levers to start the car, but all of these have failed either through inefficiency or from their complicated nature. It is an admitted fact that anything to be applied to a car for this or any other purpose must be perfectly simple and absolutely free from liability to get out of repair. This device has these qualities, besides being very efficient for the purpose.

There are many points in favor of improvements of this class which will suggest themselves to those practically acquainted with the management of street-car lines, and it is deserving of attention not only as a matter of money saving but from a humane point of view. Any one witnessing the efforts of horses in starting a heavily laden car can but wish that a device calculated to relieve the animals from these extraordinary strains might be put into practical use.

The inventor informs us that the car starter has been critically examined by competent engineers during its several months of trial, and they have spoken in the highest terms of its value and practicability. However, the device needs no special indorsement, as any one familiar enough with mechanics to understand its construction and operation will readily admit that it must be efficient.

For further information address Mr. Thomas H. Kemble, 617 North Sixteenth street, Philadelphia, Pa., or the Inventors' Institute, 733 Broadway, New York, where a model of the invention may be seen.

AMERICAN INDUSTRIES.—No. 54.

THE MANUFACTURE OF STEEL.

The Pittsburg Steel Works of Messrs. Anderson & Co. are among the oldest in the United States, having been established in 1845, more than a third of a century since, long before railroads became universal, and at a time when it was generally thought that fine steel must necessarily come from England. But the steel industry has outgrown almost every other manufacture, and the quality of the various products is fully equal, if not superior, to anything imported.

The Pittsburg Steel Works had a small beginning, but as time passed they gradually developed, adapting themselves to the numerous and constantly increasing wants of the country, until they now cover a larger area and produce steel for a greater variety of purposes than any other mill in Pittsburg. Its managers are men of energy, perseverance, courage, and practical ability, who have fostered the growth of inventions in the manufacture and application of steel, and whose efforts have been very fruitful in the development of industrial resources.

Wherever a particular kind of steel has been required for a particular purpose it has been characteristic of this firm to embody the new form of steel in their manufactures. As a consequence of this they have many specialties in their business, among which may be mentioned the five-plate safe cast steel, which is used exclusively by Hall's Safe and Lock Company, of Cincinnati, whose safes are largely used throughout the United States; agricultural steel, which is used in the large plow factories of the West; steel for hoes, for shovels, also for forks, harrow teeth and rake teeth; grain drill, reaper, and machinery steel, and, in fact, steel for every variety of agricultural implement. They have acquired a reputation in the Eastern States for a fine quality of steel used in the manufacture of table cutlery, which is equal to any of the Sheffield productions. They have also a large railroad trade in frog points, side bars, and heel plates for switches, and they manufacture steel for hammers, chisels, and drills, which is generally used in the quarries of New England. Most of the steel rods from which the wire was drawn for the Brooklyn Bridge was furnished by this firm.

To turn out all these products, Messrs. Anderson & Co. employ 575 men, whose wages amount to $400,000 yearly.

The general appearance of these extensive works is shown in the small perspective forming one of the views in our title page engraving, and the interior views convey an idea of some of the operations conducted here.

The plant consists, briefly stated, of five 24 pot Siemens furnaces, 3 sets of coke hole furnaces, 6 converting furnaces having a weekly capacity of 90 net tons, 3 single puddling furnaces, 16 hammers, a rake tooth shop, 10 trains of rolls, two of them being 20 inch plate rolls, one 16 inch bar, one universal train, one 16 inch spring, two 16 inch sheet, and one 8, one 9, and one 10 inch guide.

The wire rod mill was erected in 1877 on the Belgian system, with a capacity to turn out 20 tons of No. 5 crucible steel every ten hours. One hundred and fifty pots can be used at each heat in the steel works. These are run double turn, making three heats each turn, making them equal to 900 single pots daily. The annual output is 15,000 net tons, the product is cast and German plow steel, plate steel, and the best edge-tool steel. The cast steel consists of selected pieces broken and melted in the crucibles and poured into ingot moulds. It is afterward reduced to bars or sheets by hammering and rolling. One of the upper views in our engraving shows the crucible furnaces in the foreground, and the iron ingot moulds being filled with melted steel in the middle ground.

The open hearth steel works, added in 1879, contain one 15 gross ton and one 7 gross ton Siemens open hearth furnace, one blooming mill, and one plate mill. The 15 ton furnace, which is shown in our engraving, is the largest in this country.

The rod rolling mill, shown at the top of the engraving, turns out rods for wire manufacturing, and one of the smaller views shows one of the trains for rolling sheets of steel. Under the huge steam hammer shown immediately below an ingot of heated steel seems as plastic as clay.

The lower right hand view shows several of the immense shears employed in cutting agricultural steel into the hundreds of shapes in which it is required.

THE MILL IN OPERATION.

To a person unaccustomed to the scene, a sudden introduction to the whirr, clatter, and roar of a vast establishment like that under notice is confusing. Trip hammers pound, trains of rolls whirl out the flaming iron or steel, engines puff and rattle, furnaces glow with white heat, and the heated iron or steel flashes as it is drawn out. Immense shears clip great sheets of iron as easily as ordinary shears would paper. Vast grindstones smooth and polish the plow colters, and up and down, intense activity, wondrous power, and seeming confusion are apparent amid the most deafening noise. But there is no confusion. The mill is departmentized. Each set of hammers, or train of rolls, or set of shears, or engines, is under a superintendent or manager, who is responsible for the quality of the work. Rigid accountability follows every department of the work—the standard in this mill being as near absolute perfection as it is possible to reach. It seems amazing that administrative capacity should be so developed as to follow the broken scraps of steel or pigs of iron, from the weighing room, through all the stages of manipulation, till they come out in the form of the most perfect steel now manufactured in any part of the globe, and yet avoid confusion, loss of time, waste of material, or loss in any form. Yet it is done here in the quietest manner and without display of any kind. It is confusing to think of the accuracy in technical knowledge essential to the management of such works. The tensile strength, resistive force, enduring power of the product is to be considered; the combination of material, the chemical properties involved and to be produced. The changes of the rude lumps of pig iron from one quality to another, till it is beautiful finished steel, are perplexing to the uninstructed mind. And then the business aspects of the affair! They involve the closest study of economy, the successful dealing with many men, the survey of the world, its wants, demands, present and prospective, in the line of steel. The proprietor of the works under mention looks upon the broad world as a market. Every section of this country, South America, and Europe, afford the market. It broadens one's conception of the importance of our great manufacturing establishments when we realize how vast is the scope of their trade, and how closely they must study the competitive forces arrayed against them.

THE SIEMENS FURNACES.

In appearance, these furnaces resemble coke ovens, flattened at the top. The pots, containing the metal to be melted and manipulated, are let down through long, narrow slits, at the top, and are thence taken out when ready. The fuel used is gas, manufactured for the purpose, and mixed with air, and introduced under the furnaces by means of huge pipes. The heat generated rises to 3,000° Fahrenheit—the most terrible intensity of heat known to be artificially produced. The men who take out the pots of melted metal stand over these slits, at the top of the furnace, exposed for the moment to the intense heat, and with long iron pincers grasp the pots of melted metal, lift them out and pour the metal into receptacles to cool. These men have cloths wrapped around their limbs, and thoroughly saturate them with water before going to the furnaces, thus preventing the burning of clothes or body. In a moment they turn away, smoking from the intense heat.

THE SIEMENS PROCESS.

It may be of interest to our readers to know of the process by which steel is manufactured under this patent. This process was introduced in this country by Mr. Anderson. Cast steel is made from blister steel, broken into fragments, and carefully selected as to temper, placed in crucibles of plumbago, lowered into the smelting furnaces, and exposed to the heat of 3,000°. The most exact skill is required in this part of the process. When the contents of the crucible are ready for pouring they are poured into an iron flask, or mould, forming ingots of various sizes. Four hours are required to transform blister steel into cast steel. The Siemens furnace consists of two distinct parts, the producer, in which the fuel is converted into gas, and the furnace proper, including the regenerators. The furnace proper is composed of one heating and four regenerating chambers. The latter are placed beneath the heating chamber in such a manner as to leave space between for the passage of air and gas. The gas enters at the bottom of one of the chambers, the air enters the neighboring chamber, and the two, mingling at one end of the furnace, produce an intense and uniform flame. This heat is utilized entirely, passing the regenerators, and being used in various ways. Thus, by the reversal of the current of heated gas, it is thoroughly used, producing a continuous heat of 3,000°. The action of the furnace is so perfect that the gases which enter the stack through the waste flue to be cast into the air do not exceed 300° Fahrenheit. This is the process which has been in use here since 1868, when this firm first introduced it into this country.

This vast business in all its extensive ramifications requires executive ability of a high order. The established success which the works have achieved is largely owing to the untiring industry, indomitable perseverance, and persistent energy of Robert J. Anderson, who twelve years ago, in connection with other partners, purchased the business from Jones, Boyd & Co., the senior member of which firm opened the business in 1845. The business has thus changed hands only once in thirty years. The best evidence of successful management is found in the fact that all through the last several years of financial depression these works have never stopped except for repairs, having run double turn, and sometimes the whole twenty-four hours of the day. They are now turning out agricultural steels, and bid fair to have a future as successful as the past. Progressive in their ideas, fully up to the wants of the age, having all the elements of success, they cannot fail to obtain it.

Representatives of this firm are located as follows: A. B. Parker, No. 21 Astor House, New York; Wm. F. Potts, Son & Co., Philadelphia, Pa.; Carolan, Cory & Co., San Francisco, Cal.; Augustus Wessel, Cincinnati, Ohio; Tronell, Handy & Greer, Baltimore, Md., and Miles & Cotton, 170 Lake St., Chicago, Ill.

ASTRONOMICAL OBSERVATIONS AT HIGH ELEVATIONS.

The progress of modern optics is now furnishing observers with telescopes of a power which exceeds the capacities of our lower atmospheres for their constant employment. The obstacles to definition due to this atmosphere have grown to be so nearly a barrier to any rapid progress that attention has lately been given to the conditions of vision which it is very commonly supposed will be found to be best on mountain summits. There is no exact information on this subject, however, and Prof. S. P. Langley was therefore led to make some observations on Mount Etna during a visit there in 1878, and the result of which he records in the July number of the *American Journal of Science and Arts*. His object was to gather some sort of quantitative estimate of the degree of transparency and definition, to take the place of vague statement, and to give a kind of standard for comparison with sites in our own territory. The station chosen was "Casa del Bosco," at an elevation of about 4,200 feet. The observations were directed to the sole end of determining the character of vision, as tested at night on stars and nebulæ, and by day upon the sun. After a limited number of comparisons, he infers that at this station about nine-tenths of the light of a zenith star reaches us, and that only one-tenth is absorbed by our atmosphere. The gain on Etna over a lower station, as tried by the tests of a double star observer, was more in clearness of the atmosphere than in that freedom from tremor which accompanies good definition. The latter was indeed upon the whole better than below, but not conspicuously so.

Prof. Langley concludes, as the result of his researches, that the balance of advantages for astronomical observations is most likely to be found in a dry atmosphere, and certainly at a great elevation. Such elevations have undoubtedly the advantage of diminishing the atmospheric absorption of the more refrangible rays, an absorption so important that it probably cuts off from us the larger portion of the ultra violet spectrum. The gain for observations of precision will be, though positive, not in itself probably such as to justify the difficulty and expense of such a site; but for the study of the nebulæ and stellar photometry the gain is very essential indeed, while for almost every problem in solar physics it may be said without reserve that, for rapid progress, such observations have now become not merely desirable, but indispensable. The summit of a lofty mountain, however, is not a desirable station. At an altitude of 10,000 or 11,000 feet the observer may still enjoy all the conditions of health that fit him for labor, but beyond this unfavorable conditions increase very fast.

Quoting from his own experience of a stay of ten days upon Pike's Peak, at an altitude of between 14,000 and 15,000 feet, Prof. Langley says that at this height the attenuated atmosphere makes a long stay impossible for some, while even for the healthiest the conditions of life begin to be such as to render continuous hard work scarcely possible. At the same time the mountain condenses about itself continuous clouds, so that, except during a brief period in the autumn, the opportunities for observation are far rarer than on the plains. A dry climate and a table land at an elevation of something like 10,000 feet, sheltered on the side of the prevalent winds by a mountain range, which precipitates their moisture in clouds that rarely advance beyond the observer's horizon, appear to be the most promising conditions in our present knowledge. Upon the whole, though the ideal station, where atmospheric tremor does not exist, and the observer pursues his studies in an ever-transparent sky, is not to be found on any part of the earth's surface yet examined, we find, says Prof. Langley, within our own territory, in the dry and elevated table-lands of Colorado or New Mexico, every condition which experience points out as favorable.

Our Leading Cities.

Cities.	1880.	1870.	1860.
New York	1,208,471	942,252	813,669
Philadelphia	843,000	674,022	565,529
Brooklyn	554,693	395,099	266,661
Chicago	502,940	298,977	109,260
St. Louis	395,000	310,864	212,418
Boston	352,345	250,526	177,841
Baltimore	350,000	267,354	212,418
San Francisco	280,000	1 9,473	56,802
Cincinnati	246,153	216,239	161,044
New Orleans	215,239	191,418	168,675
Washington	160,000	109,204	61,112
Cleveland	156,946	92,829	43,417
Newark	136,983	105,059	71,941
Milwaukee	130,000	71,440	45,246
Detroit	119,000	79,577	45,619
Louisville	112,000	100,753	68,033
Jersey City	105,000	81,744	29,226
Providence	104,500	68,904	50,666

Glycerine in Gastric Troubles.

Dr. Sydney Ringer calls the attention of the profession, in the *Lancet*, to the value of glycerine as a remedy in flatulence, acidity of the stomach, and pyrosis. He states that sometimes he finds all of these gastric troubles combined, but glycerine in nearly all cases relieves them. In some cases, too, it removes pain and vomiting, probably like charcoal, by preventing the formation of acrid acids, which irritate delicate and irritable stomachs. Glycerine does not prevent the digestive action of pepsin and hydrochloric acid; and hence, while it prevents the formation of wind and acidity, probably by checking fermentation, it in no way hinders digestion. He administers a drachm to two drachms either before, with, or immediately after food. It may be given in water, coffee, tea, or lemon and soda water. In tea and coffee it may replace sugar, a substance which greatly favors flatulence, as, indeed, does tea in many cases. In some cases a cure does not occur till the lapse of ten days or a fortnight.

IMPROVED CROSS TIE.

The engraving represents a light and durable cross tie made wholly of rolled iron or steel, and adapted to receive ordinary railroad rails, which are secured by a fixed and a movable clamp at each end. The body is made of steel or iron rolled in U shaped cross section, and having flaring sides of suitable depth to give it the required strength and rigidity. This form gives a broad top which affords a firm bearing for the rails. The body is attached to a base plate, B, by means of angled plates which are bolted or riveted. Angle plates are attached to the ends of the tie, forming a flange which extends downward and forms an additional safeguard against the end motion of the tie. This flange is usually applied only to ties used on curves to keep them from shifting or turning.

The rails are held in place by two clamps at each end of the tie. The inner clamps are formed with raised ends for receiving the flange of the rail, and are permanently attached to the tie by rivets. The outer clamps are similar to the inner ones, but they are attached to the tie by bolts and nuts, so that they may be removed to permit of changing the rails. The bolts may be readily inserted or removed, as they are accessible through the open end of the tie.

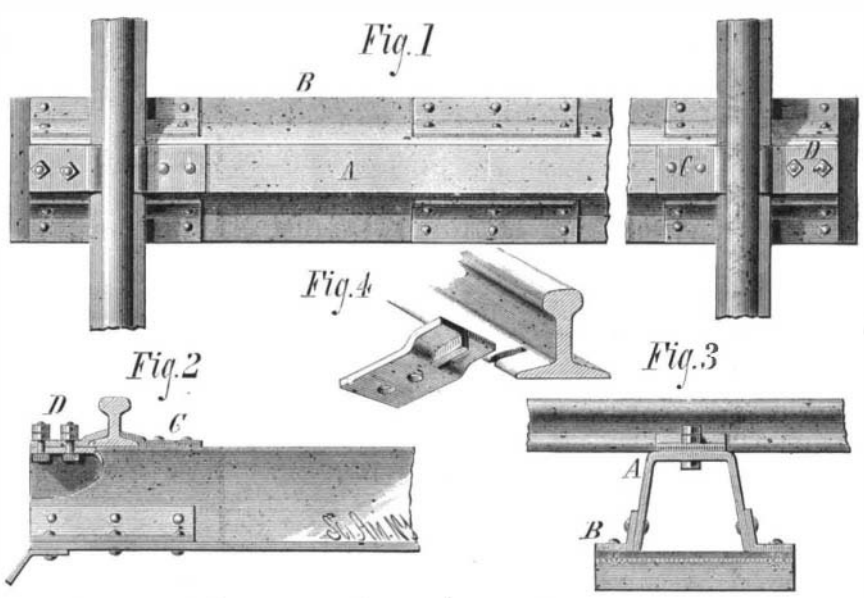
The ties will rest on the road bed, and the ballast can be tamped under it in the usual way.

To prevent the rails from creeping, the movable clamps may have lugs formed on them which may enter slots made in the rails as shown in Fig. 4. Only one tie in ten need be provided with this device.

Fig. 1 in the engraving is a plan view of the tie, Fig. 2 a partial side elevation, and Fig. 3 an end view.

The advantages of this tie over the wooden one and over other forms of iron ties will be readily seen by engineers and others familiar with the requirements. This construction secures strength, durability, cheapness, and facility of handling and application.

Further information may be obtained by addressing Mr. Louis Scofield, Chattanooga, Tenn.



SCOFIELD'S CROSS TIE.

AMERICAN MILLING AS SEEN BY AN ENGLISHMAN.

Mr. Samuel Smith, of Sheffield, President of the British and Irish deputation of millers to the late Cincinnati Exhibition, was called upon, at a reception given by the Utopian Club, to give some account of what he had seen in this country, and how the American milling industry stood as compared with the English. He expressed himself as follows:

"Among our competitors in the United States at Minneapolis, St. Louis, Milwaukee, Red Wing, and other places where the new process, or some modification of it, has been adopted, his voice would be like that of 'one crying in the wilderness.' (Laughter.) The millers in these places have thrown all that pertains to the old school to the 'moles and to the bats;' and although Mr. Z. might find some of them here and there using stiff irons, he would find few to adopt any other parts of the doctrine he expounded with so much ability at last meeting. As a rule, the organization of the American mills of the best class is perfect, and thoroughly automatic from top to bottom, every machine used in the process of flour-making being located in the right position relative to the work it has to perform. The bolting capacity of the dressing machines is much greater than that of ours, and where we use one middlings purifier, they use three at the very least. In new process milling they make all the middlings they can, which not only necessitates the employment of a larger number of purifiers, but a greater number of rollers, for softening middlings after purification, and while the entire system of machinery is worked at its highest capacity, no part of it is subjected to such a strain as to incur the risk of its doing the work badly.

"The conclusion I have come to, from all I saw in the best mills I had an opportunity of seeing, is that in order to compete with the American millers successfully there is no necessity for copying their system in anything like a slavish manner, but it is absolutely indispensable that we should adopt the thoroughness with which they do their work. They use at least four times as much silk as we are in the habit of doing in the dressing of their flour. They make more middlings than we do, and consequently use more purifiers and rollers, although in some cases stones are used for the treatment of middlings with highly satisfactory results, and if we are to hold our own we must reorganize our mills, increase our silk-dressing power, pay greatly more attention to our stones, than we have been in the habit of doing, both as regards dressing and balancing, the necessity of the latter being more than ever indispensable if the highest quality of work is required, and that, I need not say, under the conditions we are now placed, is a *sine qua non*. I certainly should not take the responsibility of recommending the adoption pure and simple of any of the specific systems which are in use in the United States in this country, partly because we cannot command to the same extent as is done in America a constant supply of the wheats that are used there. So far as our foreign supply is concerned, we must take what we can get. I noticed in an American milling paper that there was a chance of the millers of this country being able to make Minneapolis flour in consequence of the missionary efforts among us of milling experts from the other side of the Atlantic. I don't think it likely that we shall be able to accomplish that feat until we have the full supply of Minnesota spring wheat of the same quality as the Minneapolis millers have at their command. I am quite convinced, however, that by throwing our entire energies into the work, rearranging our mills upon principles which will secure for the different processes in the manufacture of flour the fullest manipulative efficiency, and adopting to the fullest extent the labor-saving contrivances which I saw everywhere in the States, and which so greatly reduces the cost of production, we could raise the quality of our own grades of flour to such a standard as would enable us to regard the competitive efforts of our American friends without any of that alarm which has been recently manifest in some parts of the country. I don't think I have anything more to say at present, but I may remark, in conclusion, that I will not readily forget the warmth of our reception in America, nor the hospitality that was so heartily extended to us."

A conversation here ensued on the remarks that had been made by the president, and the general impression seemed to be, that while there was no doubt that the reorganization of English mills to a greater or lesser extent upon principles approaching in some degree to those that had been adopted in the best mills in the United States—keeping in mind the special circumstances that controlled the action of the millers of this country, in order to deal effectively with American competition was indispensable—means must also be adopted to secure by means of special agencies under the complete control of the home trade of a fair proportion of the highest class of the wheats used with such beneficial results to their own interests by our American competitors.

Protection of Oil Tanks from Lightning.

To the Editor of the Scientific American:

Having never seen an oil tank, I can only gather by inference its mode of construction and surroundings. From the word supply, and from your statement that it is above the oil, I conclude that the pipe comes from a well at some distance, but I cannot learn that it is above ground or under it. If the pipe is underground and comes out of it a short distance from the tank, then, of course, the difference of potention between the pipe and the body of the tank will be nil, and consequently no current or spark will pass. The electro-motive force necessary to produce a spark in air, as you know, is enormous. From these considerations I think your remedy inapplicable. I should rather run a rod from the pipe up into the air, connecting it at the same time with both the top or cover and the body of the tank. This, I believe, would be more in accord with established electrical laws.

Of course, if the pipe is above ground for any distance from the tank in the direction of the well, your remedy will apply.

But another cause of the spark different from either of yours may be suggested. Oil is a well known non-conductor or dielectric, and may have a high specific inductive capacity and absorb a large quantity of electricity gradually from the earth. Being a dielectric, then, and allowing that the top or cover of the tank is insulated from the body by its style of construction, by a layer or coat of paint, thick oil, or any other way, we will have the body and the top or cover of the tank forming the plates of a condenser, with the oil or in the air or both acting as a dielectric. Under these conditions everything is very favorable for the passage of a spark between the top and body of the tank, or between either of them and the pipe, or in the reverse direction in a thunderstorm prevailing over the tank or at the distant well.

This may not be the cause, but examination in this direction should not, I think, be overlooked.

DAVID FLANERY.

Richmond, Va., July 26, 1880.

A Fast Locomotive for England.

The fast passenger locomotive lately built by the Baldwin Locomotive Works, and tested on the Bound Brook line between Philadelphia and New York, has been bought by Mr. F. W. Eames for brake trials and tests in England. It will be immediately fitted up with the Eames Duplex Automatic Vacuum Brake and shipped to London. Mr. Eames proposes, while showing the action of the Eames brake on railway trains at the highest speed possible to attain, at the same time to settle the vexed question of the relative superiority of American and English locomotives.

MECHANICAL INVENTIONS.

A device to be attached to lawn mowers for catching and holding the grass as it is cut by the mower, has been patented by Mr. Cyrus G. Baldwin, of Ripon, Wis.

Mr. Chester F. Allen, of Paw Paw, Mich., has patented an improved transfer truck for cars for transferring broad gauge cars over narrow gauge tracks without changing the truck of the broad gauge car. The invention consists in a narrow gauge truck constructed to carry a broad gauge truck, and provided with hooks for retaining the two trucks in position.

Mr. Charles F. Powers, of Sutherland Falls, Vt., has patented an improved tile facing and squaring machine, which will level and smooth by rubbing the faces and edges of several tiles at a time. It consists of revolving frames for holding and adjusting the tiles upon a rubbing bed or grinding plate or disk, and of novel devices for removing and replacing a tile without interfering with the work on the others.

Mr. Orville A. Wilson, of Bennington, N. H., has patented a cheap, strong, and durable fastening for uniting the handles and blades of knives and handles and tines of forks. The invention consists in combining a slotted handle having beveled annular shoulder, a bolster, a blade with slotted tank, and a screw bolt.

An improvement in calipers and dividers has been patented by Mr. William H. Warren, of New York city. This invention relates to measuring instruments, such as calipers, compasses, dividers; and it consists of revolving studs or pivots fixed at any convenient points on the instrument, and in combination with a slotted bar, whereby the legs of the instrument may be adjusted by means of screw and spring without loosening the clamping screws and nuts.

An improved baling press has been patented by Mr. Rufus P. Davis, of Monroe, N. C. The baling press is so constructed that the followers may be run down quickly while meeting little resistance, but slower and with great power as the bales become more compact, without forcing the bales out of shape.

Enlargement of New York Water Supply.

The works soon to be undertaken for the enlargement of the system of water supply for New York city includes the construction of a 15 foot dam at the outlet of Little Rye Pond, connecting both Big and Little Rye ponds, and forming a lake of 280 acres in extent, capable of storing 1,050,000,000 gallons. It is also proposed to build a dam on the Bronx, near Kensico, 45 feet high, making a reservoir of 250 acres, having a capacity of 1,620,000,000 gallons. A dam will be built across the Byram River 15 feet high, creating a lake with a capacity of 180,000,000 gallons. The Byram and Bronx rivers it is proposed to unite at this point.

From the Kensico dam the water will be conducted through a 4 foot iron pipe along the valley of the Bronx to a reservoir near William's Bridge in the upper part of the Twenty-fourth Ward, the elevation of which is 180 feet above tide-water and 65 feet above the Croton Aqueduct, and the capacity 100,000,000 gallons. The length of this conduit is 15 miles.

The Kensico reservoir will give the city of New York from 18,000,000 to 20,000,000 gallons more water daily. The contracts will be let August 4. It is estimated that the work will be finished in about two years, and cost about $2,700,000. By tapping the Bronx at Kensico there will be obtained not only pure water, but a remarkably good head. The country drained—over 13 square miles—is similar in geological character to the Croton Valley.