AMERICAN INDUSTRIES.—No. 59.

THE MANUFACTURE OF STANDARD SCALES.

When Thaddeus Fairbanks, in 1830, made the first application of his compound lever system in the construction of weighing apparatus, its simplicity and practical usefulness were not long in being appreciated. There was nothing essentially new, however, in the theory of their construction, except in the business-like perception with which he saw how previous well known mathematical and mechanical laws might be applied, in the combination of levers and fulcra, to fill a wide field of usefulness. Archimedes, more than 200 years before Christ, had shown a knowledge of the capabilities of the lever which has been nowhere better illustrated than in the saying imputed to him, "Give me a fulcrum on which to rest, and I will move the earth;" but the only application of the principle of the lever in this department previous to 1830 was in the old-fashioned steelyard, practically very limited in capacity, and exceedingly clumsy in operation. These steelyards and even-balance scales were then the only weighing machines in general use, and it was the obvious need of an improvement in this direction, first experienced in his own business, that led Mr. Fairbanks at the outset to make a scale for his own use, then to make others for his neighbors, and finally, with his brothers Erastus and Joseph, to make a business of this manufacture. The business in 1830 was conducted in a building 25 by 60 feet, employing 10 men. To what extent it has grown within a half century is much better set forth in the illustrations we to-day present relative to this industry than can be understood by the mere details in figures. Ten substantial brick buildings, with nearly ten acres of floor room, now take the place of the original shop; there is also a lumber yard covering ten acres, in which are constantly kept from two to three million feet of lumber; there are over 600 men employed, and 93 tenement houses for the employes; the capital invested now amounts to over $2,000,000, and the annual product to considerably more than that, while in 1831 it was less than $6,000.


MARKING THE BEAMS

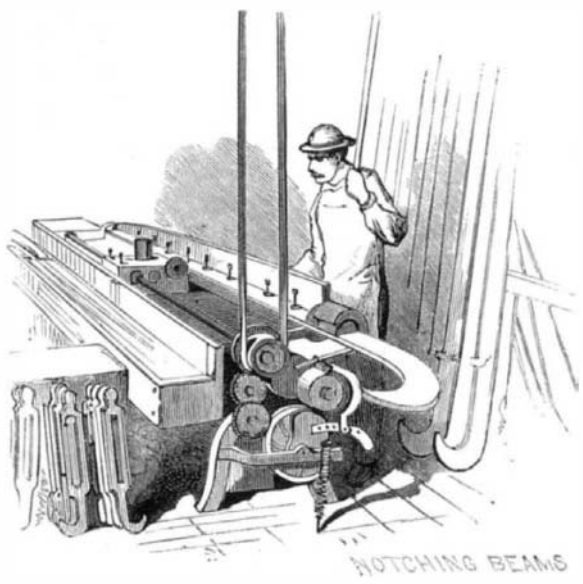
As E. & T. Fairbanks & Co. cover all departments of the work which enters into their scales, their foundry is necessarily one of the principal buildings. It is 110 feet wide by 175 feet long, with a side extension, in which are three furnaces, one of 20 tons capacity, the others of 12 tons each; also a Sturtevant blower and a 35 horse power engine. These furnaces are worked alternately, one in the morning, a second in the afternoon, and the third on the following morning, their charges being always put in by weight, from the furnace charging scale perfected by the company. These scales are built of iron, so as not to be affected by the heat, and are so arranged that the weight of each portion of a charge may be exactly known without the knowledge of the workman. The pig iron used is about three-fourths American and one-fourth Scotch. The castings embrace a wide variety of sizes, from the large levers and framework of the great canal weigh lock and railway scales down to the small balances and tiny weights everywhere seen. A fine moulding sand is obtained near by, at Fort Ann, near Lake Champlain, and 500 tons of it come every year to the foundry. A railway track runs through the foundry, and all of each day's castings are loaded on cars and run to the "pickling" and milling room, where the larger pieces have a bath in a weak solution of sulphuric acid, and the smaller ones are revolved in a drum according to the usual plan with small castings. Should any imperfect pieces be found here they are sent back to the foundry, and, if the fault be plainly due to careless or negligent workmanship, the workman is held accountable therefor. There is usually but little cause for complaint on this score, however, for the workmen have generally been many years in the employ of the company, and their theory in this, as in every other department of their business, has been to employ only the most competent and skillful hands to be had.

In addition to the business done in this foundry there is a separate department for the brass castings, in which about 1,000 pounds are melted in the crucibles daily. Lake Superior copper is principally used, together with old brass, brass filings, etc., nothing being allowed to go to waste, but especial care is taken in tempering and in the alloy for the brass scale beams, so that the notches will remain sharp and not wear off.


FIGURING BEAMS.

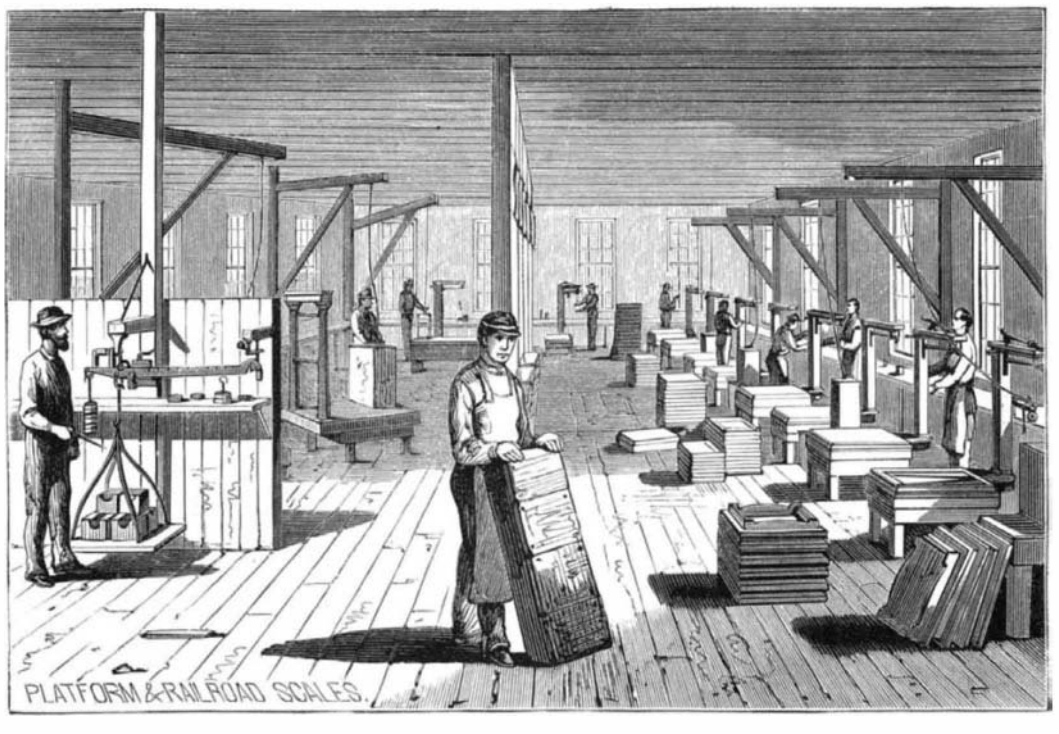
The pattern department occupies a building by itself, 32 by 80 feet, and two stories high. It is crowded with models for castings, which are stored here when not in use, some of the patterns dating back more than forty years, and affording, by contrast with those now employed, a striking record of the progress which has been made in the furnishing of lighter, more convenient, and elegant scales than were known in the early history of the business. On the lower floor are the large scale patterns, including those for the great iron levers used in canal weigh locks, some of which weigh 1,650 pounds each, while eight of them are required for each scale. Here also are the great patterns for railway scales of 150 tons capacity, but which can be increased indefinitely by adding to the number of sections. The second story is also crowded with patterns in shelves and trunks, for the firm are now making over 800 different styles or modifications of scales, some of the patterns for which take a good many pieces. The making of new patterns, however, goes on as regularly as though all this vast plant had not been accumulated. A draughting room is connected with the pattern shop, and here are constantly being made designs for scales of novel construction to meet new uses, to obviate some engineering difficulty, or to more completely serve their purpose than those already introduced. The drawings here show designs for railway scales for tracks of all widths from 30 inches to 7 feet; for railway suspension scales, in which the great levers are in a framework high enough for a locomotive to pass under them; for combination beams for mines; different devices for measuring grain, for testing machines, etc. Of the latter class of machines the largest the firm has made was for the city of New York, being of 108 tons capacity, to be used to test the strength of girders and building materials. The blacksmithing and forging department has a special building for itself, 200 feet long, in which 75 workmen are employed. It is provided with large and small power hammers, and dies for such portion of the work as can be struck out. The bar iron consumed yearly amounts to 350 tons, besides 50 tons of steel and 20 tons of nuts and washers.

The machine shop is 180 feet long by 70 wide, and is fitted up with a great variety of costly machinery, a large portion of which has been especially designed for the scale manufacture. In all parts of the works there are over 1,600 feet of main shafting, besides counter-shafting, etc., and it requires more than six miles of steam and gas pipes to do the heating and lighting. Perhaps the most interesting machinery in this department is that for making the notches in the scale beams. This operation for all the small scale beams is done on two or three hundred at once the beams being laid in a frame which travels backward and forward under a cutter until all the notches are made, and this is done so nicely that the edges are all left smooth, each beam being necessarily notched in perfect line with all the others, and thus, with the machine set carefully at the commencement, insuring entire accuracy. The large beams are cut by a heavier machine with a different movement. The marks on the sides of the beams are cut with a knife worked by a geared feeding arrangement, but the figures are stamped on by hand. The making of the scale pivots and loops with the requisite finish and temper is one of the most important portions of the work in the machine shop, for on the finish depends, in a great degree, the sensitiveness of the scales, as to the temper is to be attributed much of their good wearing qualities. The company use only direct line levers in all their machines, with devices to prevent strain from torsion, adopting clevises and links in hanging main levers. Their pivots are made from sections of steel rods, one edge being cut down smooth and true to the sharpness of a knife by a machine designed for this purpose. These pivot edges are cut and recut, gauged, and made smooth with the utmost care, and the loops on which they are to bear are lined with steel, made true and smooth. Both pivots and loops are then hardened by a process for which the company has obtained a patent, and which they claim will give the hardness of the best refined steel with the toughness of iron.


NOTCHING BEAMS

Notwithstanding the care, however, which is taken in all the previous parts of the work it is not until both scales and weights have passed the testing room that they are considered ready for shipment. Here may be found, in safes provided therefor, standards of the weights of nearly every country in the world, a part of the machinery of weighing which was perfected long before we had any such thing as "standard" scales for general use. All the scales and weights which go out of the establishment must first be proved by these standards; if the weights are too heavy a shaving must be taken off by the rimmer, or if too light a little more metal must be added, while the scales must be equally true and positive, no matter what portion of the platform the load be placed upon. It often happens, therefore, with the great care which has been taken in every detail in order to secure the most perfect work, that a scale intended to weigh several thousand pounds does not show a variation of an ounce, and will be so sensitive that this weight will move the beam.

The japanning, painting, and ornamenting, which constitute


PLATFORM & RAILROAD SCALES.

no small proportion of the work on small scales, each give employment here to a good many hands, although every facility has been provided to favor the work in these departments. The pieces of scales and weights to be japanned are piled on cars which run on tracks leading into huge ovens, thereby necessitating as little handling as possible. Some of the bronze ornaments are put on with powder, with rubber stamps and size, and others, as well as painted devices of various patterns, are transferred to the various parts by the decalcomanie process.

The tin shop, where also the sheet copper and brass are worked up into the different kinds of scoops and receivers, is provided with all the appurtenances which the inventions of the past few years have brought so prominently forward in this business. In this department 300 boxes of tin plate and 10 tons of sheet brass and copper are used annually.

The carpenter and joiner shop forms a large and important branch of the business; for here are made not only the woodwork of the scales, but the packing boxes in which they are shipped. Only the best seasoned wood is used in the scales, and to obtain a proper choice for this purpose from one to two million feet are always kept on hand. The company own large tracts of timber land convenient to their factory, and receive from their own sawmill over a million feet annually. Their platform scales with hard wood platforms have been decidedly preferred to other patterns with iron platforms, horses not being so likely to slip on them, and when the platform is worn or broken it can be easily repaired.

Of the large number of patents issued to the company for improvements made at their establishment in the scale manufacture over thirty are still in force, although the original invention on which the first Fairbanks patent was granted was made in 1830. Among the most important of their present patents are those on machines for milling knife edges, for weighing and distributing scales, for electro-magnetic weighing machines, automatic grain scales, track scales, registering and recording beams, letter balances, etc. They do not, however, lay so much stress on the value of their patent rights as they do on the perfect work they have always made it the rule of their establishment to turn out, to which end their long experience and ample capital are especially directed. Both at home and in foreign markets they have met with competition from cheap scales, but they hold, as they originally won, their position as the largest manufacturers of scales in the world by steadily adhering to the policy on which the business was commenced, of sending out only the best goods. Their exports include shipments to nearly every country on the globe, the weights and scales being often so provided as to give readings in two or three different languages, many of those now sent abroad being fitted up for weighing according to the French metric scale as well as that called for by the particular usage of the country where they are sent.

It has often been matter of comment that so large a manufacturing business has been thus successfully developed so far inland, away from water communication with other localities; but the explanation is readily found in the fact that the place has grown up with the industry, and now affords the large number of trained mechanics, drilled in this especial branch of business, without which it would be impossible to make it a success. The firm, while adhering strictly to the best business principles, have always been liberal with their workmen, anxious to promote faithful and skilled hands, and pensioning those who have become superannuated, so that, instead of having been troubled with strikes and disputes about wages, its members are regarded by their employes with more of that friendly feeling so often found in France and a few other localities in Europe, but which is seldom seen in so marked a degree here. With the growth of the town, too, have come the most liberal railroad facilities, so that, from tracks which run into the works, supplies may be received and goods shipped direct on trunk lines running to all points of the compass. A large proportion of the employes own their own houses, and different members of the firm have built and endowed various institutions for the benefit of the community in which their business has grown up, among which are a library, art gallery, lecture hall, and an academy.

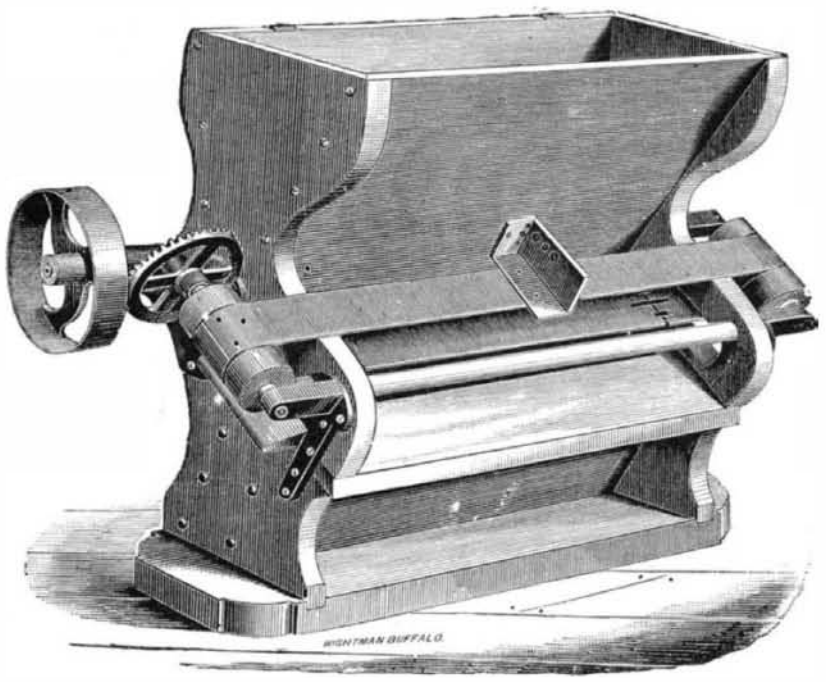
The New York office of the firm is at No. 311 Broadway, but they have besides this fifteen other warehouses in different parts of the country, and established agencies in every quarter of the globe.

Repelling Flies.

I manage to keep flies out of my stable by removing the droppings several times a day, and sprinkling very slightly the floor of the stable with kerosene. I have a tin can with a cork in it, through which is pierced a small hole; through this I drop the kerosene. A pint will last over a week, and seems to be quite objectionable to flies of all kinds.—*Wm. Horne, V. S., in Country Gentleman.*

THE MAGNETIC SEPARATOR.

The engraving shows a magnetic separator for automatically removing metallic substances from grain. As the harvesting and thrashing of all kinds of grain are now done almost exclusively by machinery, and since the introduction of wire-binding attachments to the reaper, magnets in some form for removing pieces of wire and other metallic substances from the thrashed grain have become an absolute necessity. Heretofore gang magnets, placed in spouts through which the grain flows, have been used. With this method, however, after a certain amount of metal has been collected by the magnets, it is necessary to remove them and brush it off by hand, and unless the flow of wheat is stopped the material to be taken out passes on with the grain. If the magnets are left too long in the spouts without being cleaned, the metallic material is carried by with the grain, and the consequence is that more or less of the material sought to be removed is left in the grain.



MAGNETIC SEPARATOR.

The engraving shows a machine which does this work effectually as well as automatically. The grain is fed into the hopper, from which it passes over a zinc plate the entire width of the machine. As this zinc plate is placed on poles of magnets, any metallic substance in passing with the grain over the magnets is held by the attractive force of the magnets until removed by the wiper, which, being attached to an endless belt, passes once a minute over the magnetic field, carrying off the metallic substances, depositing them in a box at the side of the machine. This process relieves the miller from care, and prevents metallic substances from going with the grain to the burrs or rolls as the case may be, unless introduced after it has passed the machine. To prevent this, the separator should be placed as near the burrs or rolls as circumstances will admit.

For further information address Messrs. Howes, Babcock & Ewell, manufacturers, Silver Creek, Chautauqua Co., N. Y.

A NEW BOILER CLEANER.

The device represented in the accompanying engraving is designed to prevent the incrustation of steam boilers by removing all the scale-forming matter contained by the water used in them, whether vegetable or other matter in suspension, or salts in solution. The simplicity of the principles upon which the action of this ingenious invention depends, and their entire accord with natural laws, commands the approval of all practical engineers. The problem of preventing incrustation in steam boilers has proved to be one of the most difficult ones in the whole range of engineering science.

Millions of tons of coal have been wasted, vast amounts of property destroyed, and thousands of valuable lives sacrificed to the evil which this device, it is claimed, effectually removes. The most careful consideration has been given to this subject by scientific men, mainly in the direction of chemical analysis. How to render the solid sulphates, carbonates, and chlorides more soluble, and thus enable engineers to relieve their boilers by frequent blowing, has been the inquiry. But the results of these investigations have been only partially successful, and the owners of steam boilers have found only too often that the remedy proved worse than the disease.

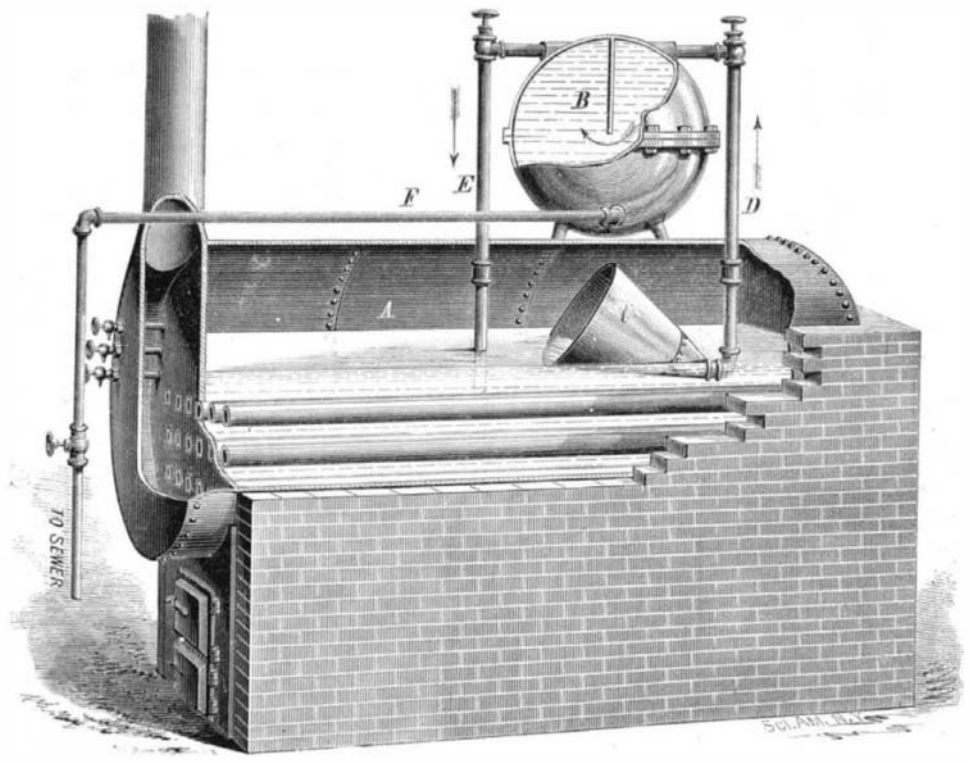
Many mechanical devices have also been tried in this and other countries, but these have been crude and complicated, involving much trouble in manipulating them, and were finally discontinued.

The invention which we illustrate seems to mark a new era in the treatment of this subject. Since its first introduction, in 1876, it has been steadily growing into public favor, until it has secured the unqualified approval of many of the most practical and scientific mechanical engineers in this country.

The proprietor, Mr. James F. Hotchkiss, by a series of experiments and improvements, has reduced the question of the removal of sediment from, and the prevention of incrustation in, steam boilers to a certainty, and over six hundred times has this fact been demonstrated by trials in every part of the country and with all kinds of water.

The engraving represents the cleaner as attached to any ordinary boiler. The large iron bell mouth, C, is placed near the tubes or flues so as to bring the bottom of the mouth on a line with the lower gauge cock (low water). This mouth is usually connected by a right and left nipple and elbow to the vertical up-flow pipe, D, piercing the shell as far back as braces will allow, and connecting with one side of the improved reservoir, B, at the top. From the opposite side of the reservoir a return pipe, E, extends to a cooler stratum of water as near the bottom of the boiler as the tubes or flues will allow, the lower the better.

This system of pipes forms a siphon, which, together with the difference in temperature between the surface and the point where the water returns to the boiler, causes a constant circulation of water as long as any steam remains in the boiler. In all boilers heated at one of their extremities there is established a circular motion of the water, which not only raises the solid bodies and agitates them, but also keeps them in constant motion in such a way that the surface currents always set back from the fire, while those at the bottom travel in the opposite direction, so that all matters contained in the water, whether originally held in suspension or precipitated from solution, are carried by ebullition to the surface, and there float until they are finally deposited upon the heating surfaces, and attach themselves in the form of scale, and this continues until the accumulations cause a great increase in the amount of fuel required for evaporation and incur the danger of explosion from overheated plates.



THE HOTCHKISS BOILER CLEANER

The Hotchkiss mechanical boiler cleaner affords a complete remedy for these evils by removing all sediment as soon as it rises to the surface. As the suspended matters are thrown upward by ebullition the surface current carries them toward and into the large mouth-piece, whence they are carried by the circulation to the reservoir, where, the water being cooler and in a quiescent state, all solids are precipitated. The solid matter may be blown out from time to time through a blow-off pipe, F, provided for that purpose. The spherical form of the reservoir permits of blowing out the mud which accumulates in it, without wasting the water.

Although the general principle of this invention has not been changed, it has been greatly improved in detail, and cheapened and simplified, so that it may be readily applied to any boiler by an engineer or ordinary mechanic.

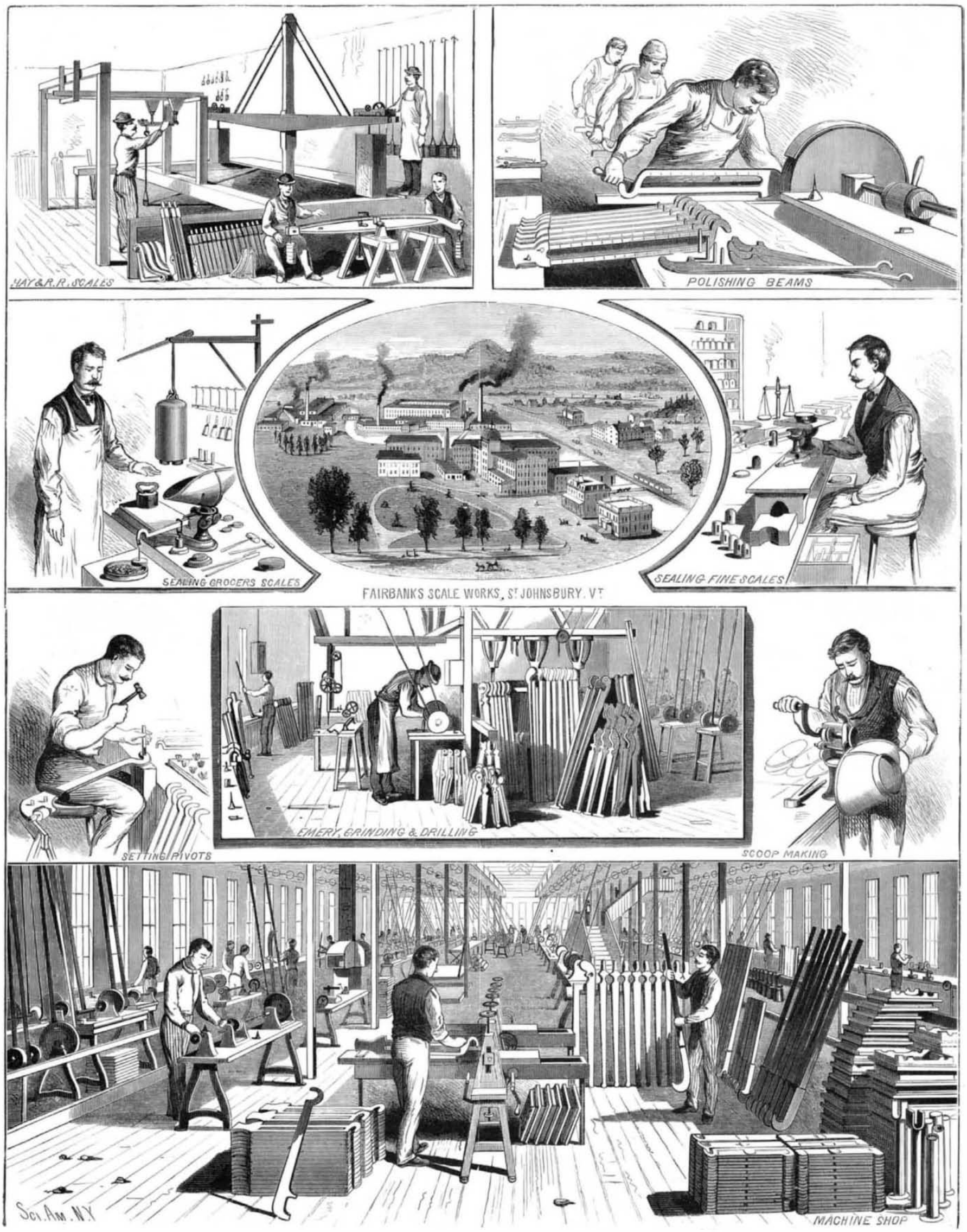
Further information in regard to this invention may be obtained by addressing Mr. James F. Hotchkiss, 84 John street, New York city.

SCIENTIFIC AMERICAN

[Entered at the Post Office of New York, N. Y., as Second Class Matter.]

A WEEKLY JOURNAL OF PRACTICAL INFORMATION, ART, SCIENCE, MECHANICS, CHEMISTRY AND MANUFACTURES.

Vol. XLIII.—No. 19. [NEW SERIES.] NEW YORK, NOVEMBER 6, 1880. [$3.20 per Annum. [POSTAGE PREPAID.



THE MANUFACTURE OF STANDARD SCALES.—E. & T. FAIRBANKS & CO.—[See page 290.]