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THE AMERICAN WATCH WORKS.

BY H. C. HOVEY.

A watch is a machine. It used to be supposed that its delicate parts could only be made by manual skill; and in a large portion of the world this notion still prevails. The idea that a machine can be made by machinery, much of which is automatic, is essentially American. In its application to the watchmaking industry it originated with Aaron L. Dennison, a Boston watchmaker, who began his experiments in 1848. In company with Edward Howard and Samuel Curtis, a small factory was started, in 1850, at Roxbury, Mass., which was removed four years later to Waltham, ten miles from Boston, a place already famous for the first cotton mill started in this country.

After struggling with numerous unforeseen obstacles, these pioneers in a new industry failed financially; and their property was bought, in 1857, by Royal E. Robbins, for Appleton, Tracy & Co., the name being subsequently changed to Robbins, Appleton & Co. In 1858 the property was bought by the American Watch Company. The original stock capital of $200,000 has been increased to $1,500,000, with an equally large surplus. The number of hands has grown from 75 to 2,400. And in place of the small factory existing in 1857, there was built a much larger one, that in turn gave way to the immense structure now in use, and that has been wholly built since 1878.

A few figures will perhaps convey an idea of the magnitude of the Waltham Watch Works in their present form. The factory itself is a brick building, with numerous long wings, several towers, and inclosing three ample inner courts, besides an elegant suite of offices at one end and an observatory at the other. The total length of the front is over 700 feet. The floors cover nearly five acres. There are 3½ miles of work benches, mostly made of cherry plank, 2 feet wide and 2 inches thick. There are 4,700 pulleys; 8,000 feet of wall rods; 10,600 feet of main shafting, and 39,000 feet of belting, varying in width from 2 inches to 2 feet. All this machinery is driven by a Corliss engine of 125 horse power.

When Mr. Robbins took hold of what was then regarded as a forlorn enterprise, only 5,000 watches had been made in all. Now over 2,500,000 have been made thus far at this one factory, of which 500,000 were made during the last eighteen months! The present capacity of the works is 1,250 watches daily, which by recent improvements will soon be increased to 2,000. There have actually been sent

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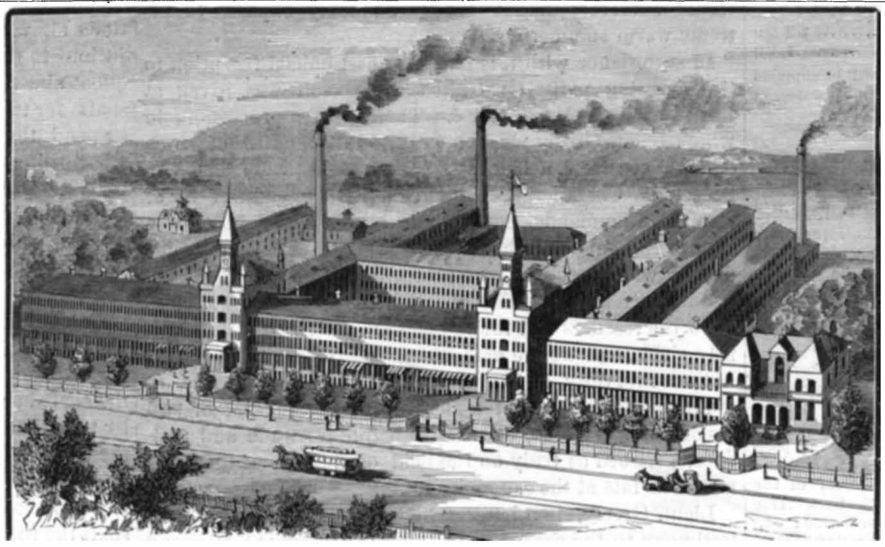


VIEW OF THE WORKS AT WALTHAM, MASS.

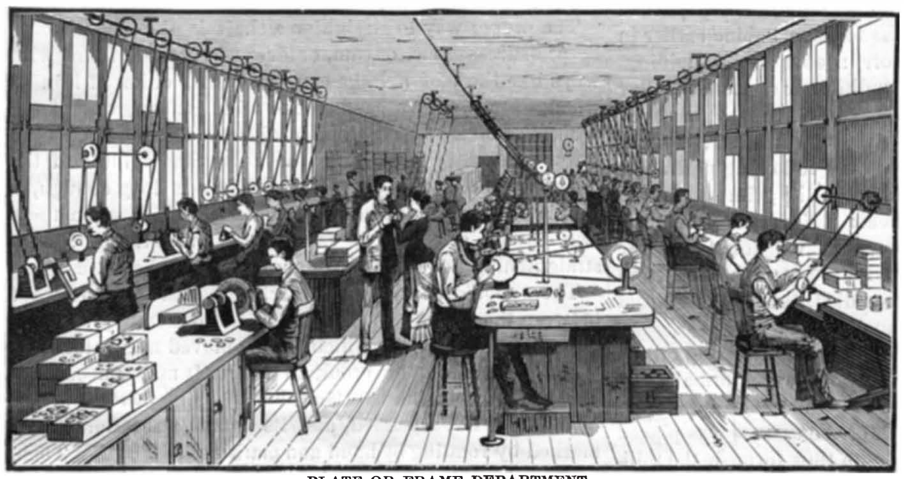
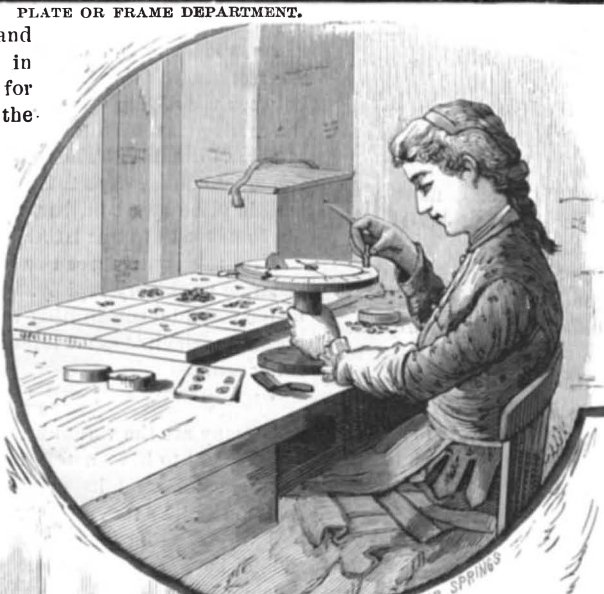


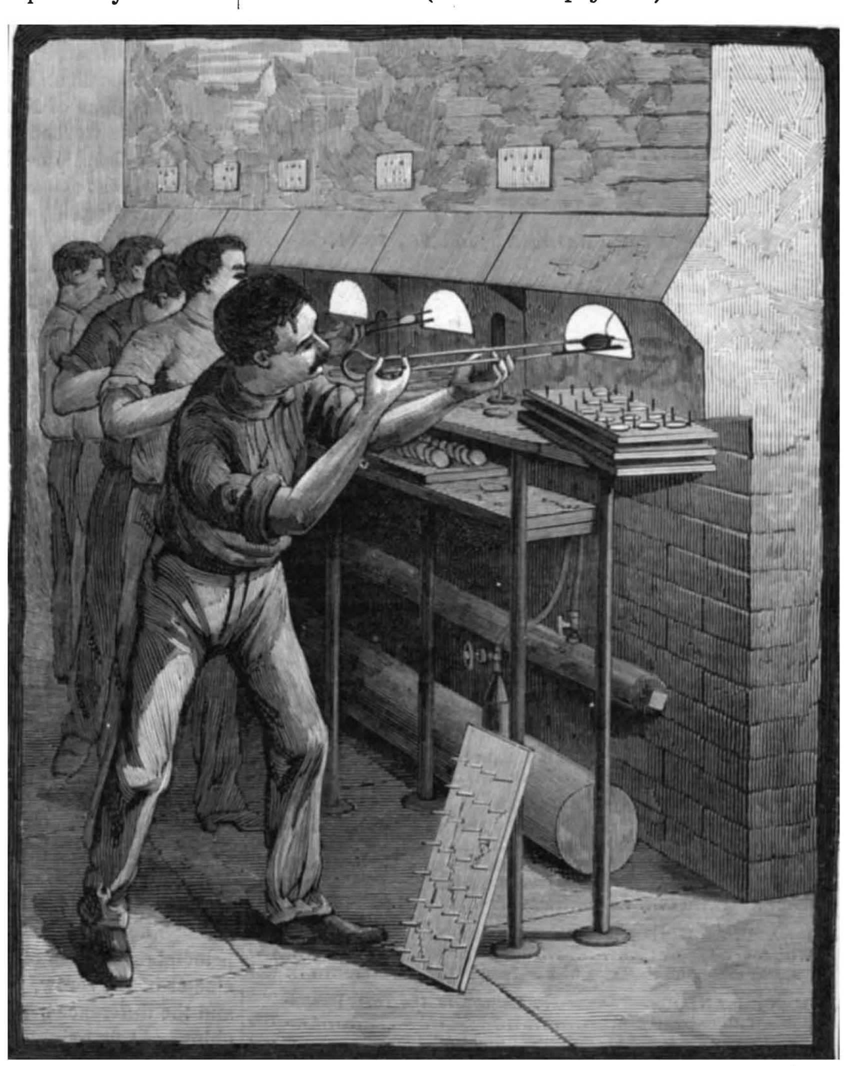
PLATE OR FRAME DEPARTMENT.

BALANCE MAKING ROOM.



GAUGING HAIR SPRINGS

JEWEL MAKING.



FIRING THE DIALS.

AMERICAN WATCH MAKING, AS CONDUCTED AT WALTHAM, MASS.

Scientific American.

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NEW YORK, SATURDAY, AUGUST 16, 1884.

REMOVAL.

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(Illustrated articles are marked with an asterisk.)

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THE SCIENTIFIC AMERICAN SUPPLEMENT

No. 450,

For the Week ending August 16, 1884.

Price 10 cents. For sale by all newsdealers

THE GREELY EXPLORERS AT HOME.

It was on the 17th of July that the telegraph brought the news of the return of the Greely relief expedition to St. John, N. B., with Lieut. Greely and five of his companions who were rescued alive, and the bodies of twelve who had perished. Since then, with the more full details that have been furnished, the general sentiment of the country has strongly expressed itself in words of earnest commendation for both rescued and rescuers. The steamers composing the relief expedition, the Bear, Thetis, and Alert, were ordered to remain at St. John until metal caskets could be obtained for the bodies of the dead, and then to come homeward gradually to more southern latitudes, so that the yet feeble survivors might not be suddenly exposed to extreme warm summer weathe.

In accordance with this plan, the first official reception to the returning party on United States soil was given at Portsmouth, N. H., Aug. 4. There was a procession, in which Lieut. Greely was too weak to take a part, but which he reviewed from a balcony, and speeches were made by Secretary Chandler, Senator Hale, Representative S. J. Randall, Commander Schley, and others. The scene was an affecting one, and the exercises were marked by a simple dignity well according with all the circumstances of the occasion, Secretary Chandler concluding his address by saying: "To the rescuers and the rescued are these receptions most fitly given, and we are here assembled to do them honor; but our first duty is to pay our tribute of praise and of mourning to those devoted men who, after months of suffering and starvation, borne with heroic fortitude and patience, perished as truly on the field of duty as if they had met their fate at the cannon's mouth."

Lieut. Greely, in a letter which was read, bore strong testimony to the energy and skill of Commander Schley and the officers of the squadron, who so determinedly pushed their vessels through the ice packs to Cape Sabine earlier in the season than was ever before accomplished, adding: "Had they known our exact condition and locality, they could not have reached Camp Clary in time to have saved another life." In view of the blundering management of the former relief expeditions, however, the following portion of Lieut. Greely's letter must seem almost like grim sarcasm to the officers who had charge of them: "Never for a moment, in our darkest or gloomiest hour, did we doubt that the American people were planning for our rescue, and from day to day, as food failed and men died, that faith and that certainty gave strength to us who lived."

The business of the relief ships was formally ended on the 8th inst., when the remains of the dead were formally delivered by Commander Schley to General Hancock, at Governor's Island, New York. Each of the caskets was placed on an artillery caisson, and a column thus formed, the military with arms reversed, the band playing a dirge, and minute guns being fired, the procession moved to the hospital, where the bodies were left for final disposition according to the wishes of the friends or relatives of the dead heroes.

SCREW BOLT HEADS.

While machine screw heads are of the solid metal from which the shanks of the screws are turned, most of the screws and bolts used in woodwork have their heads struck up cold, as are those of rivets and of nails, or else hand forged or machine-forged from the red hot bar. Rivet-made heads are necessarily made at one blow, the metal being cold, and to such an extent has this possibility of work been carried that bars of Norway iron, seven-eighths of an inch diameter, are worked cold into headed bolts, a single blow forming a head one inch and a quarter diameter. The amount of heat generated by the blow necessary to instantly change the direction of the fiber of the iron is such that the dropped bolt cannot be handled with bare hands for some time after its formation.

If the heat thus generated could all be utilized and concentrated on the head formation, the result might be something approaching a weld, and the head be a solid. But these rivet-headed bolts are not solid headed; the fibers of the straight bar are "broomed out," like the rays of a mushroom, without solid connections. This is caused partially by the suddenness of the change from perpendicular to transverse, and partially by the dissipation of the heat engendered by the blow, which is conducted from the rivet itself to the die and its surroundings.

When these heads are formed by successive blows while the iron is hot the result is somewhat different, as the fibers are gradually bent to the new direction, and near the shank they are partially welded. The heads of boiler rivets are generally welded, being brought to form under a white heat. But in the attempts to form heads by upsetting, it may be questioned if the violent redirection of the fibers of the iron in the cold rivet heading, or the slower bending of the fibers in the repeated percussion of the hammer while the iron is hot, retains the original tensile strength of the iron. It is certain that with the increasing diameter of the formed head from that of the original shank, the fibers of the iron must be forced apart, and consequently they must become less coherent as farther apart they go.

Machine screws generally are made on an entirely different principle. Instead of the shank being the original of the diameter of the screw, the head is taken as the measurement, and the difference between head and shank is turned off into chips. At first sight it would seem that there is a very great waste of material to produce the required result; but as an offset to this is the fact that the rapidity of manufacture compensates for much of this loss, and the uniformity of the product is particularly desirable. Beyond this is a claim made by thoughtful mechanics that the undisturbed relation of the fibers of the iron in head and shank is a source of strength.

However this may be, it is certain that the Spencer system of producing machine screws excels in rapidity, in exactness, and in uniformity of the product. The waste brings back more than half of the first cost of material, and at least seventy-five per cent of the oil used is saved by means of the centrifugal machine.

STRAIGHTENING SHAFTS.

Managers of machine shops and foremen of men sometimes allow shop practices that are ruinous to tools and injurious to the mechanics themselves. One of the most frequent abuses of this sort is the methods of straightening shafts for turning in the lathe. A common practice is to suspend the shaft on the lathe centers, and then, with a bar, using the tool carriage or the vee-ways of the lathe for a fulcrum, spring the shaft with a powerful leverage. Of course, the centers and the two spindles of the lathe have to bear the brunt of this trying ordeal, as may be supposed to their detriment as accurate portions of an accurate machine. Perhaps a worse practice is that of striking the shaft with a hammer while thus suspended on the lathe centers. Hardly less injurious to the shaft itself is the straightening on the anvil by sledge blows, the projecting ends of the shaft being left unsupported; it has been demonstrated by tests that the vibrations caused by this treatment diminish the torsional resistance of the bar. If a bar or shaft is to be straightened cold on the anvil, the ends of the bar should be supported on wooden horses. For short crooks in the shaft the hammer straightening should be preceded by heating to a "black" heat.

The proper way to straighten a shaft is the obvious one, by pressure—screw, or cam, or lever pressure. A frame with ways like those of a lathe can be made, either of iron or wood, to receive two head stocks with centers, one of the centers or both of them to be projected and retracted by a screw and hand wheel, as is the center and spindle of the ordinary lathe foot stock. If the frame is long enough, a supplementary double head can also be used between these two, having a center at each end, so that the process of straightening two short shafts may go on at the same time.

There should be a sliding carriage to traverse the ways between the heads, carrying a horse-neck screw press, and two vee-scored blocks, which can be moved nearer together or farther apart as the crook in the shaft makes necessary. The operation is simple. The shaft, having been centered by its ends, is suspended, and its "outs" ascertained and marked by rotating by hand and marking with chalk. Then, released from the centers, it rests on the carriage, which has been moved to one of the chalked points. A turn of the screw, the lower end of which is provided with a shallow vee-scored block that swivels on the screw, gives a pressure between the sliding vee-scored blocks on the carriage, when the carriage is moved to another chalked spot, repeating the same performance. The carriage is held to the ways of the frame by hooked clips that are attached to it, or it may be held in place by a bolt, bar, and cam, or wedge lever, as is the foot stock of some lathes.

With this contrivance two men can do a large amount of accurate work very rapidly. The rapidity of the work may be increased by substituting a cam lever for the screw, on the same principle as the lever used in bending and straightening railroad rails.

STEEL TESTS.

So many are the varieties of so-called steel nowadays that it is difficult to have a test that shall apply equally to all. But for tool steel its quality can be readily assured by a common smith's test. It should be understood that steel for tool purposes—for the cutting of the metals particularly—should be a composition capable of being hardened and drawn to temper. To be sure, it is claimed that there is suitable tool steel for certain cutting purposes that leaves the smith's hammer in good condition for use. It may be so, but it is evident enough that the proper condition of this steel depends upon its manipulation, and as that is less or more, the steel varies in resisting and durable qualities in use. Chrome steel and Mushet's steel are both valuable for certain purposes, but it is not always known when the proper quality or condition for these certain purposes is reached. Mechanics generally will prefer to guide the coming to condition by their own judgment, rather than to trust to the exactness of the manufacturer in proportioning the components, properly mixing them in a melted state, and afterward working the resultant.

The old-fashioned method of testing tool steel is as good a practical method as that of a careful chemical analysis. It is simply the heating and drawing under the hammer to a slender point, plunging while red hot in cold water, and when chilled striking it with a hammer across the edge of the anvil. If the steel will harden it will break, under these conditions, without bending back and forth. Steel that will not harden under these conditions is not fit to temper and will not retain a cutting edge. Steel that is so "high" that it cannot be heated red hot and chilled in water without flying may do for some purposes, and retain a sufficiently rigid edge by air hardening. If a piece of steel can be forged into a cold chisel, be hardened, tempered, and used, such steel is good steel, and may be relied upon for all ordinary shop purposes.

Experiment Stations.

The time has come when the profit of farming in the older States is so much a matter of shrewd management and careful attention to every point that the farmer who neglects these things is pretty sure to fail in his vocation. You cannot now simply "tickle the earth and make her laugh with a harvest;" you have got to do far more. Farmers have now begun to realize this as they never did before; and, among the many instrumentalities which they have called in to their aid, one of the newest and most important is the Agricultural Experiment Station.

The Experiment Station is not an American invention. It grew from a necessity which only the older countries vividly feel; and so it was imported here, if we are not at fault, from Germany. There is no subject on which the Germans do not spend thought; and even in their universities, where the subtleties of Fichte and Hegel employ the human mind at one end of the scale, the practical work of the house doctor suggests thought at the other. It must seem well that this is so and that all the agricultural interests are made a public concern. For farming is the occupation that feeds the world. If it is prosperous, the Wall Streets of the world are prosperous too; and this means universal comfort and success.

But the reader asks, perhaps, what it is that the Experiment Station does. The *Hour*, published in this city, gives the following brief account of its object: The Experiment Station is a farm, fully equipped and officered by the State, and set apart for the purpose of making experiments with fertilizers and original manures, soils, waters, milk, cattle food, etc. It examines seeds that are suspected of adulteration, or that are imperfect in any way; it classifies and reports upon all the various weeds, and makes studies of the different insect pests, while not forgetting to name the insects which are beneficial to the farmer. It is evident that in this way, through scientific investigators, a body of information can be procured which soon becomes of the utmost value to every farmer, and which he could not possibly afford to attain, if he could by any means attain it, for himself.

In the single matter of fertilizers—which are described as "commercial," because they are manufactured for sale—the benefit which the Connecticut Experiment Station has done alone has been incalculable. Hundreds and thousands of tons of worthless stuff had been sold to farmers before careful experiments proved their worthlessness, under names of attractive sound, that can no longer be sold to farmers who keep abreast of the times, and which are, therefore, virtually driven from the market. Even the relative value of fertilizers that are good is a point desirable to know; and the Experiment Station gives it, crediting the exact proportions and kind of matter that enter into each, so that all who will may know about them and make no mistake.

New York, Connecticut, and Ohio are among the few States that have established the Experiment Station; and the second annual report of the latter has just been issued. Its experiments the past year have been especially thorough with reference to wheat and corn culture, and are extremely useful to farmers everywhere. Those relating to wheat were published in September last, in a separate bulletin, and were widely circulated before the present harvested crop was put in. The experiments were not simply confined "to comparative tests of varieties, or yields of definite areas under the influence of different methods of culture and different manures." They include, as well, a careful study of the quality and vigor of the seed: the growth of the root; "the result of checking growth in one direction in order to stimulate at another; the effects of self and cross fertilization;" the best time and condition for performing the various processes of planting, manuring, cultivating, harvesting, and marketing; the treatment of insect enemies and diseases; a study of climatic conditions, etc. All these matters, so far as they can be, are well tabulated, and accompanied by literal text in explanation thereof.

The station takes into consideration also potatoes and garden vegetables, grasses and forage plants, and fruits and flowers. Its work upon the dairy and upon forestry is also given, so that nothing which concerns the farmer has been left undone. Fifty analyses of different kinds have been made, and over four hundred kinds of seeds have been tested during the past year. A great variety of grasses, weeds, grain, fruit, and vegetables have been received from farmers to be named and identified, and answers have been given in every case. In fact, the station is a natural bureau for inquiry, and wherever it exists it expects to be serviceable through private correspondence to the great constituency which it represents. Its monthly bulletins and yearly reports are accessible to all, and agricultural papers, and the press generally, circulate its conclusions on all the subjects to which it is devoted.

Other things which it does are to investigate and suggest remedies for rust, smut, mildew; to show the effect of different rations used to fatten stock, and the effect of the same upon the various dairy products; and the susceptibility of different breeds to different influences. All the processes of setting milk, separating cream, making butter, and the diseases of horses and cows, come within its province. Nor is drying and preserving fruit forgotten. The farmer is also told a very necessary thing in this age of rapid and reckless forest destruction—how the best trees can be easily and cheaply grown from the seed. The best time to cut timber, and the way to preserve it, is likewise shown. This service alone will be, in time, of untold benefit, not only to one State but to the whole country.

No State has ever devoted the public funds—small in amount though they are for this service—to better account than they render through the Experiment Station. The services such an institution renders in a single field in one year vastly overpays the whole expense of the Station for a long term of years. It is lamentable that the great body of farmers, as yet, themselves know so little about it; but they will come to know, in time, when its means of doing good will be immensely increased.

The Economics of Lead.

At the works of Messrs. Locke, Blackett & Co., London, may be seen the manufacture of sheet lead, lead tubing, red lead, and white lead. The sheet lead is prepared by pouring melted lead on a flat iron plate, and afterward rolling it between iron rollors. In the production of lead tube the lead is contained in a cylindrical vessel heated to a degree sufficient to soften but not to melt it. A piston propelled by hydraulic power forces the softened lead through an orifice the size of the pipe desired, in which is fitted concentrically a mandrel, or cylindrical core, the size of the interior of the pipe. The pipe, as formed, is passed over a pulley, and a coil of the desired weight is wound off on a windlass. "Compo" gas tubing is made in a similar manner.

To make red lead, the metal is melted in a shallow layer in a reverberatory furnace, by the products of combustion from a coal furnace passing over its surface; being thus gradually oxidized and converted into litharge. It is then extracted, and well ground and lixiviated with water. After this it is again exposed in a furnace similar to the first, when the litharge takes up more oxygen, and is converted into red lead. After another grinding and lixiviation, and drying by exposure to heat, it is ready for use.

The manufacture of white lead is rather more complicated. Litharge is ground and well washed in water until it is converted into an impalpable paste. A certain proportion of common salt is then mixed with it, which has the effect of precipitating an insoluble chloride of lead. This is allowed to settle, and is then treated with carbonic acid gas, which is supplied by means of a lime kiln. This secures the formation of white lead, which consists of a mixture of oxide and carbonate of lead. It is well washed, in order to remove all traces of soda, chlorine, etc.; and the white lead is then dried for use. The process for extracting silver from lead was also to be seen. For this purpose zinc is added to the lead when in a melted state, and it forms an alloy with the silver, which is less fusible than the lead, and at the same time lighter in specific gravity. Taking advantage of this principle, by means of a progressive process, passing the less fusible portions forward from one pan to another, an alloy of zinc and silver, containing but a small proportion of lead, is ultimately obtained. This is cast into hollow cylinders, and submitted to a blowpipe heat in peculiarly constructed furnaces, which has the effect of volatilizing the principal proportion of the zinc and lead, leaving the silver in a comparatively pure state.

Another process of manufacturing litharge was also in operation, consisting of blowing steam into contact with melted lead. The litharge yielded by this process is in a peculiar crystalline condition, well suited for the manufacture of white lead as above described.

Nutritive Value of Branny Foods.

At a recent meeting of the College of Physicians of Philadelphia a valuable paper on this subject was presented by Drs. N. A. Randolph and A. E. Rousel. The following are their conclusions:

The experiments of Rubner leave no doubt that a white bread contains more assimilable nutriment than one made from the whole wheat does, but this does not render it a desirable foodstuff for exclusive use. On the contrary, a weaned but still quite young omnivorous mammal thrives better upon an exclusive diet of bran bread than on white, and, presumably, because the earthy and alkaline salts are present in greater abundance in the former, and also because the indigestible constituents tend to give to the intestinal contents that bulk and consistence which are essential to the hygiene of the digestive tract. But, as has been shown by Edward Smith and others, the branny scales are needlessly irritating, and unduly hasten the passage of food* but partially digested. The end which popular hygiene attempts to effect by the retention of bran in breadstuffs can be better attained by other means. Thus, the nutritive salts of food so frequently lost in ordinary methods of preparation are readily restored by the concentration of the liquor in which meats and vegetables are cooked into a soup stock, as is practiced in almost every French kitchen. Again, the various fresh green vegetables used as salads yield in abundance these inorganic foodstuffs, the presence of which we have seen is indispensable to normal tissue activity. A further advantage of these and other succulent vegetables lies in the fact that their cellulose, while efficient in giving proper bulk and consistence to the stools, is, as compared with bran scales, soft and unirritating to the digestive tract.

From the facts, old and new, which have been presented, the following deductions appear to us justifiable:

* An observation worthy of mention in this connection is that of Rubner, who finds that, while the presence of much woody fiber and harder cellulose in the intestinal contents induces the passage of stools containing an excess of undigested proteid foods, the absorption of fats under the same conditions is not materially affected.

I. The carbohydrates of bran are digested by man to but a slight degree.

II. The nutritive salts of the wheat grain are contained chiefly in the bran, and, therefore, when bread is eaten to the exclusion of other foods, the kinds of bread which contain these elements are the more valuable. When, however, as is usually the case, bread is used as an adjunct to other foods which contain the inorganic nutritive elements, a white bread offers, weight for weight, more available food than does one containing bran.

III. That by far the major portion of the gluten of wheat exists in the central four-fifths of the grain, entirely independent of the cells of the fourth bran layer (the so-called "gluten cells"). Further, that the cells last named, even when thoroughly cooked, are little if at all affected by passage through the digestive tract of the healthy adult.

IV. That in an ordinary mixed diet the retention of bran in flour is a false economy, as its presence so quickens peristaltic action as to prevent the complete digestion and absorption, not only of the proteids present in the branny food, but also of other foodstuffs ingested at the same time.

V. That, inasmuch as in the bran of wheat as ordinarily roughly removed there is adherent a noteworthy amount of the true gluten of the endosperm, any process which in the production of wheaten flour should remove simply the three cortical protective layers of the grain would yield a flour at once cheaper and more nutritious than that ordinarily used.

Some Facts about Peppermint.

It may not be generally known, but it is nevertheless the fact, that the United States is the leading producer of peppermint and peppermint oil in the world. It is principally grown in the State of Michigan and in Wayne County, New York. Our production of the oil in 1878 reached as high as 150,000 pounds, but in 1883 the yield was computed at not more than 35,000 pounds. This year a larger acreage has been planted, but prices have advanced on account of the decreased stocks. The usual annual consumption of the world is about 100,000 pounds, but it is expected there will be a considerable increase this year, as also in other essential oils, on account of apprehension of cholera. Peppermint is grown to best advantage in good garden soils, but requires an abundance of moisture. An acre will grow plants enough to yield from eight to fifteen pounds of oil, according to the age of the plant and the locality, and the price is from $3.25 to $3.75 a pound. There are no large farms entirely devoted to this product, but it is cultivated in small quantities by many farmers. It is used in medicine, confectionery, and for perfumery, and is diluted with alcohol and water to make essence of peppermint. It is also largely used by sanitary engineers for testing joints and traps, a few drops poured in a wash bowl or closet making its presence sensible to smell at any imperfect joints in a pipe leading therefrom, its pungent odor not being apparently at all affected by the sewer gases. Peppermint is to a considerable extent adulterated with castor oil, oil of turpentine, and oil of pennyroyal, but these adulterations can be detected without much difficulty.

Freight Cars.

The rapidity with which freight cars are constructed at the Mt. Clare shops of the Baltimore & Ohio Railroad is quite remarkable, the *National Car-Builder* says. A gang of nine men can build a box car of the kind that is illustrated and described in the *Car-Builder*, in one day. A car has been built in nine hours, by as many men, but ten hours is considered the regulation time. In the old freight shops at this place there are four tracks for construction, and upon these four gangs of men turn out 24 cars per week. If more than this is done, the men are paid for overtime. The side and end frames are put together on the floor of the car, and then set up. The sides are set up in four sections, but without the plates. The plates are then lifted and held to the level of the girths by blocking sticks underneath. The plates have no holes in them for the rods to go through, but there are six castings bolted to the plates, and the rods are run through these castings, after which the stick is lifted upon the frame and driven into place. The end frames are then lifted, the corner posts put in place and pinned to the side frames. The whole end frame, like the sections of the sides, is framed separately and is set up in a few minutes. The use of castings and sill bolts makes this method of framing possible, and leaves the timbers solid where they would be the most weakened by boring holes. The bolt holes for the castings pass through the neutral axis of the timber, causing little or no diminution of its strength.

The specifications for these cars call for first class timber, the inspection of which is very rigid. An abundant supply of oak is obtained along the line of the road; it is of excellent quality, and the sources from which it comes are not likely to be exhausted for a good while yet.

The New England Institute Fair, Boston.

The fourth annual industrial exhibition of the New England Manufacturers' and Mechanics' Institute will open in Boston, Sept. 3. So far as can be judged by present indications, this year's fair will compare favorably with the highly creditable expositions which have preceded it. A specialty will be made of the agricultural and mineral wealth of the South and West and of Mexico, and New England industry in all its branches will be fully represented. Boston and its vicinity have many places pleasant to visit in the early fall, and these exhibitions have proved very attractive.

Atmospheric Changes at Nice.

Since the appearance of the brilliant sunsets, Messrs. Thollon and Perrotin have noticed that the sky at Nice seems to have lost much of its ordinary transparency. They have been accustomed, on every fair day, to examine the sky in the neighborhood of the sun, placing themselves near the border of the shadow projected by one of the observatory buildings. When thus sheltered from the direct rays of the sun, they have noticed in former years that the blue of the sky continued to the very borders of the solar disk. If they were so placed that the disk was almost a tangent to the border of the screen, but still invisible, no increase in the brilliancy of illumination indicated the place where the point of tangency would be found. This is now no longer the case. Since the month of November, even upon the brightest days, the sun appears constantly surrounded by a circular fringe of dazzling white light, slightly tinged with red at its outer edge, and with blue on the inner edge. There is a sort of ill-defined corona, with an apparent radius of about fifteen degrees. It would be interesting to know whether this fact is general, and whether it can be considered as connected with the volcanic dust or other causes of the late brilliant twilights.—*Chron. Industr.*

PORTABLE BARN.

The frame of the barn is formed of transverse sections, each of which is composed of a center post and two side posts, united by horizontal bars. The central top beam is mortised to fit tenons on the center posts, and its ends project beyond the frame, and are provided with short standards in which a long roller is journaled. The roller is turned by a pulley at one end. A piece of sail cloth, rubber, or other suitable material is secured at its middle to the roller. At the top of each side post is a notched bracket, in which the side top bars, which also project beyond the ends of the frame, are held. In the ends of the bars are journaled end rollers, each of which has a pulley and a piece of cloth attached to it.

KEYS & SLAUGHTER'S PORTABLE BARN.

A portable barn made after this plan can be erected or taken down very easily and quickly, and folded very compactly for transportation.

This invention has been patented by Messrs. B. C. Keys and A. J. Slaughter, of Murray, Ky.

Sewerage for a Town of 10,000.

The town of East Orange, N. J., population about 10,000, has lately introduced water, and is now about to put in a sewerage system. The water consumption is 300,000 gallons daily, and that is the estimated amount of sewerage to be disposed of. As this is an inland town, surrounded by several other cities, without communication with the sea, it is necessary to adopt some local method for the disposal of sewage. The engineer, Mr. J. J. R. Croes, has advised the sawdust filtration system, using the Farquhar-Oldham filter, with the addition of a small percentage of perchloride of iron. The peculiar construction of this filter will be seen by reference to the illustration in SCIENTIFIC AMERICAN SUPPLEMENT, No. 291.

The plan recommended includes a tight masonry receiving tank at the outlet, and a steam pump to lift the sewage 20 feet above the filter into another tank, where the perchloride of iron is added to deodorize the sewage; the discharge from the filter is clear and harmless.

To purify 100,000 gallons of sewage per day the tank and pumps are estimated to cost $3,000, and a filter, 8 feet in diameter, $3,000; 5 gallons of perchloride of iron, costing $1.50, and 60 cubic feet of sawdust would be required daily.

To purify 300,000 gallons per day the cost would probably be $15,000 for plant; the labor in both cases is estimated at $5 per day. The preparation of land for receiving the filtrated sewage and transmitting it to the streams would cost about $250 per acre; three acres of ground would suffice for the present demands of East Orange. Sub-surface irrigation, by laying a network of tile drains 10 inches under ground, would cost $2,000 per acre.

The approximate estimate for the entire sewerage of East Orange, as submitted by Mr. Croes, is $329,860, though much of this work would not be needed for some years.

Rain water is to be excluded. The estimate covers the laying of 40 miles of stoneware sewer pipes, calked with oakum and packed with cement.

SPRING SEAT FOR WAGONS.

The illustration herewith represents a way of holding wagon seat and similar springs in place, to prevent them from canting over when the wagon tips on sidehills or in passing over obstructions. The bars on which the ends of the seat rest are loosely connected with a stay bar, the latter passing down through keepers in the frame on which the springs rest, and also through keepers in the cross piece below. The bars on which the seat rests are rounded, and the stay bar is bent at the end below the cross piece to prevent its being withdrawn from its keepers. The loose connection between the stay bars and the bars on which the seat rests, with the rounding of the latter, tends to prevent the stay bars from being broken, while allowing the seat to move sufficiently in a lateral direction to ride easily over rough roads.

For further information relative to the patent which has been granted on this seat, address Mr. John Hodgess, Loyalton, Cal.

What Next?

The *Mechanical World* (London) makes the following invidious remarks respecting an American invention:

The resources of inventive genius are not yet exhausted in the United States, the writer truthfully remarks, and then he proceeds to say that some one who has probably heard somebody's grandfather remark that it is much more economical to supply boiler furnaces with heated air in preference to air under ordinary atmospheric conditions, has conceived the idea of heating the air before going to the furnaces by first passing it round the steam dome of the boiler. This is about the latest development we have met with of the notion of robbing Peter to pay Paul, and reminds one of the story of the four persons who went on an excursion and played cards all the way with such good luck all round that each one made his expenses for the outing. Probably the inventor has not reflected that if air be heated from 32° Fah. to 512° Fah. no chemical change would be effected, but its *bulk* would be doubled, and he would require to send twice the volume of air through his furnaces to burn the same amount of fuel. For example, if the oxygen of 300,000 cubic feet at atmospheric temperature be required for the combustion of one ton of coal, it would require that of 600,000 cubic feet if raised to 512°, a volume which, as C. Wye Williams points out, no natural draught would be equal to. Sir Humphry Davy tells us that by heating *gases* strongly which burn with difficulty the continued inflammation becomes easy, so that we have his testimony in favor of heating the *gas* rather than the air, and although he did not try the effect of heating the air and thus expanding it, he tried the effect of *condensing* it, and he ascertained that both "the light and heat of the flames of sulphur and hydrogen were increased in air condensed four times." But then Humphry Davy lived some time ago and is old-fashioned, and we shall expect next to hear that some other aspiring genius will have taken out a patent for heating the air by passing round the whole boiler before going to the furnace. Probably the best results will ultimately be obtained by combustion under pressure with heated air, for it is certainly true that the air must be heated before it combines with the fuel. How to do this successfully before passing the grate bars has yet to be solved.

The Mosquito's Instrument of Torture.

A writer in the London *Sportsman* thus describes a mosquito as seen under a microscope:

It appears that in the "bill" of the little beast alone there are no fewer than five distinct surgical instruments. These are described as a lance, two neat saws, a suction pump, and a small Corliss engine. It appears that when a "skeeter" settles down to his work upon a nice tender portion of the human frame the lance is first pushed into the flesh, then the two saws, placed back to back, begin to work up and down to enlarge the hole, then the pump is inserted, and the victim's blood is siphoned up to the reservoirs carried behind, and finally, to complete the cruelty of the performance, the wretch drops a quantity of poison into the wound to keep it irritated. Then the diminitive fiend takes a fly around just to digest your gore, and makes tracks for a fresh victim, or if the first has been of unusual good quality he returns to the same happy hunting ground. The mosquito's marvelous energy, combined with his portable operating chest, make him at once a terror and a pest.

Changeable Signs.

Make a wooden sign in the usual manner, and have a projecting moulding around it that projects one inch out from the face of the sign; now cut thin grooves into the moulding, one inch apart, allowing each cut to reach to the surface of the sign; in each of these grooves insert strips of tin, one inch wide, and long enough to reach across the signboard; when so arranged take out the strips of tin, and place them

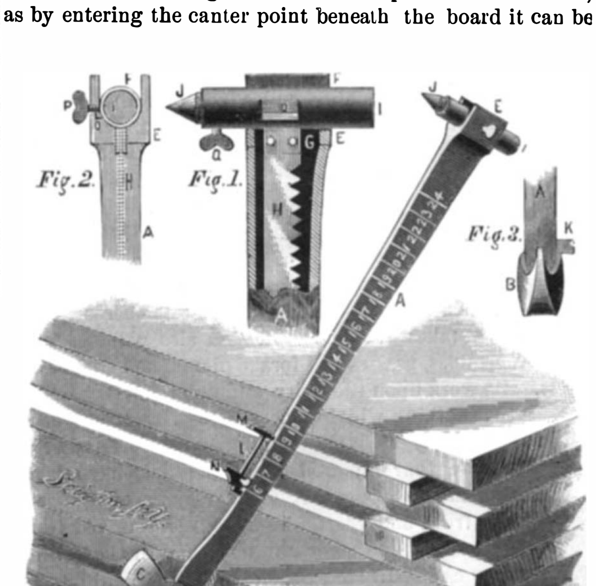
HODGESS' SPRING SEAT FOR WAGONS.

edge to edge on a level surface; paint any desired words on their united surface; when dry, reverse them and paint other words on the other side; now finish your lettering as usual on the signboard, and put the thin strips in correct order in the grooves; this will complete a sign that will read three different ways.

LUMBER GRADER'S COMBINATION TOOL.

Upon the lower end of a handle made of strong, tough wood is fitted a steel head, B, provided at one end with an ax blade and at the other with a canter, which is inclined toward the handle and has a chisel edge end. The other end of the handle is squared and is fitted with a metal band, across which and the end of the handle is formed a groove, from the bottom of which extends a recess into the handle. Fitting in the recess is a saw blade, H, provided with a tubular handle, F, that fits in the groove. At one end of the saw handle is a thumbscrew for holding a lumber lead, J, in place. At the center of one side of the handle is a flange, O, above which rests a thumbscrew in the band to hold the saw in place. Near the head upon one side of the handle, A, is a stud, K (Fig. 3), and upon the other side is a scale of inches. Upon one edge of this handle is placed a thickness gauge, consisting of a bar, L, having two prongs adapted to be driven into the handle, and having a finger, M, projecting upward from one end. Sliding upon the bar is a finger provided with a thumbscrew. Fig. 2 is a section through Fig. 1.

With this tool the grader need not stop to turn the lumber, as by entering the canter point beneath the board it can be



CALL'S LUMBER GRADER'S COMBINATION TOOL.

easily turned up for inspection. He can always stand over the center cross pieces of the pile of lumber, from which position the lumber can be easily handled. Frozen boards can be separated by a sharp rap with the point, D, at one corner of and between the boards. The gauge is for trying the thickness of the lumber, and may be set to any desired fraction of an inch. By placing the stud against one edge of a board, the width can be seen at a glance. The saw is convenient for trimming off the ends of boards, and the ax for chopping off ice and trimming off the stubs short.

Further particulars regarding this handy tool may be obtained by addressing the inventor, Mr. James F. Call, of Clear Lake, Wis

Railroads of the United States.

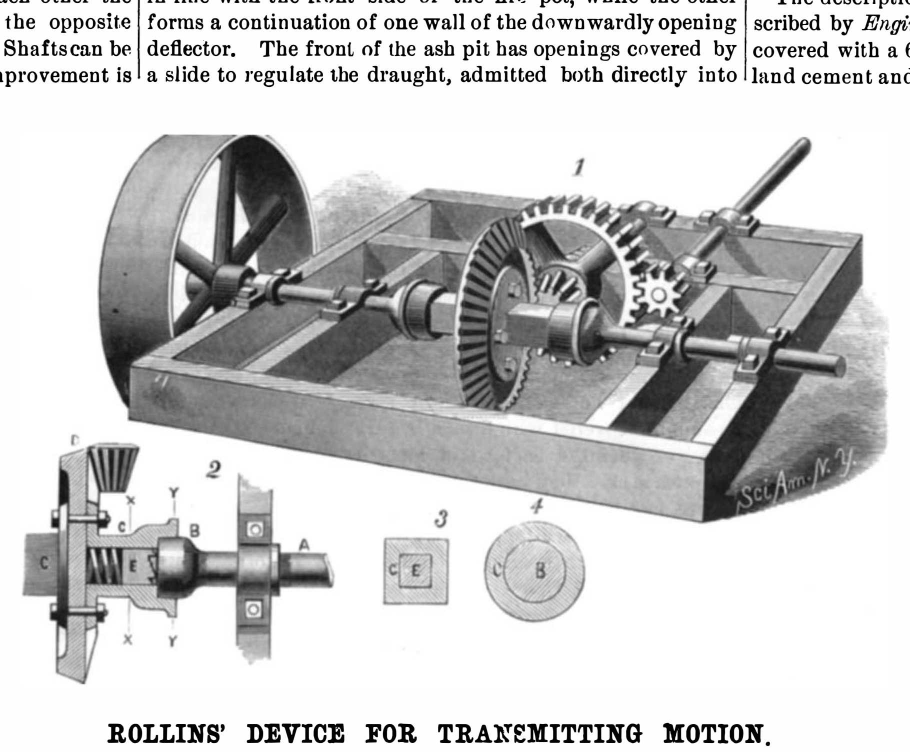
The seventeenth annual issue of "Poor's Railroad Manual," which has just appeared, fully maintains the high reputation heretofore attained by this publication. It is a complete compendium of information touching the railroads of the United States, giving their length, equipment, share capital, funded and floating debts, cost of roads and equipment, traffic operations, earnings and payments, etc. All who have investments in such property, or who think of thus employing their means, cannot fail to do so with a better understanding after looking over the facts presented in this volume.

There were 6,753 miles of railroad built in the United States in 1883, making a total length of 121,592 miles of road built up to the 1st of January last. We have nearly half the railroad mileage of the world, Germany, Great Britain, France, Russia, and Austria following next in order, but the length of our railroads considerably exceeds that of all the European lines combined. The total amount of liabilities of our railroads, on account of stock and debts, is now $7,495,471,311, an enormous amount, certainly; but it appears that their net earnings for 1883 were 4·49 per cent, which is an extremely good average showing, when it is remembered how largely their stocks and bonds have been watered. The "Manual" estimates the actual cost of these railroads at only about one-half of the amount of their funded and floating debts, and that they are thus really paying an annual interest equal to 9 per cent of their cost.

The railroad freight transported in 1883 amounted to 400,453,439 tons, the value of which, at only $25 to the ton, would have exceeded $10,000,000,000. The total length of all tracks was 149,183 miles, of which 78,491 miles were laid with steel rails. The number of locomotive engines employed was 23,823; of freight cars, 748,661; of passenger cars, 17,899; of baggage, mail, and express cars, 5,948.

MEANS FOR TRANSMITTING MOTION.

The object of an invention recently patented by Mr. W. A. Rollins, of Wyattville, County of Surrey, England, is to provide a device for transmitting motion from one part of machinery to another, in one direction, in such a manner that the parts can be revolved independently in the reverse direction. The independent shafts, A, are each formed with an enlargement, B, on the end surface of which are ratchet teeth. These enlargements project into the tubular ends of squared hollow bosses, *c*, projecting from the opposite sides of a wheel, D, held betweens the ends of the shafts. In each boss is held a block, E, in such a manner that it can slide longitudinally, but must turn with the boss. On the outer end of each block are ratchet teeth, and between the blocks and wheel are springs for keeping the blocks engaged with the enlargements. When the machine is moved so that the teeth will engage with each other the wheel, D, will revolve, but when moved in the opposite direction the teeth will slide past each other. Shafts can be coupled in a similar manner, and when this improvement is applied to tricycles the running wheels are operated from the middle wheel, the other parts remaining unchanged. Fig. 3 is a cross section through *x x*, and Fig. 4 a section through *y y*. In addition to simplicity and cheapness of construction, this arrangement admits of perfectly plain drive wheels being used in mowing machines, thus avoiding the expense of making a geared driving wheel and the necessity of replacing this expensive wheel entire if a cog in it gets broken. The clogging by grass, dirt, etc., in the gearing of the drive wheel is entirely obviated in this device. It is not contemplated to alter, further than this, the systems now in use, but to apply this arrangement to existing machines. Further particulars may be obtained from Messrs. Seely & Howell, of 14 Stone Street, New York City.



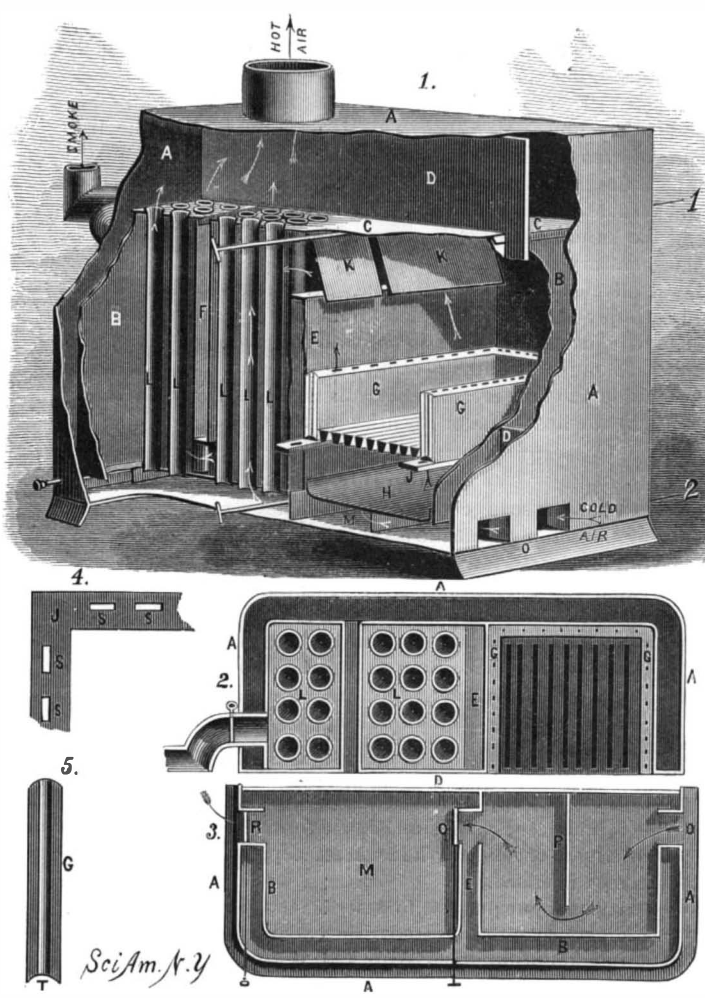
ROLLINS' DEVICE FOR TRANSMITTING MOTION.

Dry Batteries.

MM. Becquerel and Onimus have been experimenting on dry batteries. Many have endeavored to obtain a dry cell by mixing sand with chlorhydrate of ammonia. The two above mentioned obtained a modification of this process by mixing plaster with the exciting liquid, and then allowing it to solidify. As this plan can only be adopted with those cells which work only when the circuit is closed, the chlorhydrate of ammonia and chloride of zinc cells are the only ones that can be used to any advantage. Instead of using plaster only, MM. Becquerel and Onimus sometimes mix peroxide of manganese or sesquioxide of iron with it. In these cases the E.M F is slightly greater. When the battery has run down, all that is required is to moisten with more exciting liquid. The quantity of exciting liquid being a minimum, the total electrical energy is also a minimum.—*The Electrician.*

HOT AIR FURNACE.

The main object of the invention herewith illustrated is to provide an economic and effective heating furnace. Fig. 1 is a perspective view with parts broken away to show the interior; Figs. 2 and 3 are horizontal half sections, the first being above the grate, and the second showing the air passage under the ash pit; Figs. 4 and 5 are details. The fire chamber has an extended area of grate surface to permit the building of a thin fire, and at the same time secure the requisite amount of heat with an ordinary draught. The grate is supported upon flanges, J, upon the sides of the fire pot, which are provided with air passages, *s*, that conduct the heated air up into and through the fire pot lining, whence it passes over the upper edge of the fire pot to promote combustion of the gases.



TRAVIS' HOT AIR FURNACE.

The perpendicular walls of the ash pit are arranged, one in line with the front side of the fire pot, while the other forms a continuation of one wall of the downwardly opening deflector. The front of the ash pit has openings covered by a slide to regulate the draught, admitted both directly into or above the fire pot as occasion may require; by this means the exact amount of air necessary for the consumption of the gases from the fuel in combustion can be obtained. The bottom of the ash pit is made of a thin metal plate, H, that forms the upper wall of an air passage, the bottom of which is formed by the bottom plate of the furnace. Air entering through the two openings, *o*, is affected by the heat of the thin bottom plate of the ash pit. The air passage is divided about centrally by a partition, D, and has two openings at its front and two at its rear, the latter admitting the air to the compartments of the heater. Placed at right angles to the partition, D, are deflectors, P, which cause the air to travel over the greatest possible space. A valve is arranged behind each of the openings, Q, and a valve is hung in each of the two openings, R, in the rear part of the heater, one on each side of the partition. The former admit or cut off hot air from the rear part of the passage, while the latter admit or cut off cold air from the rear part of the passage.

The fire brick lining, G, composed of sections fitting in the sides and ends of the fire chamber, is formed with vertical channels passing through from top to bottom. The channels terminate in a recess made in the lower end of the lining. This recess permits the air to pass up through the channels in the lining to the chamber above the fire pot.

The air is isolated from contact with the walls of the furnace, and, being heated, the combustion of the gases is more surely effected. The crown sheet, C, made in separately removable sections of cast iron, is fitted upon the fire chamber and extended to the rear. The air chamber and deflector, E, forms the fire back of the pot, and between its upper end and the crown sheet is an opening for the passage of the products of combustion. The lower end of this chamber opens into an air inlet under the ash pit, and its sides into a surrounding air chamber.

The upper end and sides of a second air chamber, F, placed midway between that just described and the end of the furnace, open into the surrounding air chamber, while its lower end is a little distance from the furnace bottom. Passing through the crown plate and the lower plate is a series of air tubes, L, whose upper ends are flanged, in order that they may be supported without the use of rivets or similar fastenings.

A hot air chamber surrounds the fire chamber and the case inclosing the tubes and deflectors. The entire heater, save the fire chamber, is divided longitudinally by a vertical partition into two equal compartments of about equal size. Two dampers, K, are hung so as to be operated independently from the outside. Similar dampers are arranged in the smoke pipe. Either compartment is readily accessible to permit separate cleaning, the purpose being to permit the cleaning of the heater without extinguishing the fire. Heat is conducted from the heater through a pipe at the top.

Further information regarding this invention may be obtained by addressing either Mr. J. Travis or Mr. J. W. Travis, 104 Franklin Street, Chicago, Ill.

The Kerr Wood Pavement.

In this city, on Fifth Avenue, between 32d and 33d Streets, there is being laid a pavement which is new to this country, although some 500,000 square yards of it have been put down in Paris, and 800,000 in London. In principle it is a concrete pavement covered with a wooden cushion or carpeting.

The description of the process by which it is laid is described by *Engineering News* as follows: The roadbed is first covered with a 6 inch coating of concrete composed of Portland cement and broken stone, finishing off with a top dressing of Portland cement and fine gravel or sand. Upon this are laid blocks of common red pine of the size commonly used in Nicholson pavement. Between these blocks are left spaces of about one-third of an inch wide into which is poured bitumen or asphalt for an inch in depth. This fastens them to the foundation of concrete and to one another. After this has set, the crevices are filled completely with Portland cement, and the whole is covered with fine sharp gravel, which is ground into the pores of the wood and forms a protective coating. The wooden blocks are previously treated with creosote to protect them from decay and to prevent them from swelling when wet. A space of 3 inches is also left between the wooden blocks and the curbing on each side as a species of expansion joint.

The actual first cost of this pavement is somewhat more than that of Belgian blocks, but the plan upon which it has been put down in Paris is that known as the annuity system, in which the company contracts to lay the pavement and keep it in repair for eighteen years for an annuity of about one dollar per square meter. This annuity was computed on a basis which should render the expense to the city one-half the cost of maintaining a pavement for the eighteen years previous to the contract.

In this connection we give the statistics compiled by Col. Haywood, the London engineer in charge of street construction, in regard to the security of footing afforded by different kinds of pavement. As a result of observations extending over sixty days he found that a horse would travel 117 miles on asphalt, 134 on stone, and 446 on wood pavement before falling, and that falls occurring on wood pavement were by far the least serious.

American Enterprise Abroad.

Manufacturers in this country, while fully alive to supplying the home market, fertile in expedients to meet or anticipate demands, have much to learn from European manufacturers in the way of building up foreign trade. Let a demand for manufactured goods, especially for machinery, develop itself anywhere, and the representatives of English and French houses will be found on the ground industriously working up the business. They appreciate, instinctively, that trade will not look after them, that they must seek the trade, and, what is to the point, they thoroughly understand the advantages of being first in the field. In respect to guiding trade in desired directions, aggressiveness is absolutely essential; custom—habit—is a thing not easily changed, and those who commence buying goods of some particular manufacture are not easily turned in other directions. It is this quality of aggressiveness that American machinery manufacturers, when it comes to looking for foreign custom, lack. Sitting quietly at home, depending on the good quality or even cheapness of products, will not answer the purpose in such cases. The matter must be brought personally and persistently before desired customers—something that American manufacturers are not backward in in regard to home trade, but seem to fail to appreciate the greater necessity for in foreign trade.

European countries have one advantage in respect to foreign trade not possessed by this country, viz.: the lower rates of wages prevailing there operate to induce European engineers and mechanics to accept situations in countries in process of mechanical development that would not be accepted by Americans, and the preferences and influences of those accepting such situations are naturally in favor of trade with the countries from which they come. This has been found in many instances to have had considerable effect against American enterprise abroad; but, after all, this is at the most only a hinderance. Notwithstanding this and perhaps some other advantages possessed by European countries, there are unimproved opportunities for introducing American machinery abroad that require only persistent effort to yield good results.—*Chicago Journal of Commerce.*

Railway Patents.

Mr. Geo. F. Frelinghuysen, in the *American Railroad Journal*, takes to task the patentees of railroad improvements for charging railroad officials with illiberality toward inventors in refusing to adopt their inventions as soon as presented to the railroad officials' consideration. Mr. Frelinghuysen says:

The inventors and patentees who are doubtless much disappointed that they are not immediately besieged by the railroad officials for the privilege of placing the devices disclosed in their last patent on all the railroads of the United States, should remember that letters patent are not granted as rewards to the favorites, as used to be the case, but are simply a grant of security for their inventions; and that the value of the patent depends on the value of the invention which the patent covers and the business ability and perseverance of the patentee. The general misunderstanding in this regard leads many to follow after a shadow which they feel confident will give them fortune when it is once embodied in a patent. That patents have, and doubtless will be the means of securing great riches, is not my purpose to dispute, but I insist that in order to be of any value they must discover a new and useful device, which is largely needed, or for which a large demand can be created, and must then be managed and pushed with business ability.

Inventions in railway appliances differ from most other inventions, in that it is impossible for the inventor to make any experimental trials of his invention, as few persons have private railways or influence sufficient to gain permission to make the trial, even at their own expense, which is ordinarily heavy, and beyond the means of the inventor. This leads them to apply for and obtain patents for their inventions before testing them, which latter would in many cases have been sufficient to convince them of the impracticability of the devices patented.

The railroad world was not long in taking up the automatic couplings, the air brake, interlocking switches, and improved frogs, not to mention the fish joints, heavy steel rails, and stone ballast. The trouble with the railway patents lies more in the poverty of invention shown by the patentees than in any lack of desire on the part of the managements for improvements, or disposition to rob the inventors of the fruit of their labor. An examination of some of the patents shows clearly that the invention is made for the sake of obtaining a patent, instead of the patent being obtained to secure the invention. This is such a prostitution of the Patent Act that there can be little wonder and less pity that the patentees do not reap rich rewards therefrom. There is plenty of chance left for these inventive beings to reap a rich reward if they will only patent an invention instead of inventing a patent.

The couplings are not perfect; the brakes are not always to be relied on; air brakes will not "let go" quickly enough, and sometimes not at all, until the valve is opened by hand, and hand brakes are too slow, and expose the brakeman in case of accident.

There is no way of taking on coal without stopping. The heating appliances for cars are very imperfect; the ventilating arrangements, especially in cold weather, might be deemed not to exist, so far are they from being perfect. There are plenty of ways of roasting one's feet and having a draught about the head, or freezing the feet and heating the head, but to make a pure, warm, evenly distributed atmosphere in a car is unknown, or at least unpracticed.

The tracks, rail joints, switches, frogs, ties, and ballast; taking on and putting off baggage; storing and selling tickets; accommodating, assorting, and directing passengers; receiving, handling, and delivering freight in packages or in bulk, are all subjects capable of improvements, which would appeal to the pocket of the "soulless corporations," and be of advantage to the successful inventor, and a benefit to the public.

There is no use of trying to invent the Westinghouse brake again, nor the old-fashioned coupler, neither can the Miller coupler be revived, nor the Jennings appropriated.

The numerous railway patents which never see the light of even an experimental use can only have the effect of discouraging those who see them, from trying to make advances in the same branch. Those who have *inventions* may be sure of having them appreciated, notwithstanding the contrary experience of the many patentees.

Remember that a patent only gives an exclusive right. It simply excludes all others from using the thing patented without paying or arranging with the patentee for so doing, and must be without value, the *Journal* adds, unless the thing patented is such that others will elect to use it, and pay the license fee or royalties for the privilege.

Insoluble Soap.

The term soap commonly designates a product prepared by the action of caustic alkalies—potassium or sodium caustic—upon fats, fatty oils, and resin, *e. g.*, tallow, lard, whale, palm, olive, cocoanut, linseed, cottonseed oil, and colophony. It has been shown by the experiments of Chevreul relative to the chemical nature of fats, that they are composed of oleic, palmitic, and stearic acid, and glycerine as the basic constituent; hence, fats are natural products to which chemistry the term salt applies. By substituting alkali for glycerine in fats, soap is produced; the process of substitution is called saponification. When sodium caustic is employed as substituting agent, sodium soap—castile soap—is produced; potassium caustic forms also soaps which are of a more or less jelly-like consistency; while glycerine becomes liberated.

It is not our purpose to describe the process for making ordinary soap, but to study the condition which causes the formation of insoluble soap; and we shall also notice that not sufficient attention has been paid to the importance of these latter preparations in diverse branches of practical art. Alkali soap is soluble in water and a few other liquids; all other soaps are insoluble. This insolubility is turned to advantage, and becomes the very principle of chemical processes. When a small quantity of an aqueous soap solution is added to water which contains carbonate of lime, the characteristic property of the solution becomes destroyed, it has ceased to impart to the water the tendency of lather; a further addition of the solution will ultimately transfer to the water the property of forming a lather when agitated. The cause of this deportment has to be ascribed to the presence of lime, which transforms the alkali soap into an insoluble calcium soap.

Upon this fact is based the determination of the hardness of water by means of an alcoholic or aqueous soap solution; and it is also evident that the use of such water for washing purposes involves a loss on soap. A similar result is obtained when water contains other metallic salts; the presence of magnesium sulphate causes the formation of insoluble magnesium soap, copper sulphate precipitates insoluble copper soap and sodium or potassium sulphate. Thus, an insoluble soap is produced when a solution of the respective metallic salts is introduced into a soap solution.

Insoluble soaps constitute the essential part of paints. When zinc oxide is used with oil as paint, the formation of a waterproof coating depends on the production of an insoluble zinc soap; and in all paints and varnishes containing metallic oxides or metallic salts such a process takes place. In medicine insoluble soaps are called plasters, *e g.*, lead plaster. The most valuable property of these preparations is their impenetrability for water. When casts of gypsum are covered with dust it is quite difficult to cleanse them, yet when the surface of such casts is impregnated with stearic acid they have the appearance of meerschaum, and are not affected when washed with water. Another product of saponification, which gives to casts of gypsum, when applied as a coating, a beautiful green, bronze-like color, is prepared by introducing copper and ferrosulphate into an aqueous soap soution; the precipitate, consisting of a mixture of iron and copper soap, is mixed with litharge and wax.

Of all metallic oxides for the preparation of insoluble soaps, alumina is the most valuable; it possesses a great affinity for organic fiber, and thus becomes a suitable medium for fixing dyes upon cotton goods. The fiber, being impregnated with aluminum acetate as mordant, is steeped into a dyebath and is immediately coated with an insoluble lake, or when introduced into a soap solution becomes covered with an insoluble aluminum soap, which also fills up the pores of the fiber. By this process the fabric has acquired the property of being waterproof. It has been suggested some years ago to increase the durability of railroad ties and wood in general by impregnation with aluminum oleate. It suffices to impregnate the wood with aluminum acetate, and then immerse it in a soap solution; by repeating this procedure the desired result will be obtained. Such a process is employed in the manufacture of sized paper; the material of which the paper is made is soaked with a solution of wax, resin, or oil soap, and then treated with a solution of aluminum sulphate; in this manner insoluble aluminum oleate is produced upon the fiber. Zinc sulphate is often used as a substitute for aluminum sulphate.

Though common writing paper being not quite waterproof, yet, by comparing it with unsized paper, it is not difficult to conceive that the impermeability of unsized paper for liquids will depend on the formation of insoluble soap.—*Industrie Zeitung.*

An Electric Torpedo Boat.

Professor Tuck's electric submarine torpedo boat looks at a little distance very much as if it had been constructed by laying a large row boat, upside down, on top of another large row boat, fastening it there, and painting them both sea green. The shell is of iron, however. The boat is thirty feet long. It is ballasted with lead, so as to sink to the water's edge, and its displacement is twenty tons.

In the center of what may be called the deck is sunk a well hole. By a simple air lock arrangement it affords a passage between the interior and the exterior of the vessel, even when the vessel is wholly under water. It is also the captain's look out station, and is capped with a dome of heavy glass, so that if he chooses he can exclude the water and stand in the pit with his head and shoulders above the top of the boat, or he can leave the glass off and stand there in a diving suit. Close to his hand is a signaling steering apparatus, which transmits his orders to the helmsman down below. The boat has three rudders, one an ordinary vertical rudder at the stern, and the other two horizontal blades on the port and starboard quarters. These last help to govern the boat's movements up and down. To sink her, water is pumped into her compartments; to raise her, air is pumped in, and the water is forced out. Compressed air is stored aboard in six inch pipes. There is also an apparatus for reoxygenating air that has already been breathed. Moreover, there is a simple arrangement by which the ends of two rubber tubes can be floated up to the surface of the water and opened to the supply of fresh air up there.

An electric motor, driven by force from storage batteries, runs the propeller. The interior, which is arranged for a crew of four or five men, is lighted by incandescent lamps. An indicator shows the distance of the boat beneath the surface. The estimated speed of the boat under water is eight knots.

The torpedoes are to be carried outside the vessel, one at the prow and one at the stern. They are to be held there in iron cylindrical sheaths by electro magnets, which will release them when the current is cut off. They are ballasted with cork, and after placing one of them the torpedo boat retires to a distance, unreeling as it goes two wires, by which, at a proper distance, the torpedo is fired.

The lead ballast proved insufficient to sink the boat below the water. On a recent trial near the Delamater iron works, this city, a crew of three men went aboard her, and, with Mr. John Rice as captain, a test was made of the electric engine. It drove the boat several miles up and down the river at a speed of ten knots, says the New York *Sun* She answered her rudder well. She will soon be tried under water.

Waterproof Varnish for Paper.

Says the *Photo. News:* In very many cases waterproof varnishes are useful, and among their uses may be mentioned their application to laboratory labels and their use for the fixing of drawings.

There are many such varnishes, but, according to our own experience, one of the best is a thin solution of gutta percha in benzole, and such a varnish may be made by dissolving one or two parts of fine gutta percha foil in a hundred parts of benzol. The heat of a water bath serves to make the gutta percha dissolve tolerably quickly, but if it is necessary to have the preparation at once, the gutta percha may be dissolved in a little chloroform, and this is then mixed with the required bulk of benzole. Paper which has been coated with this varnish can be easily written, drawn, or painted upon; and it must be remembered that the gutta percha varnish does not make the paper transparent or spotted. It is known that gutta percha slowly oxidizes in the air, and becomes converted into a brittle resin; but this oxidation product is itself a waterproofing agent.

Alcoholic solutions of resins tend to make papers more or less transparent, but the following varnish, prepared with acetone, is not subject to this drawback.

One part of dammar is dissolved in six parts of acetone, the materials being allowed to digest together for some weeks; the clear liquid is now decanted off, and mixed with its own volume of plain collodion.

Another method of making a waterproof varnish for paper consists in digesting 30 parts of white shellac with 300 parts of ether, and then agitating the solution with 15 parts of finely powdered white lead; on filtering the solution, it will be found that the white lead has been very effectual in clarifying the solution.

The above resinous varnish gives more luster than the gutta percha varnish, but the latter gives far more flexibility, a considerable advantage in many cases.

Not only silver prints, but also collotypes, and often photo-mechanical impressions, may often be advantageously treated with one of the above varnishes; and it must not be forgotten that anything which protects a silver print against damp serves to diminish the tendency to fading.

DREDGING AT OAKLAND, CAL.

A part of the extensive harbor improvements in progress at Oakland, near San Francisco, consists in the excavation of a tidal basin to improve the scour, at or near the harbor entrance. The material removed by the dredging operations is deposited in adjoining salt marshes, and retained there by means of embankments constructed along the shore line, so that a considerable area will be reclaimed. Fig. 2 shows the floating discharge pipe that carries away the mud. The dredging machines employed are, says *Engineering*, on the same principle as those used at the Grand Amsterdam Canal Works, that is to say, they belong to the type in which the material to be raised is first reduced by suitable machinery to a condition of mud, and then pumped to the surface, and delivered by means of a pipe line.

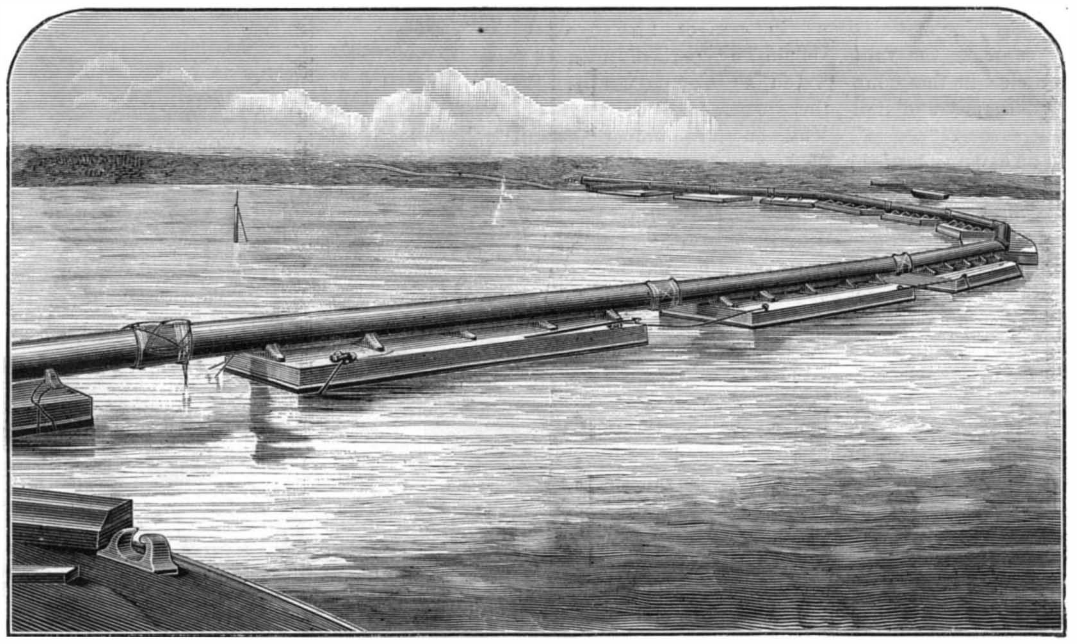


Fig. 2.—THE FLOATING DISCHARGE PIPES.

Fig. 1 illustrates the general form of the dredging machinery used at Oakland Harbor. The submerged and mixing part of the arrangement consists of a horizontal wheel with plowshares attached around the lower face. By means of steam power on the boat, rotation is given to this wheel, which is inclosed in a casing, so that water can enter only on the under side. On the top of this casing is fixed the rising main, 20 inches in diameter, of a centrifugal pump, 6 feet in diameter, placed on the boat. The delivery main of this pump, also 20 inches in diameter, is extended from the vessel by a line of wrought iron pipe, with ball and socket joints and rubber connections; it is supported in position to the marsh where the mud is delivered. By this arrangement, which is shown clearly in the engravings, the material excavated, after being mixed, passes directly through the pump and delivery mains, and only comes to rest when it is discharged. As much as 40 per cent of solid matter can be carried in this way, but 15 per cent is found by experience to be the most convenient amount; one obvious advantage resulting from this dilution being that the solid material is more widely and uniformly distributed over the area to be reclaimed.

The pump is driven by a pair of engines having cylinders 16 inches in diameter and 20 inch stroke, and two other engines with cylinders 12 inches in diameter and 12 inch stroke drive the cutting and mixing gear, the winches, hoists, etc. Steam of 90 pounds to 95 pounds pressure is supplied by two 100 horse power boilers. The greatest length of delivery pipes employed has been 2,850 feet, and through this length 41,000 cubic yards of mud were delivered in 190 hours. During a period of eight months one of these machines raised and deposited 250,000 cubic yards, or an average of 30,000 yards per month. In one month of this period there were moved over 60,000 yards, through a distance of 1,100 feet. The total expense per day of ten hours of one of these machines, including interest, depreciation, and insurance, amounts to 100 dollars, or about 20*l*., and in connection with the work there are other expenses, as follows:

1. The construction and maintenance of levees or embankments for confining the freshly dredged material. 2. The services of nine or ten men to guide the flow and distribution of the material as it is delivered. The cost of previous dredging operations on the Pacific coast by ordinary appliances has averaged 24 cents, or 1s., per yard, while the maximum expense per yard, with the system we now describe, is a maximum of 6 cents, falling in some cases to 5 cents per yard. The Oakland Harbor dredging operations are under the control of Col. G. H. Mendell, of the United States Corps of Army Engineers.

Fig. 1.—DREDGING APPARATUS AT OAKLAND HARBOR, CALIFORNIA.

One Hundred and Forty-seven Miles without a Stop.

The New York Central and Hudson River is running special newspaper trains to Albany, and of a recent trip the New York *Tribune* speaks as follows:

"For the trip of the *Tribune's* special train from New York, Mr. Toucey, General Superintendent of the Central and Hudson River roads, detailed locomotive No. 85, George Remington engineer. No. 85 has only recently come from the shop, where certain slight but important alterations were made in the engine, in which Mr. Toucey and Mr. Buchanan, Superintendent of Motive Power, have been greatly interested. For ten years the New York Central Company has been trying to perfect some plan for the consumption of smoke in their locomotives. It is believed that success has been attained in No. 85, and those who travel behind that big locomotive the coming summer will not have to close the windows of their cars, either in the tunnel or elsewhere, so far as smoke in concerned. The smoke consumer is in itself simple enough, being merely two pipes, one in front of the firebox and one in the rear, each of which admits jets of steam into the flames, rising through the burning coal. The steam effects perfect combustion, and while completely consuming the smoke makes a gain also in the heat obtained. Usually, when the fireman is throwing in coal or stirring the fire, and for a few moments after each operation, a cloud of smoke pours from the chimney of the locomotive. In the whole trip to Albany (where the engine was taken off) nothing that was visible came from the chimney except the escape steam. The improvement was wonderful, and the Central officials seem to be justified in feeling that they are a little ahead of the rest of the world with their new device. So far only two or three locomotives have been supplied with the smoke consumers, but others are to be soon.

"The trip to Albany was also noteworthy because the engine ran the whole 147 miles from New York without stopping for water, oiling up, or anything else. The company are aiming to introduce this idea in all their fast trains. Of course, water enough could be carried in a tender sufficiently large for such a trip. But the weight would heat the journals. The plan adopted is to scoop up a fresh supply of water from troughs laid at intervals between the rails, the train holding its headway and never stopping a moment. To run an engine so far without oiling requires alterations in the oil cups, etc., but all the difficulties have been overcome, and the long run was made successfully. The improvement shows that the Central Road keeps up with the times."

Keeping Wood in Moist Ground.

A Brooklyn, N. Y., carpenter writes us that, in 1864, he laid down some old painted half-inch door panels as a flooring for a coal bin at the rear of his yard, and that, on taking them up seven years afterward, they were just as sound as if they had been but recently cut from a thrifty living tree, although so pliable with moisture that he could have bent one of them around a six inch stove pipe. Our correspondent suggests that the painting of railroad ties, or coating them with white lead and oil, would be very efficacious for their preservation.

THE AMERICAN WATCH WORKS.

(*Continued from first page.*)

out 30,000 in a single month, and 30,000 watches are needed all the time in the finishing rooms to enable the hands to work to advantage.

Out of the American Watch Company all the others have originated, namely, those at Elgin, Rockford, Aurora, and Springfield, Ill.; at Springfield, Mass.; Lancaster, Penn.; Nashua, N. H.; Columbus, O.; Fredonia, N. Y.; Marion, N. J.; besides others that have failed and others just starting. Taking no notice of cheap, inferior goods, there are made, on an average, 3,650 watches a day by nine first-class factories. According to Mr. Robbins' estimate, the value of a year's product of gold and silver watches in this country exceeds $16,000,000; and the business directly and indirectly furnishes employment for 100,000 persons.

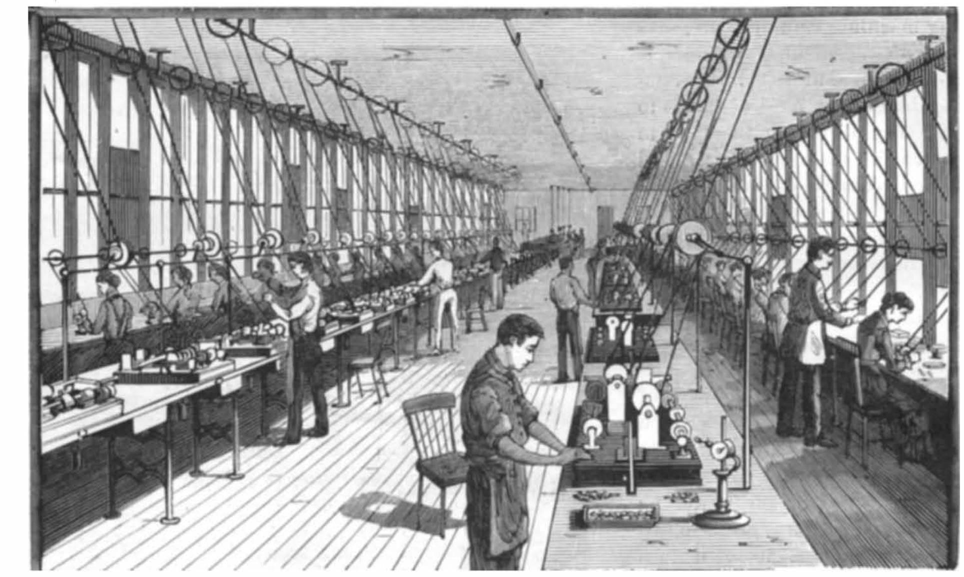
The factory at Waltham is located on an expansion of the Charles River, and is environed by parks maintained at the company's expense. The rooms are thoroughly ventilated, and all the sanitary arrangements are excellent. Consequently the operatives are a remarkably healthy, cleanly, and bright set of people, mostly young persons, whose unimpaired eyesight and steady nerves qualify them for the delicate work before them. Intelligence and integrity are also required in a business involving the handling of quantities of precious metals and jewels.

For certain kinds of work female operatives are preferred, on account of their greater delicacy and rapidity of manipulation; and it should be added that women get the same wages as men for doing the same kind and amount of work. All the apartments are lighted by large windows by daytime, and for night work there are 200 incandescent electric lamps and 3,500 gaslights, requiring over 22½ miles of piping. There are 38 furnaces using gas as fuel.

There are 25 distinct departments, each having its foreman, and all in telephonic communication with the central office. Mr. Ezra C. Fitch is Superintendent, recently at the head of the salesrooms, at No. 5 Bond Street, New York. G. H. Shirley is Assistant Superintendent, E. A. Marsh is the Master Mechanic, and D. H. Church Master Watchmaker, through whose kindness the writer had access to the various departments.

Most of the foremen and a number of the hands have been in the employ of the company for from twenty to twenty-five years. The "Foremen's Association," of which Mr. H. N. Fisher is President, meets once a month to discuss matters relating to the advancement of the work. Probably few persons realize how many distinct operations are required to produce a single watch. The managers themselves did not like to make a statement until at my request the question was laid before the foremen: "How many distinct mechanical operations are required in order to construct one of the grade of watch movements described as an 18 size, full plate, stem-winder, jeweled 4 pairs?" Each foreman made a list of the operations in his own department, and the startling sum total was 3,746; and the number would be considerably larger for some of the higher grades.

It is evident that the mere *finish* of a watch is no test of its excellence. The greatest pains are taken by the American Watch Company in perfecting the original model. Every variety of design and appliance that human ingenuity can devise is sought for; and a retinue of special artists, draughtsmen, and inventors is continually busy to make each part and process as economical and accurate as possible. The various machines are thoroughly and exquisitely exact. They are all made in the extensive machine shops belonging to the company. A great hue and cry has been raised in Europe against machine-made watches, as if necessarily clumsy and defective; whereas the reverse is true. In the anxiety to secure a high finish, many a hand-made watch is polished to death. The aim of the American Watch Company is to secure actual interchangeability of pieces. It may be too much to say that the corresponding parts of all their watches are identically alike. But they will come within one ten-thousandths of an inch of it! *e. g.*, a jewel hole should be two ten thousandths of an inch larger than the pivot that works in it. A few turns of the polisher would make a change. Hence microscopic measurement has to be resorted to in fitting pivots to jewels. But ordinarily, in assembling parts together, no measurement is necessary, but they are used exactly as they come from the machines. Furthermore, automatism in tools is the coming necessity for cheapening labor. The American Watch Company already uses many automatic and semi-automatic tools, and is constantly inventing more. The work thus secured is so nearly perfect that should any part of a watch fail in actual use the owner need only send on the number of the movement to enable the factory to supply an exact duplicate of the part. The order could be sent by postal card, and filled by return mail. To facilitate this a systematic record is kept; and this is so well done that any watch ordered could be located at any stage in its manufacture; and the same could be done for 1,000 or for 10,000 watches.



SCREW MAKING ROOM.—AMERICAN WATCH CO.

The "movement" of a watch is made up of two plates and the wheels, etc., between them. It may be as well, before going further, to refresh the reader's memory as to the general mechanism of a watch. The plates are known as the pillar plate and the top plate. On full plate watches the most peculiar thing is the barrel bridge, the object of which is to allow room for the main spring. A three-quarter plate is flush and the top plate not cut through, the main spring being narrower than in the former. All American watches have what is called a going barrel, instead of the fusee, preferred in the English system, though long discarded by the Swiss as superfluous. The going barrel contains the main spring, and drives the center wheel and pinion, which revolve once an hour, carrying the minute hand. The third wheel and pinion are simply intermediate between the center wheel and the fourth wheel, which carries on its staff the second hand, revolving once a minute. The fourth wheel also drives the escape wheel, so called because it only lets one tooth escape at a time, bringing the machine to a dead stop five times every second. They used to make all watches with 14,400 beats to the hour (or 4 to the second); this is called "slow train," and is now obsolete except for one-quarter second or "stop watches." The English standard was advanced to 16,200 beats to the hour (4½ to the second). The Swiss and American standard is 18,000 beats to the hour (5 to the second), called "quick train." Experiments have also been made up to 21,600 beats to the hour (or 6 to the second), called "fast train;" but results are not satisfactory. Experience has proved the "quick train" watches to be the best timekeepers.

THE CASE MAKING DEPARTMENT.

The factory watches are all "lever escapement," universally accepted as best for pocket timepieces. The lever consists of a pallet and fork, and receives an oscillatory movement from the escape wheel. The balance, to which the lever imparts motion through the medium of the roller jewel passing alternately in and out of the fork, regulates the whole machine. It consists of a comparatively heavy wheel running on an axis with finely adjusted pivots, and with the least possible friction; and a hair spring attached at one end to the balance wheel and at the other to the balance cock, which is fastened to the top plate. The value of the hair spring is to determine the speed with which the balance wheel vibrates (*i. e.*, five beats a second). The balance is bimetallic, to correct the contraction or expansion of the hair spring, so that the watch may run true regardless of temperature.

The minute and hour wheels are located under the dial, and are driven by a system of gearing. The cannon pinion fits friction tight on the center staff, being so put on to enable the hands to be set. The cannon pinion drives the minute wheel, and the minute pinion drives the hour wheel; the proportion being such that while the former revolves once an hour, the latter revolves once in twelve hours. Most of the watches now made are wound up by turning the stem of the case, and the hands also are set by a similar device, dispensing wholly with the watch key.

The safety of all this complicated movement from any injury that might result from the breaking of the main spring is secured by a safety-pinion screwing on to the arbor of the center wheel by a triple left hand thread. Should the mainspring break, the recoil would merely unscrew this pinion, and thus release the whole movement without any consequent damage.

THE AMERICAN WATCH CO.—THE PINION ROOM.

A volume would be needed to describe all the 3,746 operations required for the construction of an ordinary watch. But a general description of the main departments may meet the demands of the present article.

The Plate Room is where they manufacture the pillar and top plates. The material used is generally brass, although nickel is used for some of the more costly watches. The plates are rough punched by the Scovill Manufacturing Co., at Waterbury, Conn., and brought in this form to Waltham. Eighty operations are required for the pillar plate alone. These include facing off both sides; punching for dial feet, which are guides through all subsequent operations; turning for diameters; drilling, countersinking, burring, recessing, tapping, stoning, numbering, finishing both sides; putting in the pillars and turning and drilling them; making and inserting the click stud; cutting recesses for the lever arm, the barrel, and the various wheels; putting in the minute wheel pinion, and drilling and cupping the train holes. The pillar plates are then distributed in sets of ten trays, ten boxes to a tray, ready to receive the other parts. The top plate also goes through a like process, being punched, recessed, milled, pierced by screw holes, numbered, drilled, tapped, and stoned, potance put in, and the plates distributed. The parts being assembled and screwed together, several operations are performed, after which they are taken apart and finally distributed. During this process, at various times, the plates have to be boiled in soapsuds to clean them from dirt. The *barrel bridge* is also punched, trimmed, stamped thrice, milled, recessed, and distributed. The *balance cock* is trimmed, flatted on emery wheels, turned to thickness, the star wheel regulator put on (an improvement on the arm regulator); it is stamped, burred, drilled, tapped, beveled, etc., and finally they are strung up by hundreds to be sent to the jeweling room.

The ratchet cap for the winding wheel is turned, drilled, recessed, etc., finished, and sent to the gilding room. Thus there are 157 operations in the plate room alone, as I made out my list going from bench to bench, only a portion of which are indicated above, but each requiring great care and precision. My first intention was to go through each department with equal thoroughness; but the task would have taken a month, and the results would have required many explanations to make them generally intelligible to any but experts. Hence in describing remaining departments I shall give salient points instead of detailed processes. *The Press Room* is in charge of N. P. Mulloy. The first thing that was exhibited was a sort of cabinet, in whose glass jars and tiny drawers are myriads of parts of watches, each sort labeled, *e. g.*, regulators, yokes, forks, cam clicks, lever springs, winding wheels, train wheels, gold and steel balances, hour hands, minute hands, second hands, etc., everything in short that can be made by *punching*.

The effect is striking of seeing so many objects of a kind massed together, *e. g.*, 10,000 second hands in one jar—the result of one day's work in that line, the monthly order calling for 160,000. The counting is done by weight. A box of center wheels, was weighed in my presence, and found to weigh 146¾ oz. A single ounce was then weighed, and the wheels were counted and found to number 136. Consequently it was ascertained that there were 19,979 wheels in the box. Some idea of the multiplicity of operations in this department may be had on learning that there are over 200 different sorts of hands now made! Many parts made here, and in other departments, are so small as to be almost microscopic, and measurements have to be made by a fine gauge micrometer. Curious to see the working of the instrument, I measured a single hair, finding it to be $\frac{5}{1000}$ of a centimeter in diameter. Many operations have to be verified to within $\frac{1}{2000}$ of a centimeter, *i. e.*, to $\frac{1}{10}$ the thickness of a human hair!

Visitors always notice with interest the double row of iron tumblers whirling oddly in every way, used for brightening by attrition the steel works which are too minute to be polished by hand.

The Pinion Room, in care of Martin Thomas, who has been in the employ of the company for 23 years, has another cabinet of jars, boxes, and drawers, with pinions of every sort and in every stage. Probably as much is involved in perfecting the pinions as in any other department of watch making. Everything must be as exact as possible. The process begins with cutting the wires to be used in lengths of 18 inches. Then these are cut automatically to the right lengths, roughed out, and pointed. Five or six turnings follow, and then the leaves (or teeth) are cut. It has long been known that these should be epicycloidal in form; but under the old system it was difficult to effect this with desirable exactness. Drawings on a large scale could be made with mathematical precision; but it was another thing to reproduce them in almost miscroscopic miniature. And then, it is said, that many workmen had a singular prejudice to these peculiar teeth, fancying than to resemble bishops' miters! Here the superiority of machinery over handwork is visible. Machines have no prejudices nor æsthetic notions, and are as able to shape a little pinion exactly as the great wheels of the largest engine. The cutters and polishers of the machine for making the pinions are themselves kept true and in perfect order by a machine invented for giving the exact epicycloidal form. The final result is that, when all the parts of the watch are assembled and set in motion, the action is perfectly smooth and continuous, an end that cannot be secured in any other way. This statement holds good for all grades of watches made here, the cheapest as well as the most costly.

After the leaves have been cut, the pinions are hardened and tempered, polished and finished ready for use. Seven barrels of flour a month are consumed in making dough for various uses, besides many barrels of pith, and quantities of rouge and Vienna lime. At the time of my visit pinions for 100,000 watches were actually going through the works.

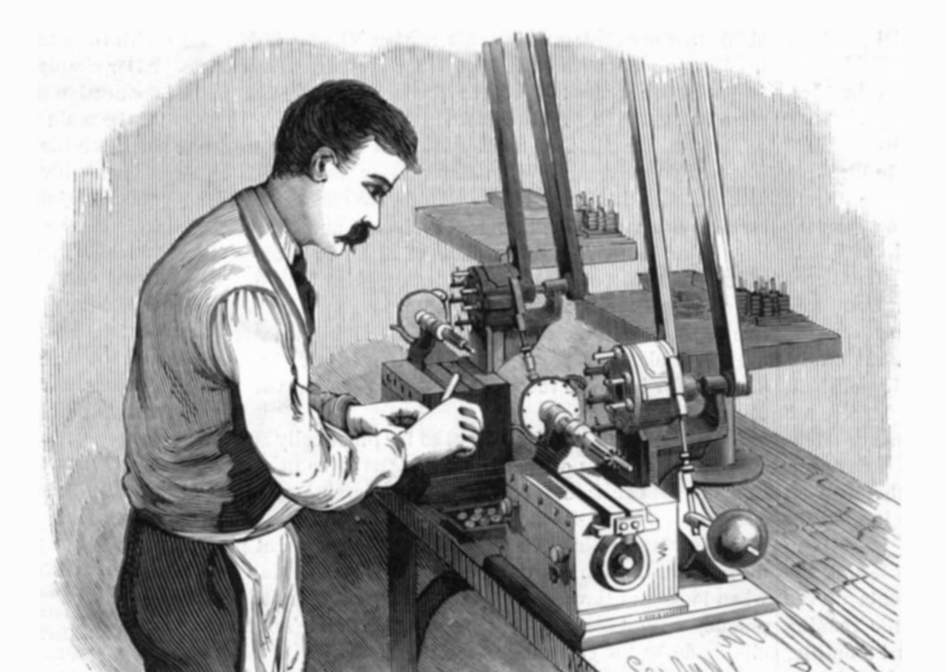
The Screw Department exhibits the perfection of automatic machinery more visibly than any other. The foreman, Mr. C. H. Mann, assured me that, were it not for the necessity of hand finishing some of the finest work, there would not be needed more than a dozen workmen to make the daily average of 100,000 screws. There are twenty-four of these automatic machines, each making from 3,000 to 4,000 screws a day, not including night work. There is also an automatic pin machine that makes 20,000 pins a day for use in fastening hair springs. All these machines were invented and made here. The material used for screws is mostly the finest of Stubs steel; but some of them are made of brass and others of gold. Most of the wire is purchased of the proper size and supplied to the machines, which then make the screws, after which they are hardened and finished. The process for common work is to put several hundred screws on a block to be ground off on laps.

The finest quality, however, have to be finished and blued singly, and all counted, because done by the piece. To illustrate the possibilities of this department, Mr. Robbins assured me that from steel wire, costing the company but $5.00 they could make 247,000 screws, weighing one pound, worth $1,715.00. Most of the screws, of course, are of a larger size than this. It should be added that in this room is included the roughing out of work for various parts of the watch, *e. g.*, the pinions, center staffs, etc.

THE AMERICAN WATCH CO.—THE GILDING ROOM.

Gilding Room.—All the brass movements have to be gilded, which is done under the direction of Mr. C. B. Hicks. The parts must first be stoned, then inspected, after which they are put through a bath of nitric, sulphuric, or muriatic acid. Having been rinsed, they are brushed with revolving wire brushes to prepare them for the gilding bath. Then they are rinsed in alcohol, dried in saw-dust, inspected, and such as are ready for the finishers are folded in tissue paper and sent to their rooms. The gilding is done both with electric dynamos and with old style Daniell battery. From $40 to $50 worth of gold is put on the works of 1,000 watches in the process of gilding. An exhaust fan carries off all deleterious fumes, perfect ventilation is insured, and every precaution is taken against any poisonous effects from the various chemicals used.

Balance making begins with a plain steel blank made of best steel. According to the foreman, J. L. Keyser, there are 85 operations in all required for making an expansion balance. The principal steps are as follows: First the center hole must be drilled, after which the disk is turned to a true diameter. It is then forced into a recess of a low brass capsule, and a ring of high brass is inserted between them. Having been prepared with a borax flux, it is heated sufficiently to melt the high brass on to the steel. It is then faced off to a definite thickness, turned, and rolled to condense the brass. The back is ground and the face recessed; after which the steel is punched, leaving the arm. Drilling, tapping, and finishing follow. Finally, the screws, 22 in number, are put in, being of different sizes, weights, and metals to conform to the varying strength of the hair spring.



THE AMERICAN WATCH CO.—MAKING ESCAPEMENTS.

The Escapement includes the roller, roller jewel, pallet with its two jewels and arbor, fork and guard pin, screws, escape wheel and pinion—thirteen pieces in all—requiring the most exact precision. The mechanical principles involved are such as have been determined by repeated experiments, but cannot be easily explained without voluminous detail. This department is in charge of Mr. H. N. Fisher.

The escape wheel cutting is done by an automatic machine carrying six cutters, three steel and three sapphire. Fifty wheels are cut at a time, and it takes six cuts to make each of the fifteen teeth. The machine stops when they are done. Each wheel is then set on its pinion and topped, to make it sure that it will run true in the round.

The garnet pallet stones are placed 30 or 40 together, on a steel block ground, and finished on one side and then on the other. The edges are finished the same way. They are then stacked on a graduated plate, and marked with a diamond to be broken off to a length. They are then put in a grooved plate, set at the desired angle for the impulse force. All are finished with diamond dust on ivory laps. The polishing is done with an oscillatory motion, so as to give less bearing for the escape wheel. Jewel pins are shellacked into a spindle, in rectangular slips, turned with a diamond to remove corners, then ground with copper laps, and polished with shell laps charged with diamond dust. One side is flattened for one-third its length, and than they are ready for setting.

Matching the escapement is done in the watch, which is regarded as preferable to the old method of doing it by the depthing tool.

The Jewel making department is under the direction of Wm. R. Wills. The first object exhibited was a cabinet containing agates and other materials for making polishing laps. Then a safe was opened containing about $50,000 worth of precious stones. To some extent Brazilian diamonds are used for splinters to drill with. But for general purposes African diamonds are good enough. Diamond bortz, in the rough, costs $1.50 a carat, or $225 an ounce; and the company requires about 12,000 carats a year. It should be noted, however, that, contrary to the popular notion, no watch jewels are made of diamonds, because they could not be drilled. Glass also is never used, nor quartz crystal. The stones used are rubies, sapphires, garnets, and occasionally crysolite and aqua marine. A full jeweled watch takes 19 jewels, called, for the pieces to which they belong, balance, end stone, escape, pallet, third, fourth, and center jewels. Every watch has the same grade throughout, *e. g.*, one will have all garnets, another all rubies, etc.

The balance jewel, however, in all watches is either ruby or sapphire. There are 40 different grades of garnets; but the only sort used here is the hard violet from Bohemia and Germany. The process of making diamond dust is, first, by means of a crusher, and then a steel mortar held down by heavy weights. The result is a powder one-fifth diamond and four-fifths steel. After separation the dust is used in that state for diamond saws only; but, for polishing, it is graded by successive precipitation from olive oil. The jewels, having been sawed into thin slabs, are next rounded to size, shaped, drilled, and faced. The jewel hole is opened to a certain size, varying from 0·005 to 0·020 of a centimeter, in order to fit the pivot—a process requiring the finest possible finish and polish, regardless of the quality of the stone. There were made, in the month of June, 350,000 jewels, employing 255 hands, of whom 175 were males.

The Hair Spring is a tiny thing, but has a department of its own under Mr. Thomas Gill. The material is steel wire 0·022 of a centimeter in diameter, and spun for this special use. It comes in coils, and the first thing done is to draw it through ruby and sapphire dies down to 0·018 of a centimeter. Next, it is rolled flat between hardened steel rollers, and afterward drawn between pairs of diamond dies, from which it comes out 0·027 of a centimeter wide and 0·968 thick. It is then cut into lengths of 14 inches, which are wound in little boxes, three in a box, these wired together in pairs, face to face, and hardened and tempered. They are then separated, cleaned by acid, and blued. The spring is now attached to a brass collet in the center, and to a steel stud at the outer extremity. Gauging the hair spring is a delicate operation. The gauge is a dial plate, 7 inches in diameter, beneath which is a spring of known strength attached to the center staff and jeweled. This dial is accurately divided into 2,000 divisions, each 0·01 of an inch wide. The hair spring is put on the end of the staff, where it is held by friction; the stud being attached to an arm held by an outer ring revolving about the dial, which is stationary. One revolution is made each way, and the strength of the hair spring determined by an index hand attached to the staff. It is seldom equally strong both ways, the variation amounting to from 5° to 10°; the average strength is about 1,000°. It takes so many degrees of strength in a hair spring to run a certain weight of balance and make the requisite number of beats per hour. All balance wheels are weighed; the average being 8 grains. One degree on the dial equals about 4 seconds of time an hour, and in the balance 0·01 of a grain makes the same difference. An exact record is kept of the weight of the balances, which goes with the work till it is completed. The last step is the actual timing and toning the hair springs in watches; after which they are laid away to be used according to their numbers. Each hair spring belongs to its own balance and each balance to its own watch, but they *do not meet each other till the watch is done.*

To show how greatly raw material can be enhanced in value by skill, it is worth mentioning that out of one pound (troy) of fine steel wire, worth from $2.70 to $5.40, may be made 17,280 hair springs, worth $7,152 at lowest wholesale prices.

The Dial Making Room is under Mr. Charles Moore, who has been with the company since 1859. The dial has a copper foundation, which is pressed and pierced at one operation. Next, the dial feet are brazed in. Pulverized enamel is laid both on the back and the face, and then fused on, or "fired." Having been smoothed they are fired a second time, inspected, and sent to the Painting Room, of which E. L. Hull is foreman. Here the face is spaced into 12 equal divisions that are indicated by lead pencil marks. Two circles are drawn likewise, to mark the length of the letters or figures. Dabs of paint go on where the hours are to be; enamel paint being applied by a camel's hair brush. When dry, the tops and bottoms are cut off to the proper length, then by suitable tools straight spaces are cut through, leaving the heavy lines of the "hours," and the surplus paint is carefully scraped off. Painters then draw in the hair lines of the hours, and put on the name of the company. The "minuters" next, by the aid of an accurately graduated machine, paint on the minutes. After inspection the dials go back to the third firing. A circular cut is then made through the enamel on both sides, and the intervening copper is burned out with acid, thus making a hole for the seconds dial, which has been undergoing operations similar to what has been described. After the edges of the hole and of the "seconds bit" have been ground and polished, the bit is soldered to its place.

Time regulation is, of course, very important. Two superior clocks are kept for this purpose; one for mean time, and the other for a constant rate. The Watch Company want to keep as near to the standard time as possible; but for practical purposes the main thing is to fix a uniform rate for adjusting their watches. Hence they are not content with Harvard time, because they evidently think they can do a little better; Harvard running its excellent sidereal clock for mean time rather than for constancy in time keeping. The Waltham observatory has a transit instrument, and an astronomical clock electrically connected with all the rooms where the timing of watches is an object. A chronographic record is kept, and a daily record of errors and variations of temperature and barometrical pressure. The clocks themselves are kept in a dark room whose temperature is maintained at 70° Fahr. all the year round. The barometrical pressure is regulated by an air pump for the constant timer, which is kept in an air tight case.

The Case Department is managed by Mr. Daniel O'Hara. Silver cases only are made at Waltham; the gold ones being all made at New York. The silver comes in bars, which are first rolled down and pressed into shape. Then the material goes to the turning room, where the pieces are snapped together and fitted. After the turners are through, the jointing and soldering are done. Now the cases are milled through for the joints, and the caps put on. In the opening room the winding crown is put on, and the joints fixed so that the case will open at right angles. It next goes to the springing room to receive the lifting spring and catch spring. The case is then taken apart for polishing, and the backs are sent to the engraver and engine-turner. It is now matched up again, and the pins put in, and finally polished; when it is backed and glassed ready for delivery. There are 150 operations needed to manufacture an ordinary watch-case. The department produces 650 silver cases a day, employing 400 hands. At the time of my visit they had on hand $90,000 worth of silver, and about $10,000 in gold for joints, etc., to guard which three large vaults have been constructed. The washings of aprons and hands, and the sweepings of the floors, and the cast-off garments of the workmen, are all saved up to be reclaimed in the refining room; and thus a large amount of metal is saved monthly.

While, as has been stated, it is the object of this article to treat the watch as a machine, rather than as merchandise, it ought to be stated, in conclusion, that the American Watch Company, besides its salesrooms at No. 5 Bond Street, New York, and at 403 Washington Street, Boston, has its agencies at Chicago, London, and Sydney. Most of the watches made are sold in this country; yet their excellence is appreciated abroad, as is proved by their increasingly large exportations.

Having inspected the shops at Waltham, a new delight was felt in looking at the finished watches as displayed to the public. My attention was especially directed to a newly invented case having no springs nor hinges, all parts screwing together, thus making the watch secure from dust and moisture. Also to fine timers with chronograph attachment, a Swiss invention for marking any particular moment, to within a quarter of a second, without interfering with the general movement. By pressing a spring, the sweep second hand is arrested; by another pressure it is made to fly back to 12; and by still a third pressure it is made to go again. The explanation is that the attachment is thus first lifted clear from the movement and temporarily detached, being afterward, by the same pressure, thrown into gearing again by means of a heart cam.

In reply to my inquiries, the following statement was made by Mr. Robbins, showing the augmentation of value of material by applied skill, movements only being considered:

A watch movement 18 size,		weighs 1 oz. 19 dwt. Troy.
" " 14 "	¾ plate,	" 1 oz. 13 dwt.
" " 8 "	"	" 1 oz.
" " 14 "	full plate,	" 1 oz. 9 dwt.

From these, and others taken at random, the conclusion was reached that the average weight of a watch movement is about 1½ oz. of metal, being nine-tenths brass, one-tenth steel, worth 3½ cents, brass being worth 30 cents a pound and steel being worth 62 cents a pound. These finished movements are worth, at manufacturers' prices, from $3.50 to $100 net.

Justice to the writer requires me to add that this article lays not the slightest claim to merit as from an expert, and quite possibly is in need of indulgence for errors of a technical sort. Yet for the general reader it may possess a certain interest and value of its own, as an impartial description and an unsolicited tribute to the science, perseverance, and skill characterizing one of the finest, most praiseworthy, and truly wonderful of our manifold American industries.

Photographs of Metallic Objects.

Although many persons will prefer to have a plain print of such an object as a medal or a piece of plate, there are others who may think that a photograph showing a metallic luster, and consequently very nearly resembling the original, is more satisfactory; and as it is very easy to make an excellent reproduction of a bright metallic object by transferring a transparent photograph to a metal or metallized surface, we propose to give some practical directions which will enable any person to make such reproductions.

The negatives for such pictures must be taken with uniformly dark backgrounds, as any light places would naturally show the metallic luster of the backing, and the effect of the picture would consequently be completely spoiled. In short, the background should be uniformly black, and ought to be reproduced on the negative as clear glass, or something very near to it.

As far as our experience goes, the best reproductions of metallic objects are made by developing a carbon print directly upon a metal plate—copper, either gilt or silvered, being most convenient. The prepared copper plates, which are sold at a moderate price for use by the engraver, are extremely convenient, as they may be had in a great variety of stock sizes, while the prepared surface is smooth, and in a good condition for being gilded or silvered. It is not worth while for us to give directions for gilding and silvering, as such work is done at a very low price by the trade platers and gilders, who abound in Clerkenwell. The commercial "brown" tissue is a good color for general work. As vigorous reproductions are generally required, it is well to use a rather weak bichromate bath for sensitizing—say about two per cent; and in other respects the mode of working is precisely that recommended for making carbon transparencies on page 359 of the present volume, the metal plate being used instead of glass.

The direct method on metal renders it necessary to use a reversed negative; and when an ordinary negative is to be printed from, it is necessary to transfer the carbon print from the support upon which it is developed, and this transfer may either be made upon a plate of metal or upon a sheet of metallized paper. When the carbon print is to be transferred after development, it is best to develop it upon a flexible support, as directed upon page 332, and to transfer it to the metal plate or paper—gilt or silvered—in the manner directed for ivory on the one hand, and for canvas on the other hand.

As many of our readers are not so far practically acquainted with the process of carbon printing as to be in a position to make an occasional print with a tolerable certainty of success, it is satisfactory to know that excellent metallic pictures may be obtained by making a transparent picture upon glass, in such a way that the image shows unreversed when looked at through the glass, and backing up the transparency with a piece of gold or silver paper. Transparencies made by the gelatino-bromide process of Mr. Wellington (page 79) are excellent for this purpose, but collodion, gelatino-chloride, collodio-chloride, or, indeed, transparencies by any other process, may be used.

M. Geymet recommends a somewhat complex process of transfer with collodio-chloride, which we may summarize as follows: A stout paper is coated with a moderately thick layer of plain gelatine, such a layer as would be produced by drawing the paper quickly over a solution of one part of gelatine in four of water, and this is coated with collodio-chloride, and printed as directed by Dr. Liesegang on page 772 of our volume for 1883. When toned and fixed the print is placed in water at a temperature of about 80° Centigrade, and as soon as the edges of the collodion film become loosened by the dissolving of the gelatine, a clean glass plate, which is about half an inch smaller each way than the print, is laid on a table, and the collodion print is laid down smoothly upon it, and after all inclosed air has been expelled by stroking with the hand, the loosened edges of the film are turned over the edges of the glass. It will now, in all probability, be easy to strip the paper away, leaving the collodion on the glass plate; but if the gelatine should not be sufficiently softened for this, the back of the paper must be treated with a sponge saturated with hot water. When the paper has been removed, the same sponge serves to clear away all traces of gelatine from the film. A sheet of white paper is next taken and laid upon the film, care being taken to insure contact all over by stroking it down with the hand or with a squeegee. The edges of the collodion film, which were previously turned over the glass, are turned back on the paper, and the paper, now carrying the film, is slowly stripped off the glass.

All is at last ready for transfer to the final support, whether this be gold paper, silver paper, or a metal plate; but this support should have been previously gelatined by having a solution of six parts of gelatine in one hundred parts of lukewarm water poured over it. The surface thus gelatinized is allowed to dry, but should be dipped in water immediately before the final transfer is made. The collodion film (now supported by the paper) is laid down on the final support, and the paper backing is next smoothed down with the hand so as to expel all air bubbles, and the whole is allowed to dry. It is now easy to strip off the paper covering, and the picture should be varnished with an amber and chloroform varnish.

If it be desired to imitate the appearance of an old and tarnished metal object—say antique bronze—a little green and yellow aniline color should be added to the gelatinous mixture used in making the final transfer.—*Photographic News.*

A New and Startling Invention.

Under the above heading the N. Y. *Mail and Express* describes a new railway improvement which certainly has the merit of novelty. It is believed to be the invention of Major Bundy, the editor of the above journal, notwithstanding he credits its authorship to a citizen of Connecticut. The frequent attempts of railway trains to pass each other on the same track have been attended so uniformly with disastrous consequences, that it has become to be the general belief that the feat is impossible, and that engineers will do well to desist from further efforts to accomplish it. To the ordinary mind it seems inevitable that if two trains approach each other on the same track, and do not slacken their speed, a collision must ensue. But there is a man in Connecticut whose mind is not ordinary. Of course, we do not mean by such a statement to insinuate that the Nutmeg State possesses only one man gifted with extraordinary mental endowments. The woods there are full of them, but so far as heard from, there is only one who has exercised his genius in solving the problem of how to enable two trains to pass on the same track without collision.

The plan of this ingenious person is very simple, as all really great plans and ideas are. He proposes to place on the front of every locomotive going in one direction a long inclined plane, upon which are two rails. These come close to the track at the forward end of the plane, and at the hinder end are connected with other rails that run along the tops of the cars, and down to the main track again on another inclined plane in the rear. When the train provided with this attachment meets another on the same track, the latter simply goes over the former, its weight making the connection of the front of the inclined plane and the rails of the main track perfect, and acting at the same time as a brake on the speed of the train underneath.

If this invention had been made a few years sooner, the number of double track roads in the country would not now be half as great as it is. A single track, with occasional switches for heavy freight trains, Major Bundy says, would answer all purposes, and the cost of constructing railroads would be decreased 25 per cent. The system will, of course, be adopted immediately on all single track roads, and within a few years the sensation of riding over or under another moving train will be so common as to pass almost unnoticed. This is a great country.

Power for the New Orleans Exhibition.

Director-General E. A. Burke has accepted the following proposals to furnish engines for the World's Exhibition:

	No. Engines.	No. H. P.
Cummer Engine Company	1	180
Cummer Engine Company	2	300
W. A. Harris	1	650
W. A. Harris	1	150
E. P. Allis & Company	1	500
Brown Engine Company	1	400
Robert Wetherill & Company	2	600
Armington & Sims Engine Company	4	500
Westinghouse Engine Company	2	400
Taylor Manufacturing Company	1	200
Smith, Meyer & Schuer	1	200
Novelty Iron Works	1	200
Buckeye Engine Works	1	125
E. M. Ivers & Son	1	100
Lane & Bodley	1	75
Jerome Wheelock	1	280
Hooven, Owens & Rentschler	1	500
Total	23	5,360

Flight of an Exploded Boiler.

A Lynn, Mass., correspondent, referring to a recent remarkable flight of a boiler illustrated in these columns, reminds us that, about two years ago, there was a notable boiler explosion of a similar character in that city. The flying portion formed a large part of the whole boiler, describing a circle high in the air, and landing 900 feet from where it started.

ELECTRO-PNEUMATIC VALVE.

It is impracticable to open and close valves such as are used upon steam pipes by the direct agency of electricity. Many appliances have been used to close valves on air pipes or the draughts of furnaces by clockwork set in motion by electricity, but these have proved unsuccessful for the reason that only small and easily moved valves could be operated, and the mechanism was large, complicated, and expensive. The device herewith illustrated—the invention of Prof. W. S. Johnson, an electrician of Milwaukee—makes use of compressed air which acts directly upon a piston, or its equivalent, and actuates the valve, which may be of any size. Since the electricity only performs the simple duty of admitting or releasing the compressed air from the chamber that operates the piston, a very feeble current is all sufficient, and, what is more important, the same quantity of electricity will move the largest valve in the world as readily as it will move the smallest, in other words, a single cell of any battery will stop the largest engine. The air is stored in a small tank, that is filled as occasion requires by means of a small air pump.

The valve shown in the sectional view, Fig. 1, is used on all pipes of steam, water, or brine systems. Fastened to the upper end of the stem is a saucer-shaped piece, H, above which the umbrella-shaped piece, J, is held by standards. Upon the under side of the piece, J, and fastened firmly to its edges to produce an air tight joint, is a flexible diaphragm, K, made of cloth and rubber. There is an opening through the pipe, M, into the chamber formed between the piece, J, and the diaphragm. It is easily seen that if air under pressure be admitted through the opening, M, the valve will be pushed downward to its seat; when the air is allowed to escape from the chamber, the spring, *b*, will open the valve to its full extent. The force with which the valve is seated will be quickly perceived, when it is remembered that the area of the diaphragm is much greater than that of the valve. When the area of the valve is 0·78 of an inch and the steam pressure 60 pounds per square inch, the pressure upon the valve disk is 47 pounds. The area of the diaphragm is 9 inches. If the air pressure should be 10 pounds per square inch, the valve would be seated with a force of 90 pounds, or 43 pounds in excess of the steam pressure. Since the area of the diaphragm may be increased at pleasure, it is evident that the valve can be operated against any pressure of steam.

The compressed air is admitted to the chamber by the electro-pneumatic valve shown in side elevation in Fig. 2. The pipe, M (Fig. 1), is attached to nipple F, while a nipple on the opposite side and not shown in cut is connected by a short rubber tube to the iron gas pipe that leads to the reservoir of compressed air. When the valve operates, the compressed air passes freely through it from nipple 1 to 2, and thence to the diaphragm valve. When the electric circuit is broken, the valve closes the outlet to the compressed air reservoir, and opens the outlet to the diaphragm valve, which, being relieved from pressure, opens again. The engraving shows the electro-magnets, the armature, the lever moved by the armature, and the piston valve, which is lifted by the armature when the valve moves.

By means of a thermostat, the electric valve may be used

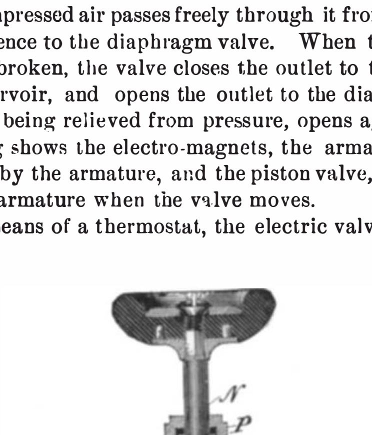
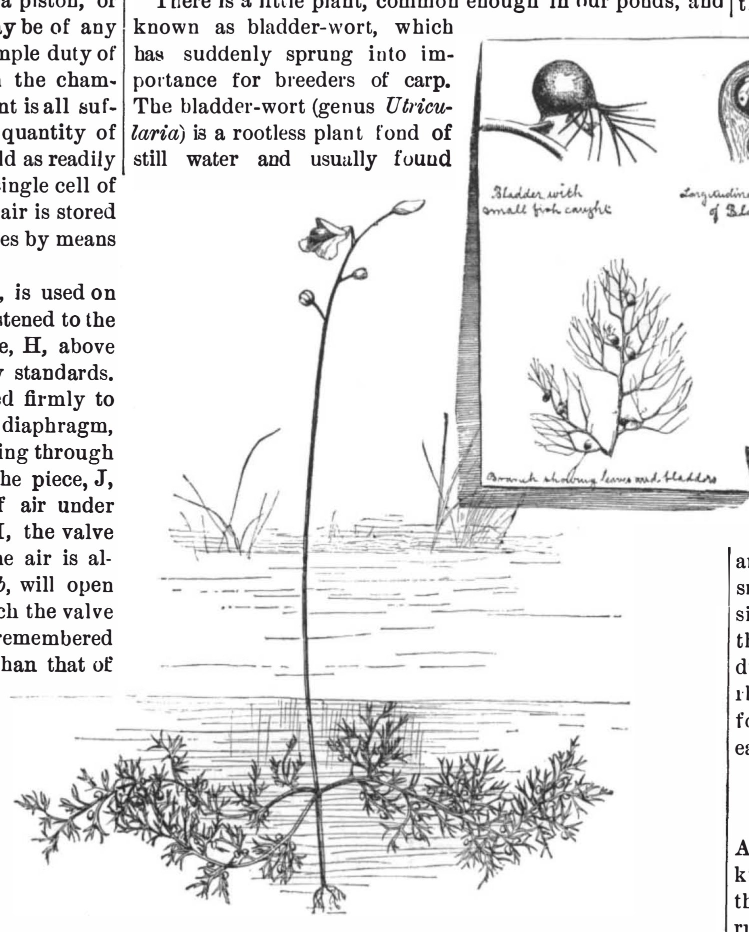


Fig. 1.—SECTIONAL VIEW OF DIAPHRAGM VALVE.

to control temperatures, the electric circuit being closed when the apartment reaches the desired temperature. The valve permits the compressed air to enter the diaphragm valve and shut off the steam, hot air, circulation of water, or whatever is the source of heat. Common gravity batteries are employed to operate the device, or it can be arranged so as to be worked by an open circuit battery like the Leclanche. But a few minutes' work each week are required to keep the pressure in the reservoir up to 10 pounds. This system is simple, automatic, and noiseless, and the many uses to which it may be put will be evident to our readers. When placed upon the heating pipes of a building it insures not only a temperature just warm enough, but one in which there are no fluctuations beyond the fraction of a degree. When applied to heating apparatus, the same battery and air reservoir answer for all the valves, a small gas pipe conveying the compressed air from the reservoir to all parts of the building. These devices are made by the Milwaukee Electric Mfg. Co., of Milwaukee, Wis., and will be exhibited at the International Electrical Exhibition to be held under the auspices of the Franklin Institute, Philadelphia.

HOW OUR CARP ARE DESTROYED.

There is a little plant, common enough in our ponds, and known as bladder-wort, which has suddenly sprung into importance for breeders of carp. The bladder-wort (genus *Utricularia*) is a rootless plant fond of still water and usually found floating half in and half out of water, the branching and stem-like leaves forming the submerged float from which rises the flower stem. To the leaves are attached curiously insect-like bladders filled with water, and varying in size in the different species, reaching at times a diameter of one-fifth of an inch.



FISH EATING PLANT—UTRICULARIA.

It was formerly, and with much probability, supposed that these bladders served the purpose of floats; for until a few years ago it was taken for granted that air and not water filled them. It is now known, however, that the bladders serve a more useful purpose than merely to keep the head of the plant above water; they are the digestive organs of the *Utricularia*, and at the same time are so constructed as to form a very ingenious but extremely simple trap for catching food. It is into these bladders that thousands of carp eggs find their unwitting way, together with many insects, crustacea, and other tiny objects, both animate and inanimate.

It is only recently that the *Utricularia* has been accused of destroying carp eggs, but for nearly thirty years it has been known as a receiver of small insects and crustaceans, and it has been known as an insect feeder for at least twenty years. Mrs. Treat, of this country, in 1875 gave a full and interesting description of the habits of one species (*Utricularia clandestina*), and Darwin and others, of Europe, studied the habits of other species in Europe and elsewhere.

In its character as an insectivorous plant the bladder-wort might fail to arouse general interest, but as a destroyer of carp it has a commercial as well as botanical and scientific character. The common bladder-wort (*Utricularia vulgaris*) affords the easiest subject for study, inasmuch as its bladders reach the largest size and may be satisfactorily examined with a moderate magnifier.

The bladder is pear-shaped, with an opening at the small end. Around the mouth are antennæ-like projections or bristles, which, according to Darwin, are for the purpose of warding off and keeping out insects of too great size. The mouth is closed by a valve which yields readily to light pressure, but offers an immovable barrier to the once captured creature. The utmost strength compatible with such a structure has apparently been attained. The valve is a thin and transparent plate, and by means of the water behind it, is made to stand out a bright spot, which Darwin thinks may attract prey. Something certainly attracts the tiny denizens of the water, for they swim up to the mouth and crawl into the bladder by the readily yielding door. As there is no seductive secretion here, as in the case of many insect destroying plants, the great naturalist's surmise is probably correct.

Some of the insectivorous plants, on catching their prey, at once pour out a digestive fluid analogous to the gastric juice of the human stomach, but with the *Utricularia* it is not so. The insects or other food when caught in the bladder are merely captives, and swim about in their confined quarters with eager activity in their endeavor to find an outlet, until asphyxia for lack of oxygen comes on. Even now the plant makes no effort to digest the animal food, but waits patiently until decay takes place, and the animal matter is by putrefaction resolved into fluids which the numerous papillæ lining the bladder can absorb.

Darwin's experiments showed not only that living animals could make their way into the bladder, but that inanimate objects falling on the valve would be engulfed with lightning-like rapidity. With all this information to begin with, it is not strange that naturalists should turn to the bladder-wort to seek a solution for the great destruction of the carp, for the carnivorous plant was known to possess facilities not only for the capture of floating spawn, but even of the newly hatched fish. Examination and repeated experiment proved conclusively that the greedy little bladders were making sad havoc with the fish, and in consequence carp breeders are bidden to open war vigorously on *Utricularia* and all its species. It may seen at a hasty glance that the small bladders can hardly be responsible for any very extensive destruction of eggs or small fish, but the doubters of the ability of insignificant agents, acting together, to produce stupendous effects may be referred to the microscopic rhizopods or the earth worms, each in their own way performing wonderful feats in the way of earth building and earth preserving.

Apple Tree Borer.

In answer to correspondent respecting tree borers, the Albany *Cultivator* states as follows: The apple tree borer, known as the *round headed borer*, in its perfect state is a beetle three-fourths of an inch long, with two broad whitish stripes running the whole length of its back, with rather long and curved horn-like antennæ. This beetle lays its eggs in the bark of the tree near the ground early in summer, and on till midsummer. These soon hatch, and the young larvæ begin to gnaw their way inward, cutting gradually into the solid wood. They are about three years in reaching maturity, when they come out in the form of the beetle already described. Their presence in the tree may be readily detected by the fine sawdust-like castings from the holes. They are easily reached and killed by clearing away the openings of the holes with the point of a knife, and then punching them with a flexible wire or small twig. We have never found anything better than a small flexible twig from which the bark has been stripped to make it small enough to enter the holes. The operator knows when he reaches them by the peculiar touch. It is better to examine the trees often enough to find the larvæ when they are young, and before they have penetrated far into the solid wood. A partial remedy for preventing the laying of the eggs, is coating the bark from the ground well up with soft soap, or soap made as soft as thick paint, with washing-soda and water. If applied in fair weather, it becomes dry and will not so soon wash off. It may be applied two or three times from the first to the end of June. This insect attacks the pear, quince, mountain-ash, and thorn. The *flat headed borer* is half an inch long, more or less, of a shining greenish-black color. It is very common in the Western and Southwestern States, and is also found far north. It attacks the trunk of the tree from the ground up to the limbs, and lays its eggs at the South late in May, and in Canada in June and July. The eggs soon hatch, and the worms bore through the bark into the sapwood. It is much shorter-lived than the round headed borer. Sickly trees are more liable to its attacks than strong and healthy ones. The larvæ are easily found by using the knife, and are destroyed; and the eggs may be mostly excluded with the soap and soda already mentioned. This insect attacks the oak, soft maple, and several other trees.

Fig. 2.—SIDE ELEVATION OF ELECTRO-PNEUMATIC VALVE.

Manufacture of Glass Beads.

The above manufacture includes turned massive beads, pressed, drawn, and blown descriptions. The first named kind was first manufactured in Venice, and about 200 years ago was introduced into the Fichtelgebirge district of Bavaria. At first the beads for rosaries were the principal articles made, and they are still produced in Bavaria, whence they are exported in quantities to Spain, Portugal, etc. The manufacture is, however, less important than formerly. As an illustration of the scale of production, it is remarked that a workman can make of some kinds of beads as many as 36,000 per day.

In contrast to the heavier Bavarian descriptions come the Venetian productions. These are mostly beads for embroidery. The process of manufacture is a curious one. The glass is drawn into thin tubes and then cut up. The beads are afterward placed in heated drums, where the sharp corners are rounded off. After being rubbed in chalk and charcoal, they are strung together. In Bohemia a kind of bead for trimming is made in a similar manner.

In making the blown or so-called lamp beads, a bellows is employed, with which a paraffine or gas flame is brought to a blowpipe flame. In this process, as carried out in Venice and Thuringia, drawings are made on the glass balls or beads with pointed implements made of glass, and these designs are burnt in by the flame. The deadening process so extensively employed is both chemical and mechanical in its character. In the chemical operation, hydrofluoric acid is used, by means of which the surface of the glass is removed. There was formerly another process used in France which was a secret. A German workman, however, found it out by accident. This is the sand process, which is now used in Thuringia for the operation of deadening.

The manufacture of pressed beads is effected by pincers, of suitable form. The glass is heated on a moderate fire and brought into the mould. In this manner beads and buttons are produced in very effective styles, both plain and colored. Of course the beads have to pass many times through the workman's hands before completion. To this branch belong the amulets, which are sent to the Gold Coast, and are used in various sizes according the rank of the wearer. Originally these amulets were made of agate, but as this substance is eight or ten times dearer than glass, the latter material has been adopted.

The Central German Society of Industrial Art has lately been giving attention to this subject, on which a lecture was delivered by Herr Bettmann, of Frankfort, himself a manufacturer of the articles in question.

A RUSSIAN FLOWER BASKET.

The accompanying illustration gives a good idea of a unique style of flower basket which was shown at the late

A RUSSIAN FLOWER BASKET.

International Horticultural Exhibition at St. Petersburg. It represents what many ladies will consider a great convenience when carrying flowers, as it obviates the necessity of carrying a basket, or of stooping to place the flowers in a basket on the ground, and may be used if desired as a walking stick. The standard of the basket may be stuck into the ground in any convenient place, and moved about as required, while it may be made as light to carry as ordinary sun umbrellas. In fact, the device shown seems to suggest the idea of making the basket so it may be closed up umbrella like.

AN AUTOMATIC FIRE EXTINGUISHER.

The apparatus herewith illustrated, which has been perfected by Mr. Grinnell, of Providence, R. I., and is known as the Grinnell sensitive automatic fire extinguisher, is intended to arrest a fire in its earliest stage by the action of the heat of the fire itself. Although this apparatus has been used extensively in this country for several years, it was but recently introduced in England. The essence of the extinguisher, says *The Miller*, in describing a recent experiment in London, resides in the fact that metal sprinklers, connected with pipes leading to water under pressure, can be closed by solder, which when cold is perfectly capable of holding a previously locked device; and yet which is certain to fuse at a temperature of say 155° Fah. To protect any building from fire by this extinguisher, lines of small pipe are carried through the building near the ceilings, and from eight to ten feet apart; these are all connected with a larger pipe leading from the public water main, or any source of supply that will keep the water in the pipes under pressure. Should a fire start at any point the heat at once rises to the ceiling, where the temperature is very soon raised sufficiently to melt the solder, which then releases the valve, and the water is profusely distributed on the fire.

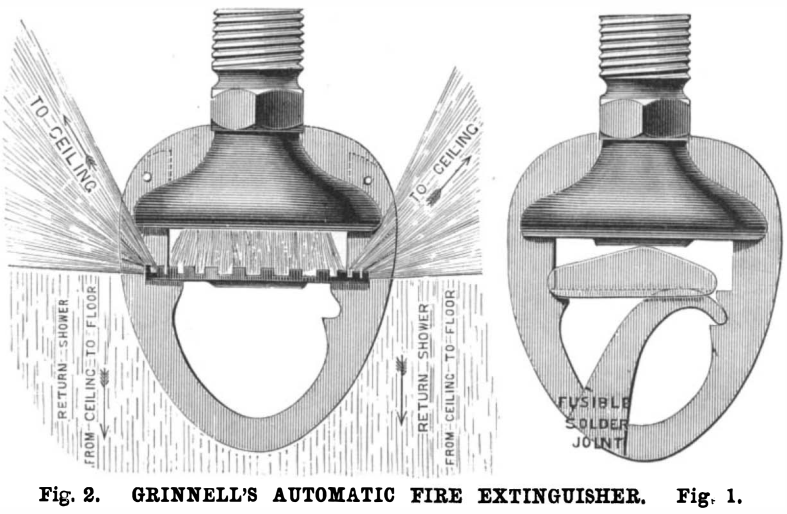


Fig. 2. GRINNELL'S AUTOMATIC FIRE EXTINGUISHER. Fig. 1.

Fig. 1 shows the sprinkler closed; Fig. 2 shows it in action. The base of the extinguisher is formed by a thin metallic diaphragm, capable of yielding to the internal water pressure, and in the center of which is an opening through which the water is discharged. Around the opening is the valve seat, the valve being a disk of soft metal held in a circular brass plate, which has a toothed edge and acts as a deflector, by which the stream of water is cut into spray and distributed on both ceiling and floor. The valve is held against the seat by a pair of compound levers, one of which bears centrally on the deflector. Both levers fulcrum on a thin brass yoke secured to the body of the extinguisher, and the long arm of the second lever is secured to the yoke by the fusible solder.

When the heat of a fire softens the solder joint between the second lever and the yoke, the diaphragm, with its valve seat and the valve, moves a sufficient distance to completely sever the joint before the water can escape to cool it. The levers are thrown from the yoke; the deflector is forced from the opening to the notches which form the fulcrums that held the levers, and the deflector is in the position shown in Fig. 2.

The system includes an alarm gong or whistle, that works simultaneously with the fire extinguisher, and thus calls attention to the fact that a fire has started somewhere in the building. The test is thus described by our contemporary: "The flooring of a light wooden shed, 30 feet by 20 feet, which was fitted with a system of piping and six jets, was covered with wooden shavings, which were in a moment kindled into a fire that threatened the whole structure with speedy destruction. The flames, however, had not raised their head for more than half a minute before the extinguisher began to rain down a shower that in fifteen seconds left no other trace of the fire beyond some blackened bits of shavings. We left the scene with the conviction that the Grinnell automatic extinguisher is a most powerful weapon against fire, and that it deserves the closest attention of millions."

Test for Sulphite of Soda.

By the use of sulphite of soda in the pyro developer, negatives of a superior color and quality are produced. The purity of the soda is quite important, and a simple method of testing a given quantity has been recently suggested in the *Photo. News* as follows:

The best method of testing a sample of sulphite is to add nearly sufficient of a strong acid to convert the salt into bisulphite, and to notice if any effervescence occurs. If effervescence takes place, carbonate of soda is present, and the sample of sulphite should be rejected.

To be more exact, first put 4 drachms of the sodium sulphite into a glass flask; add 6 fluid drachms of water, and heat gently, so as to cause the salt to dissolve. Allow the solution to cool down to about 85° Centigrade, and add a mixture of 1 fluid drachm of strong hydrochloric acid and 2 fluid drachms of water. The slightest effervescence or the formation of minute bubbles of gas on the sides of the flask will indicate the presence of carbonate in the sulphite.

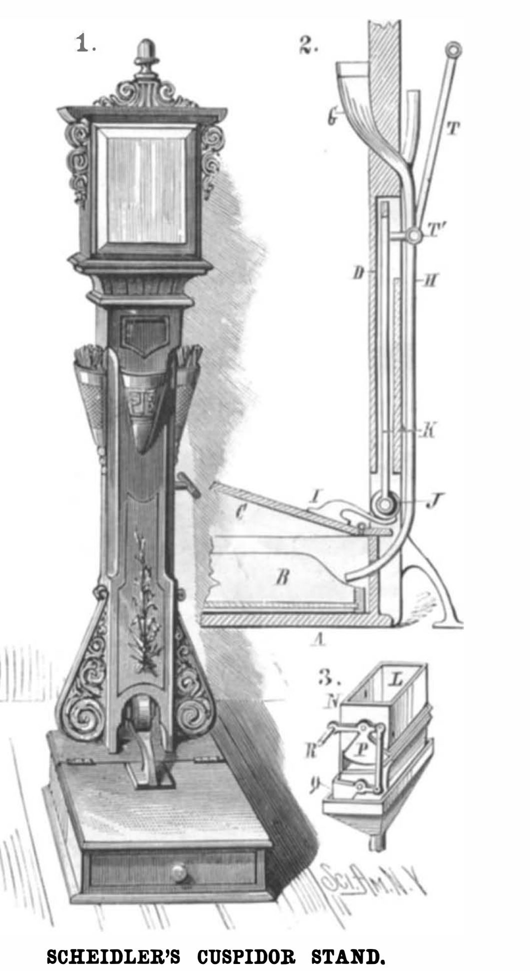
Gas from Seaweed.

In the course of a lecture on the "Economic Applications of Seaweed," recently delivered before the Society of Arts by Mr. Edward Stanford, F.C.S., the lecturer spoke of the establishment in the Hebrides of works for the recovery and treatment of seaweed. The principal product sought to be made in these works was iodine; but, in the process, the weed was calcined in retorts, and the works were lighted by the gas produced during distillation. It was stated, however, that, owing to the presence of salts of sodium, the gas after passing through a series of purifiers still burnt with a strong monochromatic yellow flame. Iron retorts, heated by coal or peat, were first used, but have been superseded by brick ovens. The tangle weed swells in the oven, and produces a very light and porous charcoal, without sulphides, from which the salts are easily washed out. This charcoal is more like animal than wood charcoal. Ammonia is collected from the distillate, and is used on the farm attached to the works, and the tar is utilized on the roofs, etc.

CUSPIDOR STAND.

This is a useful and ornamental device, and, as represented in Fig. 1, entirely conceals the purpose for which it is designed, except as that might be in part apprehended from the lighters or matches in the receptacles at either side, or the ash receiver at the front of the stand, which is tastily designed, with a mirror in the top. The principle on which this cuspidor stand is constructed will be readily understood by an examination of the cross sectional elevation in Fig. 2, where may be seen the box, A, drawer, B, with hinged cover, C, the latter operated by the curved arm, I, through the roller, J, and the rod, K, sliding vertically in the standard, D, the rod, K, having a projecting arm, T', with a connecting rod, T, pressing down on which opens the cover. At the back of the top of the standard is hung an ingeniously contrived sand box, shown in Fig. 3, formed of two troughs, the upper one of which is shown at L, and both secured on a plate, N. These sand troughs have end pieces, P and Q, connected by a bar and operated by a handle, R, with which the rod, T, may also be connected when it is desired to cover with sand the expectorations in the box, B; the sand from the sand box, as also the ashes and other deposits from the cup, G, flowing down the tube, H. The drawer is supposed to always contain a portion of sand, sawdust, or some similar material, and of course permits of as frequent change as desired; while, for use in a sick chamber, the sand may be mixed with any approved disinfectant.

For further information relative to this patent apply to



SCHEIDLER'S CUSPIDOR STAND.

Mr. Andrew A. Scheidler, of No. 103 West 56th Street, New York city.

A LOCAL paper of Dakota is responsible for the following: A Dakota farmer in 1881 planted a single grain of spring wheat and from it grew twenty-two stalks, each bearing a full head of wheat, yielding in all 860 grains of wheat; 760 of these were planted the next year, producing one-fifth of a bushel of splendid wheat. This was planted last spring, yielding seventeen bushels, making 1,020 pounds of wheat from one grain in three years.

ENGINEERING INVENTIONS.

A railroad switch has been patented by Mr. David H. Foreman, of Lancaster, Pa. This invention provides a safety "facing point" feature, safety trailing actions, and self-locking arrangement, designed to insure absolute safety for fast trains upon a main line, regardless of any lack of duty, confusion, or misinterpretation of signals on the part of the engineer.

A railway cable grip has been patented by Messrs. Henry Dods and Frank Hindes, of Virginia City, Nev. The grip plate is arranged to shift along the car when gripped to the cable, with piston rods and cylinders at each end, and springs on the pistons between the grip plates and cylinder heads, with air cushions, and various novel devices of construction and arrangement.

An automatic car brake has been patented by Mr. Edward Ebi, of Cedar Rapids, Iowa. The tender has a bar held to slide longitudinally under it, with a buffer at the front end of the bar, a hand lever, a locking pawl, and other devices, intended to afford means whereby all the brakes of a train can be applied automatically by the momentum of the cars, at the pleasure of the engineer.

An apparatus for making steel by the Bessemer process has been patented by Mr. Alfred Davy, of Sheffield, York County, Eng. The invention consists in employing, with a portable vessel, stand pipes adapted to discharge air into the metal in the vessel beneath the surface by pipes dipping in from above, thus enabling cast iron founders to make steel and steel castings without the costly plant now provided for this purpose.

An improved arch for supporting evaporating pans for sugar making and other purposes has been patented by Mr. Chauncey C. Alfred, of Fairfax, Vt. The invention covers a novel construction and shape of the arch, whereby a more even and perfect distribution of the heat is obtained under the bottom of the pan, the firebox of the arch having a grate arranged within a drawer, so the fire may be readily drawn when the sugar has been sufficiently exposed to the heat.

An apparatus for removing incrustations from water mains and pipes has been patented by Mr. Edward H. Keating, of Halifax, Nova Scotia, Canada. This invention provides a novel construction of compound plowing machines or machine scrapers, to be propelled by natural gravity, force, or power of the water furnished from the reservoir or fountain head, or from the ordinary stationary engines, for cleaning out any water pipe or main which may have become foul by incrustations, stones, etc.

MECHANICAL INVENTIONS.

A saw tooth has been patented by Mr. Philip V. Conover, of Uvalde, Texas. This invention covers a novel construction in detachable saw teeth, and in combining with the same a spring bolt, whereby each tooth and its locking key are held securely in position, with facility for detaching as required, and so that any drawing action in cutting the wood tightens the attachment of the tooth.

An attachment for squares for builders' and joiners' use has been patented by Messrs. Andrew G. Olson and John McFarlane, of Duluth, Minn. The invention consists in an adjustable scale or divided measuring attachment for squares, whereby increased facilities are afforded for measuring or laying out rafters or beveling the toes and heels thereof, and also for laying out stairs and other purposes.

AGRICULTURAL INVENTIONS.

A cable railway for plantations has been patented by Mr. George W. Thomas, of Cypre Mort, La. This invention covers an improvement on a portable railway formerly patented by the same inventor, and combines with such railway a system of endless cables for propelling cars, and also for drawing agricultural implements across fields, etc.

A grain drill has been patented by Mr. Francis B. McCabe, of Lewistown, Pa. The invention consists in improved shifting devices for ranking and cleaning the hoes, and means for automatically working them, in the construction of an adjustable lock spring hoe, in a fertilizing feeding device, and in a lifting device for the hoes.

A combined sulky plow and cultivator has been patented by Mr. Thomas Huddlestone, of Portage la Prairie, Manitoba, Canada. This invention covers a novel arrangement of parts for such construction of a combined plow and cultivator as may be readily adjusted for any desired kind of plowing, and to promote convenience in adjusting and controlling the machine.

A plow has been patented by Mr. James W. Montgomery, of Thomasville, Ga. This invention relates to plows which may be changed to use either as shovel plows or cultivators, and narrowed or widened to suit the widths of rows to be cultivated, and its object is to adapt the plow stock and beams so the plows may be set at different relations to each other fore and aft, and at different distances apart transversely, etc.

MISCELLANEOUS INVENTIONS.

A sleigh shoe has been patented by Mr. Henry A. Morrell, of Pittsfield, Me. The invention covers a sled runner shoe with one or more longitudinal ridges along the lower side or bottom of the shoe, to prevent the sled from sliding laterally on wads sloping sidewise, and to enable the sled to run with less friction.

An escapement for time pieces has been patented by Mr. August W. Kientoff, of Dallas, Ore. This invention relates to balance wheel or pendulum escapements, and provides a novel construction and arrangement of parts, making an escapement which can also be applied to a common toothed escapement wheel.

A harness pad has been patented by Messrs. Oscar L. Dorr and Thomas J. Tamplin, of South Walpole, Mass. This invention consists in an imitation sheepskin pad, in which the wool of the sheep or other animal is incorporated with a fabric backing or holder in place of the skin, so the filling can be frequently renewed.

An indicator for public assemblies has been patented by Mr. Harry S. Grimes, of Portsmouth, O. It consists of an endless apron of flexible material over top and bottom rollers, having grooved guide plates to receive sheets on which are letters, the operator thus publicly exposing messages to be read at fairs, meetings, and assemblages.

An indicator for merchandise has been patented by Mr. John Wayer, of Syracuse, Ind. The invention consists in a casing having openings and containing slides carrying numbers, the slides being locked in place automatically by suitable springs, making an indicator to number articles of each different size or number contained in the receptacle.

A luggage carrier for tricycles has been patented by Mr. Charles R. Zacharias, of Newark, N. J. This invention provides means for readily attaching a luggage carrier to the tube containing the steering rod of the vehicle, and its adjustment to or detachment therefrom as required, and so the carrier when not in use may be conveniently attached to be out of the way.

An automatic feed device has been patented by Messrs. William Schwarting and John F. Traster, of Wolcott, Iowa. The invention consists in an attachment for hoppers which, being connected to the feed gate and pressure board, effects the regulation of the feed to the grinding rollers, and wherever material is to be supplied from a feed hopper.

An automatic governor has been patented by Mr. William J. Radloff, of Rudd, Iowa. It is designed more particularly to regulate the wind gates or slides of thrashing machine cleaners, and consists in improved mechanism for use in connection with centrifugal ball governor levers to automatically open and close the wind gates, and regulate the wind currents.

A tongue support has been patented by Mr. Nathaniel Johnson, of Harrisburg, Ill. This invention covers improvements on a former patent issued to the same inventor, and consists in combining with the axle curved hounds having their front ends connected with or made integral with longitudinal hounds, between which the rear end of the tongue fits.

An adjustable bench hook has been patented by Mr. Harry Cooper, of San Antonio, Texas. It is made with a plate carrying a sliding bar, to which is adjustably secured a hook, the sliding bar and hook being locked in place by a clamp and cam attached to the plate, and the plate and its attachments are locked to the bench front by a stationary lug attached to the plate.

A mixing machine has been patented by Messrs. John McKeage and William Wells, of Brooklyn, N. Y. The machine is intended for mixing flour, grain, and similar substances, and the body is so shapes that it is revolved with a peculiar wabbling gyratory action, causing the material inside to be tumbled from side to side and end to end, thus becoming thoroughly mixed.

A brick machine has been patented by Messrs. Charles A. Carpenter and Joseph Hill, of Keokuk, Iowa. This invention covers an improved mechanism for filling the moulds, shifting them to the pressers and partly pressing the clay, another pair of pressers completing the pressing, then shifting them to a discharger, and discharging them, all being done automatically.

A cotton gin feeder has been patented by Mr. Thomas F. Swinnie, of McFarlans, N. C. This invention provides a mechanical cotton gin feeder to obviate the necessity of manual labor, a mechanical elevator and a self-adjusting mechanical rake being located relatively to each other in a novel way in connection with a removable sided independent box, with various other novel features.

A combined hat and coat hanger has been patented by Mr. William R. Cole, of Pottsville, Pa. It is constructed to form a long and separately pivoted pendent button hook attachment or coat hanging hook and is a compact device, few parts serving to form the coat hanging hook, the hook by which the device is suspended, and the spring bat holding hook or clamp.

A floor jack has been patented by Mr. Emmett J. Lobdell, of Northville, N. Y. A movable head carries a rack with which engages a dog or pawl pivoted to a lever, itself pivoted to the outer end of the head, and there is a thrust block adapted to be fastened in position and attached to the lever by a pin and slot connection, thus making an inexpensive and effective jack for closing the joints of flooring, etc.

A fire grate has been patented by Mr. James D. Richards, of Patriot, Ind. This invention combines, with the walls and front bars of the grate, the bottom bars made longitudinally adjustable, two rock shafts connected to or engaging with them, and a bar for so connecting the rock shafts that either will oscillate the bottom bars, the grate being specially adapted to control and economize hot air and thus save fuel.

A stem winding watch has been patented by Mr. George F. Johnson, of Aurora, Ill. The invention consists in a novel construction and combination especially of the setting lever and locking bar, and spring controlling the latter, whereby the spring operates to hold the setting lever in position, both when drawn out and pressed in, and prevents it when closed from dropping, and by striking the cover of the watch case interfering with the closing of the case.

A device for protecting balance wheels of watches has been patented by Mr. Everton J. Arrick, of McConnellsville, O. This invention is mainly designed for use in watch repairing, and consists in a flanged holder for balance wheels, which will admit of necessary work or repair without removing the staff from the wheel, and of the wheel being chucked in the lathe at either end of the staff, free from all risk of damage to the rim of the wheel while in the lathe.

Business and Personal.

The Charge for Insertion under this head is One Dollar a line for each insertion; about eight words to a line. Advertisements must be received at publication office as early as Thursday morning to appear in next issue.

Notes & Queries

HINTS TO CORRESPONDENTS.

Name and Address must accompany all letters, or no attention will be paid thereto. This is for our information, and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all, either by letter or mail, each must take his turn.

Special Information requests on matters of personal rather than general interest, and requests for **Prompt Answers by Letter**, should be accompanied with remittance of $1 to $5, according to the subject, as we cannot be expected to perform such service without remuneration.

Scientific American Supplements referred to may be had at the office. Price 10 cents each.

Minerals sent for examination should be distinctly marked or labeled.

(1) G. C. R. desires a formula for making mastic preparation for covering brick work outside. A. Mastic cements are generally mixtures of 100 parts each sand, limestone, and litharge, with 7 parts linseed oil. These ingredients carefully mixed and well worked together will have the consistency of moist sand, but little coherence. When pressed, however, the mixture gradually acquires the hardness of ordinary sandstone. A waterproof mastic cement consists of 1 part red lead to 5 parts ground lime and 5 parts sharp sand with boiled oil. Or, 1 part red lead to 5 of whiting and 10 of sharp sand mixed with boiled oil.

(2) P. C. G. asks how to make a good gold writing ink. A. Gold ink is prepared by taking equal parts of honey and gold leaf; triturate until the gold is reduced to the finest possible state of division, agitate with 30 parts of hot water, and allow it to settle. Decant the water and repeat the washing several times; finally dry the gold and mix it with a little gum water for use. 2. How to make rubber stamp inks. A. Rubber stamp inks are simply solutions of aniline colors mixed to a proper consistency with glycerin.

(3) J. W. C. asks: How can I blue malleable iron similar to the blue of steel squares, nails, tacks, screws, and other articles? A. After polishing heat them over a charcoal fire until the blue color comes, then cool them in dry sand or ashes. A pan of hot sand is good to heat in if the articles are small enough.

(4) E. N. P. asks: What is the stuff that is used to nickel plate with by just rubbing the mixture over it. It only plates brass, copper, zinc. A. The solution is probably a silvering solution, such as made by preparing a solution of one part potassium cyanide in six parts water; to this there is added a concentrated aqueous solution of silver nitrate (free from acid) until the precipitate is redissolved. The foregoing solution is then mixed with fine chalk and applied after previously having cleaned the objects. Nickel cannot be applied in the manner described in your letter, and it may be possible that you have in mind the Stolba process which is described in our answer to query 28, in the SCIENTIFIC AMERICAN for May 24, 1884.

(5) W. H. S. asks: What sort of a crucible will answer wherein to melt gold? Will a small one of sand do? A. The ordinary sand crucibles, such as used by jewelers.

(6) S. L. W. asks: Does increase of leverage necessarily decrease speed? A. Yes. This is one of the essential laws of mechanics.

(7) T. H. S. asks if a driving belt composed of a band of thin steel covered with leather would possess the properties of a leather belt, in addition to that of not stretching which the steel would afford. A. A leather lined steel belt would no doubt be very rigid. The mechanical difficulties attending its application and its cost would probably negative its value. The property of staying in its place upon the pulleys is due greatly to the elasticity of leather belts. The rounded face of the pulley could not easily control a rigid flat belt.

(8) W. R. B.—The pitching of a ball in a curved line is a well attested fact. But the pitching alternately around 4 posts as sketched by you is extremely doubtful. See SCIENTIFIC AMERICAN SUPPLEMENT, Nos. 402, 410, for a discussion of this subject.

(9) M. E. L. asks how to obtain more knowledge concerning liquid carbonic acid as a motive power, as a sequence of the labor of Dr. Raydt. A. We have no further information on this subject than we have already printed. Dr. Raydt's experiments possibly open up a new field, but all previous attempts to utilize carbonic acid in place of steam have been failures.

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July 29, 1884,

AND EACH BEARING THAT DATE.

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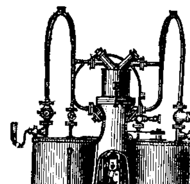

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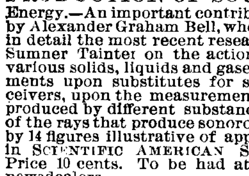

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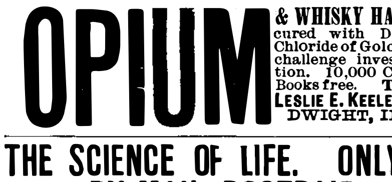

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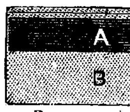

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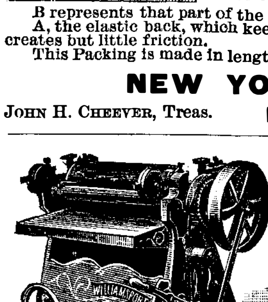

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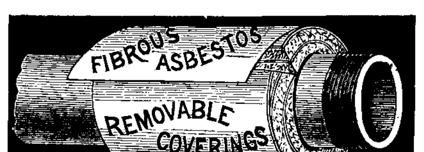

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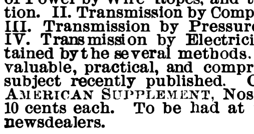

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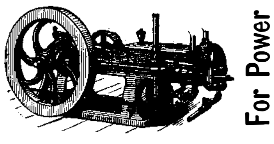

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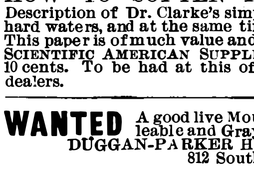

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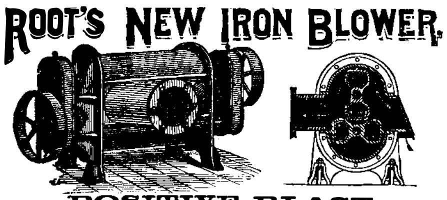

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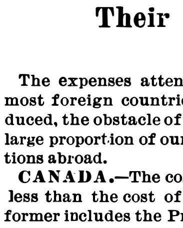

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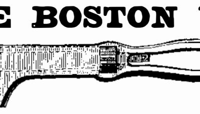

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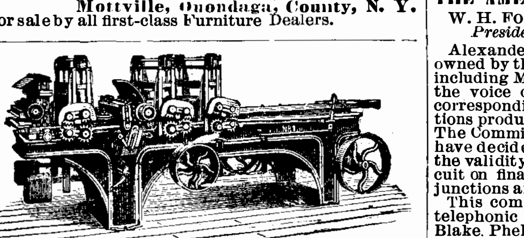

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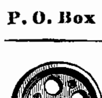

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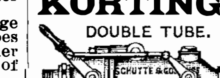

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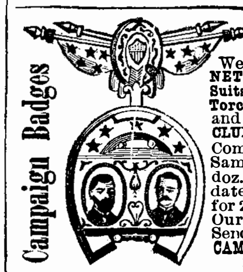

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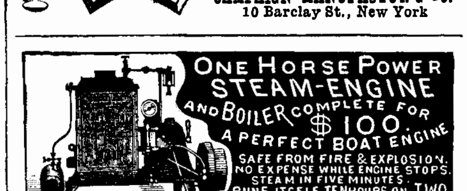

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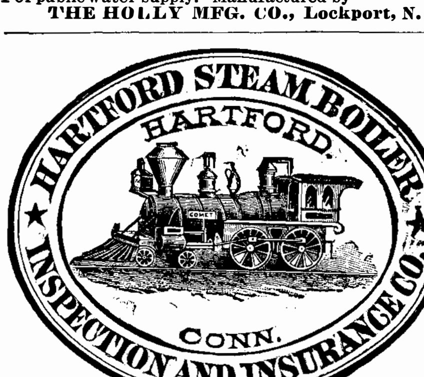

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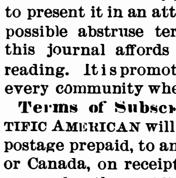

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