Inventions Give Employment to More than they Throw out.

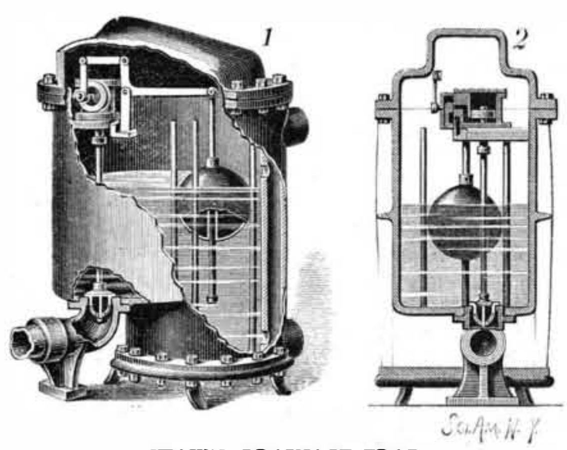
Frequently one sees appalling computations of the vast number of workmen who are constantly thrown out of employment by new mechanical inventions that take the place of human hands. But along with the displacement of hand labor there has gone a replacement, in consequence of the increased production that always follows a cheaper process of manufacture. Especially is this observable in all artistic matters. Pictures that are now produced and given away as advertisements could not be bought except by the well-to-do people a century ago. Art has been applied to a thousand articles of daily use, and artistic forms thus perpetuated have come to the homes even of the poor. Cheaper processes of engraving are now in use; but instead of causing the employment of fewer artists this requires the services of more and better artists, and they are paid now more than they ever were. A new class of artists have sprung into existence. They are known as pen and ink draughtsmen, and it is they who have made the illustrated newspapers of to-day far superior to those of even a quarter of a century ago. They command a salary of from $5,000 to $15,000 a year.

But it is not alone in picture making that the progress of invention gives new employment for artists. There is an immensely wide field for designers in wall papers, carpets, all sorts of textile fabrics, silverware, furniture, and hundreds of other departments. There are armies of artists engaged in making patterns and designs that were never needed in the world until new processes of duplication created an almost insatiable demand for variety.

Other fields of employment have also been opened in the present generation for vast numbers of workmen. In the construction of electrical apparatus, of watches, of machinery and tools, and the thousand and one products of invention, there is room for the laborer. There are more women employed even at sewing, and at better wages than ever for the skilled. The type-writing machine has already its army of wage earners. The discovery of crude oil has put legions at work, and, looking at the whole subject, it must be admitted that though mechanical inventions have put a great many persons out of work, they have also put a great many persons into work, besides producing for the multitude an endless variety of beautiful and useful as well as cheap products.—*Baldwin's Textile Designer.*

AN IMPROVED DRAINAGE-TRAP.

The accompanying illustration represents a drainage-trap for automatically discharging the water of condensation whenever a certain quantity has accumulated, Fig. 2 being a transverse sectional view. It has been patented by Mr. John Shaw, Sr., of Bayonne, N. J. In one side of the casing is a channel connected at its upper end with an inlet pipe leading to the steam supply, this channel being connected with the interior of the casing by apertures near the top and bottom, and there being opposite the bottom aperture a blow-off pipe with suitable valve, by means of which the casing may be cleaned of sediment. A short distance above the bottom of the casing is an offset, in which opens a water outlet pipe having a valve opening inward, the valve being on the lower end of a piston rod moving vertically in a cylinder supported on a bracket in the upper part of the casing. On this cylinder is formed a valve chest, the valve opening and closing ports leading to the top and bottom of the cylinder, and also controlling an outlet port through the bracket. The valve stem carries an arm pivotally connected bya link with the short arm of a bell-crank lever fulcrumed on the bracket, and pivotally connected with a rod pro-

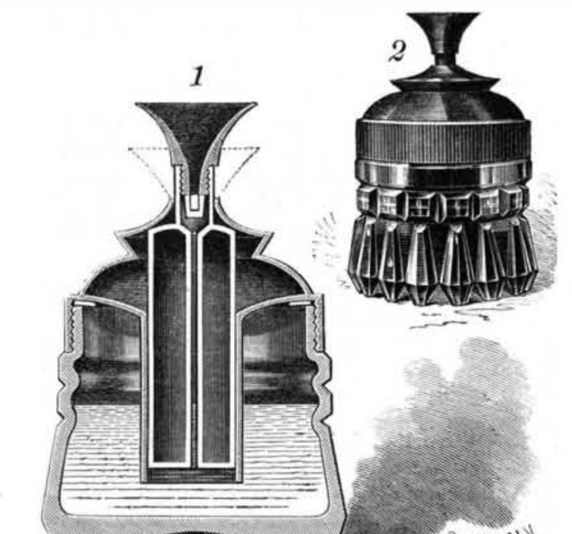


SHAW'S DRAINAGE-TRAP.

vided with collars between which travels a float, guided in vertical guide rods. As steam passes to the interior of the casing, the water of condensation finally closes the bottom opening from the side channel, and the float rises until it presses against the top collar on the vertical rod. As this rod is moved upward by the further accumulation of water, the bell-crank lever is turned to operate the valve and admit steam into the bottom of the cylinder, lifting the piston and opening the valve in the water outlet pipe. The sinking of the float as the water goes out, pushing on the lower collar of the vertical rod, swings the bell-crank lever to uncover the upper inlet port of the valve, whereby steam is admitted to the top of the cylinder, forcing the piston downward and again seating the valve in the water outlet pipe. The valve seat of the water outlet pipe is located somewhat above the bottom of the casing, to prevent sediment passing into the pipe.

AN IMPROVED INKSTAND.

An inkstand designed to almost altogether prevent the evaporation of ink is shown herewith. It has been patented by Mr. Emry Davis, of Kane, Pa. The inkstand is closed air-tight by a cover, formed of an inner



DAVIS' INKSTAND.

annular concaved disk of soft rubber and an outer ornamental metal cover, flanged and threaded to the stand. In the cover is fitted a tube reaching nearly to the bottom of the ink well, the tube having a flange fitting closely the central opening of the rubber disk, and making an air-tight connection between the tube and cover. In the tube is placed a float, in which is placed a funnel or dip tube which reaches up through the annular cover, the lower end of the tube being open at the bottom to receive the ink. If desired, a light coiled spring may be used at the bottom of the float to lift it suddenly in the tube. In use, the float is held up by the buoyancy of the ink, as shown in full lines in Fig. 1. To fill the pen with ink, it is placed in the upper end of the dip tube and pressed down, as shown in dotted lines. The pressure lowers the float, and the air confined above the surface of the ink causes the ink to rise in the dip tube and fill the pen. On removing the pen, the float rises and the ink recedes in the dip tube, so that there can be practically no evaporation.

Electric Welding.

It was at a meeting of the Boston Society of Arts in the fall of 1886, where Prof. Elihu Thomson, the inventor of electric welding, first explained and illustrated by practical experiments the art of electrical welding, discovered by him, to a large and interested audience who could scarcely believe their eyes when they saw copper and iron rods one-half inch in diameter welded in a few seconds, together with other equally startling experiments.

Professor Thomson, like every great and original inventor, was impressed by the discovery which he had made, and eagerly followed up his experiments, conscious that he had solved the problem of how to spare human strength a large share of the extravagant waste expended to meet the requirements of an increasingly exacting and fastidious civilization. By careful study and patient perseverance, supplemented by elaborate facilities for experimenting, rapid and striking improvements were made in the mechanical and electrical apparatus employed in the art, until now, when the process may be, in a sense, considered perfected, or at any rate rendered in every way fit to be placed on the market as a great labor-saving device, and a method by means of which results in metallurgical art and science can be achieved which were utterly impossible until now.

It was to see these devices in practical operation that representatives of the scientific and daily press, numbering about 50, in response to the thoughtful invitation of General Manager H. A. Royce, of the Thomson Electric Welding Company, were recently given a reception, at the Malden, Mass., Electric Light Company's station, where three transformers, a 30-unit welding dynamo, and specimens of work in riveting, shaping, and welding were shown.

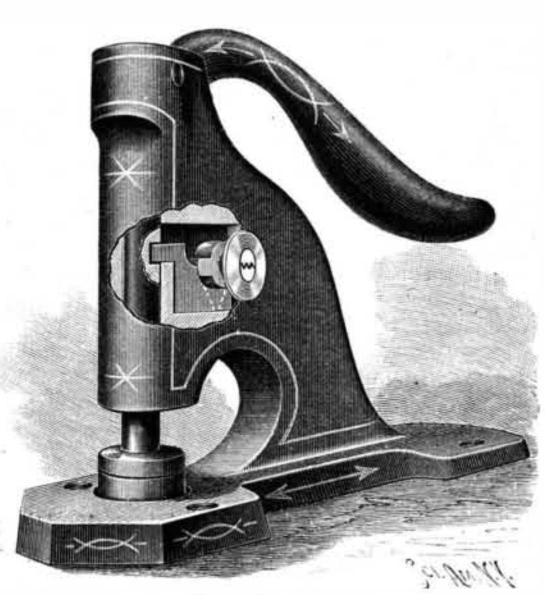
The proceedings were in charge of Manager H. A. Royce and several able assistants, well known electrical engineers. Together, these gentlemen manipulated the entire machinery and superintended the experiments, answering a multitude of questions and explaining in the fullest possible way, but in plain and unpretentious language, the entire process to the eager crowd of wondering, curious, and dazed visitors, who, almost to a man, found difficulty in expressing their astonishment, as they bewilderingly stood and watched the process of welding going on in almost every conceivable form, and between many different metals, including joints in lead, brass, and iron pipe, and quite a number of other forms of materials. The apparatus exhibited was of the indirect type, the welding being done on a transformer or "welding coil," receiving current from a dynamo. For small work the company manufactures a direct welding machine, in which the transformer is dispensed with and the current taken direct from the armature to the clamps attached to the field magnet of the dynamo. One-half inch bars of copper and iron rods from ½ to 2 inches in diameter were repeatedly welded on the three transformers, all of which were used in order to show the ease with which various types of machines can be adapted to all classes of work. The smallest transformer, weighing 500 lb., was used in welding ⅝ copper, which is four times the size of the largest overhead conductor employed for electric railways. The strength of the joint was evidently greater than that of the rest of the rod, for, on twisting, it was broken at some distance from the weld. By a still larger transformer the method of butt welding extra heavy 2 inch iron pipes was shown. An absolutely tight joint obtained in this way is of great value in the manufacture of ammonia machines. The third transformer, welding 2 inch solid iron in less than two minutes, gives a current of over thirty thousand amperes and consumes about fifty horse power. The rapidity, ease, and certainty with which the work was done, the strength and good appearance of the welds, excited the admiration of all.

Blasting Holes to Plant Trees.

"Few people elsewhere in the world may ever have heard of blasting holes to plant shade or fruit trees," said a cultivator the other day, "yet the practice is common here and shows good results. In most places there is found sufficient top soil for any purpose, but as land has become valuable, people have cast about for means to utilize lands where the coarse sand rock comes too near the surface for successful tree planting. A blast, well put in, creates a pocket for broken rock mixed with top soil, which furnishes a basin to hold moisture as well as a deeper and cooler hold for the roots. It is yet too early to say what will be the ultimate results of such planting, but in a climate like ours, where a superfluity of rainfall is not likely to occur, it will no doubt be successful."—*San Diego, Cal., Union.*

AN IMPROVED SEAL-PRESS.

A seal-press or hand-stamp, so constructed as to prevent its use by unauthorized persons, is shown in the accompanying illustration. It has been patented by Mr. John G. Strodtmann, of Petersburg, Ill. The plunger is forced downward by a cam lever, a spring lifting the plunger when the pressure is removed. A lock is embedded in the standard so that its bolt will engage a notch or shoulder upon the plunger, the notch being so located upon the plunger that, to engage with the bolt of the lock, the plunger must be in its lower position, in contact with the die, as shown in the illustration, whereby the faces of the dies are made inaccessible when the press is locked. The notch of the plunger and the lock-bolt are also concealed and protected



STRODTMANN'S SEAL-PRESS.

within the press frame, the frame of the press being preferably made in two parts, divided in a central vertical plane, and permanently riveted together, the lock being held in an interiorly recessed portion, while the rivets uniting the parts are finished flush with the surface, and the frame thereafter japanned or otherwise finished in such manner as to conceal the position of the rivets. The lock may be a multitubular one which cannot be easily picked, and presents its key-hole and the end of the tumbler barrel only to view, flush with the side face of the frame.

Some Facts about Rubber.

At a recent meeting of the Merchants' Club, of Boston, Messrs. Geo. A. and A. H. Alden, rubber brokers, thus summarized the leading facts connected with the India rubber industry:

Rubber is a coagulated sap of the *Siphonia elastica* and its kindred genera, a tree, shrub, bush, vine, or weed producing merchantable quantities of rubber in Brazil, the North and West Coasts of South America, Central America, Mexico, East and West Coasts of Africa, and India. Even our common milk weed would produce a very fair rubber. The standard and most reliable rubber in quality, as well as the highest priced—the celebrated "fine Para biscuit"—is produced in Brazil, while the lowest grades and most irregular qualities are the productions of the West Coast of Africa; the latter, in fact, are even there deteriorating—due to carelessness or fraud on the part of the gatherers. We received from a manufacturer some little time since, by express, a hat, boots, and overalls, which, he wrote, he found in a ball of rubber, and that he expected to find the man before he got through with the lot.

The most interesting country in which to study the production of rubber is Brazil, where it has reached its highest standard in that region of heat and moisture, marvelously dense forests, and still more marvelous waterways, the Amazon valley, than which does not exist in the whole world a more fertile region for its size, with its rank growth of vegetation, rubber and dyewood trees, Brazil nuts, artistic woods, fruits, coffee, cocoa, cotton, the Cachassa berry—from which is produced the native rum—tobacco, sugar, and farinha plantations—farinha being the native flour of Brazil. This wonderful river, with its tributaries, drains a territory larger than the whole of the United States, the rise and fall of water between the wet and dry seasons being 45 feet and upward, so that, during the wet season, the rubber-producing districts (which cover a considerable portion of the valley) are flooded. And here let me say that the so-called rubber plant found in your houses, and admired for its beautiful foliage, is not the tree which produces the rubber of commerce.

Notwithstanding the excessive and continuous heat, the attendant and numerous discomforts always to be found in a tropical country, and the liability to dangerous sickness prevalent to a greater or less degree at different seasons, the valley is inhabited (very sparsely, it is true) by an industrious and hard-working people, as shown by the large and ever-increasing exports from Para, which is the principal shipping and receiving port for the valley, situated somes sixty miles from the mouth of the Amazon, on one of the many arms of the delta—a city of about 40,000 inhabitants, composed of Brazilians, Portuguese, negroes, and half breeds, with a few American, English, German, and French, who are located there to buy and ship the produce as it arrives.

The rubber is only gathered on the Upper Amazon during the dry season, when the heavy daily rains of the wet season have ceased and the river has contracted itself within its banks. The flooded country gradually becomes less and less marshy, and enables the laborers to penetrate the forests fringing the water courses, to tap the trees. Without experience it is difficult to form an adequate idea of the almost impenetrable vegetable growth on these annually flooded bottom lands, under the influence of an equatorial sun.

At the beginning of a season, say the latter part of May or the early part of June, the emigration of laborers to work on rubber estates is very marked, the steamers from the south (mostly from the province of Ceara) going up the Amazon loaded with rubber gatherers, many of whom return again in the autumn when the rainy season commences. Those who remain live a most indolent life in lightly built bamboo huts, perched on piling to elevate them above the rising waters.

On the lower Amazon, among the islands, rubber is collected and brought to market every month in the year; but the rubber from the upper river gathered during the dry season only reaches market in the wet season, for the double reason of the necessity for high water to enable the river steamers to reach the higher branches of the river and the enormous distances required to be sailed over by these steamers, whose trips into Peru and the head waters and back cover a greater distance than from here to Liverpool and back, and consume a greater time. Between Para and the Andes Mountains there are 30,000 to 40,000 miles of navigable water of the Amazon and its tributaries.

The rubber from this valley was formerly brought to market in the shape of bottles and shoes, made by the natives over clay moulds, which were then broken and taken out. This method was continued until about 1848 or 1849, when a wooden mould, something after the shape of a paddle, was adopted by the gatherers, and is exclusively used to-day.

Grants of seringoes, or rubber lands, are made by the provincial governments upon application of discoverers or explorers of same, on the condition of their occupying and working the trees, which are in turn mortgaged to the Para or Manaos merchants as security for the advancement of supplies to the gatherers against rubber to be delivered throughout the crop. Nearly all the available lands are thus taken up, although not all thus pre-empted are worked. These seringoes exist not only on the river margins, but in the interior as well—always, however, in low districts of a swampy nature, near or around lakes or ponds; and from these inland lakes small streams drain into the river, down which the rubber is floated to the forwarding points for shipment to Para.

Some of the seringoes are very extensive, and many men are employed—divided into gangs—some to keep the paths open from tree to tree by constant chopping and cutting at the wild and luxuriant vegetable growth which would otherwise choke up the paths and render them impassable in a short time. Another gang gathers the milk or sap of the tree, by cutting into the bark in a V-shape, and sticking to the tree at the point of the V a small clay cup or saucer of about two gills capacity, into which the white, milky sap slowly trickles. It is then collected, brought into camp, and distributed in large basins among the makers, each of whom has a smouldering fire of nuts covered by a portable clay chimney a foot or so high, from which issues a dense, black smoke. The operation is then a very simple one. The maker covers his paddle with a thin layer of sap, which naturally adheres to it, holds it in the smoke for a moment, at once coagulating it. He then adds another layer, by dipping, and again holds his paddle in the smoke. This operation he repeats again and again, until the merchantable "fine Para biscuit" is produced. The paddle is cut out and the operation repeated.

The biscuit, when finished and cut from the paddle, contains 56 per cent water, which must be wholly evaporated before it is ready to be put into goods. This loss is divided between the different parties who handle it. The greatest loss is between the camp and Para, where every biscuit is cut for grading of quality. The sweepings of the camp, drippings of the trees, and cleanings from the basins, etc., are more carelessly rolled together into scrappy balls, which are termed negro-heads. In Ecuador, the sap is floated on to water and mixed with ashes and other foreign stuff to hasten its coagulation, not to mention that it increases its weight.

In Nicaragua, the sap is drawn into tin dishes and is coagulated by mixing with the bruised leaves of a plant which flourishes in that vicinity.

The natives in Africa have a method of gathering by smearing the sap on their naked bodies, coming into camp veritable living rubber men.

The product of rubber of the Amazon valley has more than doubled in the last ten years. The crop ending the summer of 1878 was 7,598 tons, while last year's crop was 15,725 tons. The total consumption of all grades of rubber in the United States last year was 30,000,000 pounds, the value of which was about $15,000,000.

The Brazilian governments—imperial and provincial—collect an export duty of 22 per cent on the market value, at the time of shipment, which amounted to about $5,000,000 last crop.

In the manufacture of rubber goods, more than 30,000,000 pounds of metallic oxides and carbonates are used. In addition, large quantities of earthy materials are used, principally to make weight. Cotton and woolen cloths are consumed to the extent of 20,000,000 pounds. Devulcanized or reclaimed rubber, amounting to 25,000,000 pounds, is also used. This includes almost all the cast-off rubbers, for these old goods eventually find their way back to the mills to be ground up and made into shoes again. This old rubber is worth from 8 cents to 30 cents per pound, according to quality. Without this old stock to draw upon, rubber goods would be a great deal more expensive to the consumer. The capital invested in rubber mills in the United States exceeds $25,000,000, employing a large number of people—men, women, and girls. The value of rubber thread, toys, etc., made amounts to $5,000,000; clothing, $5,000,000; mechanical goods, $15,000,000; and boots and shoes, $28,000,000. The number of boots and shoes made daily for nine months in the year will foot up to 150,000 pairs.

The First Inventor of the Monitor Turret.

A correspondent of the Washington *Star* rightly says the real inventor of the monitor revolving turret was not Captain John Ericsson, but Theodore R. Timby, a native of New York State and now a resident of New York. The writer asserts that the contractors for the building of the Monitor, Messrs. John F. Winslow and John A. Griswold, of Troy, N. Y., C. S. Bushnell, of New Haven, Conn., and others, paid Mr. Timby $5,000 for the use of his invention in the construction of that vessel, and a like sum for each turret constructed by them in the building of other ironclads for the government. The following documentary evidence is presented to substantiate the claim:

First, a letter of Mr. Timby to Rear Admiral Ammen, under date of March 7, 1888, which is sworn to by the former. In this letter Mr. Timby states that the first sight of the circular form of Castle William, on Governor's Island, suggested to him the idea of the revolving plan for defensive works, and in April, 1841, when he was 19 years of age, he came to this city and exhibited a model and plans of a revolving battery, to be made of iron, to the then chief of engineers and chief of ordnance. "In January, 1841," Mr. Timby continues, "I made a model of a marine turret, which model is now in my possession. At this date I made my first record in the United States Patent Office, and from Jan., 1841, to 1861, I continued to urge the importance of my plans upon the proper authorities at Washington and elsewhere." He adds that he took out patents in 1862 covering the broad claim "for revolving towers for offensive or defensive warfare, whether placed on land or water." Extracts are quoted from the Patent Office records showing that a caveat was filed January 18, 1843, and a patent was issued September 30, 1862. In that year he says that he entered into a written agreement with the contractors and builders of the original Monitor, John F. Winslow and John A. Griswold, of Troy, N. Y., C. S. Bushnell, of New Haven, Conn., and their associates, for the use of his patents covering the turrets, by which they agreed to pay him and did pay him $5,000 as a royalty on each turret constructed by them.

Recent Changes at Niagara Falls.

There have been recently two very heavy falls of rock at Niagara Falls. At first a mass of rock fell from the Horseshoe Falls, and twenty-four hours later another mass was precipitated into the abyss below, with a noise so closely resembling that of an earthquake as to alarm the residents of the neighborhood. The result of the displacement is a change in the shape of the fall. Formerly the Canadian portion of the fall could be described as a horseshoe; but the breaking away of rocks in the center some years ago made it V-shaped. Now that a further displacement has occurred, the fall has returned to its old condition. It is, of course, generally known that the falls of Niagara are gradually moving to the south. The deep cut through the solid rock marks the course they have taken in their backward movement. It is a wonderful excavation, a chasm dug out by the sheer force of water.

Not less astonishing has been the removal of the debris. The rock has been thoroughly pulverized, and has been swept out of the river, to be distributed in Lake Ontario. Once it was thought that in the wearing away process the falls would reach Lake Erie, and there degenerate into a series of rapids. But the theory has been set aside by one which retains the cataract, although the latter will be the shadow of its present self, and much reduced in size. The latest idea is that the falls will recede two miles and then remain stationary, their height at that point being 80 feet, instead of 164, as at present. The supposition is supported by an argument which appears reasonable. The present site is a limestone formation, some 80 or 90 feet thick, with a shaly foundation. As the shale is washed away the limestone breaks off, and the falls take a step backward. But the end of the shaly deposit will be reached two miles from the present falls, and then the rushing water will have more than it can do to wash away the solid precipice over which it will be projected. *Iron* suggests that it would be a waste of time to attempt to estimate the number of centuries that will elapse before Niagara Falls will have found their permanent site.

What Invention Has Done for Milling.

In his speech at the Smith purifier banquet in Jackson, Hon. H. A. Hayden, the Jackson mill owner, gave some interesting personal reminiscences. It seems that he started in the milling business in 1845, in a little custom mill three miles south of the city of Jackson. He had enlarged gradually, and within a year or two had been able to turn out 8,000 barrels of flour a year, which he considered a big business. He then increased his capacity to fifty barrels a day by the addition of three runs of stones—the old flat burr stone, capable of grinding five or six bushels an hour with one half chest of reels.

The best cloths used in those days were No. 10, and the bulk of the flour was made with No. 9. But the product was good for those days, and found a ready market. Then came a demand for better flour. Up to this time millers had considered middlings as offal, and it was run through the flat stones and made into a low grade flour which was hard to sell. After a few years he had purchased other mills and adopted modern inventions as rapidly as they were offered, but always with a feeling of distrust in "new-fangled fixin's." Millers in those days worked from daylight until the day's work was done, be it 9, 10, or 12 P. M. They were not afraid of work, and to this labor the speaker largely attributed his success.

When the new process was talked of, he had considered it foolish, but he was finally forced to acknowledge that with it the best grades of flour could be made from material thrown away in the old methods. He reluctantly adopted the rollers instead of stones and remodeled his mill. The success was far greater than had been thought possible. Other improvements followed, and to-day the finest grades of flour are made where the best flour of years ago could not be sold at any price.

The Loom.

At a recent meeting of the Manchester Association of Engineers, Mr. C. P. Brooks read a paper on "The Loom: Its History, Use, and Construction." He said the loom occupied a highly important place among the machinery employed in the industries of England, as they would realize when he stated that in 1885 there were 773,704 looms working in the United Kingdom, 560,995 of which were engaged in the cotton trade, while this year 450,000, or nearly three-fourths of the cotton looms in the kingdom, are working within a radius of 30 miles from Manchester, or, if the radius were increased to 50 miles, they found 600,000 looms within the extended distance—facts which in themselves should serve to draw their attention to an apparatus of such value and utility to the cotton trade of this country.

After giving a detailed history of the invention of the loom, the work it performs, and also various other facts in connection with it, Mr. Brooks observed that the production was one point which had been greatly improved during the past half century. In 1830 looms were running at 130 picks per minute, now an average width of loom was run at 200 picks per minute; and while, according to Edward Baines, the historian of the cotton trade, a steam loom weaver in 1823 attended to two looms, four were minded at present. This increase, however, did not strike one as being phenomenal, when the great strides obtained in other industries were considered, and he had no doubt there was still room for great improvement in this respect.

It was a notable fact that the inventions of the power loom, and many subsequent improvements and attachments, were attributable to others than those engaged in the trade, or even others than engineers. A minister, a calico printer, and a cutler and typefounder had all left their impress upon the weaving branch of the cotton trade, while Arkwright, the barber, and Hargreaves and Compton, the weavers, were important inventors in the spinning branch. However, invention seemed now to be organized as a profession, and he had no doubt that cotton machinists would not lose sight of them for improvements that might be made in the future.

In his opinion, one of the points that required attention in loom making was additional speed, which was difficult to attain. As at present constructed, the loom worked worse, caused more spoiled cloth, and even in some instances gave less production, if speeded, so that to attain the desired object the loom must be improved in its working parts, so as to give less vibration and manipulate the threads more tenderly. This would have in some measure to be attained by planing all points of the framework, hardening the working parts, and also by other means which would suggest themselves. The further simplification of the loom was also desirable. It was not now by any means an intricate machine, except the loom for fancy weaving; but the simpler the loom could be made the better, and the limit in this direction had scarcely been reached. The fancy branch of cotton weaving seemed to be developing, and there was, he had no doubt, a field opening up in which cheap, simple, and effective machinery for fabricating the ornamental cotton cloths would have great success.

SOME EXPERIMENTS IN SOUND.

BY GEO. M. HOPKINS.

The most perfect exhibition of vibrating flames can be made only with expensive apparatus; but the student can get very satisfactory results by the employment of such things as are shown in Fig. 1. A candle, a rubber tube, an oblong mirror, and a piece of thread are the only requisites, excepting the support for the mirror—which in the present case consists of a pile of books—and a little paper funnel inserted in the end of the rubber tube and forming the mouthpiece.

The thread is tied around opposite ends of the oblong mirror, and the mirror supported by passing the thread

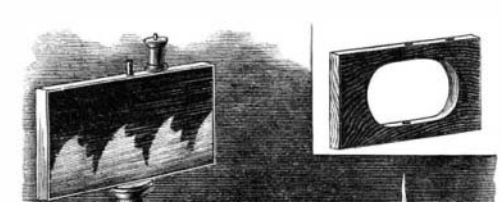


Fig. 2.—ROTATING MIRROR.

through the upper book of the pile, which juts over to allow the mirror to swing freely without touching the books. The mirror is made to vibrate in a horizontal plane by giving it a twisting motion. One end of the rubber tube is placed very near the base of the candle flame, and the other end, which is provided with the paper mouthpiece, is placed before the mouth and a sound is uttered which causes the air contained by the rubber tube to vibrate and impart its motion to the candle flame. The vibratory character of the flame is not noticeable by direct observation, but on viewing the flame in the swinging mirror, separate images of the flame will be seen. These images are combined in a series which, with a certain degree of accuracy, represent the sound waves by which the fluctuations of the flame are produced.

To show that these images result from a vibrating flame, it is only necessary to view the flame in the mir-

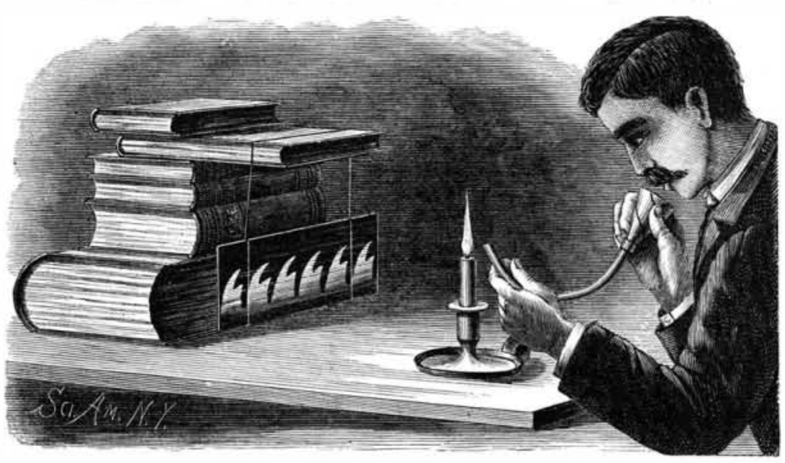


Fig. 1.—SIMPLE METHOD OF PRODUCING AND VIEWING VIBRATING FLAMES.

ror. When no sound is made in the mouthpiece, only a plain band of light will be seen.

A somewhat more convenient arrangement of mirrors is shown in Fig. 2. In a baseboard is inserted a wire, one-eighth inch or more in diameter and about a foot long. On this wire is placed an ordinary spool, and above the spool a thin apertured board (shown in the detailed view), the board being about 8 inches long and 6 inches wide. The board is perforated edgewise to receive the wire. In the upper edge of the board, half way between the center and end, is inserted wire, upon which is placed a small spool, serving as a crank by which to turn the board. Upon opposite sides of the board are placed mirrors of a size corresponding to

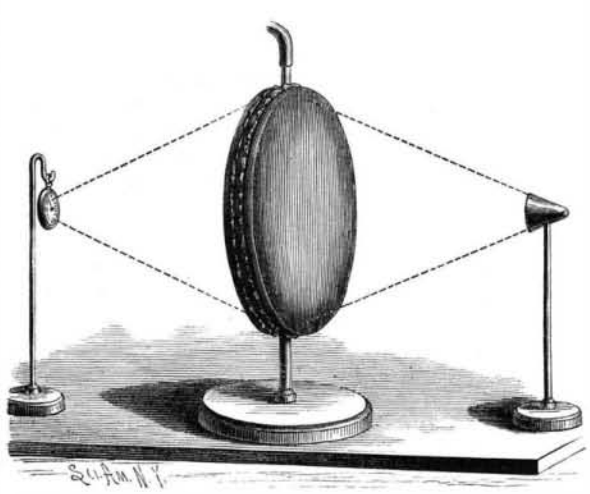


Fig. 3.—SOUND LENS.

that of the board, the mirrors being secured to the board by strips of paper or cloth pasted around the edges. The image of the flame is viewed in the mirrors as they are revolved.

In Figs. 3 and 4 is illustrated an adjustable lens for showing the refraction of sound. The frame of the lens consists of three 12-inch rings of large wire, soldered together so as to form a single wide ring with two circumferential grooves. In the central part of the ring, at the bottom, is inserted a standard, and in the top is inserted a short metal tube. Over the edges of the ring are stretched disks of the thinnest elastic rubber, which are secured by a stout thread wound around the edges of the rubber, clamping them in the grooves of the ring.

By inflating the lens through the tube with carbonic acid gas, it may be focused as desired. A watch placed at the focus upon one side of the lens can be distinctly heard at the focal point on the opposite side of the lens, when it can be heard only faintly or not at all at points only slightly removed from the focus, thus showing that the sound of the ticking of the watch has been refracted by the lens, in much the same manner as light is refracted by a glass lens.

The Light of Shooting Stars.

While commenting on a memoir presented to the Academy of Sciences, M. Cornu gave it as his opinion that the light emitted by shooting stars is not due to conflagration or to the heat of impact. In those high regions our atmosphere is too unsubstantial to render the explanation acceptable. It is much more likely the phenomenon is one of static electricity developed by simple friction, and it is well known that rarefied gases can be made to glow intensely with but very little electric fluid.

Promoting German Industry.

The Society for the Promotion of Industry, Berlin, has just offered about $5,250 in prizes for solutions of various problems. For the best treatise on mechanical engineering applied to the construction of machinery, 5,000 marks = $1,250 and a silver medal are offered; while $750 and a silver medal are to be given to the best chemical and physical inquiry into the nature of iron paints most used. The greatest prize is to be given to the most meritorious solution of the point as to how far the chemical composition of, and particularly the amount of carbon contained in, steel is a standard for the usefulness of cutlery and edge tools. The amount offered, in addition to a silver medal, is 6,000 marks = $1,500, of which 3,000 marks = $750 have been granted by the Minister of Commerce; 4,000 marks = $1,000 are to be given for the best description and actual estimate of such elevators as are most generally constructed for hoisting passengers, baggage, and goods in factories, hotels, public and private buildings, arranged after their different kinds, as well as of the necessary safety precautions and their tests, and of the regulations of police and trade companies for the building and management of these lifts, the cost of construction, the working expenses, and necessary space. A silver medal and 3,000 marks = $750 is to be given for a description of the chemical processes which take place in producing pure cellular fluid from wood and other vegetable substances by means of soda and other sulphide processes. For the second best answer the Society of Wood Cellular Material Manufactures have offered a prize of 1,000 marks = $250. The time given for the answers is to November, 1890, but in the case of the query regarding iron paints the time allowed is to November, 1894.

The Industrious Squirrel.

A Danbury farmer points to the squirrel as affording an instance of agility, quickness, and hard work. Last fall he stored several bushels of butternuts in the second story of his corn house, and recently he noticed that they were disappearing much faster than the legitimate demands for his family supply warranted. He discovered soon afterward that a squirrel, a small red one, which the farmers' boys call "chipmunks," had found a hole under the eaves of the building, and was stocking her storehouse with the nuts the farmer had gathered. As an experiment to learn how rapidly the squirrel had worked, he removed all but twenty of the nuts and set a watch upon them. Six hours afterward every nut was gone. The distance from the corn house to the tree where the squirrel had its nest was just eighty rods. In going for a nut and returning with it the sprightly little animal had to travel a distance of 160 rods. Computation showed that the theft of the twenty nuts required just ten miles of travel. But this did not include all. Several times dogs frightened the squirrel, and it had to turn back, and twice the family cat got after it, requiring it to take a circuitous route to reach the storehouse. The nest was examined soon afterward, and a big, fat, lazy male squirrel was found snoozing quietly while his little mate was performing a prodigious feat to supply him with food.—*N. Y. Sun.*

The Paradoxes of Science.

The water, says a writer in *Blackwood's Magazine*, which drowns us, a fluent stream, can be walked upon as ice. The bullet which, when fired from a musket, carries death, will be harmless if ground to dust before being fired. The crystallized part of the oil of roses—so grateful in its fragrance, a solid at ordinary temperatures, though readily volatile—is a compound substance containing exactly the same elements, and in exactly the same proportions, as the gas with which we light our streets. The tea which we daily drink with benefit and pleasure produces palpitation, nervous tremblings, and even paralysis, if taken in excess; yet the peculiar organic agent called theine, to which tea owes its qualities, may be taken by itself (as theine, not as tea) without any appreciable effect. The water which will allay our burning thirst augments it when congealed into snow; so that it is stated by explorers of the Arctic regions that the natives prefer enduring the utmost extremity of thirst rather than attempt to remove it by eating snow. Yet if the snow be melted, it becomes drinkable water. Nevertheless, although, if melted before entering the mouth, it assuages thirst like other water, when melted in the mouth it has the opposite effect. To render this paradox more striking, we have only to remember that ice, which melts more slowly in the mouth, is very efficient in allaying thirst.

Fig. 4.—SECTION OF SOUND LENS.