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OUR NORTH-WEST REBELLION.

The troubles in the North-West have suddenly come to an end as was expected. The poor benighted rebels will, no doubt, think twice again before rebelling.

Great credit is due to our brave volunteers and those in command for the thorough way in which everything has been done and the country wont soon forget the self-sacrifice and valour displayed by those who are now numbered among the dead. Now that war is over it behoves those in authority to punish with one hand and mete out justice with the other. General Middleton and others will, no doubt, be able to give valuable suggestions to the Government as to the securing a permanent peace in the North-West, or the avoidance of such an unfortunate occurrence in the future.

METEOROLOGICAL PHENOMENA.

Toronto had a most phenomenal Sunday, meteorologically speaking, on the 7th June last. The day entered hot, increasing in intensity until late in the afternoon, when, suddenly heavy, dark clouds appeared in the west, followed by a steady and solid downpour of hail-stones for fully five minutes.

The stones were so numerous and the size quite phenomenal, averaging about one-half inch in diameter of solid clear ice.

Such showers seldom occur in our midst and are oftener known by report than actually seen. The hail shower was no doubt quite local and only extended over a few square miles doing damage to fruit and other blossom. Thunder and lightning raged all night with heavy rains, and ushered the next morning in disagreeably cool.

GAS AS A FUEL FOR HEATING AND COOKING PURPOSES.

The general public do not seem yet to have appreciated the immense advantage and convenience of gas as a fuel in preference to coal or wood, especially during the warm seasons.

The prevalent notion is that gas is too expensive to use for cooking and other purposes and that gas stoves and other appliances make this draw-back still greater. Now these notions are more or less erroneous, and the sooner they are dispelled the better for the sake and convenience of the household kitchen.

It should be remembered that it has now been demonstrated beyond a doubt that gas burners can be suitably fitted to almost any make of ordinary cooking stoves including even the oven, and that very many households are getting their ordinary coal or wood stoves so fitted that either gas, wood or coal can be used at will to suit the requirements and wishes of the owner. The great advantages of this system are that it is much cheaper, handier and compact while much of the fumes go away up the chimney.

In warm weather the system has indeed superiority over all others because cooking, etc., can be done so quickly without raising the temperature of the room in the slightest degree while at the same time it permits the attendant to work pleasantly, and in point of cleanliness, there is absolutely no comparison.

Gas companies are in the habit of giving a reduction for gas used for heating, cooking and other purposes and experience has proved that for ordinary cooking the cost runs from 30 cts to 60 cts a week for families from 3 to 12 persons. In fact it is as cheap if not cheaper than coal or wood all other things considered.

Where gas is not available, coal-oil stoves will doubtless hold their own, but where gas can be had its immense superiority over all other fuels can be fully established.

The day may not be far distant when cheaper gas may induce parties to adopt it for general house-heating purposes as well. One difficulty to the more general adoption of gas for heating is that the gas for illuminating, is the only quality obtainable, whereas a gas for heating use could be manufactured at fully one-half the cost but its separate distribution to customers would at present be a still greater difficulty.

BRITISH POLITICS.

British constitutional usages have at last compelled Mr. Gladstone to relinquish his hold on the Govern ment of the Empire, and accordingly the Seals of office have been transferred for the time being to the Conservatives under the leadership of the Marquis of Salisbury.

The period of time under which the new Government may necessarlly act is very short because a general election has to take place in November. Still some party must keep the machinery in motion and in so doing be responsible to the people.

It is to be hoped that during the short time the Conservatives have to rule they will do so wisely and receive the support of all shades of politics, especially the Liberals, who have through Mr. Gladstone pledged the necessary support on general questions.

No one will deny that the Salisbury Government have a difficult task in hand in as much that they are entirely on suffrance. Although guided by high and patriotic motives in accepting the situation during an hour of peril brought about by the unpopularity in the house of the Childer Gladstonian Budget, perhaps it would have been better had a direct appeal been made to the country and thus establish a permanent Cabinet.

BRITISH ARMED CRUISERS.

It appears that the Admiralty have at last decided to buy outright the Steamship *Oregon*. This ship is among the fastest afloat and was lately fitted up as an armed cruiser.

The above shows in a small degree the latent maritime power of England, which can call into requisition a fleet the speediest and most powerful afloat, built especially under the Government rules to suit various requirements.

THE "STILETTO'S" SPEED.

Considerable interest has been directed towards the small steam yacht *Stiletto*, which lately outrun the invincible and speedy Hudson river boat.

The remarkable coincidence is that the *Stiletto* was designed by a blind man, but it must not be forgotten that there are boats afloat and on the Ships now it Britain which could leave the *Stiletto* far behind in a race.

We publish a letter from Mr. A. Taylor who claims the discovery of a certain geometrical truth and leave our readers to question or decide as to its originality, because we hesitate in such a field to say off handed whether or not Mr. Taylor is right or wrong as to his claim.

Mr. Taylor deserves credit, however, in trying to solve such a difficult problem as the tri-section of an angle less than 90° because as we read it, this is practically his contention. We give an illustration by construction as we consider Mr. Taylor has not made his points quite clear and besides has introduced useless and extra lettering, etc.

R H T is the given Isoceles triangle, of which A R is drawn at right angles to R T—the problem being to divide the exterior angle A R H into two parts one of which will be double the other. Draw O H parallel to A R and with R as centre and R O as radius equal to the sum of three sides of the given isoceles triangle cut H O produced in O then join R O—the line R O will be found to fulfil the conditions stated above.

The same construction will suffice where the base of Isoceles is zero.

Hoping the above will throw some light on the subject to our readers.

OUT-DOOR GAMES PLAYED UNDER ELECTRIC LIGHT.

An interesting and novel spectacle was witnessed by a large and appreciative crowd lately in Toronto, viz., that of a football match played between 9 and 10 in the evening under the electric light. It was found by actual play that with a dozen good arc lights suitably located round the field, everything was nearly as easily distinguished as in broad daylight. An important change, however, was found necessary, in that of painting the football perfectly white.

The above deviation will no doubt be found useful, because sports, games, and matches may be played during the cool of the evening in the hottest seasons, and at a time when the public generally can more conveniently attend.

The addition of a band and other musical attractions will do much to popularize these evening out-door entertainments under electric light, especially during the summer seasons.

A RAY OF LIGHT IN THE FOG.

The cost of production is cheaper in England than in Germany or France. The proof of this is found in the fact that the wages per hour are highest in England. It is not necessary to show, for it is too well known, that dairly wages are higher in textile industries in England than on the continent; add to this the difference in worbing hours, and the superiority of the English workman together with cheaper cost of production, is very marked. At present the hours throughout France in textile industries are rarely, if ever, under 12 a day, while in Germany they are still longer, being 13 at Dusseldorf, 14 to 15 at Treves and Aix La-Chapelle, and even 16 in Franconia—this, too, without deductions for Sundays and holidays. A commission in France has had under consideration the advisability of shortening the hours of labour, but cannot recommend it because of German and English competition. Some befogged writers on trade will be still more confused when they remember that the hours of labour in England are but nine a day on the average in these industries, and that the daily wages are higher than they are in France, where the workmen are employed at least 12 hours a day. On the theory of pseudo-economists, of whom the United States bears a good crop, England ought not to be able to compete with France; the fact, however, is directly the reverse. England pays more wages for fewer hours' labour, because her labour is more valuable than French labour, even working more hours, and because the English cost of production is lower, thereby leaving a greater share of the product to be divided among the workmen. The United States census shows that wages are but 17 per cent. of the value of the product, while materials are 63. There are commonly no less than seven classes of items in the cost of production—management, labour, taxes, materials directly used in the product, accessory materials, repairs, and interest on capital. It seems as if it would take a century yet for some people to learn that there is something in the cost of production besides lobour, and that the cost of labour is commonly low when wages are high, and that wages are invariably high in the long run when the cost of production is low.

The smoke from the charcoal works at Elk Rapids, Mich., which was formerly wasted, is now manufactured into chemicals by being blown by immense fans into a purifier, from which it eventually comes in the form of an acid that is clear as amber. From the acid are produced acetate of lime, alcohol, tar and gas. Each cord of wood contains 28,000 cubic feet of smoke; 2,800,000 feet of smoke handled every twenty-four hours is said to produce 12,000 pounds of acetate of lime, 200 gallons of alcohol, and twenty-five pounds of tar.

THE KORTING-LIECKFELD GAS ENGINE.

Among other interesting machinery now open for inspection at the International Inventions Exhibition, at London, England, is a Körting-Lieckfeld gas engine built by Messrs. Körting Bros., of London. From the illustration on the opposite page, for which we are indebted to *Engineering*, it will be seen that the engine is of the vertical type, with one cylinder. The working details are so arranged as to be easily accessible for oiling and cleaning, and are so simple in construction that a skilled attendant is not required. The cylinder is open at the top, and, besides being used as the working cylinder, also answers the purpose of a pump to draw in and compress the charge of gas and air previous to its being ignited. The ignition takes place as soon as the piston has passed the dead point, this type of engine being declared by Beau de Rochas in 1862 to be the most economical. Along the front of the engine is placed an auxiliary shaft to which motion is transmitted from the main crank-shaft by means of wheel gearing; this shaft makes only one revolution for every two revolutions of the engine, and its purpose is to control the motion of the different valves, which are actuated by cams. One of the main features of the engine is the mixing-valve, through which the gas and air are drawn in, and by means of which a mixture of perfectly constant proportions is always obtained.

The principle laid down by Beau de Rochas in the year 1862 has been adopted in the old engine of Keithman, in Münich, and also in Otto's new motor, and is briefly this—there is one explosion during every two revolutions of the fly-wheel when the engine is working at its full power. During these two revolutions four distinct operations are performed inside the cylinder, which may be understood from the following table:

	First Revolution.	*Second Revolution.*
Up-stroke of the piston.	The gas and air are drawn in.	The charge is ignited at the dead point, an the motive power developed.
Down-stroke of the piston	The charge is compressed.	The waste gases are expelled to make room for a fresh charge.

In consequence of the ignition taking place at the dead point it is necessary to increase the length of the cylinder, in order that a space may be left behind the piston to contain the charge; the stroke of the piston, therefore, does not reach to the end of the cylinder, and as a result only part of the waste gases are expelled during the return stroke, the remaining part being mixed with the next incoming charge. In the Körting-Lieckfeld engine no attempt has been made to arrange the mixture in any particular manner; there is neither a stratification of the gases nor a uniform weak charge, and the space at the end of the cylinder is no larger than is necessary to obtain the desirable compression of the charge. Accordingly there is no extra dilution of the charge with atmospheric air, and the power of the engines is therefore very great in comparison with their small size; this is a great advantage in cases where it is necessary to economise space.

We come now to the constructional details, and will show in what manner they contribute to the efficiency of the engine. Fig. 4 shows the mixing-valve, together with the inlets for gas and air and the manner in which the gases combine before passing to the cylinder. The gas, as it comes from the main, passes first through the valve *d*, which is opened at the proper time by a cam on the motion shaft. This valve is also used to regulate the speed of the engine by diminishing the number of explosions; thus supposing that the engine is not working at its full power, the governor balls will be raised, and, acting through the bell-crank shown at the top of the engraving, will force the rod *e*, which is pivoted on the valve spindle away from the rod *f*, and, the connection being thus broken between the cam and the gas valve *d*, the latter will remain close until the engine recovers its normal speed, and no explosion will occur during the interval.

The gas has a free passage into the mixing-valve through the slits *b*, which are made in the movable part of the valve. This is opened by the partial vacuum caused when the piston makes its first up-stroke, and immediately uncovers the small gas ports. The air ports, marked *a* in the engraving, are also opened at the same moment. The chief thing to be noticed in this valve is that, whatever be the extent of its opening, the quantities of gas and air drawn in are always in the same relative proportion to each other, so that the ultimate mixture in the cylinder never varies. The mixed charge is now drawn along the passage into which the end of the igniter protrudes, and from there the greater part passes into the cylinder, mingling with the waste gases which remain from the last explosion, while a small proportion is retained in the passage. A back-pressure valve, placed immediately under the igniter, intervenes between the two, and closes as soon as the piston has finished the first up-stroke. The down-stroke is now commenced, and the charge, is compressed to from two to three atmospheres. The ignition then takes place, the arrangement by which this is effected being a peculiar feature of Mr. Körting's engine, which we will now proceed to describe with the help of Figs. 5 and 6; *a* is the body of the casting, having in its lower end a movable hollow ram, bored with holes immediately above the conical valve *d*, and in its upper part a solid ram or plunger to which motion is imparted from a cam on the auxiliary shaft. While the compression is going on the upper ram *m* is pressed down on the valve seat *t*, and closes the communication between the outside flame and the inside of the cylinder, as shown in Fig, 5. As soon as the charge is sufficiently compressed, the upper ram is suddenly lifted, and the pressure on the lower end of the loose ram *k* forces it up against its seat *d*, again preventing any escape of the charge except through the extremely fine hole at the bottom of the hollow cone, which allows only a very small quantity to pass; the explosive mixture coming through this finds its way to the outside flame, as shown in Fig. 4, where it ignites, and the flame retires at once into the cone. The ignition cannot be communicated to the charge through the small hole, owing to the great velocity of the gases issuing therefrom, but the flame continues to burn at that part of the cone where the gradually decreased velocity allows the combustion to take place. When the piston has reached the dead point and it is desired to effect the explosion, the upper ram *m* is forced down upon its seat, and the lower ram *k* falls about 1-10th inch (see Fig. 5), allowing the flame contained in the hollow cone to ignite the charge, the communication between the two being made by the small holes at *d*, already referred to, through which the flame passes along the channel *v* into the cylinder. The compressed charge is therefore ignited, and the piston is driven upward; on its return part of the waste gases are expelled, the exhaust-valve through which they are allowed to escape being opened at the proper time by a cam on the motion shaft. A certain proportion of the waste gases are retained in the cylinder, as already stated, to mix with the next incoming charge.—*Mech.*

THE WHEELOCK ENGINE.

Messrs. D. Adamson and Co., of Dukenfield, near Manchester, are the exhibitors of a horizontal non-condensing engine fitted with the Wheelock expansion gear, invented by Mr. Jerome Wheelock, Worcester, Mass., and of which they are the makers in this country. This engine, which is of excellent design, is shown by the engravings which we illustrate; it has a cylinder 16 in. in diameter and 3 feet stroke. The special features of the Wheelock gear are shown by separate views of the cylinder (Figs. 4 and 5). From these views it will be seen that the steam passages are at the bottom of the cylinder, so as to insure thorough drainage of the latter, the passages at each end of the cylinder leading to a bored chamber fitted with a partially rotating valve. This valve acts like an ordinary slide valve, placing the cylinder passage in communication with either the steam or exhaust. Between the two main valve chambers is a central steam chamber with which the steam pipe communicates, the admission of the steam from this chamber to either of the valve chambers being controlled by the cut-off valves shown. These cut-off valves, it may be noticed, have their faces hollow out, so that when moved from their shut position the steam can pass them in two ways. This arrangement enables the cut-off valves to give the requisite amount of opening with a very small movement. It will be noticed that no steam can leak into the exhaust from the steam chamber without passing both the cut-off and main valves.

Both the main and cut-off valves are keyed on hardened steel spindles, which support them, and which, on the driving ends, are fitted with steel bushes ground to a steam-tight fit in the long boss on each valve chamber cover. The inner end of each bush and a collar on the valve spindle against which it abuts are also carefully ground. No packing is used, a steam-tight, and, at the same time, practically frictionless, joint being obtained by the use of the bushes just described. At

THE KORTING-LIECKFELD GAS ENGINE.

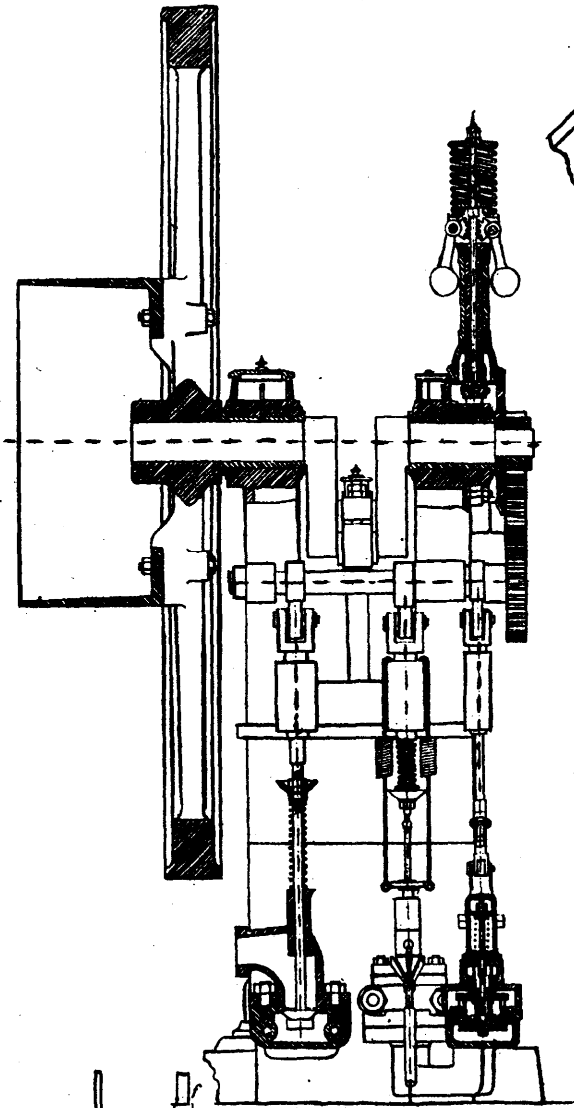


Fig. 1.—Front Elevation and Section.

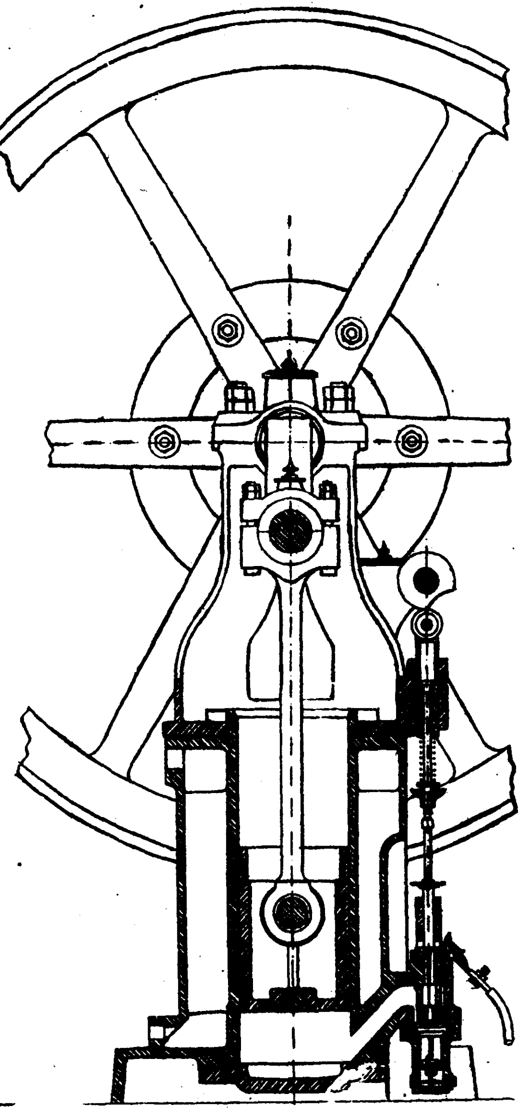


Fig. 2.—Side Elevation and Section.

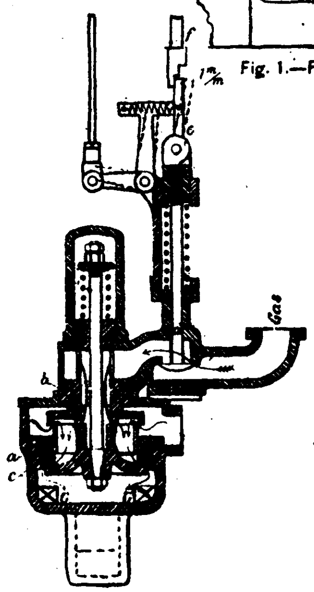


Fig. 4.—Mixing-Valve.

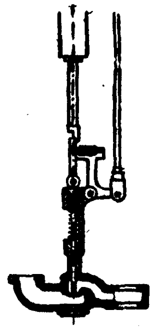
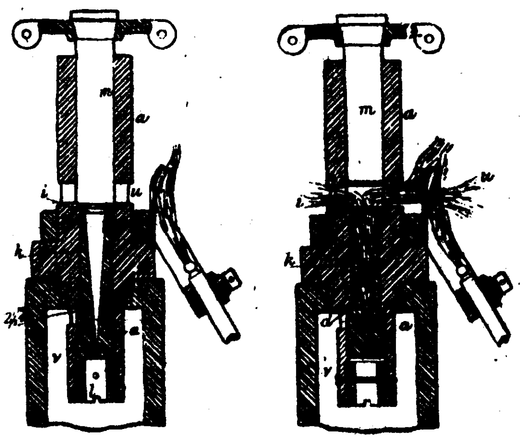
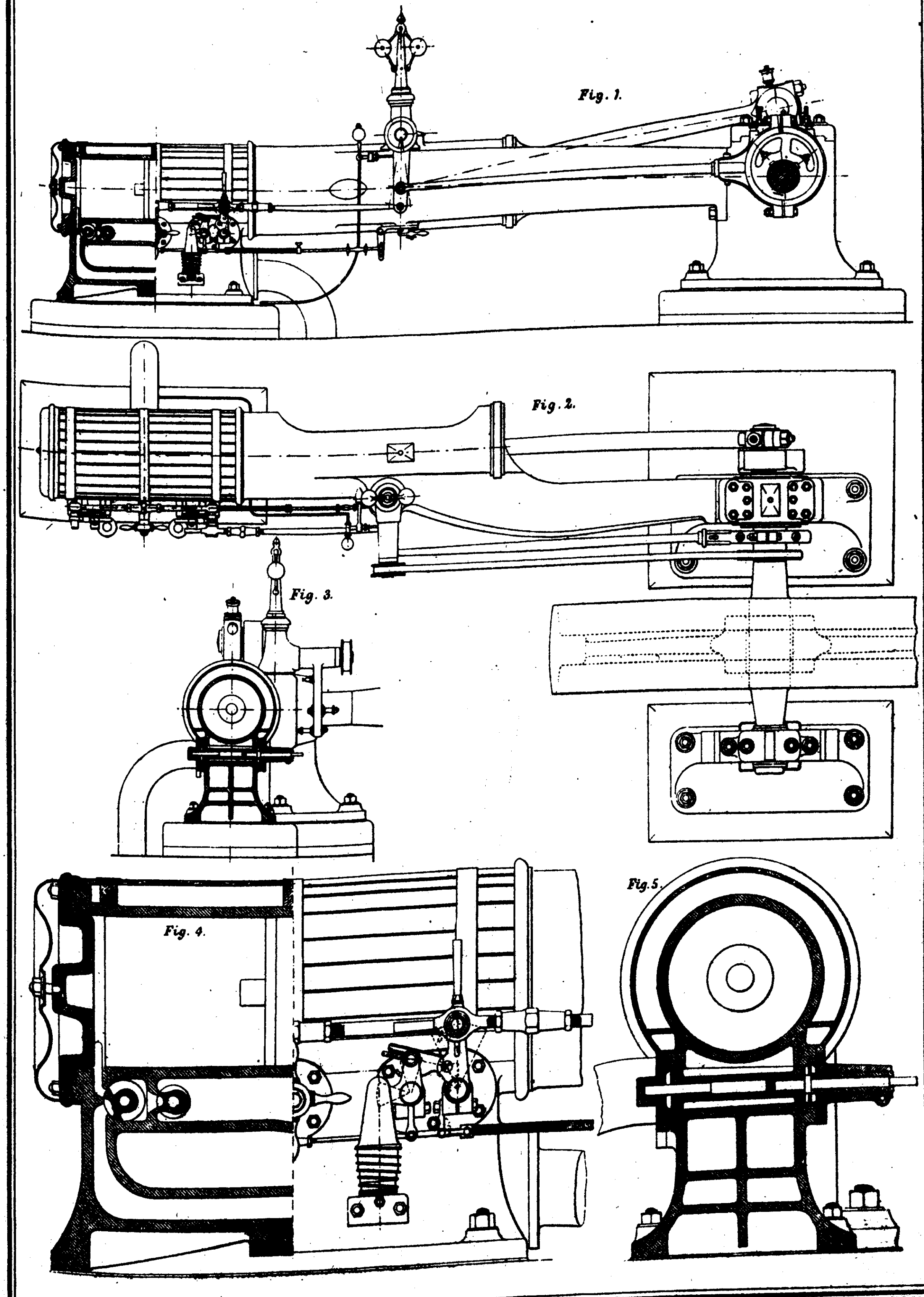


Fig. 3.—Gas-Valve.



Figs. 5 and 6.—Igniting Arrangement.

WHEELOCK ENGINE.



the other end of each valve chamber the cover is fitted with a cover having a spindle projecting into the end of the valve, which is bored and bushed with hardened steel to receive it. In this way the valves are practically carried on trunnions, the contact between each valve and its face being only just sufficient to insure tightness. To enable the pressure of each valve on its face to be adjusted, the valves are made very slightly taper, so that they can be adjusted endways. Valve made in this way have proved most durable in practice, the spindles and bushes remaining quite steam-ti ht after many years' use. At Messrs. Adamson's own works valves thus fitted have been in use over six years, working with 90 lb. steam, and are still perfectly tight.

The manner in which the valves are actuated will be understood on reference to Figs. 4 and 5. From these it will be seen that each main valve spindle has keyed upon it a lever, and these levers are coupled to the eccentric rod, which gives to the main valves a motion corresponding to that of an ordinary slide valve. To each main valve spindle is jointed a stirrup link provided on its underside with a hardened steel catch which engages a corresponding hardened block on the end of the vertical arm of a bell-crank lever keyed on the corresponding cut-off valve spindle. The horizontal arm of the bell-crank just mentioned is coupled to a spring which tends always to pull the cut-off valve into its shut position. By means of the stirrup link and catch above mentioned, the cut-off valve is pulled open by the movement of the corresponding main valve lever, this movement continuing until by the action of a cam controlled by the governor the catch is disengaged and the cut-off valve closed by the action of the spring. The work thrown upon the governor by this gear is very light and the gear is very sensitive, giving a most efficient control of the engine. The governor is of a high-speed pattern. Altogether the engine is a most interesting one. We may mention that Messrs. D. Adamson and Co. have lately completed six pairs of compound engines of this type for the new works of the Sugar Manufacturing Company at Kilbowie, near Glasgow.—*Eng.*

MR. TAYLOR'S EXPLANATION.

To the Editor of the Canadian Magazine.

Sir: The undersigned claims the discovery of the following truth, viz: If one of the legs of an isocelese triangle be at right angles to a given straight line, that the linear measure of the sides of said triangle is the length of the trisecting line which divides the angular difference between the vertical angle and the right angle.

The outer end of the said trisecting line must be raised to the same altitude as the intervening lower limb of the isocelese triangle; then the angle on one side of this trisecting line will be double the adjacent angle on the other side of it.

The construction: Let A,R,T, be a right angle; and triangle A R H any part of that angle; draw U T parallel to A R; make H R equal to T R; join H T; R T H is an isocelese triangle. Draw H Y parallel to A R. The line R O divides the required angle A R H into two parts, one of which is double of the other, for the line O R is within the angle, and its length is equal to H R, plus R T, plus T H; and O touches the parallel H Y.

The construction and demonstration is analogus to that employed in proof of the trisection of a right angle. Similarly any angle of a triangle may be quinquisected. The base of the isocelese triangle, associated with the trisection of a right angle, is zero. All lesser angles are similarly trisected, but with this difference, viz: they are allocated with an adjacent isocelese triangle, having a positive base.

ARTHUR McN. TAYLOR.

Fredericton, May 28, 1885.

IRON MAKES WAY FOR STEEL,

Few people not actually engaged in the metal trade are aware of the wonderful strides made by steel in recent years. In fact steel is wholly taking the place of wrought iron. Steel is simply a mixture of iron and carbon, the quantity of carbon ranging from .25 to .20 per cent. of the mass. It is not only stronger and, for almost every purpose, better than wrought iron, but it is cheaper.

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

The result of these low prices is that bridges are no longer made of iron. Steel beams have taken the place of iron in the fireproof buildings. Steel ships are built instead of iron ships. Steel boilers replace iron boilers. Steel rifles replace the old cast iron cannon. Wherever tensile strength is required, steel is used. Although no iron rails are made now, there are still a few old iron rails in use. As fast as worn out they are replaced by steel rails.

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

One field in which steel has not yet wholly displaced iron is in the manufacture of nails. The plates from which nails are cut can be rolled from steel ingots as easily as from puddled iron, but the steel plate is harder to cut and the cutters charge a little more for the work. The plants engaged in making steel nails are limited in number, and the price of steel nails is higher than that of iron. The steel nail is smoother, stronger and handsomer, and has made its way in spite of the higher price, but the difference in price is rapidly dwelling, and will not doubt, soon disappear altogether. In November, 1884, the Wheeling manufacturers charged thirty cents and the Troy men twenty-five cents a keg more for the steel nails. Quotations during the last of February this year were $2.10 per keg for steel nails and $2 for iron. The profit to the manufacturer of the steel nails is much greater on account of the smaller cost of the plates, and the only thing that prevents the iron nail-makers from using steel plates entirely is that it takes money to change the plant, and after the great depression of the past two years, money is not over abundant among iron manufacturers in any branch of the trade.

A curious outgrowth of this improvement in the manufacture of nails is the action taken by the trades unions in the West at the instigation of the puddlers. By the old puddling process of making iron plates for nails, the pig iron was melted mass with long rods until the impurities were burned out and the iron became pasty instead of liquid. By the new process the melted pig iron, in a big pear-shaped kettle, is subjected to a powerful blast of air, which is forced up through it from the bottom, until the impurities are burned out. Then another small amount of melted pig iron is poured in and the mixture is ready to be cast into ingots. By the old process twenty skilled men could turn out fifteen tons of nail plate in a day, while by the new process four common laborers and one skilled mechanic can turn out from 150 to 250 tons in a day. Naturally the puddlers must lose their occupation. They have induced the Contractors' and Master Carpenters' Association of Wheeling to boycott the steel nails, and all union builders will be asked to boycott them also.—*New York Sun.*

The United States has 17,000 dentists, who use a ton of gold and five tons of other metals and make 4,000,000 artificial teeth annually. Only one American in eighty is found to have perfect teeth, and one-third of the population make more or less use of the artificial product.

BERNAY'S STEAM PUMP.

Mr. Joseph Bernays, of Newgate street, London, is exhibiting in the West Annexe of the International Inventions Exhibition, Group XI., two steam pumps of novel design, one of which will be shown under steam. The novelty consists in the use of a connecting-rod of a length equal only to the radius of the crank) so arranged that it passes from above the crank at one end of the stroke to below the crank at the other end, whilst maintaining at every point its proper relative position to the crank. The rod thereby turns completely over for each revolution of the shaft, and, adding its own length to that of the crank at each end of the stroke, causes the piston travel to be four times the radius of the crank, instead of twice only. All side strain is avoided, and the use of crosshead guides is dispensed with, while at the same time the glands are protected from wear. The smaller of the two pumps at the exhibition is a ram pump (No. 1), having a steam cylinder 2⅝ in. in diameter, ram 1½ in. in diameter, with a stroke of 3 in., and delivering at 160 revolutions per minute about 180 gallons per hour. The other is a double-acting pump with a steam cylinder 6 in. in diameter, a water cylinder 4½ in. in diameter, and a stroke of 9 in. The cylinder is lined with gun-metal, and the glands are bushed with the same metal; this pump will deliver at an average speed 4800 gallons per hour. Mr. Bernays has granted an exclusive license for the making of his patent pump to Messrs. T. Larmuth & C., engineers, of Salford, Manchester, and the various details of construction have been very carefully considered. Every working part of the pump is in view and easy of access.

A general perspective view of the second pump is given, accompanied by four detail views explanatory of the arrangement of the crank and connecting-rod. Figs. 1 and 2 illustrate the arrangement shown in the large engraving, and Figs. 3 and 4 another arrangement which is slightly easier to comprehend. In Fig. 3 the pump ram is shown at the end of its stroke, and the crank and connecting-rod stand in a line with one another. In Fig. 4 the piston has made one quarter of its stroke, and a tail.piece formed on the connecting-rod, has come into gear with a pair of toggles on the framing. This tail-piece and the toggles run together like wheel gearing until the stroke is nearly accomplished, when the connecting-rod attains the position of Fig. 3, and then goes into gear with the opposite toggles.

In Figs. 1 and 2 the connected rod is formed in one with an eccentric block. The block is made in halves, and is fitted in to a strap, to which the piston and pump rods are connected. There are two tail pieces, one at each side, and these gear into toggles as already described, and cause the eccentric block to rotate in the strap and around the crank-pin at the same time. The piston moves accurately in accordance with the true law of the "versed sine," both on the in and out stroke; it therefore reaches the cylinder ends at greatly reduced speed, and the slide valve can be set alike for both ends.

The pumps take up very little space, and can be fixed in places where other flywheel pumps would be impossible. They are made in all sizes, and can be adapted for any purpose.—*Eng.*

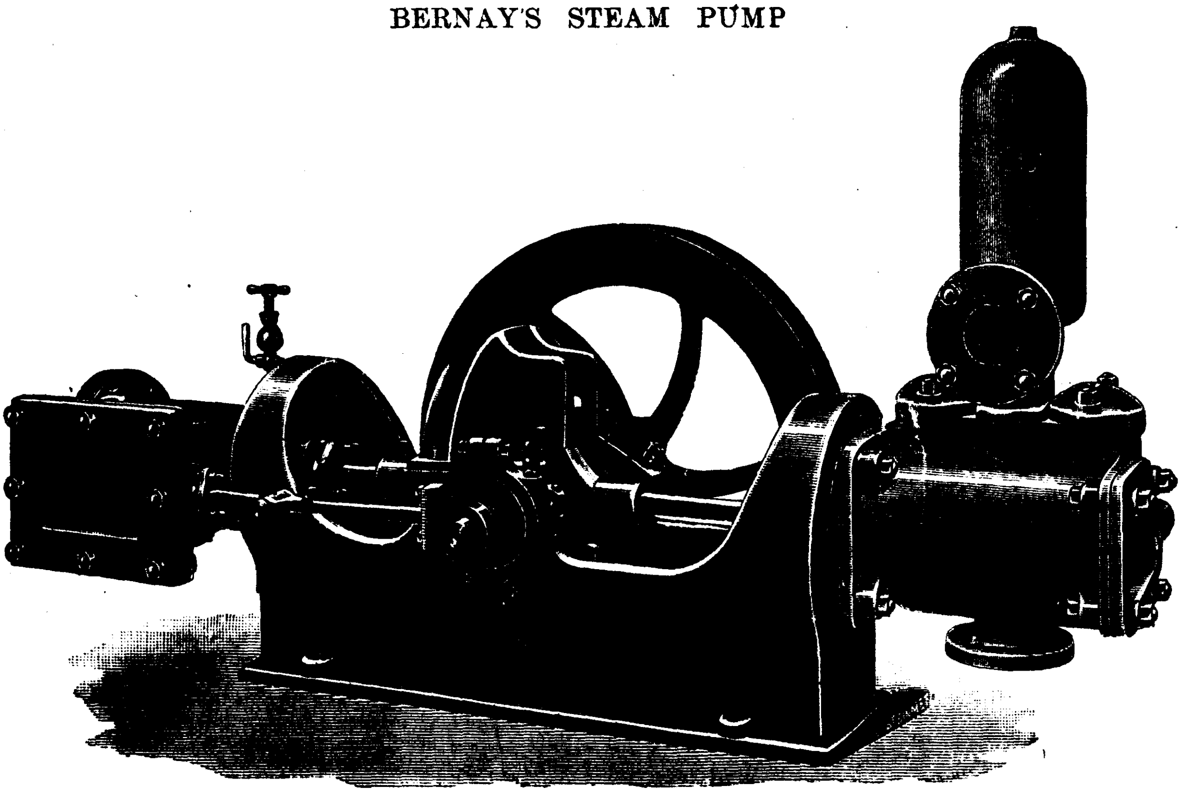
DUNCAN'S COMPOUND LAUNCH ENGINE.

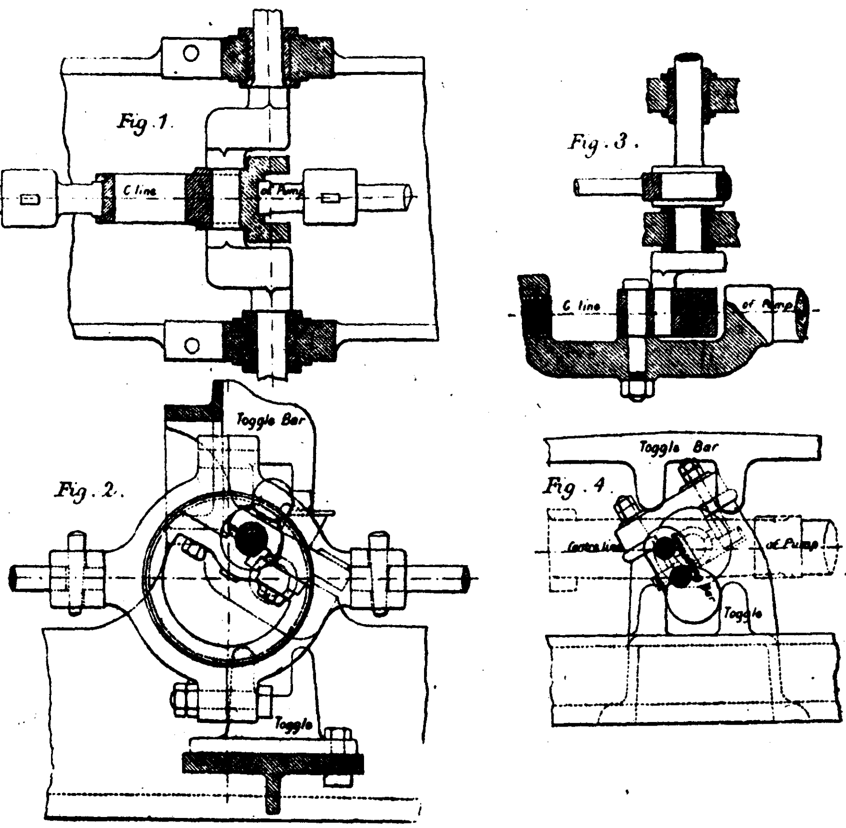
Messrs. Duncan Brothers, of Queen Victoria Street, E.C., exhibit a couple of launch engines the one fitted with the Bremme valve gear, and the other a compound engine fitted with the arrangement of reversing valve designed and patented by Mr. Robert Duncan, of the firm of Messrs. Ross & Duncan Whitefield Works, Glasgow. Of these latter engines we give detail views showing the arrangement of the reversing valve to which we have referred. In our illustrations, Fig. 1 is a vertical section through both cylinders and distributing valves, Fig. 2 a horizontal section showing both the distributing and the reversing valves, Fig. 3 a vertical section through both valves, Fig. 3 a vertical section through both valves of one cylinder, and Fig. 4 a similar view through both reversing valves. The steam is distributed by piston valves S_1 S_2 working in casings with ports all round them, so that the valves are in equilibrium and there is no unnecessary strain thrown upon the eccentric, of which there is but one. The eccentric rod has a crosshead which is connected to both valve rods, and imparts equal and similar motions to each. To render this possible it is necessary that the cranks of the two cylinders should be either together or separated by 180 deg., as steam will be admitted to both cylinders simultaneously. The latter arrangement is the one adopted, as it provides for the easy balancing of the parts, the motion of one crank and piston being contrary to that of the other, and thus tending to reduce vibration. There is no lap on the valves, only a little cover, the steam entering until the termination of the stroke in both cylinders, and flowing direct from the smaller to the larger without the intervention of a receiver. The reversing valves are exactly alike, and but for constructive reasons might equally as well be in one. They are stationary except at the moment when the engine is being reversed, when they are moved simultaneously by a lever and a rock shaft. The steam enters first one of the reversing valves, then flows past or through it into the distributing valve of the high-pressure cylinder. After doing its work there it returns through the distributing valve to the second reversing valve, and thence to the low-pressure cylinder. When the valves are in the positions shown, steam entering at the branch D has access to the centre of the valve R_1, Fig. 2, and thence by the passage M_1 to the centre of the valve S_1 by which it is alternately delivered to either end of the high-pressure cylinder. The exhaust from the cylinder escapes past the end of the valve into the casing, and gains access to the valve casing of the other cylinder through the passage L (Figs. 2 and 4). It is delivered to the cylinder by the valve S_2, acting like an ordinary slide valve, and when exhausted it passes from the cavity of that valve, through the passage M into the cavity of the reversing valve and thence by the branch E into the air or the condenser, as the case may be. Under these conditions the eccentric follows the crank, but if the reversing valve be moved downward until the steam entering at the branch D blows into the casing instead of into the cavity of the valve, then the direction of motion is changed and the eccentric goes in advance of the crank as usual. The high-pressure valve then distributes the steam by its ends and receives the exhaust in its cavity, while the low-pressure valve operates in the opposite manner. For work in which it is necessary that the cranks should be at right angles, Mr. Duncan proposes to employ two tandem engines, each controlled in the manner we have been describing.

Thom's Slide Valve.

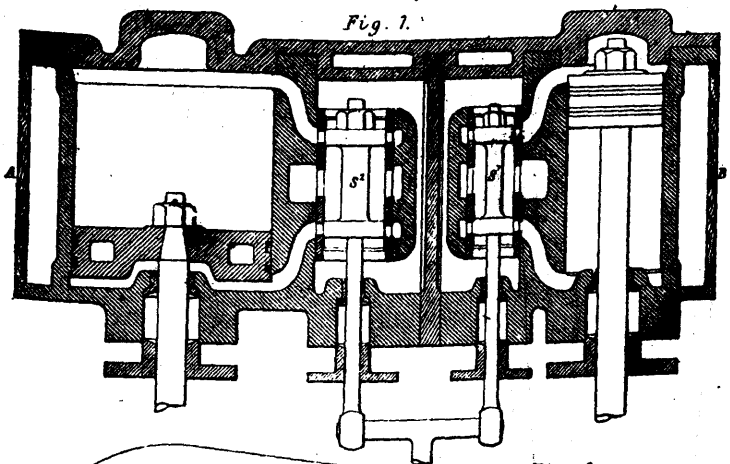
Mr. John Thom, of 8, Storey-square, Barrow-in-Furness, is the exhibitor of his "economical" slide valve, which we had occasion to notice a few months ago in connection with the engines of the s.s. County of Salop, and engravings of which we reproduce 199. From the views there given, which show the valve in six successive positions during one stroke of the piston, it will be seen that the valve is of the Trick, or Allen type, having a passage through its back for affording a double admission of the steam, the openings of this passage, however, being so placed that during a certain part of the stroke of the valve the passage through its back form a communication from one end of the cylinder to the other, thus enabling a certain amount of steam to pass from the pressure side to the exhaust side of the piston. Thus, if the various views be examined, it will be seen that in the fourth position shown—the piston being then approaching the bottom of its stroke—the valve is so situated that steam from the upper end of the cylinder can pass along the valve passage to the underside of the piston, thus filling the lower steam ports with steam of the pressure then existing at the upper end of the cylinder, and increasing the cushioning at the lower end. This action is particularly useful in the case of the low-pressure cylinder where, when working with a good vacuum, the pressure of the steam ordinarily available for cushioning is but about 2½ lb. absolute per square inch, and when in consequence it is sometimes necessary to give great lead to the low pressure valve in order to get sufficient counter-pressure against the piston at the end of the stroke to secure smooth working. In Mr. Thom's arrangement, on the other hand, this necessary cushioning is obtained by the transference of steam which would otherwise be passed into the condenser, and a material saving is thus effected. It will be seen from the views, that the face on the cylinder is double-ported, the ports next the exhaust opening being used for exhausting only, and being smaller than the outer ports, which are enlarged to give the full advantage of the steam entering through the passage on the back of the valve. Mr. Thom's slide valve has now been applied to a number of steamers, in some cases to both high and low-pressure cylinders and we are informed with very satisfactory results, both as regards saving steam and producing smooth running.

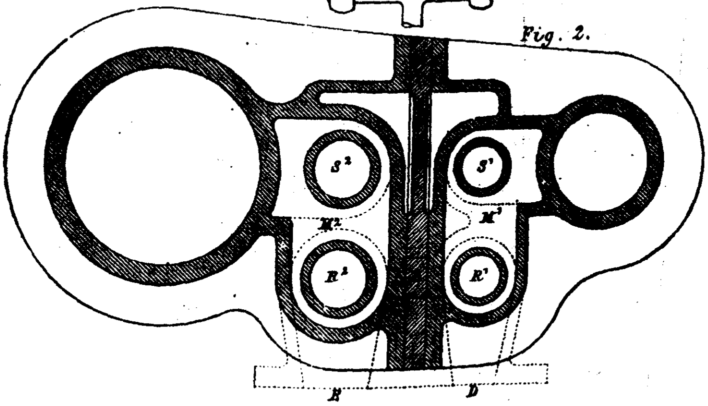
BERNAY'S STEAM PUMP





EXHIBITS AT THE INTERNATIONAL INVENTIONS EXHIBITION.





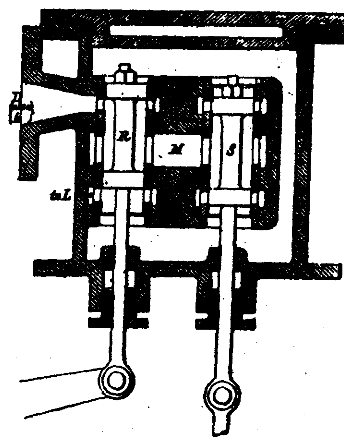


Fig. 3.

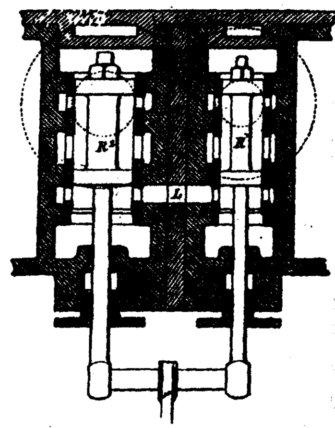
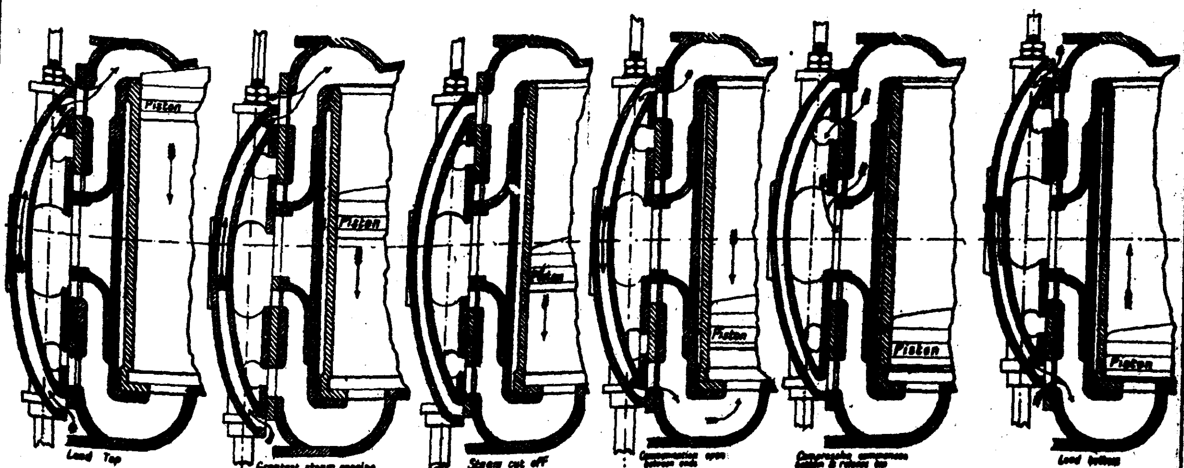


Fig. 4.

DUNCAN'S REVERSING VALVE FOR COMPOUND ENGINES.



THOM'S SLIDE VALVE.

THE CONDENSATION OF GASES ON GLASS.

It is well known to those who endeavor to obtain in glass vessels the very perfect vacuum first arrived at by Crookes, that the operation of exhausting by the mercury pump is much facilitated by heating the tubes of the pump and the glass vessel to a high temperature. The difficulty of removing the film of air and moisture adhering to glass tubes is also well known to makers of barometers and thermometers. When in exhausting by the Sprengel pump the vacuum is gauged by a millimeter or half a millimeter of mercury, the drops of mercury falling in the tube of the pump produce a loud, sharp, hammering sound, and sometimes break the tube. If the tube be now heated, however, by a Bunsen flame, this hammering ceases, and on close inspection of the fall tubes, air is seen to be carried down in them. This air is liberated from the glass walls of the tube by the heating. The deposition of thin films of moisture on glass insulating-rods is also well known. Professor Quincke finds their thickness to be comparable with $5 \div 10_5$ cm. Mr. J. T. Bottomley, an English investigator, has recently made some experiments on this subject, his object being to measure the quantity of gas condensed on the surface of glass. The glass employed consisted of fine glass thread—some of it made from flint-glass rods, the rest of flint-glass tubes. According to his results, communicated to the British Royal Society, Mr. Bottomley found that 8.24 per cent. of the gas deposited on the glass fiber was carbonic acid gas, and 24.8 per cent. of oxygen. The residue, 75.2 per cent., was mainly, if not wholly, nitrogen. The total quantity of gas collected was calculated to be at 15° C., and 760 mm. pressure, .45 c. cm., and the glass surface of condensation to be 1448 sq. cm., or equal to that of a square 38 cm. in the side.—*Ex.*

RESISTANCE OF WIRES ON COILING.

An interesting series of experiments has recently been made by Mr. J. Hopps, of the Indian Engineering College, Cooper's Hill, England, and his results will be published shortly in the "Proceedings" of the British Physical Society. We may state, however, that Mr. Hopps experimented with wires of various metals, and employed an ingenious testing machine, recently exhibited to the Physical Society. Observers have found that coiling iron wire decreased its resistance, and uncoiling it increased its resistance. Mr. Hopps, however, finds that with soft iron wire, during the first few operations of coiling and uncoiling, the coiling is accompanied by a degree of resistance, and uncoiling by an increase. The same holds for wires of copper, German silver, lead, aluminium and magnesium. With zinc an increase of resistance attends coiling and uncoiling, but the increase for coiling is only from $\frac{1}{4}$ to $\frac{1}{80}$ of what it is on uncoiling. It will be remembered that, during the Paris Electrical Exhibition of 1881, M. Violle suggested as a standard the light radiated by a square centimeter of platinum at the fusing point, or, in other words, at its point of solidification. The congress which then sat recommended the Carcel lamp, of the Dumas and Regnault type, as a secondary standard, and the International Conference has now definitely adopted the Violle light as the premary standard.—*Ex.*

EFFECT OF LOW PRICES.

The three-cornered fight among wages, prsces and interest (profits), has an excellent illustration in the iron industry. Prices return to the manufacturer and his workmen the equivalenu of the product, and, after paying out of this the other items of the cost of production, interest and wages (and a small amount for management), must divide the rest. Late years have demonstrated the diminution of interest through price reduction, and that wages are at times subject to loss through the same decrease of returns. Capital would show the loss upon labour, and labour upon capital, and sometimes they are compelled to divide the loss; but, in any event nearly all the strikes have this origin. In 1881, when $5.50 was fixed at the rate for puddling, bar iron sold for $56 and pig iron at $25 per ton; now the same bar iron sells at $40.32, a decline of 28 per cent., and the same pig iron at $18, a decline of 28 per cent. The falling price has cut down the value of the product, and hence the amount to be divided as interest and wages. Manufacturers say that wages must go down and, the workmen not agreeing, 55,000 of them were lately out of work and iron furnaces worth millions of dollars were doing nothing.

QUICK CAPITAL.

One of the savings that modern business has developed is the quick turning over of capital. An "active" capital of $500 that is turned over twice a year, is just as serviceable as a capital of $1,000 in the same business turned over but once a year. The saving is in the amount of interest, which, in the former case, is just half what it is in the latter. The fast mail train recently put on the Pennsylvania railroad, so shortens the time between New York and St. Louis that the bankers and merchants of the latter city will save about $60,000 a year in interest on remittances. Under the new arrangement the remittances will pass through the Clearing House at New York the day of their arrival instead of on the following day, as before, and one day's interest upon about a million of dollars is saved to St. Louis business men.

SOUTHERN PINE.

The supply of southern pine seems exhaustless. A large fleet of schooners and other craft is devoted exclusively to its transportation from Virginia, North and South Carolinas, Georgia and Florida. The latter state is renowned for the long boards that are cut from its trees. Georgia owns the standard of quality. Trees from which the pitch has been partly removed in the manufacture of turpentine, turn out lighter wood, but such cuttings have not the wearing merit of sawings from virgin trees. Since the war, owing to better railroad facilities, large tracts of new forests have been opened to commerce. Europe, especially England, is a large buyer of this wood. Its excellence in railroad work on account of toughness and comparative lightness, is becoming recognized abroad as well as in this country. When yellow pine vessels become dismasted or capsized at sea they form most dangerous wrecks, and at night are an especial terror to navigators. Their buoyant cargoes prevent them from sinking. Several abandoned schooners have been known to drift about the ocean from six to eighteen months. In ship work the durability of this pine has been long acknowledged, but it is only within a few years that its usefulness for house purposes have been appreciated. In former times it was tedious stuff to work by hand, but its toughness is now overcome by improved tools and steam dressing, and the increased call for hard pine wainscotings and cellings that has attended the active building operations of late, has been readily supplied. No wooden flooring that is used bare is superior to narrow strips of seasoned Georgia yellow pine. A well-laid surface of the wood improves with age and friction, its resinous quality hardens and forms for it a sort of natural varnish. Art, too, has recently touched this sturdy old timber. Thin door panels are sawed out of planks containing thick deposits of rosin. When these panels are placed in doors that the sun can strike, the effect produced is a rich, red wine color, showing inside of the room. There is a process of artificially seasoning pine. There is also one of steaming it, so that the rosin will show uniformly in the board, but the naturally veined surfaces are handsome enough when properly smoothened.—*New York Tribune.*

THE INERTIA OF CAPITAL.

In some books on political economy the removal of capital from one employment to another is spoken of lightly, as if it were an easy process. No delusion can be greater. Such changes can, of course be made in some kinds of business without very serious loss. A banker, whose fixed plant consists of a few chairs and tables, may, if he has been prudent, wind up his affairs and invest his capital elsewhere, but a manufacturer or farmer, with money sunk in all sorts of ways, cannot sell his plant without heavy loss, except in very particular times and under extraordinary cicumstances. The times when he could so sell are prosperous times, when he would not desire to abondon his occupation and find another. The times when he wishes to retire would be the very times when others besides himself are suffering from reduced profits, and when few would be disposed to enter on such a business. So, if he sells, he must sell at a great sacrifice in order to tempt a purchaser. Rather than do this he will continue his business, at the risk of no profit, or at a loss.—*The Contemporary Review.*

STEAM YACHT MAGNOLIA.

The steam yacht Magnolia was built in 1883 by the Herreshoff Manufacturing Company, of Bristol, Rhode Island, U.S.A., for her present owner, Mr. Fairman Rogers, of Philadelphia and Newport. She was expressly designed for cruising along the Atlantic coast and about Florida, and is interesting as being quite a different type of steam yacht from that usually built. From Newport, Rhode Island, to the mouth of the St. John's River, Florida, there is an almost uninterrupted inland passage along the coast of about 1,200 miles, suitable for steamers of draught not exceeding 4 ft. or 5 ft., which for variety of scenery and climate is unequalled in the United States. Through Long Island Sound, with its varied and numerous harbours, to New York, thence through the Delaware and Raritan Canal to the Delaware River, again by canal to the head of Chesapeake Bay, which in itself with its many interesting rivers, is a cruising ground of months, then through Carrituck, Albemarle, Pamplico, and Core Sounds to Beaufort, N.C., is all through smooth water with numerous harbours, which a vessel of light draught can make at short intervals. From Beaufort to Charleston, S.C., is outside 240 miles, with two or three intermediate harbours. From Charleston to the St. John's River is all inside through narrow passages behind the sea islands and across the estuaries of the rivers flowing into the Atlantic. The route can be varied by running out of any of these estuaries, and into another, if the weather outside is sufficiently tempting. This kind of cruising called for a boat which should have light draught, seaworthy qualities, and the maximum accommodation for a long residence on board.

The yacht here described has fulfilled the conditions so well that the owner, who was familiar with these waters, and, therefore, knew exactly what was required, would not, in designing another vessel for the same purpose, make any essential changes.

As the Great Lakes and the St. Lawrence River also form a delightful summer cruising ground, and the locks of the Erie Canal, through which this region is reached, measure 100 feet by 18 feet, the length of the yacht was fixed at 99 feet, and her breadth at 17½ feet. A draft of 4 ft., a flat floor, and 6½ ft. clear head-room in the cabin, with a flush deck fore and aft, settled her other dimensions.

The light draught made twin screws necessary, and in long cruises in out-of-the-way regions there is a great advantage in having two entirely separate boilers, engines, and screws, as in case of an accident to one of them the other is available to produce at least one-half the speed that both would give.

The drawings show the arrangement of the interior. The owner's part of the boat is forward, the crew space aft. As speed was not any object, the lines of the hull are full, both fore and aft, giving large room clear up into the bow, and the power being small, very little room is occupied by the engines and boilers, and being light they can be placed aft of the centre of the boat without affecting her trim.

The frames of the yacht are 3 in. by 3 in. white oak, steamed and bent. The planking is yellow pine 2⅜ in. to the turn of the bilge, diminishing to 1⅞ in. at the top. The deck is 2 in. white pine. The deck beams and frames are connected by oak hanging knees.

There are three water-tight iron bulkheads, one 10½ ft. from the bow, one fore and one aft of the engine-room.

Commencing at the bow, the fore peak gives ample room for anchor chains, extra coal, paints, and stores of various kinds. Aft of that is a space with a water-closet, wash-basin, closet for candles and lamps, place for trunks and for the head sails. This is accessible from the deck by a scuttle and ladder leading into the forward end of the fore and aft passage. Next is a bath-room and water-closet on the port, and a cabin-steward's room on the starboard side. The door in the passage is so placed that it throws the bath-room into the state-room part, separating it from the steward's room, which communicates directly with the deck. Next come two sleeping cabins, 7½ ft. by 7½ ft.; then the owner's room, 16½ ft. by 12 ft. This has two double beds and washstands, and can be divided at pleasure by a movable bulkhead into two rooms, each 8¼ feet by 12 ft.

The dining cabin is 16½ ft. by 16 ft., and has buffet, piano, and stove at its after end. The companion way from the deck opens into the dining cabin. The engine-room occupies the next 12 ft., the coal bunkers being on each side of it. Next to this is the galley, 16½ ft by 7 ft., then the rooms of sailing-master and engineer, next the ice-box on one side and water-closet and signal-lamp room on the other, and the remainder of the space is devoted to the crew and contains six pipe-iron bunks which turn up if required.

The hull has very little dead rise amidships, principally for the purpose of giving wide floors inside, and also because an enterprising navigator in these shallow waters may sometimes get aground with a falling tide, an accident which would be very dangerous with a sharp-floored vessel, but of no great importance with a flat one.

The boilers are of the latest Herreshoff type, a coil made of strong iron pipe in straight pieces connected by return bends just like steam-heating radiators. There are six flats of this pipe over the fire, the water entering at the top and passing through in a continuous flow to the bottom of the boiler. This kind of boiler can be made of any form to suit the space at disposal, and is therefore very economical of space. There are two separate boilers inclosed in one case, with one smoke stack. The boilers are so low that nothing projects above the deck but the stack.

The engines are of the well-known Herreshoff type, compound condensing, 6 in. and 10½ in. by 10 in., exhausting into copper condensers laid outside on the garboard strake close to the keel.

The ordinary speed of the yacht is ten statute miles per hour with 50 lb. of steam and 250 turns per minute. Screws 3 ft. diameter, 50 in. pitch. With a forced draught she has done 11.4 statute miles with 80 lb. of steam and 320 turns. Her full bow is of course prejudicial to her speed, but it makes her very dry forward, as she rises over the seas instead of plunging into them, an important quality in a boat in which the owner's end is forward.

The consumption of coal is between 175 lb. and 205 lb. per hour, about 2 lb. per indicated horse-power, and she can carry from ten to sixteen tons, depending upon how it is stowed. Six tons can be put in each bunker and the rest forward in reserve.

Anthracite coal is used, 2000 lb. to the ton. Upon one occasion a practical test showed the consumption of coal to be as follows: Ten tons lasted 17 days, during which the yacht steamed 482 miles in 60¾ hours, and laid with banked fires for 347½ hours. The steaming was, at a number of times, and mostly on a narrow and crooked river, not at the best speed. The two coal bunkers are of the same size, although the drawing does not make them look so owing to its showing a small tunnel, through which a car runs from the galley to the cabin, avoiding the necessity which exists in most small steam yachts of having to carry dishes over the deck.

The yacht is schooner rigged, with a staysail, and sails very fairly, making about six knots with a fresh beam wind, and lying within five points of her course when beating to windward. Her foot of keel, through the whole of her length, enables her to lie up closer to the wind than was anticipated.

The flush deck is surrounded by a mahogany rail and rope netting. The pilot-house is of mahogany and plate-glass, and serves as a deck-house. It can be taken down to pass under the bridges of the Erie Canal, for which purpose her masts would of course be unshipped. Communication between the pilot-house and the engine-room is by means of a telegraph, so arranged that pushing the handles of the levers ahead means "Go ahead," slow or full speed according to the notch, and pushing them astern means "Go astern," the indicators in the engine-room following them. The two handles can be moved together for both engines, or singly for either engine to be worked by itself. Rigid brass rods connect the parts, and pointers in the cabin show what signal is made.—*Eng.*

A DISTILLERY has lately been put in operation in Charleston, S. C., for manufacturing oil from pine wood. The material is subjected to intense heat in sealed retorts, and one cord of it is said to yield fifteen gallons of turpentine, eighty gallons of pine wood oil, fifty bushels of charcoal, 150 gallons of wood vinegar, and a quantity of inflammable gas and vegetable asphaltum. The oil alone is worth about twenty-five cents a gallon, and is used by painters and shipbuilders. Apart from its commercial value, the process is interesting as showing how modern chemistry is able to supplant those old destructive chemical processes by which a single article was produced from a given material and all the rest wasted or ruined.

THE STEAM YACHT "MAGNOLIA."

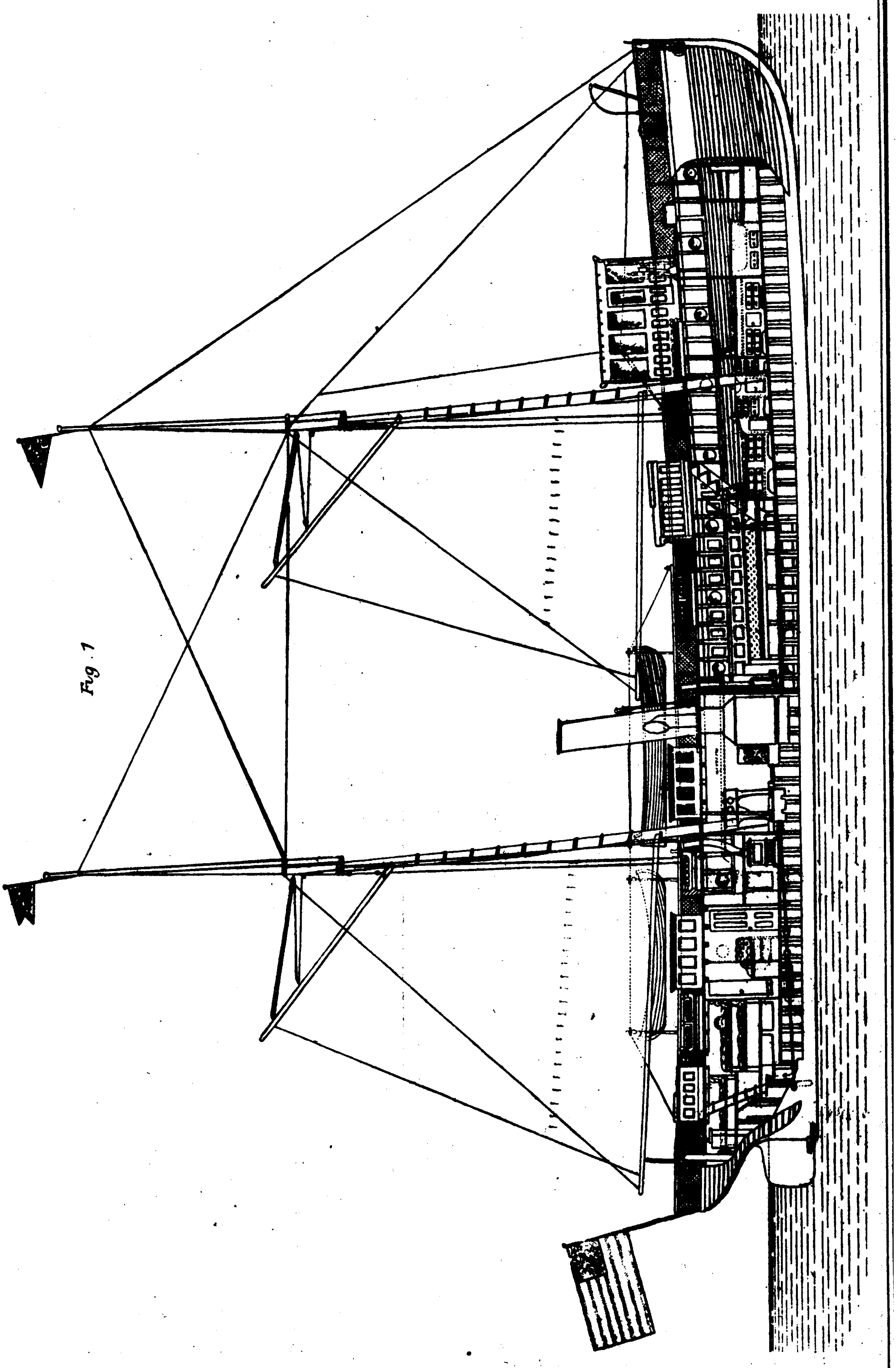
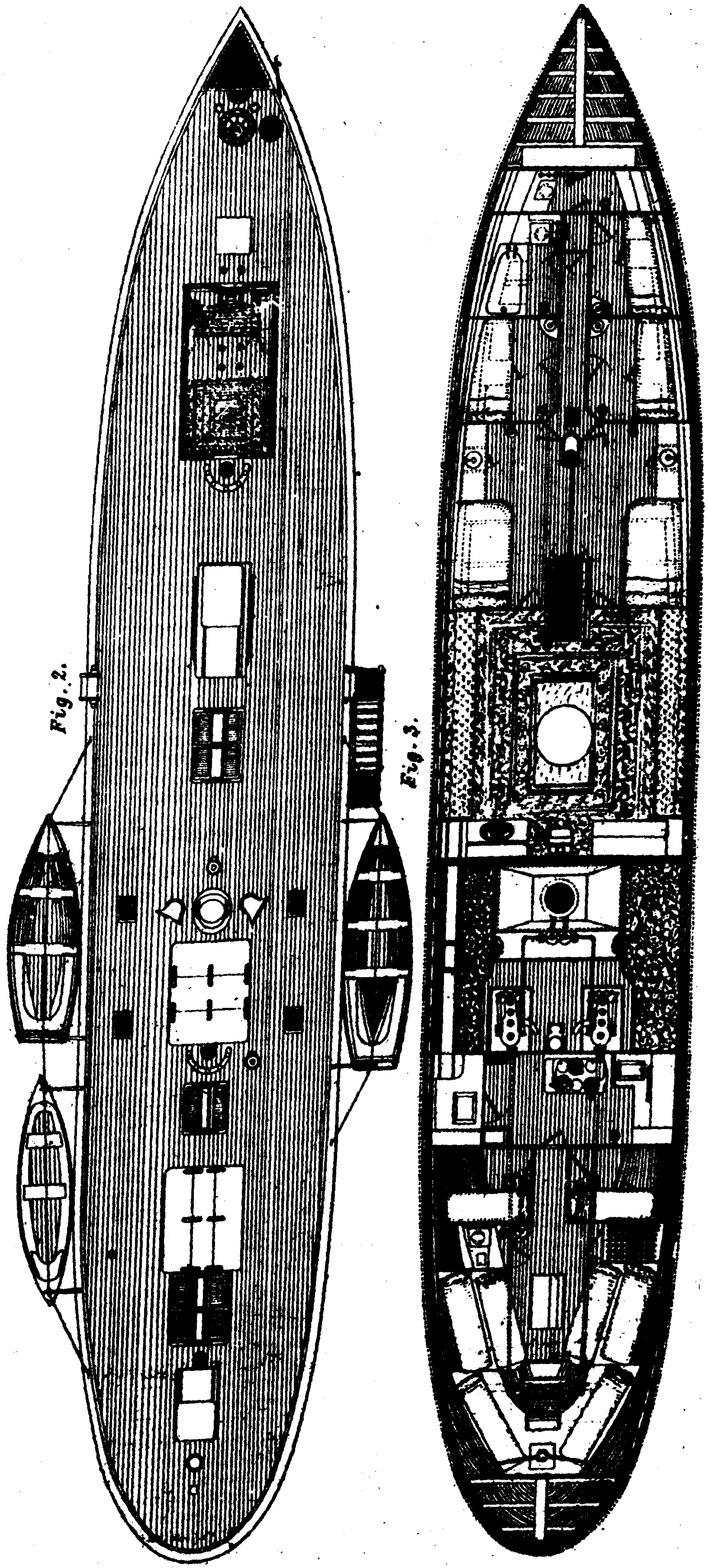


Fig. 1



THE STEAM YACHT "MAGNOLIA."

MACHINE TOOLS.

An interesting exhibit in this group is a model of a boring, recessing and screw-cutting apparatus, intended to be fixed to ordinary pillar, radial, or horizontal drilling machines. This is contributed by Mr. John Snowden, of Deronda-road, Herne Hill. The model is made to a scale of 3 in. to a foot, and consists of a casting made to fit to the machine it is to be used on. In this casting provision is made for taking the Snowden drill and a special form of thread-cutting spindle of a novel kind containing an expanding cutter for recessing the bottom of a hole to the diameter at the bottom of the thread. This cutter can be easily changed for the cutter which forms the thread. The cutters can be operated at will while the machine is in motion, an automatic index being attached to the spindle in order to show the workman the amount of cut taken each time, and also when a full thread has been made. Referring to our illustrations, which represent a machine of this class, Fig. 1 is a front elevation of the radial arm of a drilling machine having a bracket attached to it, the upper portion of which serves as a bearing for the drilling machine spindle, whilst the lower part is formed into a long bearing, the front A being hinged to enable the bearing to be quickly opened. B BI BII are swivelling bolts. By slacking back the nuts a little these bolts can be removed with the nuts still on, and this enables the bearing to be opened for the insertion of the screw-cutting bar or drilling bar as may be required. This arrangement of bracket and bearing saves a length of two ft. in the distance of the plate from the bottom of the bracket, over the space that would be required if the bracket were solidly made. Fig. 2 is a side elevation of the same part of the apparatus. In this is shown a double-ended lever E, through which a bolt F passes which engages with a shifting nut shown at G in the small section. This is held in or out of gear by the notched lever H (Fig. 2), which can be shortened or lengthened to suit nuts of different pitches. Fig. 3 is a partly sectional view of a screw-cutting bar with the cutter removed, and Fig. 4 is an elevation of the same in which the indicator referred to for guiding the operator is shown. The remaining figures show details which will be easily understood from the description we have given. Fig. 8 represents a specimen of the work, and in Fig. 10, P is a cutter for chamfering the edges of holes in order to assist the entry of bolts; it also serves to indicate the required depth of holes when drilling them.

USEFUL APPLICATIONS OF ASBESTOS.

Of late years the mineral asbestos has received much attention at the hands of inventors, and many useful applications have been found for it. There are several varieties of the mineral; some of these furnish a long silky fiber, tough and elastic, which may be treated like the animal or vegetable fibers, and spun and woven into fabrics. Other varieties have a shorter fiber, but are susceptible of the minutest subdivision, and of being felted; while others, though having the fibrous texture, are hard inelastic and brittle enough to permit of being readily crushed and pulverized. All of these varieties are utilized in the arts in the production of a number of diverse manufactured articles, many of which have acquired an established reputation and secured a permanent foothold.

The following brief account of the productions of The Asbestos Packing Company, of 169 Congress street Boston, will give a good idea of the extent and variety of the manufacture. The company named were among the first to engage in it, and have secured a very general recognition for the excellent quality of their products, which they state to be due, first, to the superiority in the quality of the material they employ—American asbestos, obtained from their own mine in Canada—and, second, to the care and skill exercised in the various processes of manufacture.

The following is a list of these products: Piston, valve and journal packings; steam-joint packings; yarns and twines of various sizes; cloth for filtering purposes; refined fiber of different qualities, boiler coverings, roofing, etc. This piston packing is a braided rope, composed of unadulterated asbestos fiber. It is claimed to be practically indestructible by heat; to be capable of outwearing any of the vegetable packings made for the same uses, besides requiring less oil. Its merits are especially demonstrated wherever it is used in connection with superheated steam or acids. The valve packing above named is composed of pure fiber, spun so as to form a wick, and is claimed to have the same advantages over cotton, hemp or other wicking.

Another valuable product is the asbestos mill-board of the company, which possesses decided merits for steam joints of all kinds. It will resist a high degree of heat and the action of acids, and contains nothing which can injuriously affect the iron. By using a little care in breaking a joint, the same packing may be used repeatedly.

The company also manufacture an indestructible fire-proof asbestos paper, known as "asbestos flooring felt." It is used in the place of ordinary sheathing paper, and by reason of its freedom from decay and its fire-proof quality, it is admirably adapted for use between floors, under slate shingles, weather-boards, etc., as a safeguard against the spread of fire. On account of its excellent protective qualities in this respect, which have been repeatedly demonstrated, it is rapidly growing in favor among architects and builders, and its consumption is steadily increasing.

The company number among their products the water-proof building paper known to the trade as "Sackett's sheathing." This consists of two sheets of paper cemented together by an intervening layer of water-proof composition. It is claimed to have the following merits: It is strong, clean to handle, inexpensive, vermin-proof, and impervious to moisture and gases, combining all the advantages of tarred, rosin-sized and other sheathings, without any of their disadvantages.

For roofing, the company manufacture a very popular product known by the trade name of "The A. P. Co." two-ply and three-ply roofing. This material can be applied by ordinary workmen, and makes a light, durable and inexpensive roofing, suitable for buildings of every description.

The advantages of a good non-conducting covering for steam pipes, and heated surfaces of all kinds, have long been recognized by intelligent steam users, and for this purpose the company prepare an asbestos cement felting which possesses admirable fire-proof and non-conducting qualities. The value of this product has been fully demonstrated by many varied and severe tests, which it has successfully resisted, and by the uniform satisfaction which it has given in service to mill owners and steam users in all sections of the country. The asbestos cement felting of the company is affirmed to be composed of materials of high non-conducting qualities, and to be free from all ingredients which might in any way injure the heated surface to be protected.

The company also manufacture various grades of asbestos yarns and twines for special uses, asbestos cloth for filtering and other purposes, and are constantly adding to their list of manufactured articles as the increasing knowledge of the mineral and its many valuable properties become better known and appreciated.

The company have a large and growing foreign trade, not in their manufactured goods, but also in supplying many of the largest foreign manufacturers with crude and refined fiber, a fact which bears strong testimony to its excellent quality.—*Ex.*

MACHINERY DESIGNING.

BY OBERLIN SMITH.

As a given point in a machine may be made to move in an elliptical path by controlling it with a combination of a straight and a circular movement, it is evident that what may be termed a modified ellipse may be produced by modifying either of these directive shapes. Practically, it would be easier to modify the straight line than the circular. If this were changed to different curved lines, various changes would obviously be made in the ellipse, or, rather, in what was the ellipse under the first conditions named; thus, in an oval turning lathe the parallel guiding surfaces which run against the circular eccentric disk might be made in a curved form instead of straight. A series of forms resembling an ellipse, but somewhat pear-shaped, may be produced by a point upon a connecting-rod which is attached to a straight slide at one end and to a crank at the other, as the connecting-rod or pitman, as such a rod will hereafter be spoken of, of a steam engine. Evidently, those near the crank are nearly circles, while those at the sliding end are very long, narrow figures, approaching nearer to a straight line. Here, again, a great variety of paths can be produced by modifying the straight line into a line consisting of simple or compound curves. In practical work such a curve would usually be produced by attaching the connecting-rod to a swinging lever instead of allowing it to slide, as does an engine cross-head. If we consider irregular paths of circuit—that is, those which follow no particular known curve, but which do not return the same way as they went out—we still find that their number may be infinite. The best practical way of producing any such given path desired is usually by two sets of cams, one of which will modify the motion of the other, and thus produce a circuit rather than a reciprocating path—that is to say, any motion of circuit may be produced by a combination of two reciprocating motions whose general course is at a right angle to each other, or approximately so, but lying in the same plane, in accordance with the condition with which we started out.

Reciprocating motions proper, where the point in question always returns by exactly the same route as it went forth, are usually operated either by cranks or cams, and their direction is governed by slides or some other kind of guiding surfaces which are on the same contour as the path of motion itself, or else they are governed by a lever whose axis is at some distant point from said path.

Of course in the latter case the path is always an arc of a circle. In the former case it is usually a straight line, as in the cross-head of a steam engine, the gate of a vertical sawmill and numerous other familiar mechanical constructions. The principle of guiding by slides can, of course, be used for other than straight paths of motion, although, on account of the difficulty of construction, such slides, when they are of any other shape than straight or in arcs of circles, are too great to admit of their frequent practical use. Of course, if they are circular, it is usually easier to do the guiding from a distant axis than to use the curved guides, although this is not always the case, as when such an axis might be too distant on account of the radius of curvature being long. The above explanations refer to governing the direction of motions rather than to producing them, and embrace only some of the very commonest methods. It would be beyond the scope of these articles to describe or illustrate all possible mechanical movements, or even all those of occasional use. For a tolerably complete list of such motions the reader is referred to a little book entitled "507 Mechanical Movements," published by Brown & Brown, New York, 1881, in which he may may find many things not hitherto "dreamed of in his philosophy." Copies of some of these models have been brought to this country, and a fine collection is being gradually accumulated at Cornell University.

When the designer has ascertained what particular path is necessary or most desirable for any given point in his machine he has to consider not only how said motion shall be guided or directed, but in what time each portion of the motion shall be made relatively to the other portions. If the motion is circular and the time uniform, he will probably use some of the means suggested in former articles of this series—as couplings gears, belts, etc., and, in cases of wanting irregular time "can perhaps use some of the eccentric gears, Withworth motions, etc., which were there mentioned for the purpose. In the case of elliptical motions, some of the same devices can be used plus the devices necessary to obtain ellipses similar in principle to oval chucks. If the motion required be a straight reciprocating one, governed by slides, he, of course, uses a crank and pitman if possible, as being the simplest and smoothest working of any device in use, the motion beginning with infinite slowness at one end and increasing gradually to a maximum at [approximately] the center, decreasing to the same infinitely slow speed at the end, and repeating about the same motions during the return stroke—that is, when the axis of the crank-shaft is in the same straight line with the path itself. Modifications of the speed at the beginning and end of the stroke, and also between the going forth and returning journeys, may be made by placing the axis out of this line of motion, as by placing the shaft of a horizontal steam engine above or below the level of the cross-head pin.

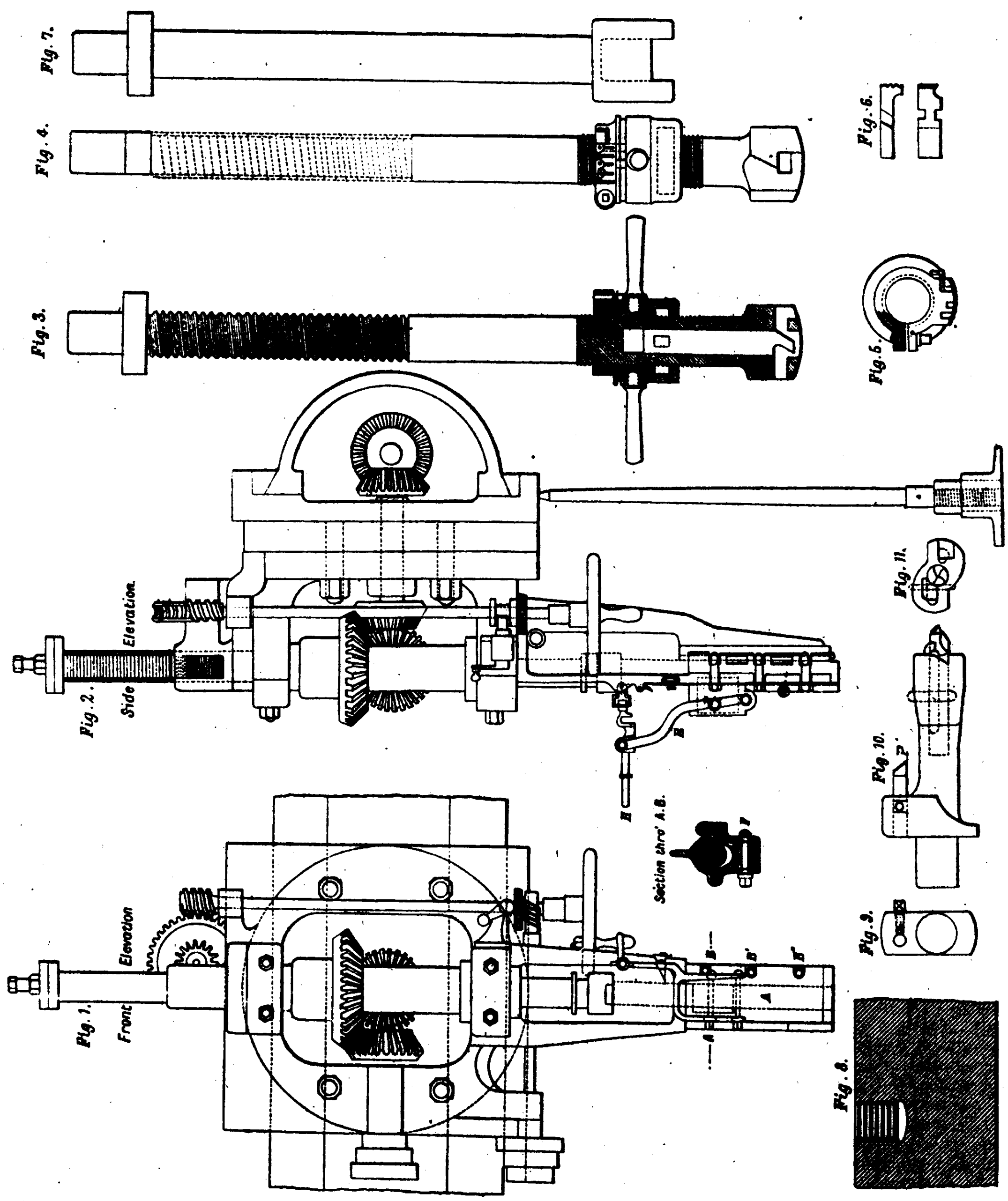
Various other modifications may be made in the time of a straight reciprocating motion by inserting a "rock-shaft" between the crank and the slides, with a separate pitman from such rock-shaft to each. Thus, if a sliding block, A Fig. 12 moving in a path, A B, be driven by a pitman, A G, form a lever-arm, C D, having its axis at D, and swinging over to the position C' D [with a uniform angular speed], when A is moved to B it is evident that A will move much more slowly at the latter part of its stroke than at the first part, because the effective lever-arm which is moving it at the latter part is not C D in length, but is C'' D, and of course, with a given angular motion, the shorter a given lever arm is, the slower the outer end of it moves. If now, to illustrate another case, the rock-shaft D have in its turn its driven lever arm D E operated by a pitman attached to E, and running off horizontally to any source of uniform motion which will swing E to the point E', it is obvious that the angular motion of D will be faster at the latter part of its stroke, because it is moved by a shorter effective lever-arm than at the first part, namely, D E'', and if C D E is a straight line, and C D is equal to D E, this accelerating motion will just balance the tendency to a diminishing motion caused by swinging C over to C', and the motion will be uniform, as is the motion which drives E.

If we take another case, as is shown in Fig. 13, where the driven lever-arm is placed as at D F, we find that a uniform horizontal motion operating at F will at first work upon an effective lever-arm D F'', while in the latter part of its stroke it will work upon a longer one, D F'; consequently, there will be a diminishing angular motion, and, as the lever-arm D C tends of itself to give a diminishing motion to A, this motion will be doubly diminished by the effect of the special positions of both lever-arms.

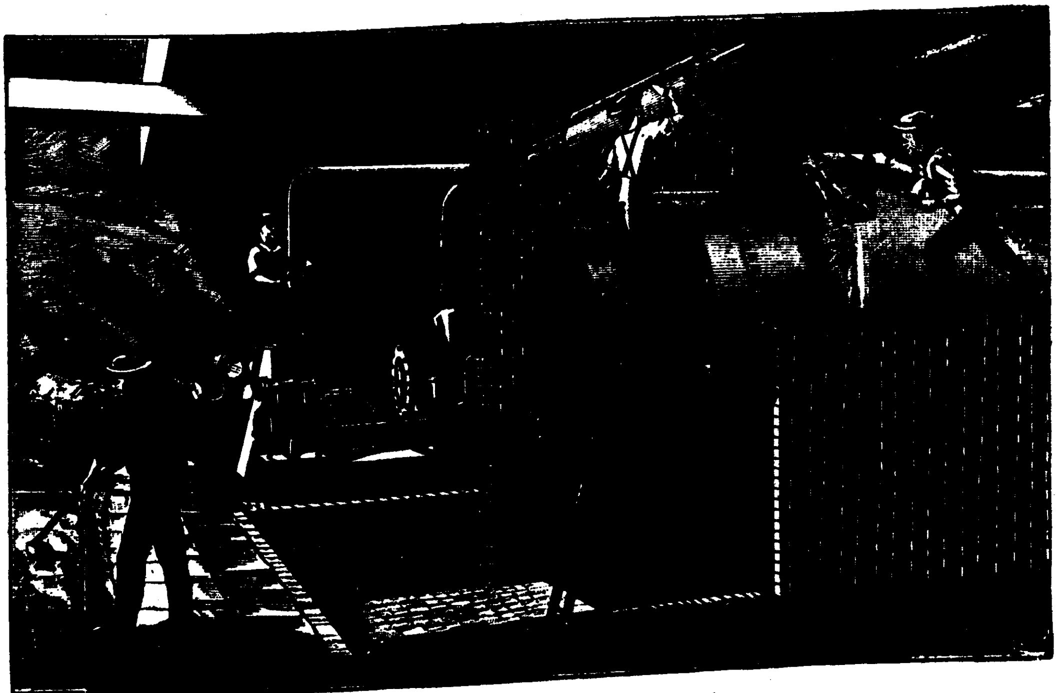
In Fig. 14, if we move A by the lever-arm D G until G swings up to G', the angular motion of D being uniform, we have an accelerating motion from A to B, instead of a diminishing one, as in Figs. 12 and 13. If, instead of making the motion of D uniform, we cause it to accelerate by moving it from the lever-arm D H, which is pulled with a uniform horizontal motion at H, and which decreases its effective lever-arm to the length D H'', it is clear that we have another source of acceleration, and that the motion of A will be doubly increased, just as it was doubly diminished in Fig. 13. If we wish to give A an approximately uniform motion in its journey to B, we must start the lever-arm in the position D I, Fig. 15, and swing it to D I'. Of course the motion is in this case [supposing, as before, that D is moving uniformly] somewhat accelerated in the middle of the stroke when the point I is at I'', but the speed at the end of its journey is about uniform with that at the beginning. Obviously, the same principle applies to the driven-arm D J, whose motion will be the same at the starting point or at the finishing point D J'. The accelerated motion, which is spoken of as being in the middle of the stroke at I'', would not have its highest speed exactly in the middle unless the pitman were of infinite length, because I'' is not exactly halfway between I and I' with any finite pitman A I.

This same irregularity exists in all ordinary engines, and is the cause of a somewhat different relative speed of the piston at given distances from the ends of the outward and inward strokes. Such action is shown in Fig. 16, where the the cross-head K is at the middle of its stroke, and where, if the speed was equal during the first and last half of the stroke, N would have to be at N', because the angular motion from N'' to N' requires the same time as that from N' to N'''. With a reasonably long pitman, however, it is of too small amount to be worth practically considering. The same effect as would be produced by a pitman of infinite length can be secured by allowing the crank pin to work in a block, sliding in a straight slot, through a yoke attached to the piston-rod and at right angles to the axis thereof. This is a well-known device used in some kinds of steam pumps, and is often a desirable one. Its chief objections are the greater friction of the sliding-block and the difficulty of taking up its wear, as compared with the "stub ends" of a pitman; also the lateral stress upon the piston-rod, on account of not taking the pressure from a point lying in its axis, as is the case with an ordinary cross-head. Various interesting modifications of this construction may be made by placing the slot in the yoke at some other than a right angle to the line of sliding motion, or by making it in various curves instead of straight. By these changes quite a variety of relative speeds of motion can be produced. The writer's object in treating so much in detail devices so common and well known as are explaned above is to call attention to the important and satisfactory results which can be obtained by a judicious combination of cranks, shafts, rock-shafts and connecting pitmans, arranged with the lever-arms to occupy various desirable angular positions at the beginning and end of their strokes. In some cases peculiar speeds of motion may be obtained by attaching one end of a pitman to the middle, or any other intermediate point between the ends, of another pitman which is already controlled at both ends by rock-shaft or by a crank at one end and a rock-shaft at the other. Advantage has been taken in a very effective manner of the

BORING AND SCREW-CUTTING APPARATUS AT THE INVENTIONS EXHIBITION.

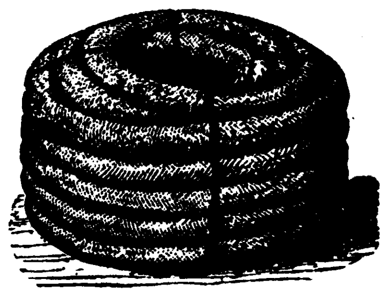


APPLICATIONS OF ASBESTOS.

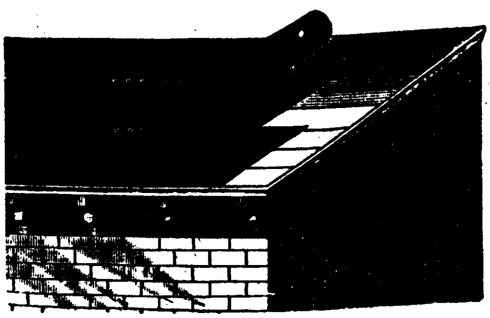


Covering for Boilers, Steam Pipes, etc.

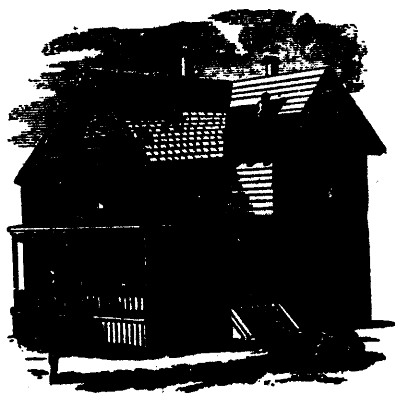
Asbestos as Mined.



Rope Packing.



Roofing.



Different Methods of Applying Asbestos Flooring Felt.

general principles here mentioned by various steam-engine builders [notably, among the rest, Mr. Corliss] to obtain a desired motion for their valves relatively to the motion of the eccentric-rod by which they are driven. It is evident that if A, Fig. 14, were a valve it could be made to almost stop for a considerable time if the point G were brought down level with or a little below D, even though D were oscillating at a uniform speed. In designing paths of motion controlled by these methods, it will usually be found desirable to do the work mechanically by means of pasteboard levers and pitmans, swinging upon pins or thumb-tacks stuck into the drawing-board and connected at their joints by thumb-tacks placed upside down, with their heads resting upon the paper of the drawing. Of course it is possible to lay them out in a purely graphic manner, by finding successive points which represent uniformly graduated points of time, but a more satisfactory result can be obtained by " seeing how the thing works' with pasteboard levers and other temporary members of a machine, as above mentioned.

If one's brain is mathematically inclined to an exceeding degree, and one has a taste for roaming in pure space, as do the astronomers, he may work out the paths in question by calculation merely, but this to ordinary minds is a much more difficult process than the graphical, or the still better mechanico-graphical, method before described. Leaving out of the question all of the peculiar and somewhat unmechanical methods of obtaining motions which may occasionally be required, and which there is no space here to speak of, it may be said in general that if a desired path of motion cannot be obtained nearly enough to answer by some combination of cranks, levers and slides [which should always be used if possible, on account of their smoothness and positiveness of motion], the next best thing is to use cams. These are, on the whole, among the most useful devices in all the field of engineering, and, although very largely used, are by the average designer and mechanic much more largely abused, and have in many cases been made to bring great discredit upon their race on account of the miserable design and performance of certain of their sinning members.—*Mech.*

NEW WAR SHIPS OF THE BRITISH NAVY.

As an example of the latest additions to the Royal Navy, we give an engraving of H. M. S. Imperieuse, for which we are indebted to the *Illustrated London News*. The Imperieuse and her sister ship the Warspite' are designed as fast cruisers, carrying four heavy revolving guns in barbette towers, and capable of being fired in any direction, besides six lighter guns. Each ship will be able to carry 900 tons of coal, and to steam at the rate of sixteen knots an hour. These ships are brig-rigged, carrying a large spread of canvas for crusing. The dimensions of the ship are: Length, 315 feet; displacement, 7, 300 tons; horse power, 8,000.

THE ROTARY STEAM SNOW SHOVEL.

This machine was invented for the purpose of clearing away snow obstructions from railroads and for preventing the periodical trouble and expense resulting from disturbance to business that arises from roilroads getting blocked with snow. Every practical railroad man in the regions subject to heavy snowstorms, will readily recognize the importance of a device which provides the means of promptly and effectually clearing the snow away from obstructed roads.

For fifty years inventors have labored on designing a snow plough that would open up roads deeply covered with snow, but the idea worked out was to plough open a great furrow, and the appliances produced to do this have been expensive to operate without doing satisfactory work. Instead of attempting to turn over a great furrow, which, in most cases, prepared the way for a worse obstruction when the next storm came on, this machine cuts out a wide swath that opens the track, and throws the snow entirely away from the right of way.

This snow shovel is manufactured by the Rotary Steam Snow Shovel Co., of Paterson, N.J. As many of our readers are not familiar with the workings of this excellent machine, we will give a description of it:

The knife-wheel and shovels (or fan wheels) are driven by two powerful engines with their own boiler. Cylinders of engines are 17 in. diameter by 22 in. stroke, and the boiler is 50 in. diameter with fire-box 69 in. long, 34 in. wide, and 66 in. deep. It has 155 flues 2 in. in diameter, 11 ft. 2 in. long; heating surface 1,030 square feet. Boiler and engines are securely fastened to the main frame of heavy I iron, 12 in. deep by 5 in. wide, the front end of which receives the strong bed-plate and pillow-block castings, carrying the fan-wheel and knife-wheel shafts, and right angular to those of the engine shafts. There is also an outside frame of channel iron for the purpose of carrying the car body, which encloses the boiler and the whole machinery. The front bed-plate casting, with the main pillow block, extends to the whole width of the outside frame, which is 9 ft. 6 in.; it is well ribbed to enable it to receive the six gussets of ½ in. steel plates which carry the drum and to which latter those gussets are fastened by means of 3½ in. by ½ in. double angle-iron. The drum is otherwise well braced to the frame to enable it to bear all the possible strains and shocks which might occur in going through deep drifts. The fan-wheel shaft is hollow, and receives the shaft of the knife-wheel, there the bearings at each end, which are of considerable length; where anti-friction metal is employed for such bearings, the space between these bearings is used as a receptacle for oil, which latter will last for a considerable length of time. The solid shaft after passing through the hollow shaft, and some distance of the back end of the latter, rests in a thrust-bearing, to provide against the fore and aft thrust of the knife-wheel. The motion of the knife-wheel and fan-wheel are transferred from the engines by means of beveled gears, one gear on the hollow shaft and one on the solid shaft; gearing each into both of the gears of the separate engine shafts, so that one engine must run in the opposite direction from the other engine. There is a slight difference in the diameter of the gear wheels, the wheels on the engine shafts being the largest, having 40 teeth of 3½ in. pitch, and those of the fan-wheel and knife-wheel 33 teeth, therefore the engine shafts making 175 revolutions, the knife and fan wheels will make 200 revolutions each in opposite directions.

The arrangement for reversing the knives for the purpose of cutting the snow in either direction, that is either from the right or from the left, is somewhat difficult to explain explicitly without referring to a drawing. There are four knives consisting of ½ in. steel plate 40 in. long and 24 in. wide. They swing on the knife-arms, which latter extend from a square wrought-iron hub to a bearing fastened to an angle iron at the circumference of the wheel, which is 8 ft. 9½ in. in diameter. The space between the knives is occupied by plates of steel 5-16 in. thick, forming sectors of a circle. They are fastened to the angle iron on the circumference and radially to four other spokes of wrought steel between the knife arms. The knives are held in a position forming an angle of about 30° with the above named sector plates bearing openings of about 12 in. between the edges of the knives and the edges of the plates. At this end of the knives, next to the limb, the bearings have attached to them gear segments which again gear into others, each of the latter having one strong level wheel-tooth attachment, which projects over the end of the square next to the end of the fan-wheel shaft, but does not come in contact with the latter. The end of the fan-wheel shaft next to the square hub of the knife-wheel forms a hub, and is provided with a deep annular groove to receive a 4 in. wide ring with four level wheel-teeth corresponding to the teeth of the second segment gear of the square hub, the level wheel-ring can slide in and out on the central part of the fan-wheel hub, a distance of 3 in., and may thus be engaged with the four segments of the square hub, or may thus be disengaged after the work of reversing the knives has been performed, and which is done automatically. The first gear segments are each provided with two notches corresponding to the two positions of the knives, and a four-winged clutch-latches into those notches holding the knives in proper position, the clutch may be disengaged by sliding it parallel with the axle of the shaft, which is done simultaneously with the sliding of the bevel wheel ring, bringing the latter to gear with the second segment gears, and the knives being free, they will swing over to the other cutting position, when the bevel-ring is allowed to return; after this work of reversing the knives has been performed, the ring and clutch fly back, the clutch fastening the knives again and the ring in the same instant disengaging the gears. The clutch has four rods attached passing through a square hub connected to a sleeve back of the hub. Springs in hub keep it in proper place. The bevel-wheel ring also connects by means of rods to a sleeve around the hollow shaft, and also springs keep it disengaged from the gears. Two rods behind the fan-wheel hub pass outside the shaft through the pillow-block and are attached to a ring-shaped plate over the shaft, to which a spring latch arrangement is attached, so that when the ring-shaped plate is forced forward by means of a lever combination at a certain position of knife and fan-wheel, the clutch and bevel-wheel ring are both moved forward, the engines are then slowly reversed, and the latch on hollow shaft disengages at the proper place, fastens the knives and disengages the gears, and the shovel is ready to do its work again in the opposite direction, after the opening of the spout has also been changed so as to cast the snow on the proper side corresponding to the motion of the fan-wheel. The spouts starts from the circumference on the top of the drum, with an opening of six feet, and part of the sheet on each side forming the circumference on the top of the drum, with an opening of six feet, and part of the sheet on each side forming the circumference of the drum leads off tangentially at an angle of about 50°, so that if such sheets from each side were continued to the verticle centre line, the vertex of an angle would be formed there, but the sheets being cut off they leave an opening of about 42 in. measured horizontally.

In order to form an opening on either side of the centre line of the drum a cap or plate is introduced which swings at the vertex, forming there a bearing on each side of the sheets which in case the opening fore and aft the above plate continues at the same angles as the sheet from the drum and rest on the latter, the shaft on the top of the cap plate running across from sheet to sheet extends beyond the back sheet to receive a chain wheel and a chain running from there below to a pinion to the shaft of which a hand wheel is attached by which the cap may be changed to either side of the spout. A pawl with ratchet wheel on the pinion shaft keeps the cap in its position. There is also an arrangement attached to the bearings of cap-shaft by which said cap may be raised or lowered in the centre for the purpose of changing the angle somewhat. At an angle of 50° and at 200 revolutions of the fan wheel the horizontal distance thrown, if the snow is well enough packed, would be about 248 feet and the vertical height about 74 feet.

At the trial near Buffalo the number of revolutions were not noted, but according to the distance thrown, which was 295 ft., the fan wheel must have made at least 210 revolutions. To avoid any danger of throwing the whole machine from the track in case of ice having formed inside of the rails, an ice-breaker is attached in front of the forward wheels of the front truck, consisting of two strong pieces of steel inside of the rails in the shape of a large planing tool projecting about two inches below the top of the rail. They are attached to a frame which swings on the axle and may be raised when required from the inside of the house. There is also a flanger attached in rear of the back wheels of the forward trucks; it removes the snow remaining on the rails not taken away by the shovel. The attachment is made in the same manner as is the ice-breaker, it may also be raised when necessary. A steam brake is attached to the wheels of the rear truck.

	ft.	in.
Distance apart centres of trucks	16	8
Centre of front truck to back of drum	3	11
Extreme length of Drum	5	1
Extreme length of frame from back of drum	29	1
Extreme length of machine	34	2
Height of machine to top of spout	12	8
Width of house	9	6
Length of body of house	28	4
Length of roof of house	31	6

Weight of entire machine, about 45 tons.

But one locomotive is required to push this machine, and it was the opinion of many who saw the test that an engine with a heavy train attached would have no trouble in pushing it at a rate of fifteen miles an hour through heavy snow. Such an invention will prevent the recurrence of such freight blockades and coal and provision famines as many places experienced during the severe weather of last winter.

The interest of all practical railroad men was aroused by this test, and it is probable that a great demand for such a plough will spring up. The last winter has certainly taught us around Chicago how poor a dependence the old style plough is.

It is a good maxim, "in time of peace, prepare for war," and it would be wise for officials of roads extending through regions of great snow storms to prepare this summer for a repetition of such times as we had last winter.—*Ex.*

WORKMAN AND EMPLOYER.

THE NECESSARY RELATIONS OF LABOR AND CAPITAL, AS EXPLAINED BY MR. EDWARD ATKINSON.

PROGRESS FROM POVERTY.

Mr. Edward Atkinson is not excelled by any of our economists in writing intelligently, and his words are always food for thought. At the meeting of the New England Cotton Manufacturers' Association two months ago, at Boston, he read a paper, of which the following is a short abstract: There is a general tendency of wages toward a maximum, and of profits to a minimum. There have been, of course, great fluctuations, but it will be observed that even the reduction in the rate of wages in money, between 1883 and 1885 was accompanied by an increase in the purchasing power of money; so that wages, measured in sheetings, are now higher than ever before. I believe this is also true, if wages are measured in food or woolens. In other words, all who are employed at all can get more for their work than ever before in food, clothing and shelter. In my judgment, the operative who has deposited his earnings in one of our best savings banks for the last 30 or 40 years has received a higher proportionate interest on his capital than has been secured by the average of cotton mill stockholders on their investment. So far as these examples prove a rule, progress from poverty, on the part of operatives, has been continuous in this art, and has been perfectly consistent with the maintenance of the capital in the factory.

Mr. Atkinson then analyzed the business of a certain cotton mill in 1840 and in 1883. The product per hand has risen from 9,600 yards per year in 1840 to 28,032 in 1883, and to 29,604 at the rate of the present production; it will be 30.000, as soon as some new machinery is fairly limbered up.

Without any material change in the number of dollars of fixed capital, the mills have been almost built over and the old machinery has been displaced, while new machinery has been added, resulting in a gain from 12,500 spindles in 1840 to 30,324 in 1883, and 35,720 in 1885.

The value of the product per hand has advanced from $868 to $1,973 in 1883, and then receded to $1,924, the price of sheeting being reduced in 1885 more than the yards of product increased, the price of cotton not being very different at either date.

Now let me call your attention to an apparently singular point, but one of the utmost importance in this consideration. Suppose the operatives had been direct sharers in the actual product of sheetings at the market price in place of being paid wages in money, and you observe that, although the rate of their wages in money was reduced between 1883 and 1885, yet their wages, if paid in sheetings, would have increased from 1,936 yards in 1840 to 4,097 yards in 1883, and 4,154 yards in 1885. I shall revert to this point presently.

The wages in cents per hour have advanced from 4 49-100 for the long day's work of 1840 to 8 80-100 for the shorter hours of 1883, and 8 37-100 in 1885.

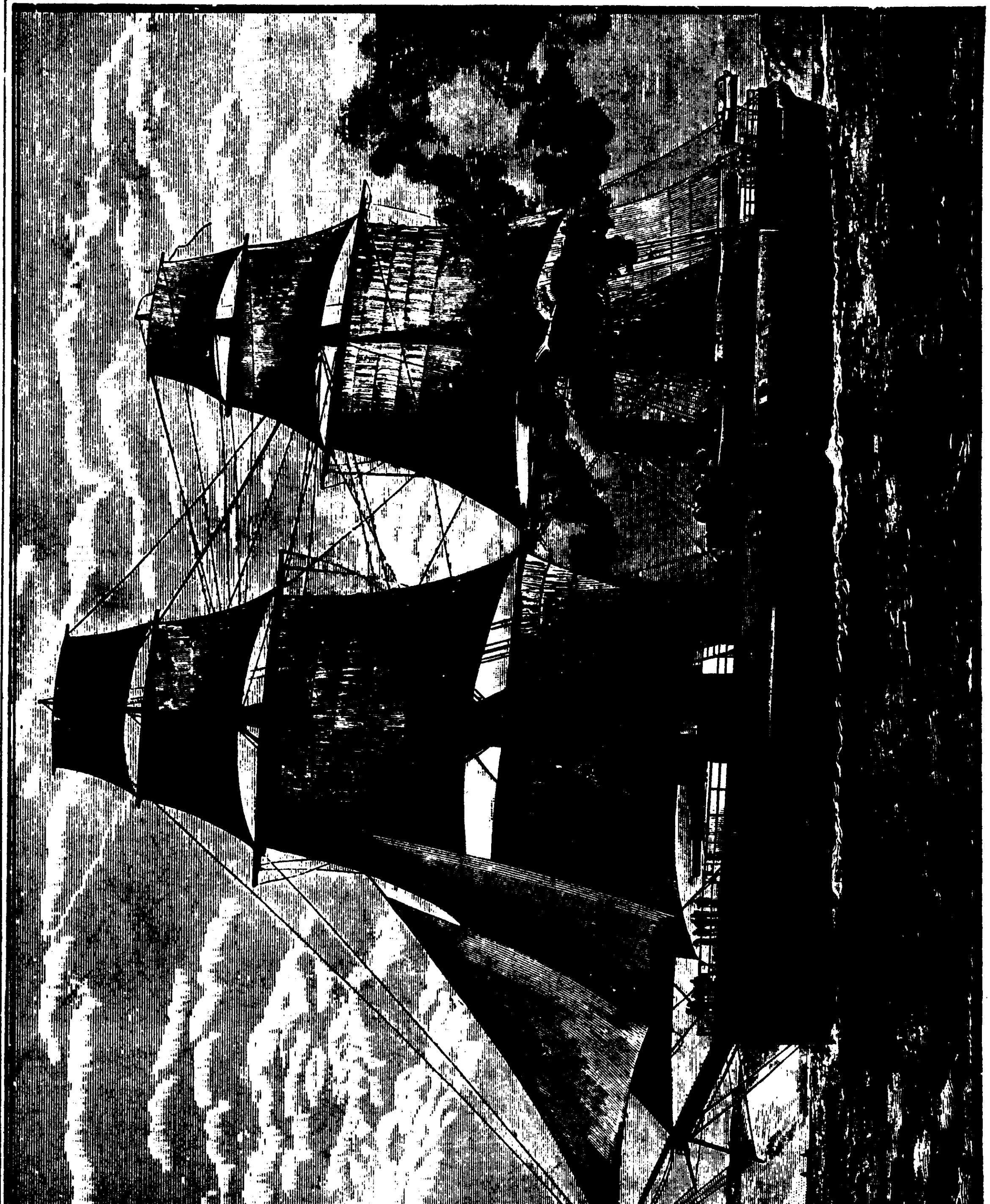
The wages per year have advanced from $175 for 13 hours in 1840 to $297 for 11 hours in 1883, and $270 for 10¾ in 1885; but I shall presently prove to you that the lower rate in money of 1885 was really a higher wage in absolute power than the higher rate of 1883, because it would buy more and yet leave a larger saving.

There were many fluctuations in the number of hands between 1840 and 1883, although the numbers come out almost even. Each revolution in, and addition to, machinery required for a time a little larger force, as between 1883 and 1885, but as soon as the additional machinery came into a thorough working condition the number of operatives was reduced, as it doubtless will be again, the last changes being barely completed.

The hours of labor have been reduced from 13 to 10¾ average. Consumers have gained the difference between 9 cents and 6¼ cents a yard.

Now let us see what has become of the share of capital. In 1840, the normal rate of profit which would have sufficed to induce the extension of the business was about 10 per cent., now it is about 6 per cent., because there is now more capital in proportion to its possible use. The proportion of the yards required to be set aside to yield 10 per cent. in 1840 and 10 per cent. in 1883 went down 49 per. cent., and the proportion required to yield 6 per cent. in 1885 went down 70 per cent. as compared to 1840.

The proportion of the price per yard required to yield 10 per



THE NEW WAR SHIPS OF THE BRITISH NAVY.—H.M.S. IMPERIEUSE.

A MAMMOTH STEAM SNOW SHOVEL.

cent. on the fixed capital in 1840 was 1 18-100 cents. and that required to yield 6 per cent. in 1885 was ½ of a cent. That is to say, it was necessary to assign a little over 13 per cent. of the value of the product to fixed capital in 1840 leaving 87 per cent. of the small product for the cost of materials, supplies, insurance, taxes, general expenses and labor, while in 1885 less than 4 per cent of the much larger product at the lower price suffices for a normal rate of profit on the fixed capital, and 96 per cent. is assigned to all other elements of cost including labor.

Between these two dates there have been periods when an dividends have been suspended; other periods, during the war, of extravagant profits; at present it is again a question whether any divident can be earned or not; but for the whole term there has been steady progress either in the rate or the purchasing power declined in greater measurer

I have partly completed the analysis of a print cloth mill, all mule spinning, by a comparison of the condition of 1871 and 1884. It will be remembered that the year 1871 was a year of inflation, feverish activity, high prices and opparently of high wages. The currency was depreciated and the end of a financial debauch on the greenback basis has been foreseen and its necessary course of loss and depression had been predicted by the few, but had not become apparent to the many.

In the mill there was no change in the number of spindles between the two dates, but other improvements made each hand more effective; the yards of product per hand went up from 26,531 yards, representing 3,382 hour's work in 1871, to 32,391 yards, representing 2,695 hour's work in 1884—an increrse of 22 per cent. in product; and a decrease of 20 per cent. in hours of labour. The wages per hand per hour were 12 45-100 cents in 1871, and 19 3-100 cents in 1884; decrease 3-37 per cent. The wages per year were $421 25-100 in 1871 in a fluctuating paper currency, and $324 33-100 in 1884 in gold, nominal decrease of 23 per cent. The price of printing cloth averaged 6 789-1000 bents in 1881, and only 3 331-1000 in 1884—a decrease of 50 94-100 per cent.

At these prices the wages of the operatives converted into yards of their own product would have yield them 6,205 yards in 1871, and in 1884, 9,737—ad increase of 56 92-100 per cent. I have been unable to get exact data for 1871 on other points, but, in a general way, it may be safely assumed that the proportion of the lower rate of wages of 1884 suitable to be assigned to clothing would have purchased not only more prints, but more worsted and woollen goods than the same proportion of the higher rates of 1871. In the course of my railroad investigations, I have elsewhere proved that the prices of beef, pork, wheat, flour, oats, butter, lard, cheese and wool fell more than 25 per cent. between 1871 and 1884; and are now still lower. It is therefore certain that $324.33 would buy more clothing and food in 1884 than $421.25 would purchase in 1881, and, unless the town where the mill is differs from other towns, the proportionate reduction in the price of shelter has been more than equal to the proportionate reduction in the rate of wages.

It will be observed that the average earnings per hand in this mill were more than in the standard shetting mill. This is because the adult male spinner does more work per man than the frame spinner does per woman or girl. I doubt not there were periods during the malignant era of paper money when prices and profits advanced more rapidly than wagee, and when higher rates of wages in paper yielded a poor subsistence, but I have not yet succeeded in making a comparison between two dates in which the condition of the labourer who was in continuous employment did not improve. That is to say, either the wages of the workman advanced faster than the cost of subsistence, or else when wages were reduced the cost of subsistence was also reduced in a greater measure.

The hardship in times of depression and of reduction in pricee, falls on two classes: On the manufacturers or merchants who carry the stocks of material or of finished goods. On the labourers who are either wholly thrown out of employment by the cessation of work in certain directions, or who throw themselves out of work because they are dissatisfied with the rates of wages.

Fortunately by far the greater portion of the work of production and distribution must go on whatever the "times," so called, may be, whether good or bad, and the actual suffering in modern days is limited to a very small portion of the community in point of number. In this matter, the commercial crises of modern times, which are usually called by what is very absurdly termed "over-production," are much less injurious than those of former periods, which were caused by scarcity.

I now call your attention to a second diagram relrting to pig iron. These figures are from the books of an iron furnace for which all the materials were purchased. It relates wholly to the art of converting ore and coal into pig iron. The two periods compared are 1850 to 1864 inclusive, a period of war, paper money, inflation and confusion; and 1875 to 1879, the period of slow and painful return to a solid specie basis. The product per hand went up from 776 tons to 1219 tons. The total product, 58,959 to 86,546. Wages advanced from $353 per hand per pear in a cebased currency, constantly losing a part of its purchasing power, to $486 in an improving currency, constantly gaining in its purchasing power. The gross value of the product remained about the same. The number of hands was reduced from 76 to 71. Consumers gained the benefit of a reduction in price from $27.96 to $19.58. The margin between the cost of materials and labor per ton and the market price went down from $9.55 to $1.09, and out of this margin were made all the general expenses, insurance, taxes and profits, if any at the last date. Who gained most, labor or capital?

You will observe that, while the profits of capital went down to almost nothing, the wage of the first period would have purchased 12 63-100 tons of iron per year, and in the second period 25 42-100 tons. That is to say, the share of the laborer in his own product was doubled.

Ere long I shall have similar data in respect to the following arts: Woolen, cassimeres, paper, iron ships, ploughs, Indian corn in Illinois, and I expect to secure similar statements regardtng many other arts. They will all sustain the same phenomena of progress from poverty to welfare. They will fully prove that that there has been: an increase of product in ratio to population, whether in respect to the product of agriculture, mines or factories; thus disproving in this country during this century, the so-called law of population propounded by Malthus, which has been the *bête noir* of economists ever since it was presented, and which I hold to be mere *a priori* conception of an insular student who could not fors-e the potentiality of modern science. An increase in the rates of wages in money, accompanied by a decrease in the money cost, as well as the labor cost, of all production. Steadies and more adequate employment for labor, both skilled and unskilled. A steadily diminishing share of the total product secured by capital, whether under the name of either rent, interest or pro, fit. I also expect to prove that there is no sign of there being any law of diminishing returns from land; but on the contrary greater variety, greater quantity and greater value of the products of agriculture in ratio to the number of persons occupied therein, thus disproving another alleged law, that of diminishing returns from land in ratio to population, which constitutes another of the *a priori* conceptions of most of the economists. Land which has become partially exhausted of its primitive fertility, has become, under intelligent cultivation, more productive than it ever was in its virgin state, and now yields a far greater product in ratio to each one of the greater number of persons who dwell upon it, than it did when sparsely populated and treated as a mine and not as a laboratory. As an example of this, witness Furman's method of raising cotton in Georgia. He brought old fields which had been exhausted by slave labor, so that each acre would yield only one-eighth of a bale of cotton, or 60 pounds, up to two and even three bales of ginned cotton to an acre, and made a profit all the time, except in the first year.

In a recent discussion on hydraulic machinary in the British Society of Arts, Sir Frederick Bramwell said the earliest mention of a mechanical mode of raising water, is in Deuteronomy where Moses told the Israelites: "For the land where thou goest in to possess it, is not as the land of Egypt, from whence ye came out, where thou sowedst thy seed, and wateredst it with thy foot as a garden of herbs." It always seemed to him that the passage pointed to the kind of hydraulic machine used in some parts of India and Egypt at the present day. In this machine there is a plank placed horizontally and supported near the center on a fulcrum. At one end of this plant there is a bucket which, when that end is down, dips into the water to be raised, and a man walking along the plank alters the balance and raises the bucket. Several modifications of this primitive means of raising water are yet common in different parts of Asia and Africa.

RAM PUMP.

The engravings above illustrate a direct-acting ram pump constructed by Messrs Frank Pearn & Co., of Manchester, for purposes where a heavy pressure is required, such as for hydraulic presses and lifts, pipe lines, and military water supplies in desert countries. The steam cylinder is placed in the centre, and drives a ram from each end of the piston rod. The method by which the steam is distributed is shown in the detail views (Figs. 2 and 3). The main slide valve K is operated from the independent sources; it is first moved into such a position that it closes the exhaust port, and then slightly opens the steam port, and secondly, it is carried over by an auxiliary steam cylinder (Fig. 3) to give full opening to the steam. These two operations are effected as follows: The piston-rod C carries an extension D which is coupled by the link E to the lever F, pivotted at G. The lever F is double, and stands astride of the piston-rod. At its upper extremity it is coupled by two rods H to a block or cross-head that can slide between stops J J1 on the rod which connects the valve K to the piston M (Fig 3). The lever is also connected through a second lever to the slide M. When the piston B approching the end of its travel the crosshead I meets the stop J and carries the valve K with it, closing the exhaust port, and causing all the clearance space to be filled with compressed vapour, so that the piston, together with the pump rams, is brought gradually to rest, and the water valves have time to drop quietly on to their seats. At the same time the slide valve L has been moved to admit steam to the piston M, and this travels forward carrying the valve K to the full extent of its stroke, so that the steam obtains admittance to the cylinder A. The subsidiary cylinder has separate steam and exhaust ports, the latter of which are closed by the piston before it reaches the end of its stroke. If the piston B should, by any chance, pass the point where it is designed to stop, its motion opens the steam port and opposes the full pressure to its further progress.

The auxiliary cylinder is made as a separate casting, and is mounted where it is exposed to full view, and is accessible on all sides. All the parts are strongly made, and there are no intricate passages that are difficult to follow, or are liable to become choked.

SCHEMID'S WATER METER.

We give illustrations of a meter designed by Mr. A. Schemid, of Zürich, and which is now, we believe, considerably used on the Continent, not only for measuring water, but the syrup in sugar factories, in breweries, etc. It consists of a cast iron body containing two gun-metal lined cylinders, and connected by an intermediate chamber. Round the body are formed two channels, one for the entrance and the other for the discharge of the water, etc., to be measured. Within the cylinder are placed two long pistons, provided with openings in such a way that each piston serves as a slide valve to the other, the flow being maintained through the ports in the connecting chamber. The arrangement of openings in the piston is shown in Figs. 5. 6, 7, and the intermediate passages in Figs. 1, 2, and 3. To the upper side of each piston is attached a crosshead working an a disc placed at each end of a horizontal shaft. To one of the disc is added a short connecting rod that drives the spindle of a counter. The apparatus is stated to be very efficient, and as it has only five moving parts, its construction and mode of working are simple. It is being introduced into this country by Mr. H. Studer, Grand Hotel, London.—*Eng.*

THE GORDON CONVERTER.

In the accompanying illustration we present to our readers the Gordon Patent Converter for treatment of molton iron, of which Messrs. Gordon, Strobel & Laureau, of 226 Walnut street, Philadelphia, are the sole agents and manufacturers. The leading features of this converter are its adaptability for both steel-making and foundry uses, small cost of construction and maintenance, and simplicity of operation. In the illustration, which is partly in perspective and partly in section, the letters designate the following parts, viz.: *A*, the fire-clay tuyeres, *B*, the 2½-inch gas pipe turned on its upper end and tapered on the lower end to a 2-inch nozzle. This pipe *B* fits closely (without being secured thereto) into the holder *D*, which, in its turn, is fitted into the piston *U* and secured to it by a double bayonet catch. Onto the holder *D* is threaded the tapering wrought iron tuyere grip *E*.

The parts *B*, *D* and *E* are to be in duplicate, and adjusted to each clay tuyere, ready for insertion. *G* is the cylinder for raising and lowering the tuyeres, *O* is the ball-joint for seating the cylinder, and *N* the pin for retaining the piston in position while the tuyeres are being changed.

C is the slag opening. *V* the tapering plug and *W* the removable bottom.

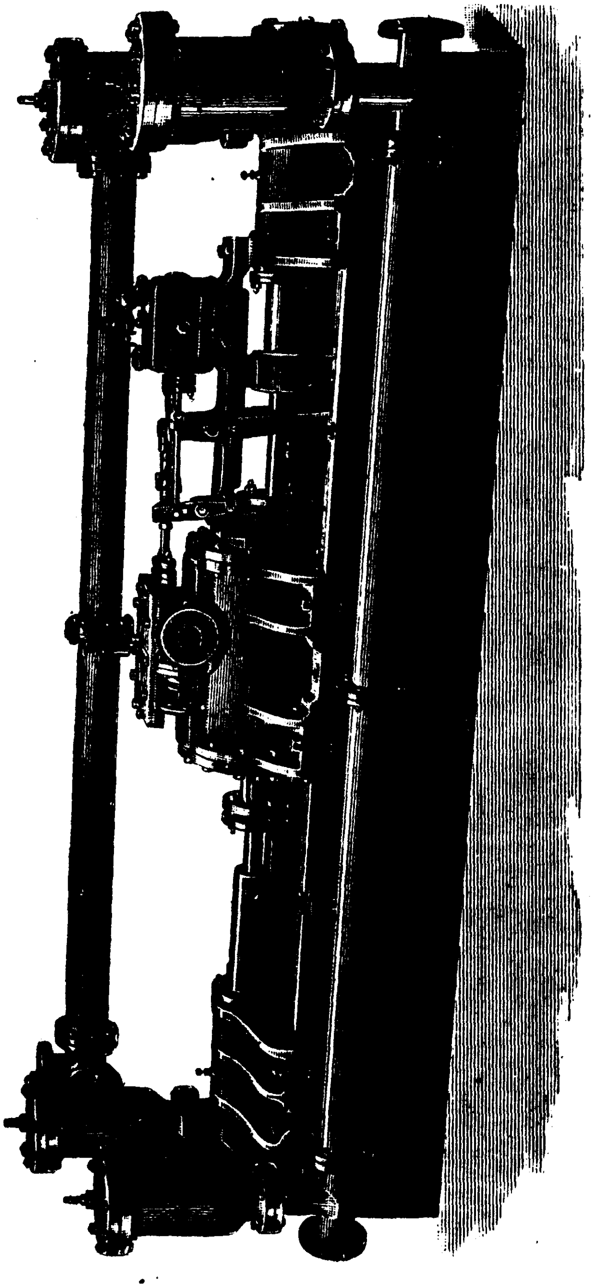
The operation of the converter is as follows, viz.: The blast through a single connection to the engines, enters the pipe *L* and passes into the tuyeres. When ready to charge, the cock in *R* is opened, whereby the pressure is simultaneously relieved from the upper ends of the cylinder, and the tuyeres are raised to their full height, by the pressure below their pistons, the valve *H* preventing too great waste of the blast. The metal is then poured through the opening *Q*, the cock in *R* is closed, and the blast passes through the small holes *T*, whereby equilibrium of pressure is established and the tuyeres descend partly by their own gravity, partly through the pressure on the area of the small piston *U*. This piston is grooved on its outer surface, permitting the escape of sufficient blast to prevent the cinder from splashing into the tuyere opening. The latter, as will be seen, can never enter the metal until the blast is on and passing through the nozzle; hence the liquid metal can never enter the tuyeres, as the valve *H* leaves its seat before the tuyere enters the metal.

When the blow is over, by opening the cock in *R* the tuyeres are simultaneously withdrawn, and the vessel can now be tapped. To replace the tuyeres it is only necessary to withdraw them as before stated, tilt the apparatus into the position shown in the illustration by the dotted lines, reset the new tuyere and throw it back again in its seat. No fastening is required, and the change can be effected in a few minutes and without stopping the engines.—*Ex.*

WORKMEN WHO OWN THEIR HOMES.

It is estimated that more than 4,000 workmen of New Jersey, who would never have made the attempt to acquire them but for the encouragement offered by a building and loan association, now own the houses they live in. These purely local institutions now number 12g. Camden county has twenty, Middlesex eighteen, Essex fifteen, Burlington twelve, Cumberland nine, Hudson nine, Gloucester eight, Monmouth, six, Cape May six, Atlantic five, Passric and Union four each, Salem three, Mercer three, Hunterdon, Somerset, and Warren two each, and Bergen one. The last report of the Bureau of Statistics shows the net assets of 121 of these associations to be $6,956,351. These co-operative banking associations show that the average shareholder is interested to the amount of $280, while the regular savings banks only show an average of $297 each. Each member takes as many shares as he or she wishes (not exceeding twenty-five), and pays $1 a month on each share, on or before the monthly meeting. This goes on till all the shares alike (in any one series) are worth $200, when they are of full or matured value, and are wound up and the money paid back. If no interest were earned, it would take 200 months for $1 a month to amount to $200, or 16⅔ yeors. Aut with the benefit of compound interest, ten years should see the shares worth $200. Loans are made at each monthly meeting of all money paid in. No interest is lost. The money is offered at auction, and whoever offers the highest rate of interest gets it. The law provides that the premium bid shall be so many cents a share of interest each month. Loans are made only to members. Any borrower can become a member by taking the needed number of shares at $1 each. The security must be real estate to the approval, first of the Security Committee and then of the Board of Directors. Loans may also be made upon pledge of the shares alone, but only to a less amount than the actual value of the shares. No forfeiture of the money paid in is possible. In case the shareholder cannot go on paying, he gives a month's notice and withdraws it. If he does not withdraw and ceases to pay, the fine is two cents a month a share. The fines only continue six months, after which the shares are put on the retired list and can be withdrawn, full value, less fines. All profits and losses must be shared by all the shares in proportion to their values. The law protects the borrower from sudden misfortune. He cannot be sold out till after six months' default.—*New York Sun.*

DIRECT-ACTING RAM PUMP.



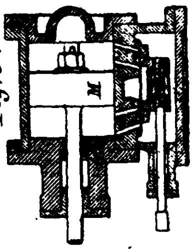


Fig. 3.

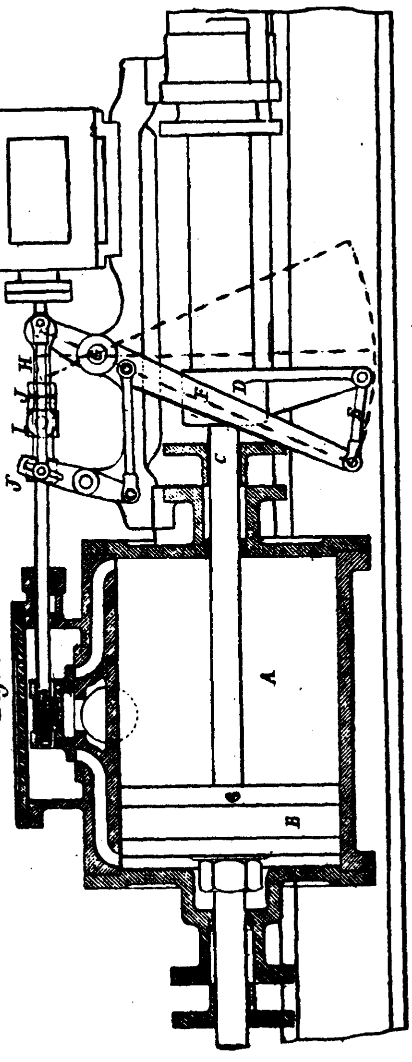
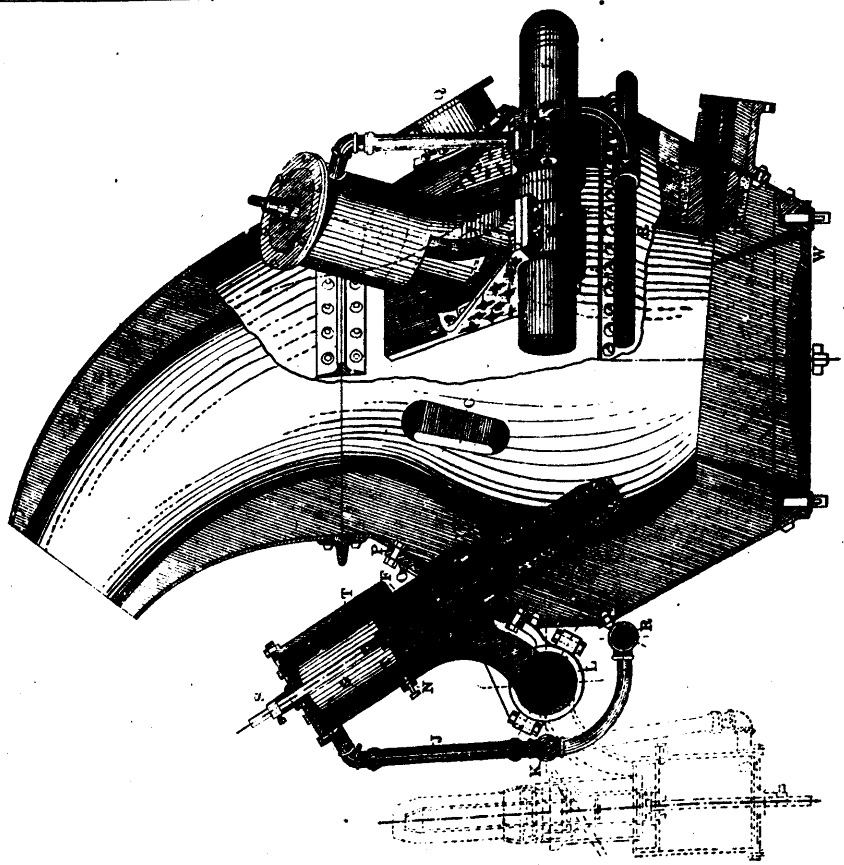
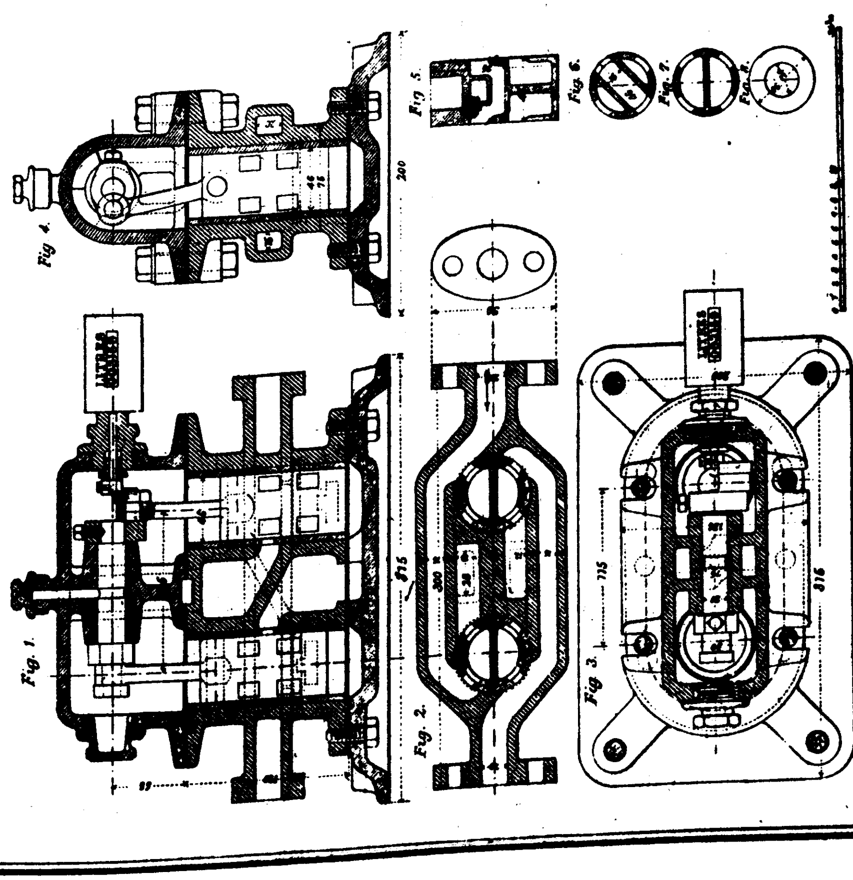


Fig. 2.



THE GORDON CONVERTER.



SCHMID'S WATER METER.

A PUMP WITHOUT VALVES.

A pump working entirely without valves and presenting some peculiar and interesting features of design has recently been brought out in France, being the invention of M. Alphonse Reis, of Anvers. The chief peculiarity lies in the arrangement of the cylinder, which has imparted to it a reciprocating motion similar to that of the piston, and the suction and delivery of the water or other medium to be pumped is effected by their combined action.

The pump comprises a fixed cylinder, C C', shown in the annexed cut; a movable cylinder, B, and a piston, or, more properly speaking, plunger, A. The fixed cylinder is made up of two parts C and C', furnished with suction and delivery pipes, the openings (G and G') for these being disposed as shown in our illustration. Both the plunger A and cylinder B are worked by the cam D, the cylinder through the intervention of the small rollers *z z*, and the plunger by means of a connecting rod. The cylinder is closed near one end by a partition which is closely approched by the plunger at the end of its stroke, and near this partition and on the periphery of the cylinder are a number of openings *t*, the sum of whose square sections is equal to the section of the supply or dilivery pipe. In the movement of the cylinder B these openings are brought alternately in front of the ports G and G', and this, combined with the motion of the plunger, effects suction and deli ery as in any other pump. Recreased friction of the working parts and freedom from being easily thrown out of gear and temporarily disabled are among the points to which attention is directed. We understand that several of these pumps have been at work in Belgium for some time, and that they have proved satisfactory in every way.—*Ex.*

SMALLER INCOMES.

The amount of income from money loaned has token a great drop in the last few years. A year ago, the prices of sixty average stocks averaged over $50 per share, and dropped during the week ending May 24 to the lowest point that had been touched for more than five yeaas—an average of $45.50. But the average prsce of the same stocks a week later was only $45.22, and for a whole year they have struggled in vain to reach an averabe of $55, which was considered absurdly low when it was touched early in May, 1884. The average rates of interest on American securities is about down to the European level in the same classes and it would seem that they cannot go mucn lower. The net inierest on the government 4½ per cents is 2.23; on the 4 per cents, 2.46; on the District of Columbia bonds, 2.94; Union Pacific land grant, 3.67; Pennsylvania railway general mortgage, 3.75; New York Central bonds, 3.83; Missouri state bonds, 3.44. The lowest government loan ever made is by Connecticut, whose 3 per cent. bonds were latelp taken at 876-1,000 of 1 wer cent. above par. The British 3 per cent. consols are sold below par and the United States 3 per cents were sold at par. Incomes have been cut down as if a heavy tax had been laid on them. In the face of this we shall not hear much more about progressive income taxes in addition to other taxation, for the purpose of cutting down the accumulations of rich men. One effect of this low rate of interest is of great economic value to the industries of the United States. Interest is a considerable item in the cost of production—probably somewhere about half the rate of interest on the capital, so that from 2 to 5 per cent. of the value of goods are taken as interest, the rate on the capital being 4 to 15 per cent. It follows, then, that under falling interest, the prices of goods cheapen by a rate that is about half the loss in the rate of interest on the capital. This has a most important bearicg on American manufactures as fitting them for competition in the markets of the world.

An auger which bores a square hole is now in common use in Cleveland, where a joint stock company is being organized for the purpose of manufacturing them for the market. The *Herald* of that city thus describes it: "Its end, instead of having a screw or bit, has a cam motion which oscillates a cutter mounted on a steel rocking knife which cuts on both sides. In order to prevent the splitting of the wood the ends of the cutter are provided with small semi-circular-shaped saws which help in cutting out perfectly square corners. It is estimated that this new process will save the labor of three men who work with chisels, as one man can conveniently cut a two inch mortise in the same length of time that he can bore a round hole."

PAPER ON THE PACIFIC SLOPE.

A REVIEW OF THE HISTORY AND PRESENT STATUS OF THE INDUSTRY.

California has done moderately well in the manufacture of paper, considering her isolated position. The first paper mill in this State was started about thirty years ago. It made both news and wrapping descriptions. A copy of the *Evening Bulletin* in 1856, on news paper made on this pioneer mill is remarkably well preserved, showing that good stock and skill were employed in the manufacture.

Wrapping paper has been made here from that time to the present and with great success, though considerable has been imported right along from the East. The best straw wrapping received here from New York has been the brand known as the Malden Bridge. This paper had the call of the market for years after its introduction into this city, and it is therefore some satisfaction to know that our local manufactures have successfully usurped its place in the local trade. It is claimed that California manufacturers can and do make a superior article of straw wrapping, equal to the best in the country. Of caurse there are various grades, some light and others heavy, some more or less brittle, and some exceeding tough. The material for this kind of paper—wheat straw—is abundant, and of first-class quality, and of course there is no reason why the manufactured article should not be well up to the requirements of the trade. The best grades have not been excelled by anything brought to this market from abroad.

The statistics relating to the imports of paper at San Francisco are not as definite as could be desired, both with reference to quantity and character. No attempt has been made to keep to keep the description separate, and consequently it is impossible to designate the proportions of writing from news or wrapping kinds. The figures have been kept in cases, bales and bundles, and for the past twenty years have been as follows:

			Cases.	Bales.	Bundles.
1865	-	-	1,376	2,213	10,915
1866	-	-	5,614	11,875	10,548
1867	-	-	8,863	15,353	7,149
1868	-	-	1,687	8,886	15,791
1869	-	-	1,088	7,106	25,363
1870	-	-	2,032	2,322	22,732
1871	-	-	4,499	3,576	41,639
1872	-	-	3,567	7,542	49,891
1873	-	-	4,223	9,917	26,513
1874	-	-	6,908	11,636	36,756
1875	-	-	5,141	8,423	51,272
1876	-	-	5,225	9,739	65,218
1877	-	-	5,573	7,622	77,271
1878	-	-	4,585	11,254	68,023
1879	-	-	2,927	6,152	75,194
1880	-	-	5,555	4,300	108,024
1881	-	-	6,107	3,450	87,092
1882	-	-	6,082	4,078	106,3 7
1883	-	-	3,968	914	100,534
1884	-	-	5,787	5,362	122,153
	Totals	-	92,849	147,469	1,110,386

The first invoices of paper overland by rail of which we have any record were in 1870, when 741 cases, 26 bales, and 151 bundles were received in that way. Since then the railroad has been steadily absorbing the paper-carrying trade, and of late years the bulk has come by cars. For the past few years, large rolls of paper for the daily press have been received in single sheets, measuring 23,200 feet long.

Marin county, we believe, is entitled to the credit of the first paper mill enterprise. This was established in 1856 about 12 miles north of San Rafael, on what is now known as Paper Mill Creek. The surroundings are picturesque and the location excellent, with an abundance of pure water. The cars of the North Pacific Coast Railroad pass close by, thus affording rail transportation to all parts of the state. Last year a new mill was erected in the same locality by the owners of the old mill, which is still standing. The new mill is the largest and best equipped in the state, provided with all the latest approved appliances for manufacturing all kinds of paper. It is claimed that in all its appointsments it is the equal of any at Holyoke, Mass., which is conceded to be the leading centre of this class of manufactures in the United States. The erection of this mill was commenced in 1883, and it was put in operation March 1st, 1884, furnishing employment to 75 persons. It is now principally employed in making book, news and manilla paper at the rate of 7000 pounds daily. The product of the old mill at the same place in 1865 was 5,630 reams news and 6,840 reams wrapping and manilla. In 1875, the same mill made 200,000 pounds news and book, 300,000 pounds hardware and 400,000 pounds manilla, against 600,000 pounds of all kindsin in 1874. The pioneer paper manufacturer of the state is S. P. Taylor, who has been in the business here for nearly thirty years, and who owns two mills on paper Mill creek, Marin county. Mr. Taylor has been laid aside from the active duties of life for several months by an illness which is it feared will terminate fatally at no distant day.

The paper mills of the state to-day are not the same in all respects as those which have been in existence. Twenty years ago we had the San Lorenze mill at Santa Cruz. This has apparently dropped out. For the past eight years we have had the South Coast mill at the same place. This mill is engaged in making straw wrapping papea. The Eagle mill at Point Arena, Mendicino county, and the Caledonia mill at Saratoga, Santa Clara County, where merged into an enterprise known as the Corralitos mill at Corralitos, Santa Cruz county, in 1882. The Stockton mill was started abont ten years ago, but was re-built in 1877. The Lick mill at Agnews on the South Pacific Coast Railroad was rebuilt in 1882. The mill at Corralitos is is engaged in making straw boards and straw wrapping. The The Stockton mill and the Lick mill make printing and wrap, ping paper, and both mills have supplied some of the paper used by a portion of the daily prsss of San Francisco. About a year ago a new mill was erected near Los Angeles. There are now, therefore, six paper mills in active operation in the state. including on in Marin county, one in San Joaquin County, one in Santa Clara county, two in Santa Cruza county, and one in Los Angeles county. The mills have probably a capacity for manufacturing from 40,000 to 50,000 pounds daily. There is a mill at Clackamas, Oregon, from which some supplies have been received of an excellent character. A new mill is now in course of erection in Washington Territory, near the Oregon line. The plan is for a large and first class mill.

There is no reason why the paper mills of the state should not supply all the wants of the state for wrapping descriptions, and this they already do to a very great extent. The stock for straw wrapping paper is abundant. Butchers require strong and heavy paper, and this is supplied. Hardware merchants require a different quality and colour, but strong stock, and this want is fully met. The chief stock in manilla, paper is jute butts, the refuse stalk of the jute plant. This stalk can be imported here as cheaply as in any other part of the country. Book and printing paper are made from cotton rags. These are not very abundant here, and yet if the demand were larger a sufficient supply could be got together to meet the wants of the mills. First-class book and news paper has been made here and is now being made. But the requirements of the daily press are large, and it has been found unsafe to rely altogether on the local mills for supplies of this kind, because of of the inability to get regular and sufficient quantities of the right kind of raw material. The leading daily papers want uniform quality and a permanent source of supply, and so the praprietors import most of their papers from the east. One of those endless rolls of printing paper, as they are called, will cover about 4½ miles in length, About three of these rolls are put on the *Call* press at once. The paper is cut as printed and folded at the same time. The operation effects a great saving in handling, and of course in labour and expense.

The trade of the California paper manufacturers probably exceeds $1.000,000 per annum. This is the cost of the product as delivered from the mills. It goes through other manipulations before reaching consumers. Large sums are also spent for eastern and foreign descriptions. All the writing paper comes from the east. There are three or more large firms in this city exclusively engaged in the handling of paper, besides a large number who handle considerable quantities in connection with other lines of business. Americans are great consumers of paper. The evident believe that paper is more effective for some purposes than powder. Paper ballots are knowd to have effected great revolutions than lead bullets.—*San Francisco Evening Bulletin.*

THE consumption of coal in the iron manufacture of the British Isles relatively to the total production of pig iron has been reduced within the past few years. The average quantity of coal consumed per ton of pig iron was 2.07 tons in 1883, against 2.55 tons in 1875. In 1884 the total quantity of pig iron produced was 7,528,966 tons, being a decrease of 961,258 on the quantity made in the preceding year.

IMPROVED SCROLL-SAWING MACHINES.

We have pleasure in presenting to our readers some descriptive matter relating to the spiral-spring scroll-sawing machines made by Henry L. Beach, of 140 Elm street, Montrose, Susquehanna country, Pa. Mr. Beach is one of the pioneers in the manufacture of this useful class of wood-working machines, and by the adoption from time to time of improvements which experience has suggested, he has succeeded in evolving a scroll saw which, in respect to simplicity, speed and efficiency, is everything that could be desired.

The machine shown in the accompanying illustration is the No. 1 tilting-table machine of this maker, and is affirmed to be constructed upon the best known principles, and to embody every known improvement that could add to its usefullness and durability.

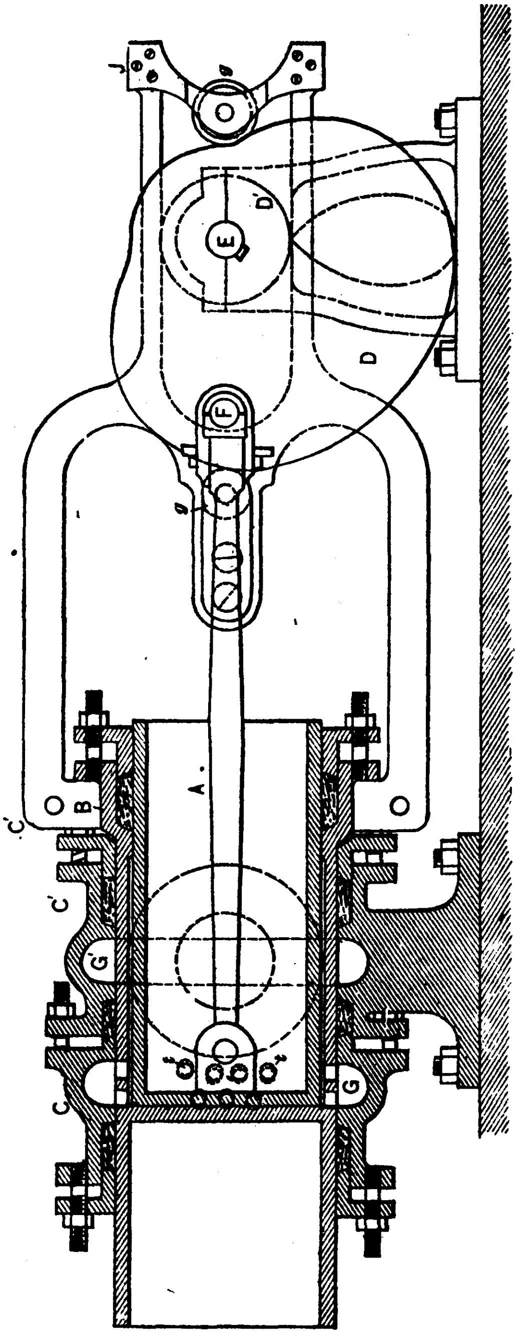
We give herewith the more important mechanical details involved in its construction and action, which will serve to bring into prominence the special features of excellence and superiority which are claimed for it by the maker.

The machine is provided with a tilting-table bed which can be adjusted in a moment to any angle, either to the right or left, up to 39°, and securely held in any desired position. The circle on which the bed rocks is ruled right and left, to exhibit the desired bevel, and by this the bed, after using on an incline, can be brought at once to a dead level. The lower frame of the machine is a solid casting, made extra heavy to insure freedom from vibration when running at high speed. The bed itself is 38 by 40 inches in dimensions by 1¾ inches thick, and is made of alternate strips of ash and cherry securely glued up. The crank shaft is of 1 3-16th inch. cold rolled iron, provided with two 3½-inch bearings, with pulley between. The upper rigging on the straining device is claimed to possess special features of excellence. The springs, air pump, guide-ways cross-head, and steel bearing with all their connections, are attached to a tubular shaft, which is secured to a heavy cast-back support by the box S and eccentric lever F. When this lever is raised, the shaft, balanced by the spring O, is free to move up and down to suit any length of saw. The back and sides of the saw are supported by the steel bearing L, which may be raised or lowered to suit different thicknesses of work. The air pump is bolted to the arm of the springs, and works noiselessly. The under guide-ways are new features on the Beach machines. They are so devised that they cannot, by expansion or contraction, tighten or loosen the cross-head. This provision allows it to run snug in its bearings, preserving the true alignment of the saw. All lost motion is taken up in the cross-head, which may be worn entirely out without redressing or fitting. To avoid the hollowing of the bed by wear, an 8-inch iron plate is let into it around the saw lot. The lower end of the saw is securely held by a strong self-acting clamp, which permits broken saws to be used without drilling or punching.

One of the notable mechanical features embodied in the Beach scroll saw is the improved friction pulley and combination brake with which it is provided, in place of the usual light and loose pulleys. By means of this device the machine may be made to start and stop instantly by a single movement of the feet without shifting the belt. This attachment permits of a notable saving of time in changing the saw on inside work. We are assured, in this connection, that the machine, when running at full speed, may be stopped, the saw removed and replaced, and the machine started at full speed again inside of four seconds.

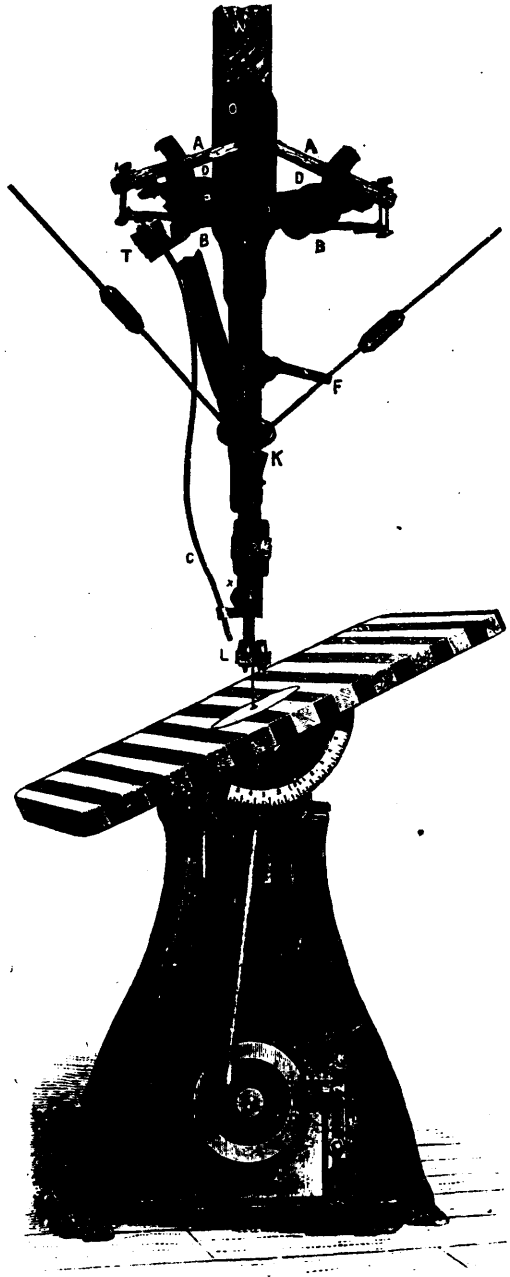
The springs used on these machines are made of extra crucible cast steel, carefully proved as to quality and temper, with the object of insuring to the fullest extent the qualities of elasticity, strength and durability.

The machine here described is commended for shop work generally, and especially to the favorable attention of those engaged in pattern work. The table can be adjusted to give the desired draft in a moment, and there is scarcely any pattern on which it cannot be used with decided advantage in saving of time in trimming up the work. The simplicity of the starting and stopping mechanism has special advantages, since it avoids the loss of time involved in the shifting of the belt, enabling the sawyer to keep both hands on his work, and greatly reduces the risk of breaking the most delicate patterns. Compared with the band saw for this class of work, it has the merits of giving the draft all around the pattern, permitting of the use of a much finer saw, and cutting the work smoother and more accurately.—*Ex.*



Longitudinal Section.

A PUMP WITHOUT VALVES.



IMPROVED
SCROLL-SAWING MACHINE.

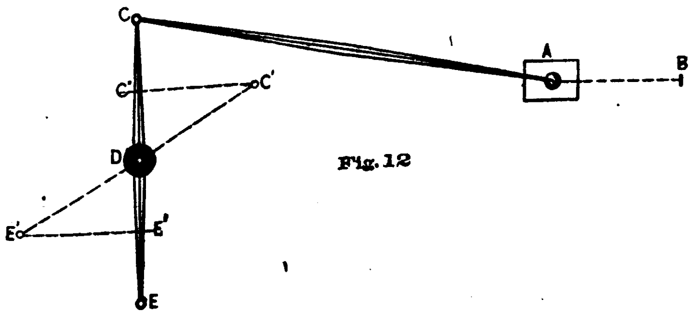


Fig. 12

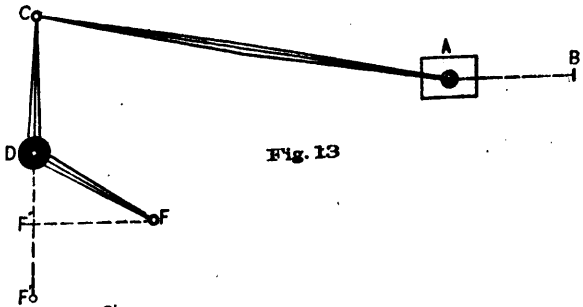


Fig. 13

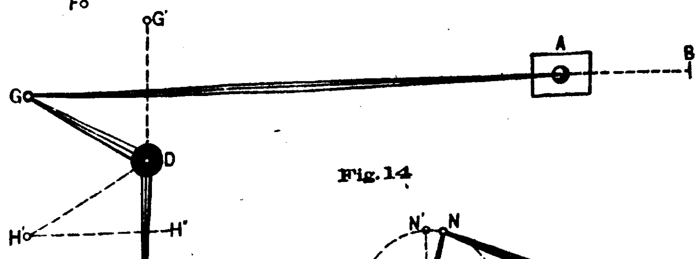


Fig. 14

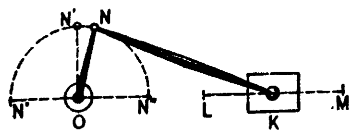


Fig. 16

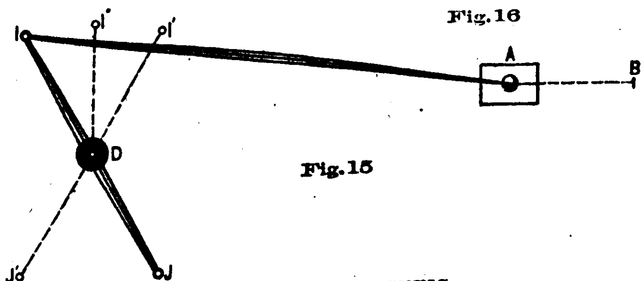


Fig. 15

MACHINERY DESIGNING.

THE STANHOPE WATER SOFTENER.

The idea of eliminating from water by chemical treatment the greater part of the mineral matters it contains, before it is used for feeding boilers, bleaching, wool-washing, and other manufacturing processes, is well known but is difficult of application. The addition of a solution of lime will throw down the bicarbonates of lime and magnesia, and similarly carbonate of soda will eliminate the sulphates of lime and magnesia. But the precipitates are not heavy, and it is exceedingly difficult to separate them from the water without very extensive apparatus. Settling tanks, especially if they be shallow, will effect the result in time, but the process is slow, and requires a great deal of space if large quantities are to be dealt with. Filtering is sometimes attempted, and should answer if carefully carried out, but the filtering material rapidly chokes, and requires to be often cleaned. The result is, that although the process is well known, and can be conducted with the greatest ease in the laboratory, yet, as a rule, manufacturers have seldom adapted it, preferring, as the lesser evil, to have the matter deposited in their boilers, and to combat them there by anti-incrustation compounds, by frequent blowing off, and by systematic cleaning.

Recently a new apparatus has been devised by which the precepitate can be extracted from the water by the continuous process, which requires comparatively little space, and no great amount of supervision. It is the invention of Messrs. Gaillet and Huet, and is manufactured in this country by Messrs. Cordner, Allen, and Co., of 38, Bucklersbury, E.C., and the Stanhope Works, Fulham, S.W. The apparatus is illustrated above, and consists of a series of wrought-iron rectangular towers occupied internally by a large number of sloping shelves. The length of each shelf is such that it does not reach entirely across the tower, and as the shelves are rivetted alternately to the two sides, a devious course is left from bottom to top, along which the water can flow, passing backwards and forward between the shelves. These, as shown in the illustration, have a very considerable inclination, and slope each way into the corner of the tower, which thus forms a pocket. The water and the chemical agents, mixed in definite proportions, enter at the bottom of the tower, and gradually rise through it at a very moderate velocity. The precipitates flow with the water, but as they are slightly heavier than it, they do not turn round the ends of the shelves with the same facility, and thus get carried into the still pockets where there is no current, and where they lie until removed by the opening of the valves which form the outlet to those places. Thus as the water ascends it gradually loses its turbid appearance and emerges at the top quite clear.

The tanks for the chemicals are shown at the top of the tower. The two larger, which are for the lime solution, are in duplicate, and the smaller is for the soda. The preparation of the reagents is as follows: A quantity of caustic soda is dissolved in the upper tank, and kept there ready for use. In one of the large tanks the workman places every twelve hours a quantity of slacked lime, and stirs it while the tank is run three-quarters full of water. The required amount of soda solution is added, the quantity being measured by a float and a graduated scale, and then more water is admitted, and the whole agitated for ten minutes. This mixture is drawn by a floating pipe from near the surface, and is thus decanted into a small tank provided with a ball-cock that always keeps the surface at one level. From this tank the chemical runs under a constant head into a pipe where it meets the unpurified water, and the two then descend and pass through the tower together as already explained. Supposing the water also to flow under a constant head, the proportion of lime and soda will always remain the same, after they have been once adjusted by an easy test. After this treatment all that remains in the purified water is sulphate of soda and chloride of sodium, neither of which are found to give any trouble.—*Eng.*

THE experiment of substituting the labour of coloured people for that of Chinese is being tried by a San Franciscoan, on his ranch in Los Angeles county Cal. He took there thirty-two families of coloured people from the South, built them cabins in Southern plantation style, and thus far is much pleased with their work. Labour on a vineyard and fruit farm, says a correspondent writing from San Francisco, is not so severe as on a cotton or sugar plantation, and the climate of Southern California is milder than in most parts of the South.

LEGISLATING AGAINST MONOPOLIES.

What is the use of legislating against patented monopolies; Cut the root of the evil and the continual tinkering of the state will be uncalled for. One mistake in legislation, if persisted in and preserved, eventually leads to many otherwise unwarrantable meddlings with the matter. The United States made a mistake, and a great one, too, as the country is forcibly realizing in many ways, in granting monopolies of manufacture and use to the owners of patented articles and processes, and in this invitation to water stock. The evils of monopoly have cropped out in telephones, barbed wire, Bessemer steel, sewing machines, in various electrical devices, and ceaselessly with other subjects. Farmers have fought barbed wire pools and patents with desperation; enormous profits have been taken out of sewing women and they have not gone into the pockets of the inventors; the right to use the Bessemer steel process will not be sold South; legislators are passing laws limiting telephone charges. The history of patented monopoly in the United States and their extortions, and the puttering counter-legislation, would fill a large volume. Start right in the beginning, and the sailing is smooth enough. Give the inventor a monopoly of royalty on his patent, but give every person in the country a right to use the invention upon payment of a uniform royalty to the inventor. The trouble has never been that the inventors got too much, but that the controlling capitalists practise extortion. Give us the new patent law, and no legislature will ever need to reduce telephone rentals to $3 a month; it will more likely be called upon to save stockholders from loss in the excessively low prices that would accompany competition.

EXPENSES OF BUSINESS.

A well informed merchant of Boston recently said to a representative of a Boston newspaper that he had been looking back over his accounts, and was surprised to find that since the close of the war there had been a steady increase in the ordinary expenses of carrying on business. That this increase of business expenses extends beyond the merchant to the manufacturer and most other kinds of business is a fact patent to most employers. Mere office work costs a great deal more now than it did in 1865; more clerks are beeded, and, on the whole, each of these receive higher pay. Assistance is required in the receiving and delivering departments to an extent and of a character that would not have been dreamed of two decades ago. Then there are a variety of incidental expenses that now enter into the computation. There are telephone charges, printing, the expense of solicitors, the whole making up an amount sufficiently large to eat up all that would have been considered fair profits a quarter of a century ago. The tendency, all the time going on, to lessen the hours of service, both in offices and workshops, of itself makes the cost of business proportionately higher. Competition is sharper than it was ten or twenty years ago, and prices are so much reduced in most commodities which enter into the necessities of a household, that mechanics, clerks and others are enabled to live much better now than it was possible for them to do ten or twenty years ago, when their wages were less and the cost of living was greater.

REMOVING COTTON FROM WOOLEN RAGS.

A successful process for removing vegetable fiber from woolen rags has lately been invented and put into operation by Mr. Duke Fox, of Dewsbury, England. The *Journal of Fabrics*, referring to Mr. Fox's process, states that the operation is more economical and more healthfully conducted than any of the methods hitherto practiced. The chamber for the reception of the rags to be carbonized was filled to its utmost capacity with worsted and woolen rags having a large admixture of cotton in their composition, and after being under treatment by the gas less than two hours, they were then removed without the slightest appearance of the body of the cotton being anything but dust, and this was effected without the woolen or worsted part of the material being damaged in strength or color to any perceptible degree. The carbonizer can be put through about four workings per day, extracting about 1,000 pounds of shallies, or from 2,000 to 2,500 pounds of cloth rags.

Scientific Items.

OUR English industrial exchanges are all faithful advocates of free trade, but recent events lead us to believe they do not favor, taking away all artificial restrictions of trade between nations, because it is morally just or philosophically correct, so much as because free trade is likely to benefit English manufacturers. There has been remarkable unanimity among them in denouncing their government for purchasing pumps for the Soudan pipe line from Worthington, our American company. Yet the British government was merely following the policy the press of that country are so ready in recommending to other nations. But even there it makes a difference whose ox is gored.

WHAT WILL BURST A GUN.—In bravado a young man placed the muzzle of his fowling-piece under the water and fired the charge. The result was the bursting of the barrel near the breech, and the mutilation of his hand. Another placed and held the muzzle of his gun square against a piece of plate window-glass, and fired the charge—powder and bullet. The glass was shattered, so was the gun-barrel. Another instance was that of an experimenter who had heard that a candle could be fired from the barrel of a gun through an inch-board. He drove a candle into the muzzle of the gun, fired, and the explosion split the barrel almost its entire length, and did not even drive the candle from the muzzle. Still another burst of a gun-barrel was caused by the use of wet grass for a wad, well rammed down over a charge of shot. But perhaps one of the most singular exhibitions in this line was a Colt's navy revolver, which some years ago was sent to the factory in Hatford, Ct. This was before the adaptation of these pistols to the metallic cartridges, and it is probable that in loading with open powder and ball only a small amount of powder got into the chambers, and the bullet was not propelled with sufficient force to drive it from the muzzle; at least the bullet did not go out, but lodged. As the shooter did not know whether the bullet escaped or not, but kept on firing until the barel burst or bulged, and when it was sawed in two longitudinally there were found fourteen bullets wedged one into the other, and so much "upset" by the hammering of the successive explosions of the powder-charges that some of them were not less than one inch diameter, flattened discs instead of conical bullets.—*Manufacturer and Builder.*

Miscellaneous Notes.

A YOUNG man in Auburn, N.Y., has perfected an invention by which a load of from two to four tons of coal can be emptied into the cellar in about half a minute. The invention can be used, it is said, on any ordinary waggon, or on a coal car, and those who have seen it in use in Auburn say that it is a most useful contrivance.

THE royal commissin appointed to investigate the subject reported that the quantity of coal remaining and available for future use in the United Kingdom, from the year 1880, at the depths of less than 4,000 feet, might be safely estimated at 135,288,613,638 tons. It appears, therefore, that with an output of nearly 147,000,000 tons per annum, supplies are yet insured for 920 years hence.

THE latest experiment in the organization of industry comes from Russia, where the employés of the large engineering works belonging to the firm of Struve & Co., have recently been planted in a complete settlement, somewhat like Pullman city, near Chicago. The workmen, of whom there are between 3,500 and 4,000, are all lodged in small cottages, most of which are made to accommodate two families only; while the public institutions of the colony include a refectory, a laundry, a hospital, a benefit society, but charity in any other form is quite unknown in the place, and the co-operative society pays a flourishing dividend.

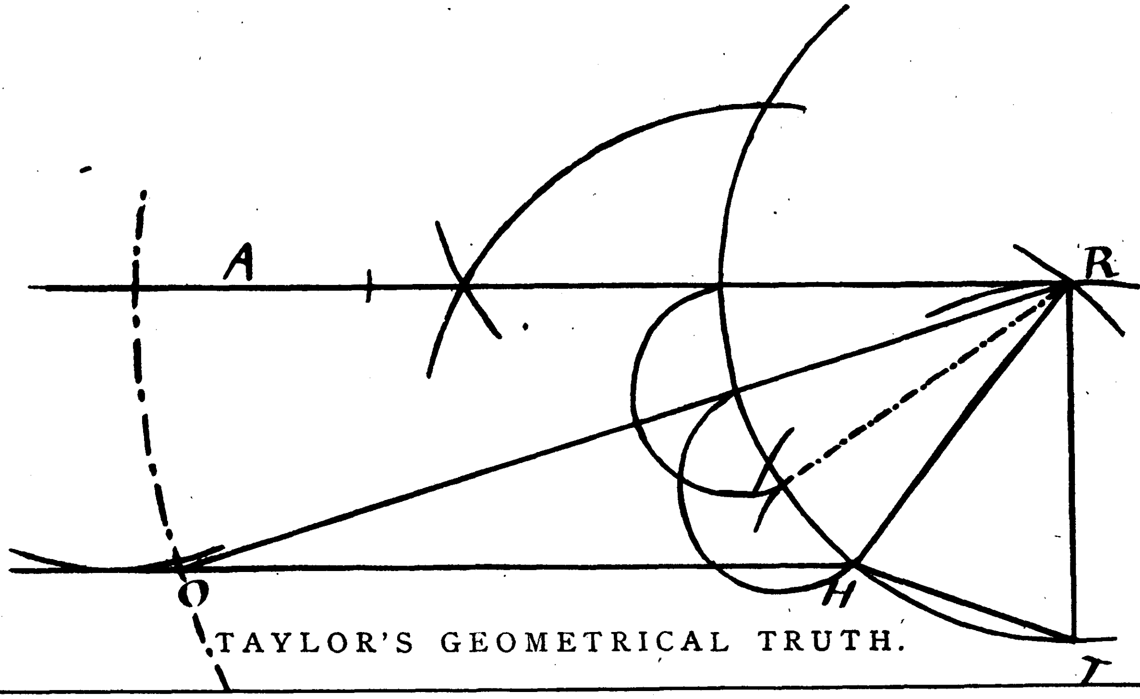
—As illustrating the excessively low rates at which ocean freights are being carried, we quote the following story from an English contemporary: "A new and cheap way of conveying goods from Liverpool to London has been inauguarated by an enterprising firm of Transatlanctic steamship owners. A Liverpool firm having 1,000 tons of rough freights for London, finding that 10s was the lowest rate quoted, made ouvertures to the managers of a transatlantic line, who accepted the goods at 6s provided they were not tied as to delivery. The shippers, being in no hurry accepted these terms, and the route specified in the bill of lading was via New York. The goods would go out to New York as dead weight, and would there be transfered into a London-bound steamer."

It was discovered upon examination not long ago, that a chimney 80 feet high at a machine shop at Holyoke, Mass., was about 42 inches out of perpendicular. The method employed in righting was quite simple. A harness was located under the cornice, and two others below the first. Two lever jackscrews were placed under the girders of one of the harness on one side, and six jackscrews similarly on the other side. The earth was then carefully loosed about the chiminey on the opposite side from that of its inclination, and water poured in, after which the jackscrews were turned gradually, and the earth again loosened and dampened with the hose. After this process had been several time repeated the earth was puddled, and the whole stands now properly righted.

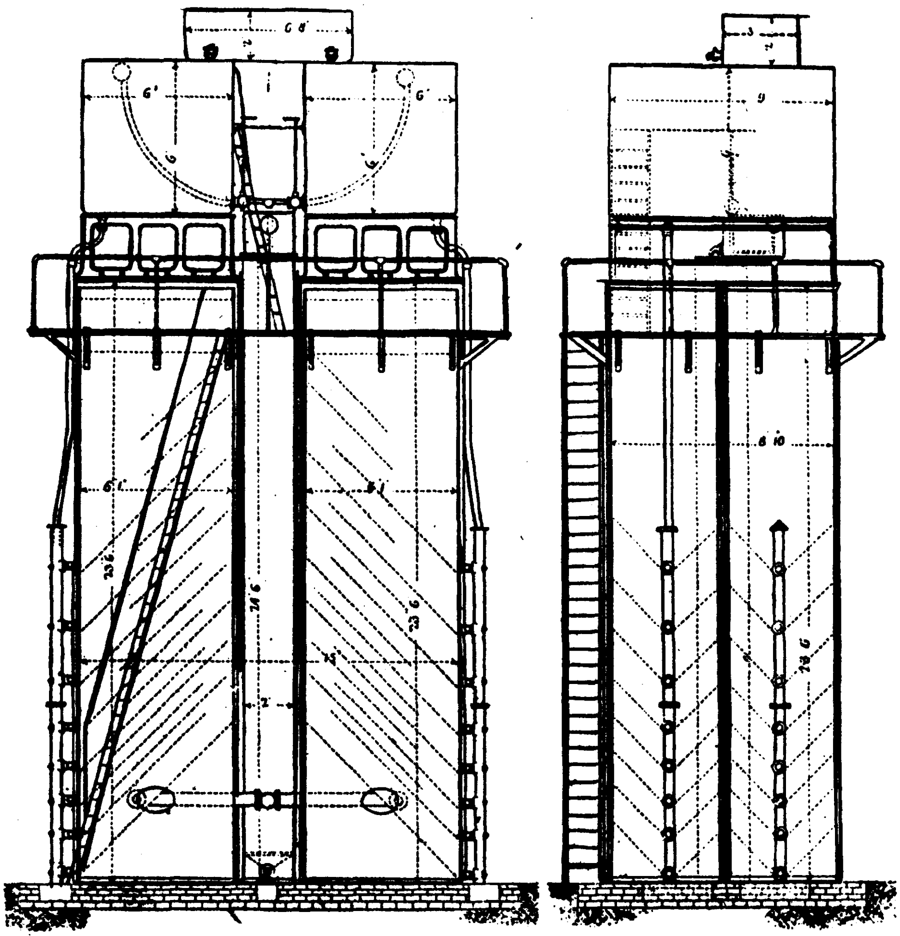
FLOATING BREAKWATER.—A newform of floating iron breakwater is to be placed as an experiment at Eastbourne, England. Its general nature is somewhat like this: Two rows of iron pontons filled with cork or otherwise constructed internally to remain buoyant when injured by collision or by acts or war, are run out to sea in parallel lines. The front facing the expected storm stress is wedge shaped, so as by dividing the mass of projected water to lessen the force of the impact and cause part of the water to ascend in a column of spray, which then falls back. The wave which rushes under the ponton has its velocity retarded by a lattice framing, carried 12 feet below the ponton. The framing also imparts stability to the ponton. Behind the wedge-shaped ponton is another ponton which serves as a wall, and in the intervening space the waves are intercepted. Two sorts of chain moorings secure the breakwater.

A GREAT railroad bridge 3,000 feet long, is to be built over the Hawkesbury River, in New South Wales, Australia. The soundings appear to show that the foundations for piers must be sent down to a greater depth than any ever sunk by man in the whole history of engineering, the water in some places being 77 feet deep, and in others, where the water is 45 feet deep, the mud and sand is 125 feet deep, making 170 feet in all to sink the piers below tide. This bridge is to be for double tracks, and will cost over $2,000,000. Proposals to build this great bridge have been asked of the leading bridge builders of England, Europe and the United States. Sir Saul Samuel, of London, on the part of the Government, has named a board of engineers, to meet in London in June to examine and report on the plans and tenders sent in by the bridge builders. The board named consists of Sir John Hawkshaw, C. E.; Col. Douglas Galton and Mr. W. W. Evans, M.I.C.E., of New York. Mr. Evans is just recovering from an attack of pneumonia and cannot avail himself of the honor thus conferred on him. This is the first time that an American engineer has been asked to serve on such a board in England, and it is to be regretted that Mr. Evans is unable to act.

A CORRESPONDENT of the London *Times* sends the following as a complete list of the vessels now being built for the French Government: Ironclads—The 'Brennus,' 10,650 tons; the 'Neptune,' 10,600 tons; the 'Marceau,' 10,600 tons; and the 'Requin'' 7,200 tons, while the 'Amiral Baudin,' the 'Foudroyant,' the 'Caiman,' the 'Indomptable,' and the 'Terrible' have been launched and are now being armed; ironclad for duty along the coast, 'Furleaux,' which is the only one of this class of vessel not finished; first-class iron-clad gunboats of 1,640 tons each, the 'Acheron,' the 'Cocyte,' the 'Phlégéton,' and the 'Styx'; second-class iron-clads of 1,050 tons each, the 'Flamme,' the 'Grenade,' the 'Mitraille,' and the 'Fusée'; cruisers, the 'Sfax' and the 'Dubourdieu,' which have been launched but are not yet armed; cruiser torpedoes of 1,280 tons, the 'Condor,' the 'Epervier,' the 'Faucon,' and the 'Vautour'; torpedo ships of 320 tons, the 'Coulevrine,' the 'Dague,' the 'Dragonne,' the 'Flèche,' the 'Lance,' the 'Sainte Barbe,' and the 'Salve,' while the 'Bombe' has been launched and is now being armed; gun-boats, the 'Metéore' and the 'Etoile'; first-class dispatch boats, the 'Fulton,' the 'Inconstant,' and the 'Papin'; second-class dispatch boats, the 'Jouffroy' and the 'Salmandre'; transports, the 'Durance,' the 'Meurthe,' the 'Aube,' the 'Eure,' and the 'Rance.' Thirteen torpedo boats are being built, as well as a large transport ship for New Caledonia, two frigates, and two sailing vessels to be used as training ships. The total amount to be spent on ship-building for the current year is £1,350,000.



TAYLOR'S GEOMETRICAL TRUTH.



STANHOPE WATER SOFTENER.