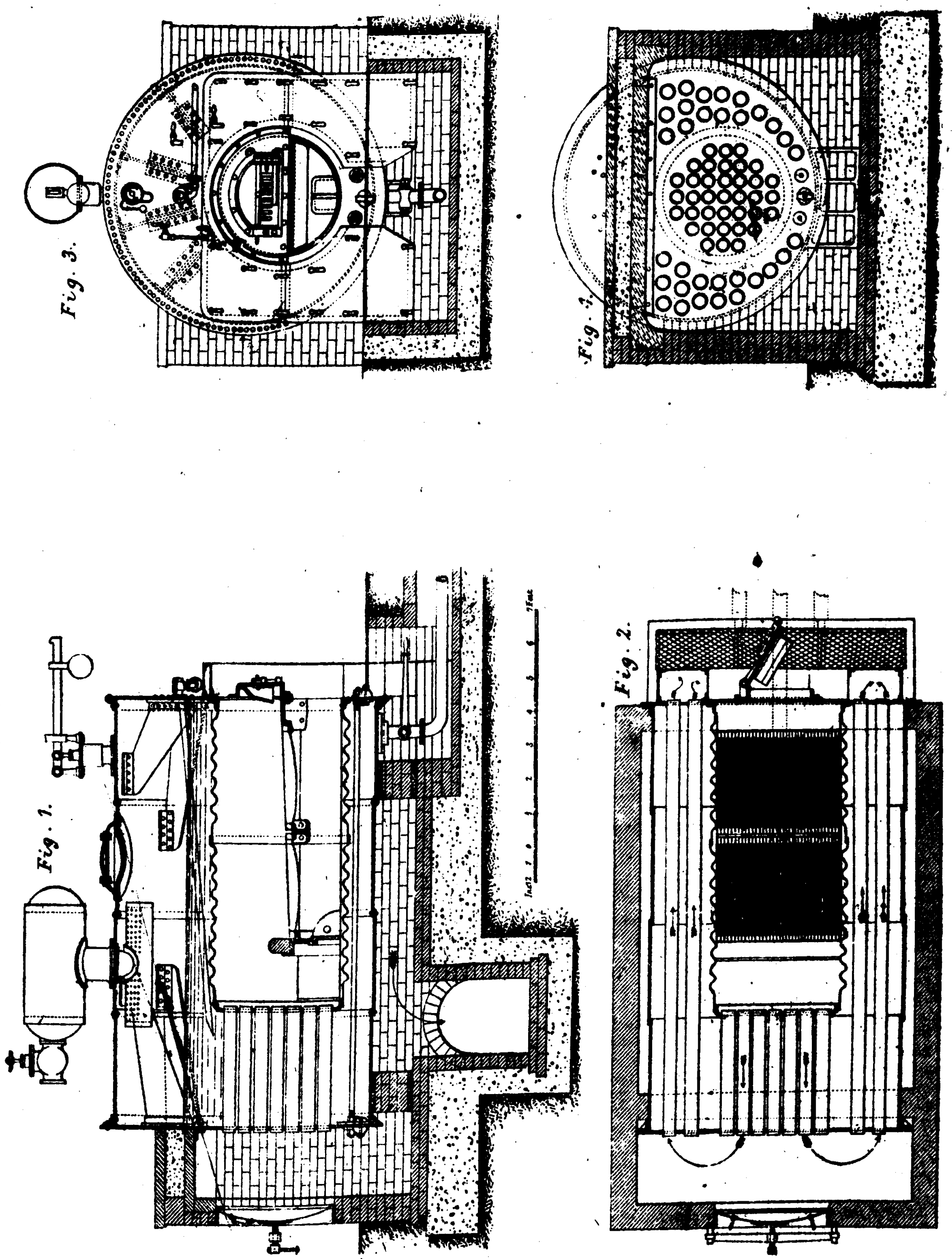


THE LANE SECTIONAL BOILER.



MICHELE'S AUTOMATIC CEMENT-TESTING MACHINE.

BELLAMY'S MULTITUBULAR BOILER.



THE PURIFICATION OF WATER.

At the International Inventions Exhibition, Messrs. Easton and Anderson, of London, show outside the Austrian Court a plant for the purification of water on a large scale by means of iron, the arrangement of apparatus being one patented by Mr. W. Anderson. Some twenty-eight years ago Dr. Medlock first called attention to the remarkrble power iron possessed of removing colour and destroying organic impurities in water, and Professor Bischof has laboured persistently in endeavouring to apply the process both to domestic use and to water supplied on a large scale. The spongy iron domestic filters enjoy a well-deserved reputation, and the bold attempt to purify the waters of the Nethe, from which the supply of Antwerp is derived, by filtration through a mixture of gravel and spongy iron, has met with very marked success so far as the effect on the water treated is concerned.

The objections to Professor Bischof's process on the large scale is that a very considerable area of land is required for the filter beds, that the cost of the iron in them is very great, and that some trouble and expense are incurred ln the periodic cleaning of the surface of the iron mixture, a process which necessitates the removal of the layer of sand over it. The apparatus exhibited, which we illustrate, is intended to overcome these difficulties. This is effected by abandoning the principle of filtration altogether, and resorting to the method of agitating or mixing continuously a comparatively small quantity of iron with the water, which, after treatment, is suffered to stand for some time in order that all the iron dissolved may become oxidised, and is then passed through an ordinary sand filter or allowed to get clear by subsidence. The general arrangement of the exhibit is the following: The water from one of the cascade basins is forced by means of a "duplex pump" through a 3 in. "revolving purifier" into a tank placed 17 feet above the ground and fitted up as an ordinary sand filter. The purified and filtered water is conducted by a galvanized wrought-iron pipe to the fountain in the Austrian Court and to the drinking fountains, while the overflow, wnich is purified but not filtered, falls on to a small water-wheel by which the "revolver" is turned, and then flows away by subterranean culverts to the centrifugal pump which operates the cascades.

The "duplex pump," by means of which the water is raised from the cascade basin, is no other than the Worthington pump, which has recently attracted so much attention as a new importation from the United States. It is, indeed, an American invention, but Messrs. Easton and Anderson acquired the patent at the time of the 1862 Exhibition when the pump was first shown, and have manufactured large numbers of greatly improved design since. The pump, which is capable of delivering 100 gallons per minute, consists of a pair of steam cylinders 5¼ in. in diameter and 12 in. stroke, each actuating directly an ordinary double-acting pump 3½ in. in diameter.

Steam is distributed by common slide valves, but the steam parts are double, one pair opening into the cylinder some 1¾ in. from the ends, and the other pair at the extreme ends in the usual manner. Steam is admitted by the outer passages and exhausted by the inner ones, but the piston is so constructed that it passes the cylinder openings of the inner passages, and by so doing closes them and imprisons a cushion of steam. The cylinders are steam-jacketted, and the cushion is effective up to the full pressure of the steam in the jackets. The valves are placed on the sides of the cylinders, and worked direct by levers actuated by studs on the piston-rod crossheads, the piston of one cylinder actuating the valve of the other. The effect of this arrangement is an extremely simple machine, which will start or stop by simply opening or shutting a cock on the delivery main of the pump. Pumps of this kind have been extensively used for the supply of towns such as Wisbech or Huntingdon, and for providing water under high pressure for working cranes, hydraulic presses, and rivetting machines, etc.; they pump direct into the mains, and produce a pressure varying from 73 per cent. of that due to the steam when working full speed, to 94 per cent. when brought up standing by the water being all shut off.

The patent revolving purifier consists of a cast-iron cylinder 2 ft. 6 in. in diameter, 5 ft, long, with closed ends fitted with hollow trunnions through which pass, through stuffing boxes, the 3 in. inlet and outlet pipes. The inside of the cylinder is furnished with six curved shelves or ledges, the office of which is to catch up the iron placed inside the cylinder and shower it down continuously through the water slowly flowing along. The iron, which may be of any kind in a fairly divided condition, cast-iron borings being the most effective, occupies about one-tenth the volume of the cylinder, and in this particular case weighs 2 cwt. The inlet pipe opens against a disc 1 ft. 5 in. in diameter, attached to the end of the cylinder, and within ½ in. of it; this compels the entering water to spread out radially in all directions, and so flow uniformly along. The outlet pipe is fitted with an inverted bell-mouth, so proportioned that the speed of the upward current through it is too low to allow any but the very finest iron to be carried up and wasted. The cylinder is fitted with a manhole and an air cock for letting out the gases which are sometimes apt to collect, and is driven by a spur ring cast on one of the end covers, actuated by a train of wheelwork which is brought into motion by a small overshot waterwheel through the instrumentality of a pitched chain.

The water from the purifier impregnated with iron is carried by a 3-in. pipe through the bottom of a wrought-iron tank 7 ft. square and 3 ft. deep, which is formed into an ordinary sand filter. The water falls from the delivery pipe some 4 ft. in the form of a thin bell jet, and in that way gets well exposed to the air. It runs through the sand at the rate of 12 cubic feet per twenty-four hours, and as the water is 18 inches deep over the sand, it will remain for three hours before it reaches the latter, thus giving sufficient time for all the iron to become oxidised and precipitated. The filter is capable of yielding about 2½ gallons of water per minute, the surplus delivered by the pumps, or 97½ gallons, after working the waterwheel by which means it is further aerated, flows into the return culvert leading to the centrifugal pump near the Albert Hall, where it is again lifted to play the cascades. The iron taken up by the water will be deposited in the culvert, which will thus act the part of a sand filter.

Three of the Anderson revolvers, capable each of dealing with 1500 gallons per minute, or together 2,160,000 gallons per day, were set to work in the month of March last at Antwerp, and are now purifying the whole of the water supplied to the city in a most satisfactory manner; the turbid and highly impure waters of the Nethe, quite as offensive as those of the Thames at London Bridge, are rendered perfectly colourless, brilliant, agreeable to the taste, and chemically more pure than any water supplied to London.

The quantity of iron consumed depends upon the quality of the water being treated, but it is not likely to exceed one-tenth of a grain per gallon, or say 14 lb. per million gallons. The cost will depend upon the current price of iron, but as borings and turnings form the best material, the expense is, in any case, very insignificant.

The power required to drive the machine is also very small, about half a horse power per million gallons per day.—*Ex.*

SAWYER'S REVOLVING GUN CARRIAGE.

The revolving gun carriage invented by Captain E. Sawyer, of Marchwood, Hants, is illustrated on page 181. The arrangement is intended to utilize the recoil produced by firing, by withdrawing the gun from the embrasure, and so insure greater security and speed, while the gun can be worked by fewer men. As will be seen from the drawings, the gun and its carriage are attached to a turntable which revolves on a centre pin. On one side of the turntable is a rack, into which gears a wormwheel used for training the gun. The turntable is mounted on a carriage, which runs on two circular rail tracks This carriage is made with two straight and two curved sides, with the same radius as the concentric tracks. The carriage is placed on four wheels, the axles of which converge towards the centre of the track, while the inner and outer pairs of wheels or of such different diameter that the tendency of the carriage is always to run around the circular track. As will be seen from the engravings, each embrasure is provided with two guns and similar concentric tracks, which intersect each other opposite the embrasure. From the face of the latter to the last point of intersection, the tracks are laid level, but for the rest of their length they slope upwards, so that when the gun is in the loading position, as shown on the left hand side of the engraving, its own weight helps it to run down to the embrasure, while, after firing, the force of recoil is rapidly absorbed as the gun is forced round the circular track. The gun carriage is linked by two bars to a pin in the centre of the circular track, in order to counteract any tendency of the carriage to leave the rails. As already mentioned, a special feature of this arrangement is the use of two guns for the embrasure, so that a high rate of firing can be maintained, since, as soon as one gun is fired, it retires to the loading position, leaving the embrasure clear for the advance of the second gun, which has been loaded meanwhile.

SUFT'S IMPROVEMENTS IN SMALL ARMS.

Figs. 1 to 3, illustrate Lieut. H. C. Suft's improvements in military and sporting small arms, the principal object of which is to provide additional security against accidental discharge, without interfering with the efficiency and handiness of the weapon. The service Martini-Henry is provided with an indicator on the outside of the lock-plate, to show whether it is loaded or not; it moves in unison with the striker, but affords no security against unintentional discharge by an accidental pull on the trigger. It is this defect which Lieut. Suft intends to obviate by the addition of a revolving pin in the stock behind the lock, and carrying a lever catch outside on the face of the lock-plate. At the end of this lever a notch is formed, rounded on the front face, and corresponding in shape with the upper end of the indicator. When the rifle is loaded, the lever engages with the indicator and the two are locked. On the pin within the lock-plate is a small arm projecting to the rear, held in position and pressed upwards by a steel spring sunk in the stock. Above the arm, and attached to it, is a pin which passes up to a thumb-plate in the upper part of the stock, on the spot where the thumb presses in the act of firing. Of the drawings given, Fig. 1 is a side elevation of part of a Martini-Henry, Fig. 2 is a longitudinal section, and Fig. 3 a transverse section on the line A B, Fig. 2. The indicator above referred to is shown at A, and it will be seen that it is identical with the present Martini-Henry indicator, except for the small notch made in the end. When the rifle is loaded, the position assumed by the indicator is that shown by the dotted lines, Fig. 1. The pin B, Figs. 2 and 3, which is set transversely across the lock, is free to turn in the lock-plates and on one projecting end it carries the catch C. On the same pin, between the lock-plates, is a small wheel D, with a projection D1, sustained on the under side by the plate spring E. The rod F is articulated to the projection D1, and its upper end passes through the opening in the upper part of the stock to the thumb-plate as already described. On opening the breech for loading, the indicator A moves back, and engages in the head of the catch lever C, and the two remain locked as shown in Fig. 1, after the rifle has been loaded and the breech closed. The rifle, however, cannot be fired until in the act of aiming the thumb depresses the pin F, which turns the spindle B sufficiently to liberate the indicator.

QUILLIAM'S CARTRIDGE MAGAZINE.

Quilliam's cartridge magazine, of which illustrations are given, is made of tin, either japanned or covered with leather. The upper portion of the magazine is divided by three partitions into four divisions, of which the centre one runs nearly the full length of the magazine, so dividing it into two distinct sections, for the purpose of keeping separate cartridges for right and left barrels. The two outer partitions terminate at the bend of the shoulder to allow of communication from the outer to the inner division. The partition and sides have strips of leather or rubber running down their entire length as shown, but not of the full width; this leaves a groove on the right and left, for the flange of cartridge to run in. A mechanical device is placed at the bottom of the magazine for controlling the exit of the cartridges, and consists of a clip, or segment of a cylinder *i*, the same radius as the body of the cartridge, and depressed at the ends to accommodate the flange. This clip is mounted on a spindle, placed under the outer partition, and is kept in position by a spring *m*, and a cam or hinged detaining piece *l*, the loose end of which rests on the shoulder of clip, so that when the clip is opened for the purpose of extracting a cartridge, which is done by pressing down the lever by the finger-piece *k*, the cam, lifts and drives back the cartridge behind it, so preventing a jam, which would otherwise take place with the one passing down before it in the centre division. The cam acts as a check over all cartridges in the outer division, preventing them from escaping until all are out of the inner division. When this takes place, the duty of detaining ceases. The cam then acts as a means for them to pass over from the outer division to the inner one, where the clip extracts them. To facilitate the loading of the magazine, the cartridges are packed shot end to flange alternately in properly constructed paper sheaths containing the same number as a division; these sheaths are passed down the compartment and withdrawn, leaving the cartridges in their proper places.

MAKING STEEL CHEAPLY.

A new process for making steel cheaply has been invented and perfected at Pittsburg. Its effect upon the future wages of skilled iron workers will probably be appreciated from the statement now made, that while steel of a peculiarly excellent quality, and specially adapted to many uses in preference to to malleable iron, has been produced in large quantities and placed upon the market, only one workman in the whole establishment has needed such skill or training as to receive wages averaging as much as $2.50 a day. By the new process, which is entitled the Clapp-Griffiths process, the silicon is so completely removed from the iron that, notwithstanding the presence of a proportion of phosphorus usually found fatal, steel of a high grade and of a remarkably useful quality is made. To the practical iron-worker, however, the most scartling fact remains that the cost of this treatment is less than half the present cost of making the ordinary pig-iron into muck bar. At the wages now paid in Pittsburg, it is reckoned that it costs $12.75 per ton to make muck bar from pig-iron, but by the new process a metal bar more useful, in better shape for handling, is produced at less waste, with a cost of only $6 a ton added to the cost of the pig.

Moreover, it is shown that, by applying the comparatively inexpensive plant required in this process in connection with ordinary blast furnaces, and taking the molten iron as it is required, hot from the blast furnace of treatment in the converter, the cost of procucing the ton of steel will be only $3 or $4 more than the cost of producing the ton of iron. In the last year Oliver Brothers & Phillips have turned out many hundred tons of this metal in different forms, such as tacks, rivets, wire rods, telegraph wire, lightning rods, horse shoe nails, pipe strips, plates, sheets, bars, angles, shovels, spades and stamping iron, which have given great satisfaction to consumers. The metal possesses, according to Captain R. W. Hunt, of Troy, who reported on the subject to the American Institute of Engineers, "an ever-constant welding property with great toughness." He says: "I obtained steel with 54 per cent. of phosphorus, and my surprise certainly did not decrease when I saw the test piece bend double, cold, and the metal work beautifully when hot.

Another great innovention in steel-making processes is announced in England, which according to *The London Iron and Coal Trades Review*, will put an almost certain end to the malleable iron trade at once, as steel ingots could be made at far less cost than that at which puddled bars are now made. It will be observed that this process appears from the description to be like the one so successfully introduced in Pittsburg, at least in general results, and in probable economy of working.

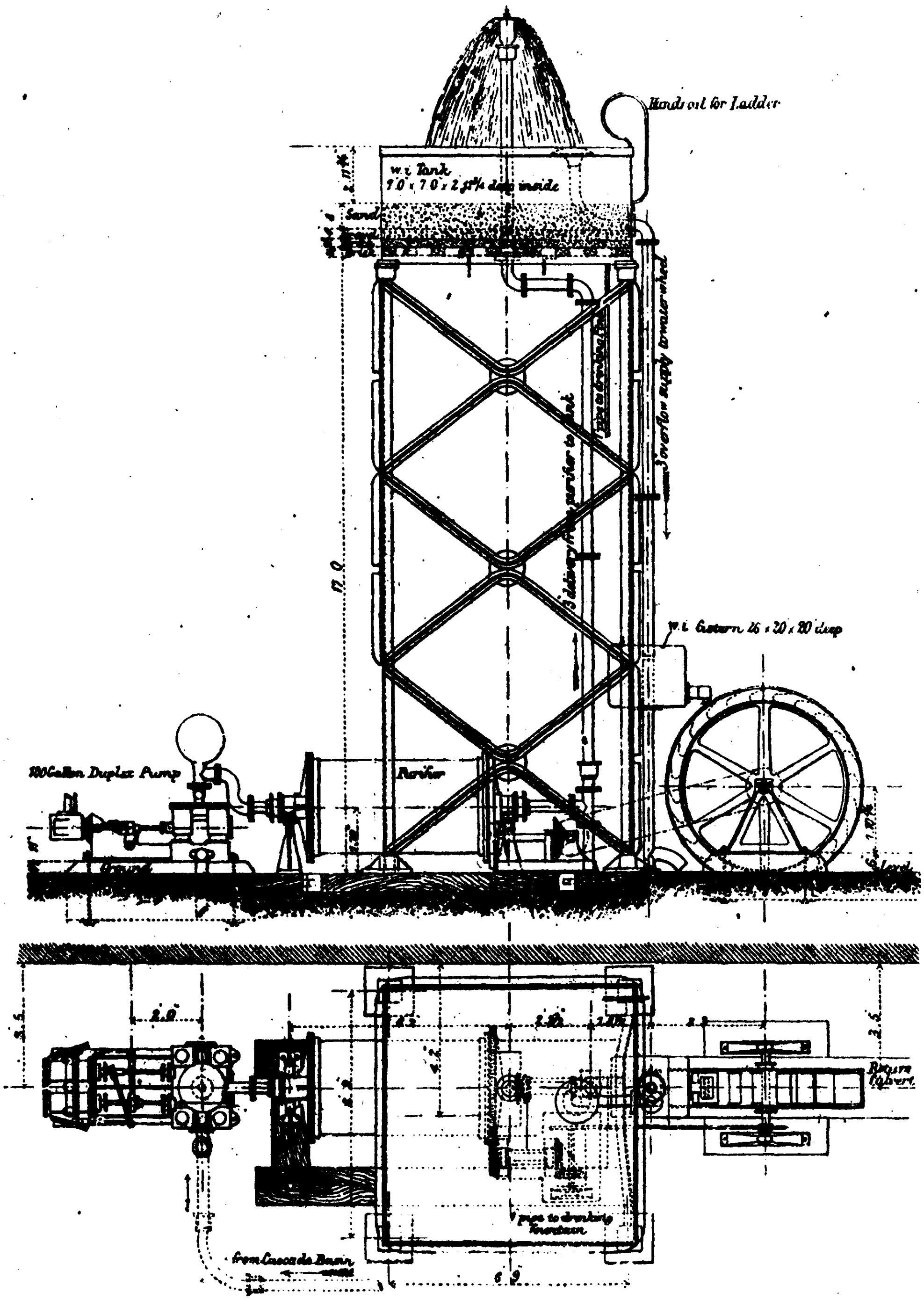
APPRENTICESHIP IN A NEW FORM.

The Baltimore & Ohio Railroad Company has taken a step toward the practical solution of the apprenticeship question. An order has been issued establishing a technological school at Mount Clare, Baltimore, "for the promotion of a higher course of instruction for the apprentices than that now pursued," with the view of affording the young men in its employ opportunities for obtaining a liberal technical education far superior to those enjoyed by the employés of other railroads.

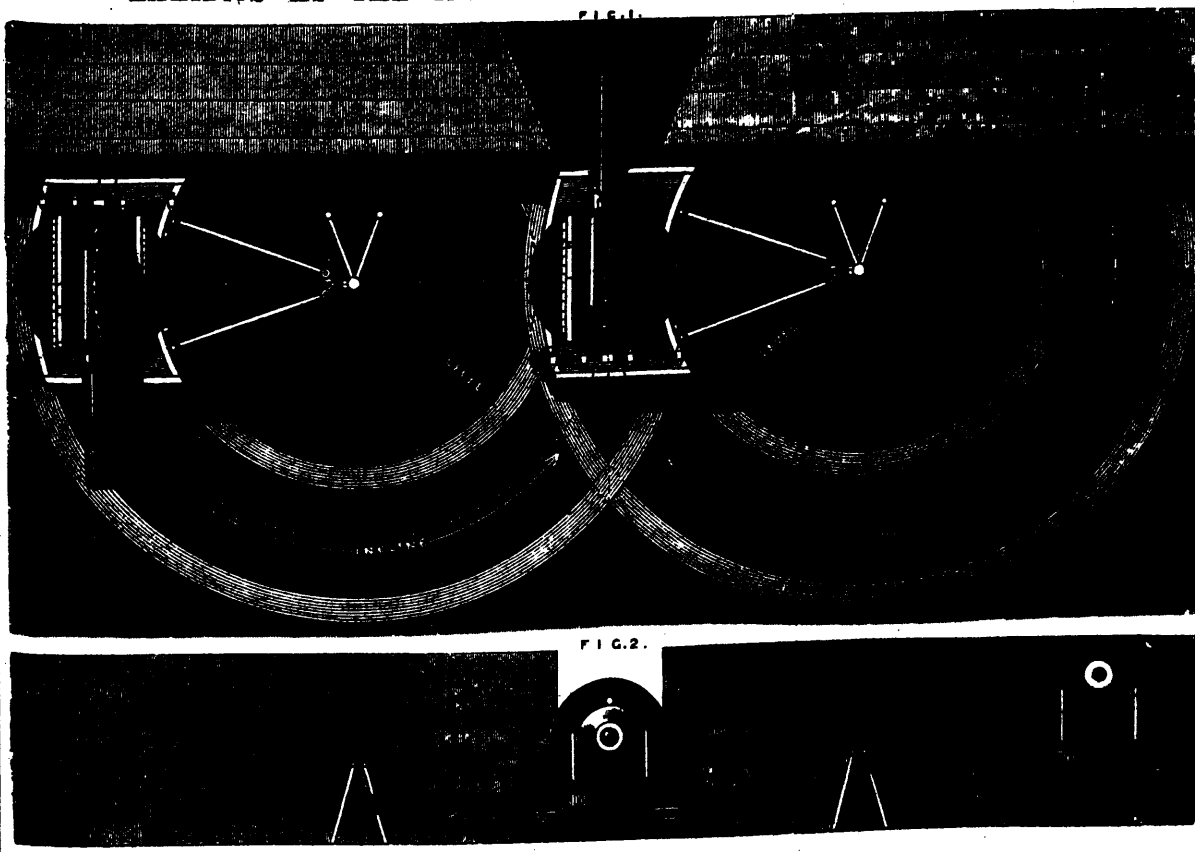
All apprentices are embraced under the following general designations, and graded into three classes: The first or junior class of apprentices, the second class of cadets, and the third or senior class of cadet officers. The company bears the expense of the education of the apprentices and cadets, and in consideration thereof expects the privilege of availing itself of their services, at fair salaries, for at least three years after graduation. From the day of their admission to the school the apprentices and cadets are to receive pay as follows: The apprentices 70 cents per day in the first year, 80 cents in the second, 90 cents in the third, and $1 per day in the fourth year; the cadets $1 per day in the first year, $1.12½ in the second, and $1.25 per day in the third year; and cadet officers $1.50 per day in the first year, $1,75 in the second, and $2 per day in the third year.

In their appointment to the school preference is to be given, other things being equal, to the sons of employés who have

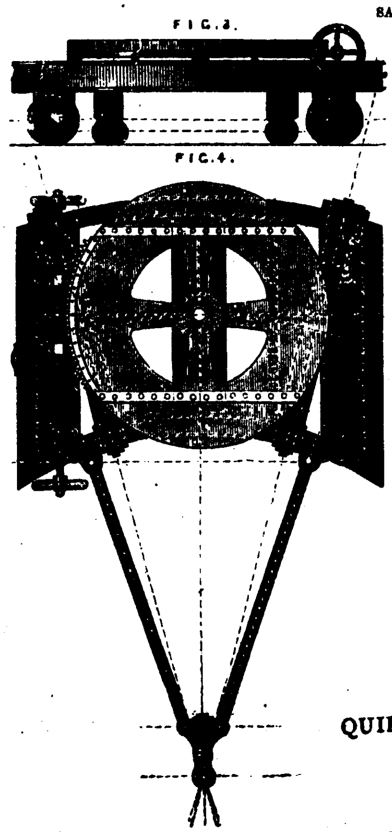
ANDERSON'S WATER PURIFYING APPARATUS.

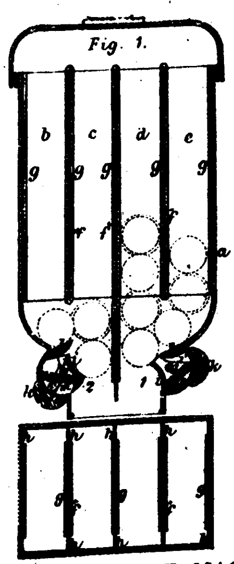


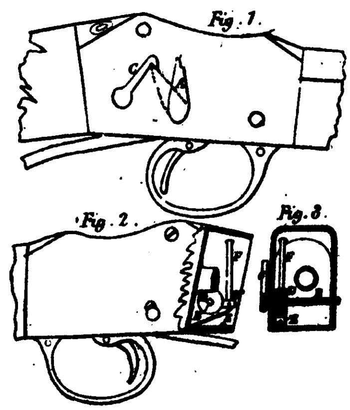
EXHIBITS AT THE INTERNATIONAL INVENTIONS EXHIBITION.



SAWYER'S SYSTEM OF MOUNTING TURRET GUNS.







SUFT'S RIFLE SAFETY DEVICE.

QUILLIAM'S CARTRIDGE MAGAZINE.

SAWYER'S SYSTEM OF MOUNTING TURRET GUNS.

been killed or injured in the company's service and free tuition is given to those only who are sons of employés having been in the service of the company for five consecutive years. They must pass a board of examiners as to proficiency in elementary studies and soundness of health, and are subject during the years of study to rigid discipline and frequent examinations. The exact scope of the school and the service for which its pupils are to be trained are not clearly defined, but it is evident from the long courses that the places to which they may aspire after their training are high indeed.—*Engineering and Mining Journal.*

BRIDGE AT VERONA.

THE iron bridge which spans the Adige at Verona, has been recently completed to replace an old masonry bridge built in the fourteenth century, and which was destroyed by the celebrated flood of 1882. In designing the new work two leading conditions had to be fulfilled, namely, that there should be a single opening of 291 ft. between abutments, and that this width should be left quite unobstructed, for the river is subject to floods, which are frequent, and very violent and sudden. For this latter reason an ordinary form of arch with the roadway above it, was inadmissible, since the water-way would be seriously obstructed ; the special form illustrated was therefore carried into execution. The bridge, as will be seen from Figs. 1, 2, 3 and 7, consists of two main arched girders, with two vertical sides in lattice work ; these arches spring below the level of the roadway and rise to a considerable height above it, in the centre. The horizontal girders carying the roadway, are connected to the arches by verticals of the form and section shown in the drawings. The longitudinal girders are of double trellis, as will be seen by reference to Figs. 1, 12 and 16. The following are the principal dimensions of the bridge :

	ft.	in
Clear opening between abutments	291	4
Rise of arch	32	9¼
Width of bridge	37	9¼
Depth of arched girders	4	7

The arched girders are connected together, in the central portion, by a system of diagonal bracing, as is shown on Figs. 2 and 7. The carriage road on the platform consists of buckled plates resting on transverse girders spaced 6 ft. 6 in. apart, and covered with road metal, and for the side walks checkered plates are used. The ironwork in the bridge weighs 400 tons, and cost 8400*l*. ; the abutments cost 3600*l*., making a total outlay on the structure, 12,000*l*. The bridge was tested by a uniformly distributed load of 82 lb. per square foot, and under this stress the arched girders deflected 1.06 in. The horizontal and vertical oscillation of the bridge, which were carefully observed and graphically recorded by special instruments, were very slight. The engineer of the work was Mr. G. B. Biadego, of Genoa.—*Eng.*

FOOT-BRIDGE AT LA VILLETTE.

WE reproduce from our contemporary *Les Nouvelles Annales de la Construction* the illustrations of a footbridge erected over the basin at La Villette, and connecting the two quays on each side of the basin. The design for the work was submitted to competition, the principal condition required being, that while the bridge should be convenient for passengers, it should not in any way interfere with the passage of boats in the basin. Various designs were submitted, and that of M. Moisant, of Paris, was accepted. The clear span of the bridge is 282 ft. 19 in., the width between the handrails is 16 ft. 5 in., and the clear headway in the centre is 35 ft. 5½ in. Access to the platform is obtained by means of staircases at each end, in the axis of, and the same width as the bridge, and by transverse staircases 8 ft. 2½ in. wide. The height of the first landing above the ground is 18 ft. The masonry, of which there is but very little in the structure, consists of two abutments, on which the bottom of the girders rest, and to which they are bolted, as shown in Fig. 3, page 165, and Fig. 11, page 164, galleries being left in the abutments for the purpose of adjusting the bolts. The superstructure consists of three girders having the general form shown in Fig. 1, page 164 ; they are placed 6 ft. 6.74 in. apart from centre to centre, and are 3 ft. 11 in. deep in the centre between flanges. These latter are 13.78 in. wide and are formed of plates .39 in. thick, the webs are also .39 in. thick, and vary in depth according to their positions ; they are connected to the flanges by angle irons 3.15 in. by 3.15 in. by .35 in. The space between the upper and lower flanges is filled in with panels, the vertical members of which are made of four angle irons, each 1.97 in. by 1.97 in. by .24 in ; the width of the panels varies with their position. These angle irons are rivetted to the webs by rivets .55 in. in diameter ; the rivets employed in fastening the webs to the flanges are .79in. The intersecting diagonals between the verticals are made of T iron, varying in size from 3.74 in. by 2.17 in. by .21 in. in the panels at the middle of the bridge, to 5 90 in. by 3.15 in. by .35 in. in the bays nearest the abutments. Rivets.63 in.are employed for fastening them to the webs. The distance apart of the cross girders varies with that of the panels ; they are fixed to the girders by means of vertical plate gussets .24 in. thick, and are made up of top and bottom members of angle iron 1.97 in. by 1.97 in. by .24 in., and diagonal connecting bars 1.58 in. by .24 in. (see Figs. 4 and 5). Outside the outer girders the roadway is extended by brackets, as shown. Upon these cross girders rest timbers longitudinals 3.94 in. by 5.51 in., and 23.6 in. apart. The planking, 1.3 in. thick, is secured to the longitudinals. The handrails are of wrought iron, and of the design shown. The total weight of the ironwork is about 150 tons. The following are the principal data from which the strains on the structure were calculated :

Strain on iron, tons per square inch	3.81
Passing load on platform, per sq. ft.	41 lb.
" " centre girders "	82 "
Weight of ironwork .. "	102.5 "
" " longitudinals and planking	20.5 "
Total load on middle girder, per sq. ft.-lb.	203.0

The vertical distance between the centre of the arch and the point of rotation is 40 ft. 4.21 in., and the horizontal distance between the centre of arch and the point of rotation, 151 ft. 2.1 in.—*Eng.*

DRAINAGE AND SEWEAGE MAIN.

The combination of Drainage and Seweage Main, as illustrated, is a convenient and novel plan where both can be located in the same line. The cross section gives a good idea of the form of construction proposed when the two mains are built together ; and it will be understood the same excavation will suffice for building both.

GROWING PRODUCTIVENESS.

The productive power of capital and labor has increased to a remarkable extent, and depending on the fact are many consequences. This power of capital, when put in the form of a machine, is well illustrated by the manufacture of envelopes. If the 2,500,000,000 that are now made in the United States every year had to be made by hand, as they once were, the labor of 2,750 persons would be required ; these persons at 90 cents a day, would receive a yearly income of $742,500. As it now is, about 400 machines, each with an attendant, do this work. The cost of the production, paying 10 per cent. on the cost of the machines, $500,000, and the same wages as before, is but $156,000, about one-seventh of the previous cost. Equal factors in the two cases—cost of paper stock, buildings, etc.—have been cancelled. The proportion would be much smaller if all the machines could be steadily utilized. Take one machine that can be so used, worth about $1,200, and making 54,000 envelopes a day. Canceling equal factors as before, the cost is $390 a year. If these envelopes were hand-made, the work of 18 persons would be required, their yearly wages being $4,860, or over 12 times the cost in the use of the machines. The effectiveness of capital is shown on all hands. In the manufacture of shoes, a man can make a pair of shoes a day by hand ; with machinery he can make two pairs : and, as showing how much labor gains in efficiency by division and by giving each workman a specialty, one man, under this system, can make nine pairs of shoes a day. A watch now costing $20, is said to have cost $60 fifty years ago. Edward Atkinson shows that, in two cotton mills in 1870, 4,321 yards of cloth were made for each operative ; in 1884, 28,032 yards ; the effectiveness of the capital and labor has increased in the ratio of .408 to 2.40, or nearly six times.

These illustrations are enough to show that capital and labor are greatly more productive now than they have been in the past. Joined to this is the fact that capital is rapidly increasing, the rate in Europe and the United States being three times faster than population ; the average annual saving of each person in this country is $25, a total of $1,250,000,000 a year, a considerable part of which becomes capital.

The wants of consumers increase faster than the productive power of labor and slower than that of capital. This is proved by the falling rate of interest and by rising wages.

It is evident that if the increasing productiveness of capital and labor were to be met by stationary wants, the hours of industrial activity would soon be reduced to a very small number, and wages and profits would fall seriously. If wants had not grown in the last fifty years, the hours of labor in some industries would now be less than two a day. As it is, the hours of labor are declining in number, notwithstanding the fact that the demand for labor grows, the reasons being principally social and physiological rather than industrial.

If the growth of wants were confined to those kinds already established, still the tendency expressed in the above paragraph would be a serious matter. In the common kinds of food, clothing, etc., the limit of consumption is nearly always reached, and it is an essy matter to bring overproduction upon the industries that produce them, by diverting to them slightly excessive quantities of labor and capital. There is a constantly increasing surplus of producing agents above what are necessary to make the kinds and varieties of articles of the most common consumption. The comforts of life would be stationary were not this surplus utilized in providing for new wants, so that it is the function of the increasing productiveness of labor and capital to help make life more and more worth living. The growth of producing capacity often treads closely upon the heels of the amplification of wants; the direst consequences of this are most commonly seen in the largest industries, because it is in them that there is the most room for the surplus and the widest competitive market for it.

LABOR IN EUROPE.

Whoever reads the reports of the United States consuls on the state of labor in Europe, will not fail to notice how much better the laborer in this country fares. He should be cautioned, however, against making an inference that is commonly made from the comparative money rates of wages; namely, that, because wages are higher here, it must follow that the cost of labor is higher here. This may or may not be so, and the wages alone are not decisive. For instance, it was shown in 1879 by Mr. James Thornley, who made careful investigation, that while the wages of the American cotton weavers are higher than those of the English, the cost of the labor here is less. The English average for a certain amount of work was $38.88 cents; the American, $22.90. The American weaver works harder and longer, and is not so well paid for a certain amount of efforts as his English cousin, though he gets more wages a day. A Youngstown iron manufacturer lately said, comparing lower wages for a certain kind of work in Alabama with higher wages for the same kind in his own establishment; that nevertheless his labor cost him less because it was more effective. A Lynn shoe manufacturer lately declared that a German workman does only three-fourths as much work in 11 hours as the American does in 10 hours. Be careful not to confound the rate of wages with the cost of labor, in talking about the "pauper labor" of Europe; for it is "pauper labor" in efficiency as well as in wages.

FORTUNES IN FOREIGN TRADE.

The Pepperell, Laconia and York cotton mills of Maine are said to have had a prosperous business the past year and to have paid dividends, respectively, of 12, 6 and 5 per cent. without touching their surplus. The stock of the Pepperell Company is worth 200, that of the Laconia 108, the York 108½. These mills produce 18,000,000 pounds of cotton goods a year, or about 50,000 yards and keep 5,000 people busy in the manufacture. In face of the depression of cotton manufacture in this country, it becomes interesting to know why these mills have done so well lately. The Pepperell and Laconia mills sell half their goods in the Chinese and East Indian markets in competition with all Europe. Their goods are said to have such a foothold in those markets that they enjoy the advantage of commanding a quarter of a cent above the market. There is quite a movement of these goods to South America, also. The owners of these mills certainly do not despise the markets of the world. They may be believers in the cry of "America for the Americans," but they would bite off their own noses if they opposed commercial relations with the rest of the world. Give us ships and cheap materials and our manufactures shall double.

PLAN FOR SILVER CURRENCY.

To save us from a money of depreciated value, the coinage of silver must be stopped. At the present rapid rate of coinage—2,000,000 a month—it will not be long before the quantity of silver will be sufficient to provide our whole money. Silver being of less value than gold, the bi-metallic standard will become a silver standard, for it is well known that money of less value will drive money of greater value out of use. The effect of this will be to send up prices and, at the same time, to reduce the value of the dollar that the workingman earns, while he will get no compensating gain in higher wages—a double damage to every wage earner in the country. Every creditor would suffer, because he would have to accept a depreciated money in payment for the better money that he lent.

The silver cranks are so numerous that it is doubtful that the coinage of this metal can be stopped, or even checked; if it must be continued, several plans are suggested for preserving the integrity of the silver dollar, by raising it to a gold standard. Mr. I. W. Sylvester, of the United States Assay Office in New York, would do it in this way: He would have the Government receive on deposit all silver offered, and issue certificates for the value thereof in dollars, at the then market price of silver, in gold. The silver, stamped with its gold value and with its weight and fineness, and the certificates of deposit for the silver, he would make a legal tender. He suggests two plans for the redemption of these certificates. One is that they shall be redeemed in the amount of silver called for, or in its value in gold at the time of redemption, leaving to the holder the profit from a rise or the loss from a fall in price between the time of the deposit and that of redemption. The other is that the silver shall be redeemed in gold dollars of the number required by the face of the certificate.

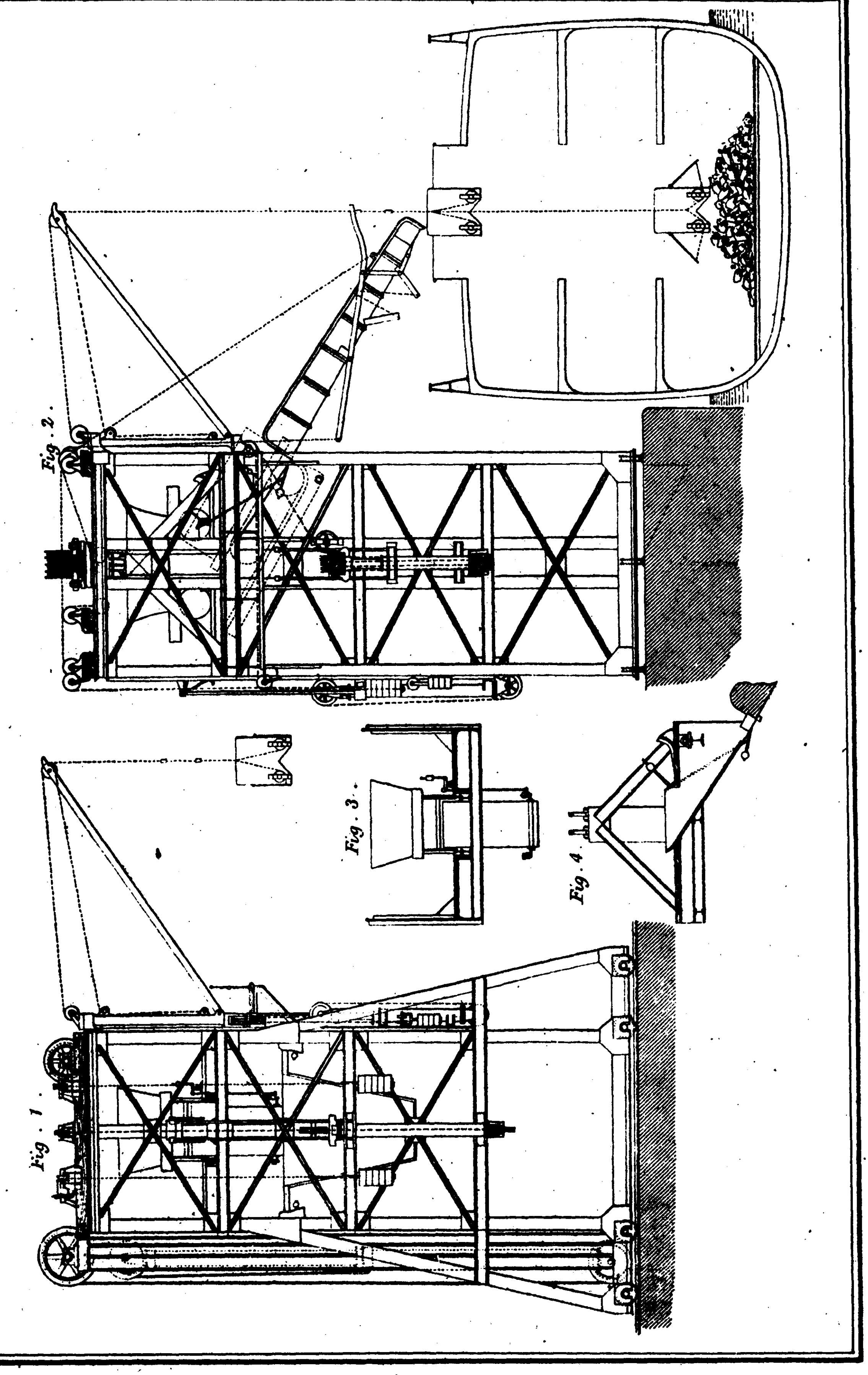
The first plan of redemption really makes a dollar of more fluctuating value than the second, because silver is the basis of the first and gold of the second. The latter plan is the best that has been suggested for a legal tender silver currency exempt from fluctuation in the hands of the people. It is infinitely better than the present arrangement, or than any other that has been in operation. Its great value lies in its capacity to make silver available in exchanges without injury or loss to any one.

A NEW ROLLER PULP MACHINE.

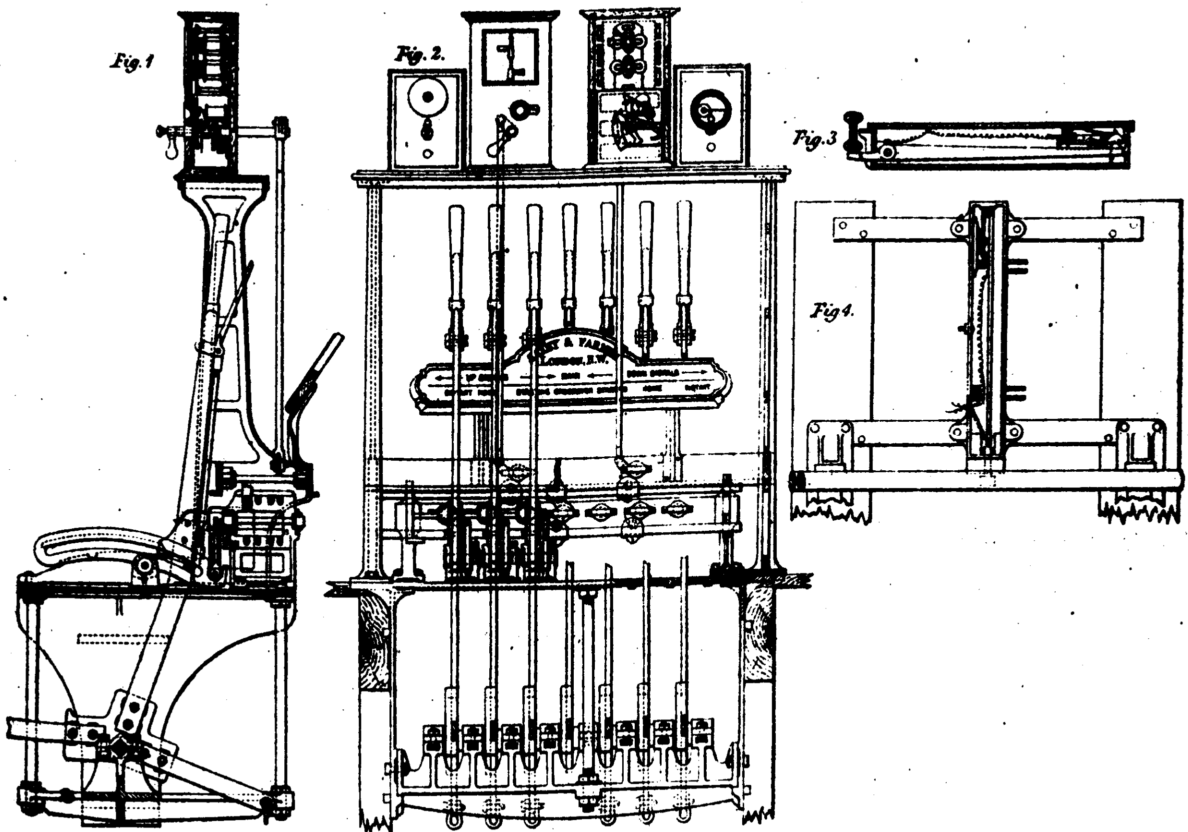
A man at Glens Falls, N. Y., has recently perfected a roller pulp machine by which sawdust, shavings, chips or any refuse of mills can be made into a first class quality of printing paper without the addition as has heretofore been found necessary, of expensive material like rags, cotton or jute. It has also been found possible to make a fair quality of paper from the debris of sugar cane, cotton stalks, wild hemp and even weeds, while soft woods like spruce, pine, fir, hemlock and poplar make a paper in every way as good as the best quality now used by the newspapers. Some made entirely from sawdust had a tensile strength per square inch of 17 pounds, while the average rag paper has a strength of 12 pounds. The new machine presses the material between immense rollers, which roll over it an innumerable number of times as they revolve within an enclosed cylinder, the inner surface of this cylinder forming an endless bed, on which these rollers by its circulation. The desintegration is assisted by the action of steam under pressure of 50 to 80 pounds, to which is added a small per cent. of alkali, which neutralizes the acids and destroys the gum of the wood. The steam and alkali also soften and soughen the fiber so that it is not broken by the rollers. Paper made from the pulp can be made at a reduction over the old way, it is claimed, of from 30 to 50 per cent.

The general manager of the leading underground railway in London recently wrote to Colonel Hain, General Manager of the Manhattan Elevated Railroads, asking for a photograph of the locomotives used on the elevated railroads. Col. Hain had engine 132, recently constructed at the company's shops at 98th Street, and a train of cars photographed on a large sheet, about 18x24 inches, which will be sent to London. The engine and cars come out in excellent shape in the photograph.

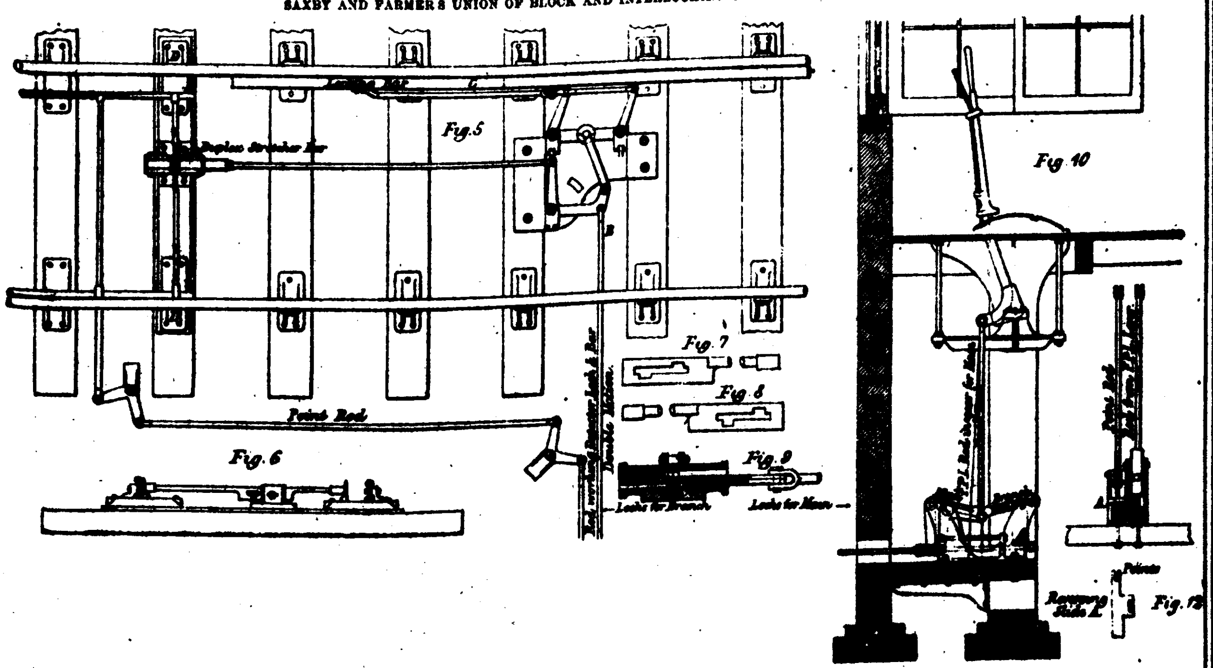
BUTLER'S COAL TIPS, AT THE INTERNATIONAL INVENTIONS EXHIBITION.



RAILWAY SIGNALS AT THE INTERNATIONAL INVENTIONS EXHIBITION.



SAXBY AND FARMER'S UNION OF BLOCK AND INTERLOCKING SYSTEMS.



SAXBY AND FARMER'S DUPLEX DETECTOR FOR FACING POINT LOCKS.

A LARGE LOCOMOTIVE.

The Baldwin Locomotive Works, of Philadelphia, have just completed a locomotive which they call the "Decapod" type, for the Dom Pedro II. Railway of Brazil, which is next to the largest locomotive ever built. The engine is for a road of 5 feet 3 inches gauge, which gives a good opportunity of making a heavy locomotive with fine proportions. The engine has cylinders 22x26 inches, which transmit the power to five pairs of driving wheels, connected, of 45 inches diameter. This gives a tractive force of 279 pounds for every pound of effective pressure on the pistons. The builders estimate that on a straight grade of one 105.6 ft. to the mile the engine will pull 500 English tons of train, but our calculations lead us to believe that the train mentioned will be a light load for the engine. The leading part of the engine is carried by a pony swing-truck, which is equalized with the first pair of drivers. The total wheel base is 24 feet 6½ inches, of which 16 feet 11½ inches belong to the drivers, which, however, have only 12 feet 7½ inches of a rigid base. The second and third pairs of drivers are plain, without flanges. The cross-head is of steel, hung below a single pair of guides. The main-rod, which is 4 inches diameter at the back end, has brasses held in straps of the ordinary form. The side-rods connect with the pins with solid brushes, which are held in solid rods, the pins having movable collars that keep the rod in position. An automatic air brake controls the engine, shoes being applied between two pairs of drivers at two points, so that eight of the drivers are made available for braking, and the brake is attached to all the four pairs of tender wheels.

The boiler of this locomotive is straight, is 64 inches diameter, and has an extended front end. The boiler sheets are iron, ⅝ inch thick, and the fire-box is of copper, while the tubes, 268 in number, of 2 inches diameter, are made of steel. The fire box is 10 feet 1 inch long, and is 39½ inches wide. A brick arch, supported by water tubes, runs diagonally back from below the bottom row of tubes about 5 feet, its upper part reaching within about 12 inches of the crown sheet. The fire-box provides 160 square feet of heating surface, and the tubes 1,780 feet, the total being 1,940 square feet. Two fullstroke pumps, connected with the crossheads, are provided for feeding purposes, besides two No. 9 Korting injectors.

A screw reverse gear is used, which operates a lever in the cab. The valve motion is the ordinary link, with balanced slide valves. All the latest improvements that contribute to the convenient and economical operation of a locomotive, are provided for this engine.—*Am. Mach.*

WORK IN THE BALDWIN LOCOMOTIVE SHOPS.

Business in locomotive building has not improved any in the Baldwin Locomotive Works. They are working about half their ordinary force half time. Most of the work on hand is for foreign railroads. During the winter they have built engines for Brazil, Peru, Australia, New Zealand and New South Wales. At present the locomotives in the erecting shop are mostly for New Zealand, there being only three engines for American railroad companies.

There is a rather novel form of locomotive in course of construction, intended for a mountain railroad in Peru. It drives a geared axle which engages with a gear wheel on the main driving wheel axle. The engine is driven by an arrangement not unlike what was used in the early Baltimore & Ohio "grasshopper" locomotives. The locomotives for New Zealand and Australia are standard Baldwin engines.

The new building erected in place of that burned down is already occupied with tools up to the third story. Below heavy tools alone have place on the floor, and they decrease in weight as the upper floors, are reached. The plan of grooping together tools doing the same character of work has been strictly followed.

This company has just completed an entire model locomotive train and railroad for the Japanese Government. The locomotive is an imitation of the Baldwin standard eight-wheel bituminous coal-burning locomotive, weighs about thirty pounds and runs on a track eight inches wide. The engine is complete in all its parts, but power to run it is transmitted from a coiled spring. There is a combined baggage express and mail car, an ordinary passenger car, a chair car with handsome lady's boudoir, and a Pullman sleeper. All these model cars are fitted up with every convenience found in the cars they imitate. They are finished in a most handsome style, and the roofs can be taken off to let any one examine the inside properly. The engine pulls this train over a track about fifty feet long, which is provided with switches, signals and all the requisities of a first-class railroad.—*Am. Mach.*

THE NEW "SCOUTS" FOR THE ADMIRALTY.

Much gratification has been expressed in Glasgow and over the Clyde district generally, that the contracts for all the six torpedo cruisers, for the construction of which tenders were recently asked by the Admiralty, have been placed on that river, the successful offerers being Messrs. James and George Thomson, of Clyde bank. These vessels are to be of what may be called the "Scout" class, that being the name of the cruiser which is now being built for the Navy by the same firm. They may be said to be of a new type, the special design of which is that, with very limited dimensions, they shall have a high rate of speed. It has been stated that in all thirty-seven firms in the various shipbuilding centres of the three kingdoms were supplied with specifications of the new warships, and seventeen of those firms are connected with the Clyde, only twelve of whom, however, lodged tenders with the Admiralty. Tuesday of last week was the last day for receiving the tenders, and on the following Saturday Messrs. Thomson were officially informed that their tender had been accepted. Such prompt action on the part of the authorities has hitherto been unknown; indeed, it is not yet three months since the First Lord of the Admiralty announced that the Government had resolved on making certain important additions to the Navy, of which the unarmoured cruisers of the Scout class are the forerunners. Four of these vessels will at once be laid down on as many vacant berths in Messrs. Thomson's shipyard, and the keels of the other two will follow in the course of a few weeks, when the Scout now in hand and a paddle steamer have been launched. The time allowed for the construction and delivery of the six vessels is two years and three months.

In the vessels of the Iris class there were inaugurated some important improvements in the forms of ships and propellers, and these were developed in the Leander, with the result that it was rendered possible to obtain a speed of 16½ knots per hour—which is the estimated speed of the Scout now on the stocks—on a much smaller horse-power than formerly. Then, again, the use of forced draught, which has of late been so successfully introduced into vessels of the Royal Navy, has also contributed to get a greater horse-power for a given weight of machinery than was considered practicable a few years ago. In the vessels of the Comus class, which were built some half-dozen years ago, the weight of the machinery was 3¼ cwt. to 3½ cwt. per horse-power. Whereas in the Scout now in hand the machinery will only weigh 2 cwt. per horse power. That fact shows most remarkable progress in a in a very short space of time. It is confidently anticipated that in the vessel now nearly ready for launching, and which is the type of the six vessels just contracted for, it will be possible for a ship 220 feet in length, having a displacement of 1,430 tons, to run at the before-mentioned speed, and carry coals enough for seven days' full-speed steaming. She is a vessel of 34 ft. beam, with a depth of 19 ft., and she is throughout constructed of steel. The new scouts, which will likewise be steel-built, will have a greater length by 5 ft., and 2 ft. more beam, the displacement being 170 tons more, or 1,600 tons in all. This increase in the size and displacement of the new Scouts will make them about one-ninth heavier.

The Scout has a protective deck over her machinery and boilers, or over fully 100 ft. of her length amidships. At the two ends, where there is no such protective deck, she is very minutely subdivided, and in this way there is comparatively little prospect of disablement arising from flooding in these parts. The protective deck in the new Scouts will extend from stem to stern, and while greatly adding to the efficiency of the ships, it will considerably increase the difficulty of their construction. She will be driven by twin-screw engines placed in one engine-room, and by four boilers of the Navy type placed in two separate rooms. The protection of the engines and boilers, on the sides of the ship, will be provided by blocks of coal forming a layer of from 5 ft. to 7 ft. in thickness, and the engines and boilers being placed well below the water-line. The armament of the first Scout will consist of eleven torpedo tubes and four 5-in. guns and eight Nordenfelt machine guns. Two of the former will be in the bow and one in the stern, all firing in a line with the keel, and there will be four on each side of the ship on the upper deck. In the new

Scouts the armament will consist (1) of 6 in. guns mounted on the Vavasseur principle, with elaborate cylindrical supports; (2) of eight machine guns; and (3) of eight torpedo tubes—one each at bow and stern and three along each side. As the armament is comparatively small, so the magazines are fairly simple, though at the same time they involve considerable care in their arrangement.

At this point we ought to add a remark or two in regard to the machinery of the new Scouts. It will be increased from 3,200 to 3,500 indicated horse-power. Several minor modifications will be introduced, which will, with the increased power, add about 12 per cent. to the cost of the machinery. Instead of consisting of one compartment, as in the Scout now in hand, the engine-room will be in two parts separated from each other by a water-tight bulkhead. This will add to the efficiency of the ships, but it will also add greatly to the weight and cost both of the hull and the machinery.

The hulls of the new Scouts will show an improvement on the appearance of the first Scout, inasmuch as they will each be provided with a removable clipper stem; and the stern will be like that of an ordinary merchant ship. The sail power will be very much increased, and a bowsprit will be added, and there will be three masts, whereas the vessel now in hand has a light schooner rig. The quarters of the officers and crew are in the poop and forecastle, and though somewhat small, they are well arranged.—*Eng.*

BUTLER'S MOVABLE STAITHS.

The coal-tipping staiths designed and patented by Mr. Samuel Butler, of Cardiff, are represented by drawings and photographs, a copy of one of which we give. Staiths have hitherto been fixed and the ships moved. This invention provides for moving the staiths and keeping the ship stationary. The object to be gained by this is to enable three staiths to be loading a ship at the same time, instead of one only, an alteration which is calculated to increase the rate of loading five times effecting a great saving in quay space as well as in the time of the ship. In its most elementary form the wagons are run on to a traversing carriage and moved sideways into the staith. They are then tipped by a hydraulic cylinder into the shute, and the contents are received in an anti-breakage box and lowered into the vessel. This box is operated by chains and a balance weight. In Figs. 1 and 2, another method of operating the box is shown.

The bottom of the shute, for about 3 ft. from its end, is made to lift on a rocking shaft beneath it (Fig. 2), actuated by side levers, to which it is connected by rods. The mouth of the shute is thus balanced by weights, at the back of the staith, which are attached by chains to the ends of the side levers. There are three chains working the anti-breakage box, and these may be locked between small rollers in the bar connecting the two side levers. The object of the three chains is to open and shut the doors, as well to keep the box square with the shute. The centre chain of these three is attached to a cross bar, which in its turn is connected by chains to the doors. The two outside chains are connected to another cross bar, which in its turn is connected to the box. The box is lifted and lowered by the chain attached to the doors, worked by the hydraulic cylinder. The chains attached to the box are kept tight by their weight, and only come into action for discharging the box, this being brought about by large links in the chains coming in contact with an adjustable stop. The depth at which the box is to discharged is determined by the position of this stop, which can be set on a rack at any point along the floor of the staith. The action of the box therefore is to open the mouth of the shute on coming up to be filled, and to close it immediately it begins to descend. The box may be made to hold one to two tons, and is automatic in filling and discharging.

The illustrations show a staith designed for shipment from low-level railways. The wagon is lifted by a hydraulic cylinder, which is carried between two upright girders. There are four flat wire ropes attached to the cylinder, passing over top and bottom pulleys, and thence over an upper pulley; from this two ropes lead down to one side of the cradle, and the remaining two ropes pass over the opposite pulley, and down to the other side of the cradle. The staiths may be constructed to discharge wagons from their ends or bottoms (Figs. 3 and 4). The action of the lift is used to pull the staith to its position. The only additional appliance required for this purpose is a chain passing over the top of the staith, to which the cradle may be attached on either side; if it be attached to one side the staith is drawn in that direction, if it be attached to the other side it is drawn in the opposite direction. Each end of this chain is fastened to mooring posts on the quay at opposite ends of the staith's path.—*Eng.*

RAILWAY APPLIANCES AT THE INVENTIONS EXHIBITION.

Railway Signalling Apparatus.

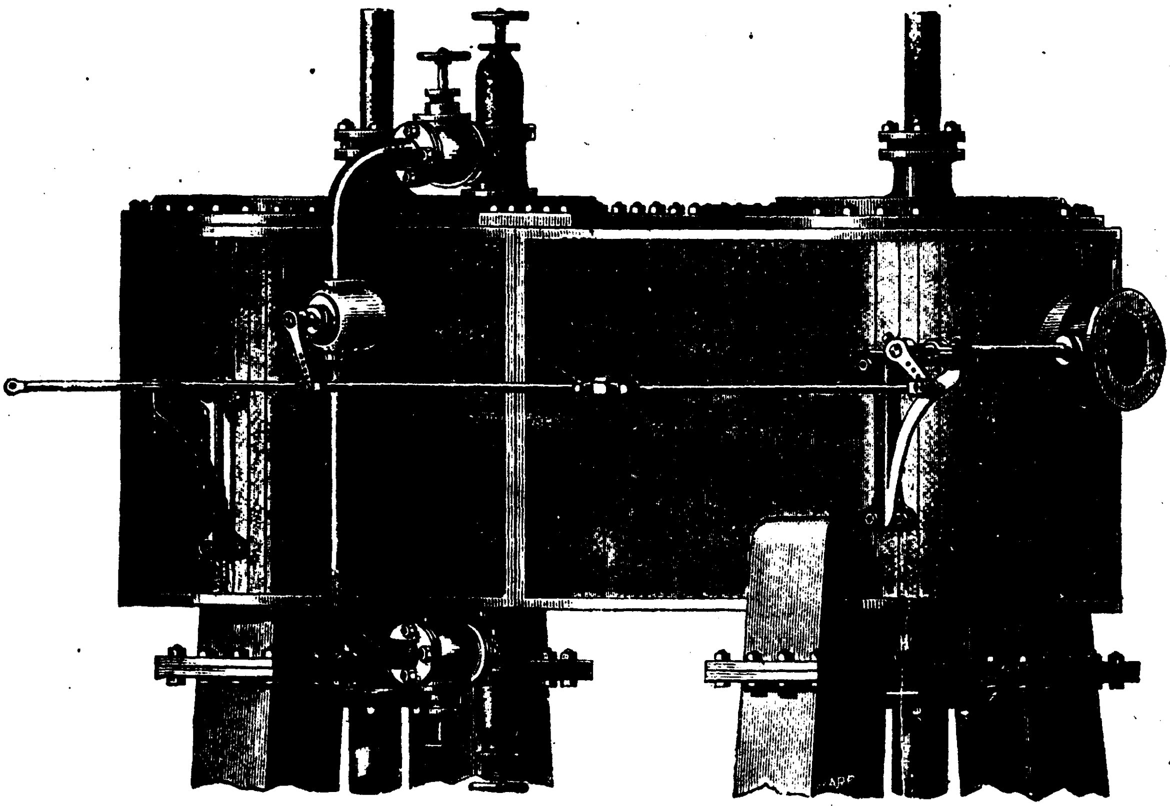
We give illustrations of a new arrangement comprising the union of the block and interlocking systems, which is exhibited by Messrs. Saxby and Farmer, of Kilburn. Fig. 1 is a side elevation in section, Fig. 2 a front elevation, Fig. 3 a section of the treadle, and Fig. 4 a plan of the treadle, contact, which acts by the deflection of the rail. These illustrations show a machine in which is contained an interlocking apparatus of seven levers for working points and signals and two improved block telegraph instruments for the exchange of train telegraph signals, with the stations on either side for up and down lines respectively. The locking handles are attached to hollow spindles in the centre of which are the spring commutator plungers. When the handles are moved to the right, which is the "line clear" position, they work gear which interlocks the point and signal levers in any manner necessary to the traffic. When the handles are moved back to the "line blocked" position they are stopped in midstroke and become firmly locked and they cannot be moved again to the "line clear" position, neither can they be placed in the position to unlock the point and signal levers until the train has passed over the treadle apparatus shown in Figs. 3 and 4. The treadle is worked by the weight of the train deflecting the rail and pressing down the short arm of a lever which is pivotted in a cast-iron box fixed to the sleepers as shown. As this short end of the lever descends the long end rises and completes the electrical circuit. A current of electricity is sent through the magnet of the block instrument and unlocks the handle, which can then either be restored to its normal position to unlock the point and signal levers, or it can be moved to the right for the "line clear."

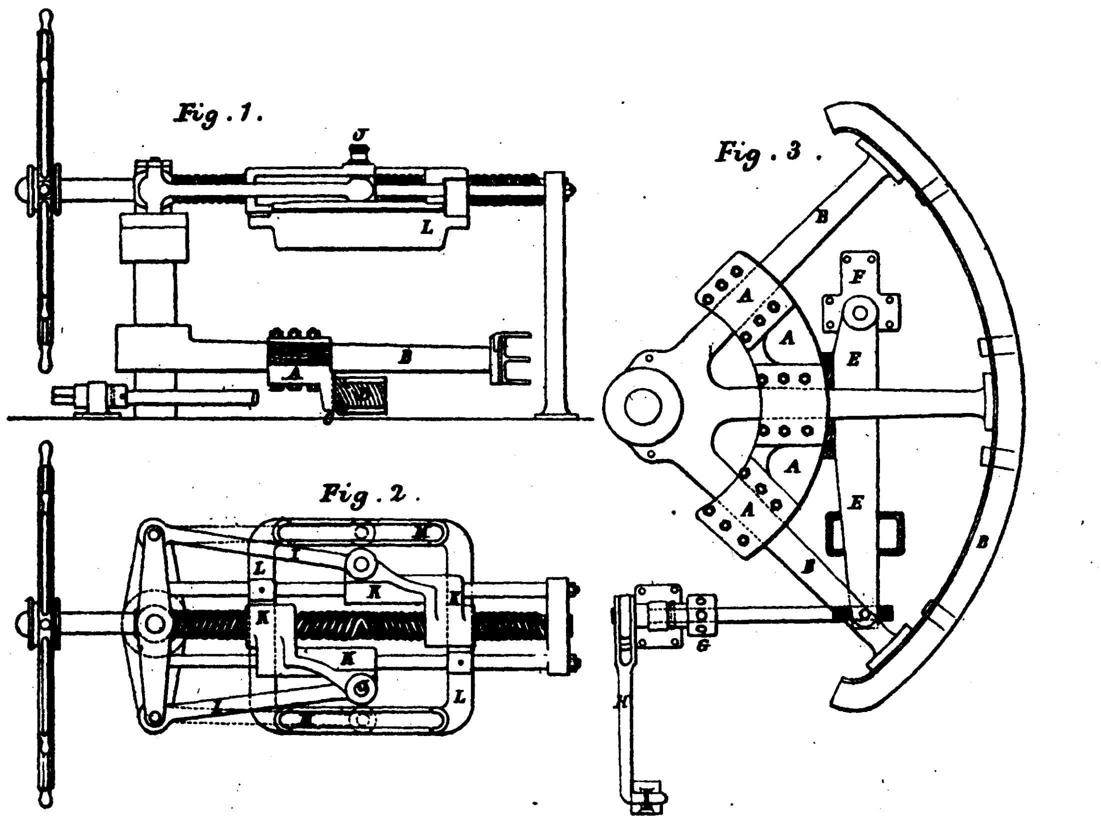
As the handles of the block instrument and the point and signal levers are combined in the same interlocking mechanism they cannot be manipulated in a contradictory manner. Only one wire is used for the signals and bells of both up and down lines. It is claimed for the treadle described that it gets rid of the difficulties usually experienced with treadles acted upon by passing trains. The short end of the lever is always in contact with the underside of the rail, and owing to the proportions of the arms, a very slight deflection in the rail gives sufficient movement for insuring electrical contact. The wear and tear are reduced to a minimum, and the liability to get out of order through violent blows from passing trains are obviated. When it is remembered, as Messrs. Saxby and Farmer point out, that both in the block and interlocking systems, the safety of railway traffic depends on the correct working of the out-door signals, the securing of accuracy in this direction is a point of the first importance.

In Figs. 5 to 12, we illustrate Messrs. Saxby and Farmer's "duplex detector," a new facing point lock which is designed to obviate danger from the failure of any of the connecting rods between a set of points and the locking apparatus in the signalman's cabin. In the ordinary arrangement should a connecting-rod break, the point lever can be shifted without moving the points themselves, but the signal would be altered and would therefore indicate that the points would be standing in a contrary direction to that which they really occupied. The detector lock is intended to guard against this danger. It consists of a double-action plunger which can be pulled when the points stand in one direction, and pushed, when they stand in the other, in a hole in the tie-bar between the tongues of the points. In this way if the points have not been moved as intended, the signalman is warned and is unable to give the signal contrary to the direction in which the points would be actually standing. In our illustrations, Fig. 5 is a plan of the general arrangements, Fig. 6 is a section, Figs. 7 and 8 show the duplex stretcher bars through which the detector bolt slides together with the duplex stretcher bar, Fig. 10 is a section through the cabin, and Figs. 11 and 12 details of reversing gear.—*Eng.*

In the consumption of soap per capital the United State lead. Italy is last on the list.

COMPOUND ATTACHMENT FOR CONTROLLING LOW-PRESSURE CYLINDERS.





PERMANENT WAY AT THE INTERNATIONAL INVENTIONS EXHIBITION.

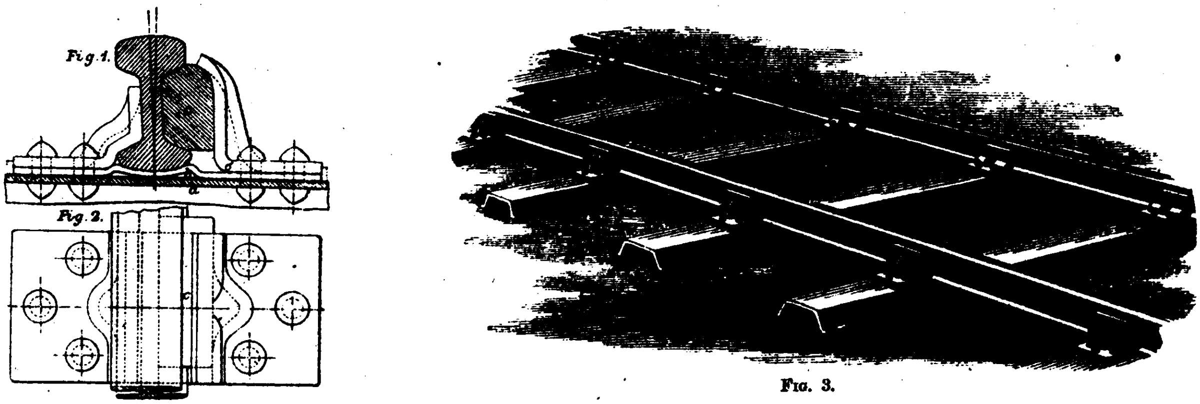
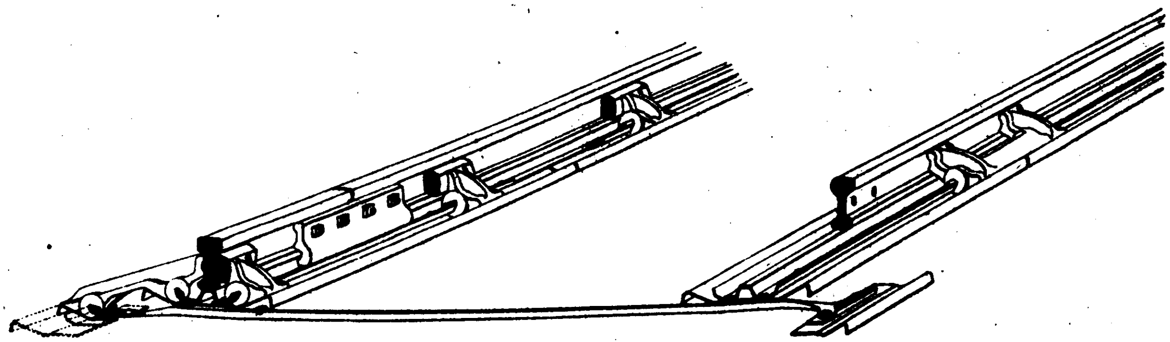
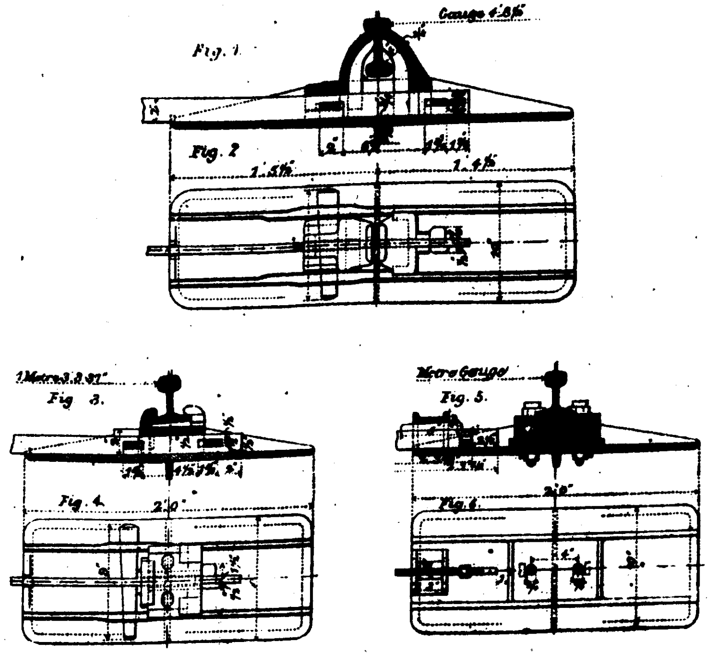


FIG. 3.

WEBB'S STEEL PERMANENT WAY; LONDON AND NORTH-WESTERN RAILWAY.



HOLTHAM'S IRON AND STEEL PERMANENT WAY.



THE DENHAM-OLPHERTS CAST-IRON PLATE SLEEPERS.

MARINE ENGINE GOVERNORS.

Many of the governors which have hitherto been employed to prevent racing in marine engines, have only controlled the supply of steam to the high-pressure cylinder, and although they may cut it off with the greatest promptitude, yet, for the moment, they make but little effect upon the low-pressure cylinder, which is still exposed at one end to the steam yet remaining in the casing, and at the other to the influence of the vacuum in the condenser. Experience has shown that with a sensitive and powerful governor the racing is not serious after the steam is shut off, yet it is evident that the result would be more satisfactory if the entire load upon both pistons could be removed. With this purpose in view Messrs. Durham, Churchill & Co., who have established a wide reputation for their marine governors, have adopted a device which they call a "compound attachment," the object of which is to equalise the pressures at both sides of the large piston at the same time that the steam is cut off by the governor. The apparatus, which is exceedingly simple, is illustrated on the opposite page, and consists of a pipe connecting the upper and lower ends of the low-pressure cylinder. The passage through this pipe is interrupted by a cock, which is always closed except when the engine races. But at the same time that the throttle valve is closed the cock is opened, and puts both ends of the cylinder in communication with each other, and consequently with the condenser. The contents of the casing are immediately evacuated through the cylinder, and the only force left tending to drive the engine is the influence of the vacuum upon the high-pressure piston, which, supposing the throttle valve to be tight, this will have little effect.

This arrangement, which is constructed under Jenkin and Lee's patent, has already had an extended trial of three years with most satisfactory results by the Cunard Steamship Company. It has also been applied to vessels of the Inman Company, of Messrs. Bargate and Co., of the New York and Cuba Steamship Company, of the Ocean Steamship Company, and others, and it is so simple that a glance will show that it cannot fail to be effective for the purpose it is intended to fulfil. It may, perhaps, be well to add for the benefit of those who are not familiar with marine governors of the Durnam and Churchill type, that they are provided with a steam cylinder to operate the valve, and thus have great power, and that they have only two positions—open and shut—exchanging the one for the other instantaneously when the speed exceeds the normal by a certain amount.

PERMANENT WAY AT THE INTERNATIONAL INVENTIONS EXHIBITION.

WEBB'S STEEL PERMANENT WAY.

In describing Mr. Webb's compound locomotive at the International Inventions Exhibition, we mentioned that this engine is shown standing on a length of steel permanent way of a pattern which Mr. Webb has patented and introduced on the London and North-Western Railway. Of this permanent way we give engravings Fig. 1 being a section of a sleeper adjoining a chair, Fig. 2 a corresponding plan, and Fig. 3 a perspective view of several sleepers with the rails, etc. In this system of permanent way the sleepers are of trough section, those first put down on the London and North-Western Railway in 1880 having been made of wrought-iron and rolled by the Ebbw Vale Company. For some time past, however, the whole of the permanent way has been made of steel, the sleepers being rolled in the rail mill at Crewe from Bessemer steel ingots 10½ in. square. The bars are produced in 60 ft. to 70 ft. lengths, and the section has been found convenient for a variety of purposes, notably for making up the flanges of plate girders, as well as for sleepers. For the latter the bars are cut into lengths, and are then punched with six holes for the chairs the holes being punched from both sides, so as to make them slightly tapered in the middle. The bars for the chairs are rolled from the crop ends of rails, cut to length, reheated, and stamped to shape in dies under a steam hammer. They are then punched for rivetting, and so well is the system of manufacture organised that the time occupied in stamping and punching a chair bracket, from the time the bar is drawn from the reheating furnace, is three-quarters of a minute only. A lining plate, placed between the chair and the sleeper, is also of steel; it is sawn up hot into proper lengths. Liners of brown paper soaked in tar are also inserted so as to prevent any possibility of shaking loose or chattering. All parts, chair, lining plate, liners, and sleeper, are rivetted together by a Tweddell hydraulic rivetter, and the moment this is completed the distance between the rails is absolutely fixed. The keys used are of the ordinary type, and are never found to work loose. This is partly attributed to the elasticity of the steel chair, and partly to the wood swelling out and filling a recess in the chair. The weight of a London and North-Western creosoted wooden sleeper with chair, spikes, screwed spikes, and felt liners is 242 lb., while the weight of one of Mr. Webb's sleepers complete is 174 lb., this being made up as follows; Sleeper, 9 ft. long, 124 lb.; two chairs, 28 lb.; rivets, 5 lb.; two lining plates, 15 lb.; and two oak keys, 2 lb. A very large number of these sleepers have now been laid on the London and North-Western line, and with most satisfactory results.

HOLTHAM'S PERMANENT WAY.

The system of permanent way designed and exhibited by Mr. E. G. Holtham, of 5, Westminster Chambers, is illustrated by a perspective view which shows the details of the arrangement clearly.

Mr. Holtham's design is based upon the retension of the modern form of steel rail now in general use. The rail is secured to the sleeper by keying it in the ordinary way between pairs of jaws, fixed upon the sleeper by a method that combines, with other advantages, that of requiring neither bolts nor bolt holes. The upper or central part of the sleeper is of a solid double-channel section, having a central rib that forms a continuous rail-seat, and lateral ribs to which the jaws are attached. These ribs pass through recesses in the bases of the jaws, into which tapered keys are driven; The jaws resting on the surface of the sleeper outside the ribs. To prevent slacking back of the keys and consequent loosening of the jaws, it is only necessary to strike the upper edge of the rib with the keying hammer, making a slight bulge outwards that precludes movee ment of the jaw in one direction, while a similar bulge, but inward, behind the key when driven tight, renders impossible any movement in the other direction. The jaws and keys ar- of cast iron, the sleepers of mild steel or malleable iron; and when the jaws are fixed as above described, the whole becomes practically one structure. As the ribs extend longitudinally the jaws can be fixed at any required intervals; and this freedom of position, when curves are being dealt with, simply abolishes the old practical difficulty with sleepers of this type, that of keeping the cross-connexions square. In case of accidental breakage of a jaw, it can be taken off and a new one put in its place, without disturbing either rail or sleeper. The cross-connexions of Mr. Holtham's system will be understood on reference to the engraving. Each cross-tie is a tie only, so far as that part of it is concerned that lies between the extreme edges of the parallel sleepers, under which it passes; each end is, however, expanded into a bearing surface forming an abutment, from which a support is carried to the rail direct. Some of the outer jaws are lengthened so that they extend over the sleepers and are secured to the centres of the bearing surfaces in the same way as they are fastened on to the sleeper, all connections being thus made by the use of cast-iron keys of uniform size, and requiring only the use of a hammer to fix them. So long as the ends of the cross-ties have an efficient bearing on the ballast, it is claimed that neither spreading of the gauge nor over-tilting of the rail can occur. The connection of two successive sleepers endwise is by a pair of double jaws, the bases of which span the joint, one end being fixed and the other having a movement limited to a small sliding range sufficient to provide for expansion and contraction. Effective fishing of the sleepers is not called for, as they have so little stiffness of their own longitudinally and vertically, but lateral stiffness is maintained by the double jaws. On the other hand, the two channels in the upper part of the sleeper admit of deep fishplates being applied to the rail joints. To provide for curves the lower and broader part of the sleeper is made discontinuousa t intervals, narrow gaps being formed for a short distance, on either side of which the central continuous part can be bent or sprung by the platelayers. For sharp curves of ten chains radius or less, the gaps may be made 6 ft. apart, with two pairs of jaws in each interval, leaving the rail free to take a correct curve, but with ordinary main line curves, 10 ft. intervals, with three intermediate pairs of jaws suitably fixed are sufficient, so that the rail actually has alternate straight and curved portions. In case of any alteration of line, a sleeper that has been used on a curve can be re-straightened or adapted to any other curve, without being returned to the works, and generally the standard sleeper is available in any situation.

The two portions of the sleeper, for convenience of handling, are connected by rivets, which however have no strains to encounter, as all connections are attached to the solid rolled upper part, and there is no tendency for the parts to separate when once laid down, even if the rivetting were absent. The sleepers are conveniently made of the same length as the rails, but this is not strictly necessary, as the rail-joint may fall anywhere in the length of the sleeper. The weight per mile for a standard line, for steel sleepers and cross-ties is about 100 tons, and for the cast-iron jaws and keys, 51 tons.

THE DENHAM-OLPHERTS CAST IRON SLEEPERS.

We give engraving of three patterns of the Denham-Olpherts patent cast-iron plate sleepers, which are exhibited by Messrs. Thompson & Browming, of 3, Victoria-street. S. W. Of our illustrations, Figs. 1 and 2 show a pattern intended for English railways; Figs. 3 and 4 the type now in use on the Indian State Railways of metre gauge; and Figs. 5 and 6 another pattern wool cushions under the rails, also in use on the Indian State Railways. The whole construction of this permanent way is so clearly shown by our engravings that a detailed description is unnecessary, but we may state that these sleepers have been largely used in India and with very satisfactory results. At the Exhibition a short length of railway, to be the British Mekarski Improved Air Engine Company for running their passenger cars and engines, has been laid with the Denham-Olpherts sleepers.

THE CABLE SYSTEM IN PHILADELPHIA.

In a recent Philadelphia dispatch it was stated that the cable of the Philadelphia Traction Company, constructed through twelve miles of the principal streets of that city, had been found radically defective, after a cost of $600,000 to the projectors, and that one of the engineers engaged upon the system had expressed the opinion that $25,000 would be required to correct mistakes and make the road practicable for traffic in cold weather. When the iron conduits through which the cable passed were laid, iron rails were run through the stringers and bolted to the top of the conduits just below the slot where the grip passes down to the cable under the street. Every change of temperature affected the width of the slot and hindered the passage of the grip.

It is stated further that work had been begun to remedy this error, and the ground was to be torn up over the entire twelve miles of track laid and substantial new ties and iron braces put in place of the lighter and defective ones that have caused all the trouble. The projectors of this road visited Chicago about two years ago to examine the system in use here, but on their return they attempted improvements which would now cost a quarter of a million to perfect.

Superintendent Homes of the Chicago City Railway Company, who explained the workings of the Chicago cable system, to the Philadelphians when they were here, was asked what he thought of the failure of the system in the Quaker City. He said:

"The first piece of cable road constructed in Philadelphia was put in one year ago last summer and was something like a mile in length. The projectors of the road had previously visited this city and we made them familiar with our methods of construction and our various appliances; but they expressed the conviction that our expenditure of money had been too great, and they endeavored to construct an equally effective road at a cost of about half the money.

"Their first construction cost, I am told by their engineer, something in the neighborhood of $146,000, and it proved an utter failure. It was taken up and thrown away. Last season the same company constructed from twelve to sixteen miles of cable track, which was in some respects an improvement on the first experimental mile, put in a year before, but the construction was altogether too light, and had no ability to resist the lateral pressure of frost, which is simply enormous. If our construction here had been made in the same way it would have given us even more trouble than they had, as our frost goes so much deeper and its pressure is so much greater.

"I notice in the papers that the cost of this road is stated to be $600,000, but it is my impression, received from various sources, that the expenditure was much greater—probably over a million. This construction had no ability to resist the great lateral pressure, and as soon as the frost came the slot closed. The engineer of the construction told me that they had taken up the pavement, inserted wedges in the slot, and forced the slot open, and had attempted to hold it open by inserting bolted rods between the slot-iron and the stringers upon which the rails are placed. But this afforded only temporary relief, for as soon as the temperature changed again the slot not only closed but drew the rails themselves toward the slot, so that in operating the cars with horses a large number of wheels and axles on the cars were broken.

"This information," said Superintendent Holmes, "was given me by the President of one of the companies in Philadelphia. We have never had the slightest trouble with our construction here in Chicago in the way of the slot closing, as we made special provision to guard against that, it being the thing to fear most. That feature of the construction was made perfectly secure. As is known to all the citizens of Chicago, the iron-work and the concrete which incloses the iron-work were made with special reference to intense frost.

"Statements have been made in the Eastern papers that the cable line here had been troubled with its slot closing up. These reports are wholly without foundation. The only thing that could have given rise to any such impression was the fact that in the construction of the road we received a few carloads of slot iron that had a ragged edge from imperfect rolling. The parties who furnished this iron instructed us to return it at their expense, but we had 1,500 men at work, and the streets torn up, and we could not afford to wait for new shipments of iron, but were obliged to use this, purposely placing the slot-irons, closer together than a finished state would permit, and afterwards chipping off the ragged edges. That was all, or nearly all, that was done before the cars commenced operating. A few spots were finished afterward, but with this exception there has been nothing to give any impression whatever that our slot had ever closed on us.

"There have been a few cases, especially in the early days of the system, when inexperienced drivers have held on to cables too long and thereby cut them, but experience has relieved us of all trouble of this sort. We have had two cases when minor portions of the machinery have proved of insufficient strength under the intense strain at times brought to bear upon them, but we have strengthened these parts by adopting much heavier machinery. In February one section of this heavy machinery was placed in position and now we have received the last of this heavy machinery. When occasion arises, or as soon as it is possible to do so, we shall remove the last portion of light work and insert this heavier construction in its place.

"The last winter has been an unprecedented one in severity of frost and volume of snow, but it has been of use to us in enabling us to discover wherein were the weak points of our construction, and so completely remedy them. The weak and imperfect construction adopted in Philadelphia should not weigh against the true merits of the cable system.

"It is absolutely necessary," said Mr. Holmes, in conclusion, "that the construction should be strong and stable to insure comfort to the public and to operators. When this is done there is no system yet devised which will compare in excellence with the cable system for transportation in large cities."
—*Ex.*

FUEL OF LARGE STEAMERS.

An English contemporary, in replying to a correspondent who asks how many tons of coal a large steamship consumes in a day, quotes the following facts from a pamphlet entitled "Bottled Sunshine," issued by T. B. Purnell & Sons, of Exeter: "Ocean steamers are large consumers of coal. The Orient line, with their fleet of ships running to Australia every two weeks, may be mentioned. The Steamship Austral went from London to Sydney in thirty-five days, and consumed on the voyage 3,641 tons of coal; her coal bunkers hold 2,750 tons. The steamship Oregon consumes over 330 tons per day on her passage from Liverpool to New York; her bunkers will hold nearly 4,000 tons. The Stirling Castle last year brought home in one cargo 2,200 tons of tea, and consumed 2,800 tons of coal in doing so. Immense stocks of coal are kept at various coaling stations, St Vincent, Madeira, Port Said, Singapore, and others; the reserve at the latter place is about 20,000 tons. It is remarkable with what rapidity these steamers are coaled; for instance, the Orient steamship last year took in ever 1,100 tons at Port Said in five hours.—*Ex.*

PREVENTION OF ACCIDENTS IN MILLS.

Under the above head Helmuth Hagemeister says in *Die Muehle* :

A statement of the causes which operate to the destruction of life or health in mills, and also of these arrangement and contrivances offering the greatest possible protection against the same, is well suited to the needs of the time and will be found in the manner following. The consideration of this topic will be confined to grain mills as those other establishments called mills, as saw mills, oil mills, etc., have nothing in common with grain mills save the name.

That such a treatise will lack much of completeness is in the very nature of the subject and the author should be held but partially blamable for such deficiencies. If devices for protection were alone to be considered, the matter would be comparatively simple. The difficulty lies in the fact that these safeguards must not retard, or at most but slightly retard, the driving mechanism. For this reason practical knowledge of milling is requisite in order to decide on the necessity and utility of any protecting contrivances. Pictures and descriptions of driving machinery are sufficient to indicate to those familiar with the subject, the danger existing in any outfit or any single part of the same, so that they can easily form an opinion as to the feasibility of using certain devices or means of safety. Theoretical knowledge alone, however, will not suffice. The construction of mills and the manner of their operation varies so much at present, that the entire time and ability of an individual are needed to obtain only superficial knowledge of the chief methods and modes of building. In addition to this milling now exhibits a certain agitation. The changes necessitated in the driving mechanism by the introduction of rollers, dismembrators and bolting machinery, are frequently not well understood. In many places work is done in an experimental fashion with uncertain tests of this and that method. Only after long experience has demonstrated the superiority of some particular system which is therefore brought into general use can a consideration of sources of danger in mills be made with any uniformity. In treating of the accidents in operating mills it seems proper to deal with the various machines or parts of machines, which are chiefly influential in producing the same. But first of all should be mentioned the clothing of operatives which ought always to be as smooth and close to the body as possible. Blouses, loose fluttering coat-skirts and cravats should be avoided. The floors of mills should be kept as clean as possible, flour dust makes them slippery and dangerous to those carrying heavy loads. Special attention must be given to the oil dropping from bearings. It should be caught in suitable receptacles, no spots of oil being allowed to reach the floor, where in the neighborhood of moving parts of the gear, they would greatly add to the likelihood of accidents.

In proceeding to consider the machinery in classes we may divide it into motors, transmission mechanism, working machines, auxiliary machines and tools.

MOTORS.

In most cases mills are operated by steam engines, water wheels or wind wheels. Therefore remarks upon this subject will extend only to these powers. All machinery of whichever class should have means provided for stopping it with the greatest possible certainty and speed. Large establishments require also a signal system throughout the mill, by which machine tenders can have the motor stopped in case of impending danger. To stop it immediately is however an impossibility, too much motion being retained by the transmission; therefore great mills need facilities for throwing single machines or group of machines out of gear. The greatest care should be taken that the motor when stopped is not again accidently set in motions, because in the idle interval workmen will be engaged in cleaning and oiling their machines and exceedingly disastrous results may ensue.

From the nature of their operation water wheels are mostly located apart from the mill. Steam engines also usually have special quarters as it is otherwise impossible to keep them free from flour dust which involves great wear of the machine, the use of large quantities of lubricants, and much waste of steam. When the engine is placed in the mill proper, its removal is absolutely necessary to secure immunity from accident. Special coverings should be provided for those parts of the engine most liable to be dangerous. Many disasters are occasioned by the breaking of the rim of the balance wheel. It is to be recommended in case the wheel is to run at very high speed that the rim be bound by a forged iron ring, and again at a short distance by a second rim formed of strong wood. Thus in case a wheel breaks the force of the flying fragments is diminished. Numerous casualties are occasioned by strangers or ignorant parties who enter the engine room. The place should be stringently forbidden to visitors and all workmen save the engineer and his assistants, and rules to that effect conspicuously posted up.

The flood gates of water wheels are seldom or never perfectly tight, a difficulty sometimes increased by wedging in of twigs, pieces of ice, etc. In that manner occasionally results an unexpected motion of the driving gear which is very apt to result disastrously to workmen cleaning or repairing machinery or the water wheel. Aside from danger mentioned this lack of tightness in the flood gates is disadvantageous in cold weather as it allows ice to form on the wheel and in the buckets, resulting when motion is resumed in great loss of power. On this account it is advisable that a trap or gate be constructed in the mill trench, in such a manner that when water escapes the flood gate it can not by any possibility reach the wheel. Such a contrivance also enables the stopping of the wheel much sooner thon by the flood gate alone.

Damp air in the wheel pit and the formation of ice in winter, makes access to the wheel slippery and difficult. Stairs and passages should therefore be kept in good condition, and suitable railings and barriers provided so that in oiling the bearing of the wheel, workmen will not be in danger of falling into the wheel or the pit.

LUNG DISEASE IN A LION.

Mr. Abraham recently exhibited before the Academy of Medicine in Ireland the left lung of a lion which had been born in the zoological gardens, had lived there twelve years, and recently died. The animal had good health until October 1st. when there was sudden cold weather. The lion refused food, seemed feverish and thirsty, and his respiration became exceedingly rapid. He appeared to have pleurisy, his chest being fixed and his breathing abdominal. An attempt to administer medicine failed. He took little food, except occasionally. He drank some niter in water, with diuretic effect. He had no cough, but two or three times he spat mucus, which toward the end became bloody. Ultimately, he became emaciated, and died. His viscera were healthy, except the lungs. There was no pleurisy, but the lungs were diseased, mottled in appearance, and hard and lumpy to the touch. On section, they presented a curious honey-combed aspect. The bronchial tubes were enormously enlarged. In the lower lobe of the left lung was a large cavity. The microscopic sections of various parts of the lung did not show the structure of tubercle, nor did any of the bronchial glands. He was not sure what the disease was. The father of the lion died in precisely the same way.

Mr. Baker remarked that lung disease was common among cats, which frequently suffered like the lion in question.

The President observed that monkeys were subject to consumption. In the lion's lungs exhibited, he had no doubt the cavity existed for years, and a small amount of cold sufficed to kill one of the large carnivora.

Mr. Abraham said that, long ago, Dr. Haughton discovered that tubercular phthisis was not so common in monkeys as was generally thought, and he showed it in a paper read many years ago before the old Pathological Society ; and in a paper read before the Zoological Garden of London, Mr. Sutton recently came to the same conclusion.—*Ex.*

SEA-GOING RIVER STEAMERS.—The first practical step towards establishing direct steam navigation between Cologne and London has been taken by the Badische Schraubendampfschiff Fahrts-Gesellschaft, Mannheim. The company has had constructed in a Dutch yards twin-screw-steamer, capable of being navigated on the open sea as well as on the Rhine. The new ship, constructed entirely of steel, is 200 feet long, with 28½ feet beam and 12½ feet depth of hold, and of 750 tons burthen. Her average draught of water at sea, with water ballast, is 11 feet; and on the river, after the water ballast, has been pumped out, only 8 feet, so that with a load of 500 tons she could go up to Cologne at an average depth of 10 feet of water. Should the new line of steamers answer the expectations formed of it, Cologne will be raised to the rank of seaport town.