AMERICAN ENGINEER CAR BUILDER AND RAILROAD JOURNAL.

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THE ALTOONA SHOPS OF THE PENNSYLVANIA RAILROAD.

I.

The principal shops of the Pennsylvania Railroad for the repair and construction of cars and locomotives, as most of our readers know, are located at Altoona, and, as many of them are also aware, this place is a sort of mechanical Mecca to which many pilgramages are made, by those who are in pursuit of information or enlightenment on the many abstruse problems relating to the mechanical engineering of railroads. A visit to this place is therefore always interesting, and it is hoped that some notes and observations of a recent ramble, through the great works which are established there will be interesting and may be profitable to our readers.

For the following facts regarding the location of Altoona and its surroundings, we are indebted to an illustrated "historical descriptive and statistical" volume published by its Board of Trade.

"The city of Altoona was laid out in 1849 and the Pennsylvania Railroad commenced the construction of its shops in 1850. It is situated about thirty miles southwest of the geographical center of the great State of Pennsylvania, just at the eastern base of the Allegheny Mountains, near the headwaters of the Juniata River—the 'Blue Juniata' of Indian legend and pale-faced song, and on the line of the Pennsylvania Railroad. It lies in the upper or western end of Logan Valley or 'Tuckahoe,' as the vicinity was called in early days, in the central part of Logan township, in Blair County. By rail it is 117 miles east of Pittsburg and 235 west of Philadelphia, although an air line would be one-fourth to one-third less. Baltimore and Washington are 150 miles southeast and Buffalo 200 miles directly north, but by rail the distance to these points is nearly twice as great.

"Originally laid out in a narrow valley, it has filled this and climbed the hills on either side and grown in all directions, so that a large part of it is built on hills of moderate elevation. The city lines, as now established, embrace a territory two and one-fourth miles wide, but it is built up as a city a distance of four miles long and two miles wide. Less than 50 years old, it has grown with such surprising rapidity that it now contains a population of over 40,000 and is now the eighth city in the state in population, and second to none in material prosperity.

"The lowest ground in the city is 1,120 feet above the level of the ocean, and the hills rise 100 to 150 feet higher, making the site and surroundings picturesque in the extreme. . . .

"The railroad passes through the heart of the city from northeast to southwest. . . . In the central part of the city, on the lower ground, are located the railroad company's machine and locomotive shops, freight warehouse, passenger station and an immense hotel, around which the business of the city clusters, this being the 'hub'; although the ever-increasing business of the road has necessitated the building of additional shops at two other places in the eastern suburbs."

The "car shops" are located about a half mile east of the locomotive shops and the "Juniata shops," which have been built within a few years for the construction of locomotives, are about a mile east of the car shops.

Elsewhere plans showing the location of each of these three groups of shops are given, and also a view of the yard taken from the west end of it, adjoining the repair shop, and which shows part of one of the engine houses, and of other buildings, and the network of tracks at that point. Another view of the car shops and the grounds adjoining will give an excellent idea of the appearance of that locality and still another one of the "Juniata shops taken from the north looking southward shows their appearance and that of their environment. The plans represent the shops and grounds, as maps ordinarily do, that is the person looking at them is supposed to be on the south side. As visitors nearly always approach the shops from the north side and as the perspective view of the Juniata shops is taken from the north the plans may at first be a little confusing.

The main or "locomotive shops" as they are called, are the oldest and most extensive and are devoted chiefly to the repair of locomotives, although also some new construction work is done there. The following are the principal buildings and their dimensions:

Middle division round house	235 feet diameter
Erecting shop No. 1	413 feet by 66 feet
Machine shop (two stories)	352 " 63 "
Erecting shop No. 2	414 " 66 "
Office store room, laboratory and test room (three stories)	170 " 40 "
Boiler house	66 " 43 "
Flue shop	125 " 40 "
Boiler and blacksmith shop	192 feet diameter
Blacksmith shop	249 feet by 56 feet
Wheel shop	249 " 66 "
Boiler flange and tank shop	124 " 66 "
Wheel annealing pits	95 " 58 "
Pittsburg division round house	300 feet diameter
Iron foundry	245 feet by 96 feet
Wheel foundry	137 " 70 "
Core room, pattern shop on second floor	80 " 71 "
Brass foundry	78 " 55 "
Pattern store room (two stories)	98 " 48 "
Oil house	57 " 47 "
Wheel foundry	163 " 63 "
Total floor area	367,314 square feet

The car shops, as their name implies, are devoted chiefly to the construction and repair of cars, but a group of small buildings are devoted to work for the maintenance of way. The following are the principal buildings and their dimensions:

Passenger car paint shop	420 feet by 132 feet
Electric transfer table and pit	397 " " 60 "
Group of maintenance of way buildings	19,142 square feet
Freight car paint shop	392 feet by 108 feet
Freight car truck shop	82 " 70 "
Planing mill	356 " 74 "
Blacksmith shop	357 " 73 "
Machine and cabinet shop	303 " 73 "
Upholstering and trimming shop (two stories)	363 " 73 "
Passenger car erecting shop	213 " 133 "
Office and storeroom (two stories)	79 " 39 "
Freight car shop	433 feet diameter
Steam turntable	100 " "
Lumber drying kilns	3,343 square feet
Fire apparatus	53 feet by 33 feet
Total floor area	368,680 square feet

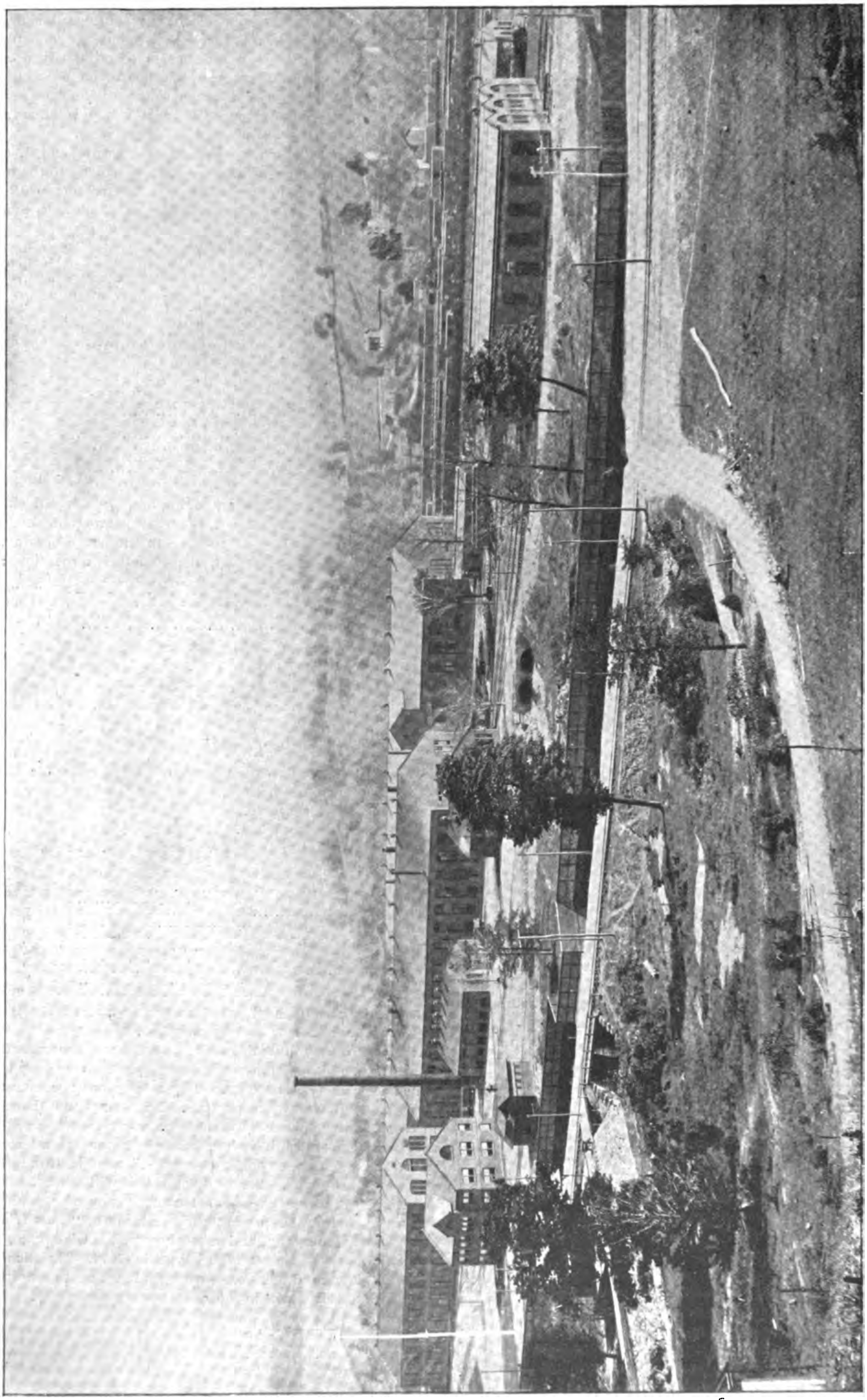
The Juniata shops are the newest and were built for the construction of new locomotives. A part of them are now devoted to the repair and construction of frogs and switches and other maintenance of way work. The shops are splendidly equipped with the latest and most approved machinery. The buildings are as follows:

Paint shop	146 feet by 67 feet
Electric and hydraulic house	60 " 45 "
Boiler shop	386 " 88 "
Blacksmith shop	306 " 80 "
Boiler house	70 " 43 "
Office and storeroom (two stores)	71 " 51 "
Hydraulic transfer table and pit	261 " 60 "
Erecting shop	351 " 70 "
Machine shop (two stories)	258 " 75 "
Total floor area	118,986 square feet.

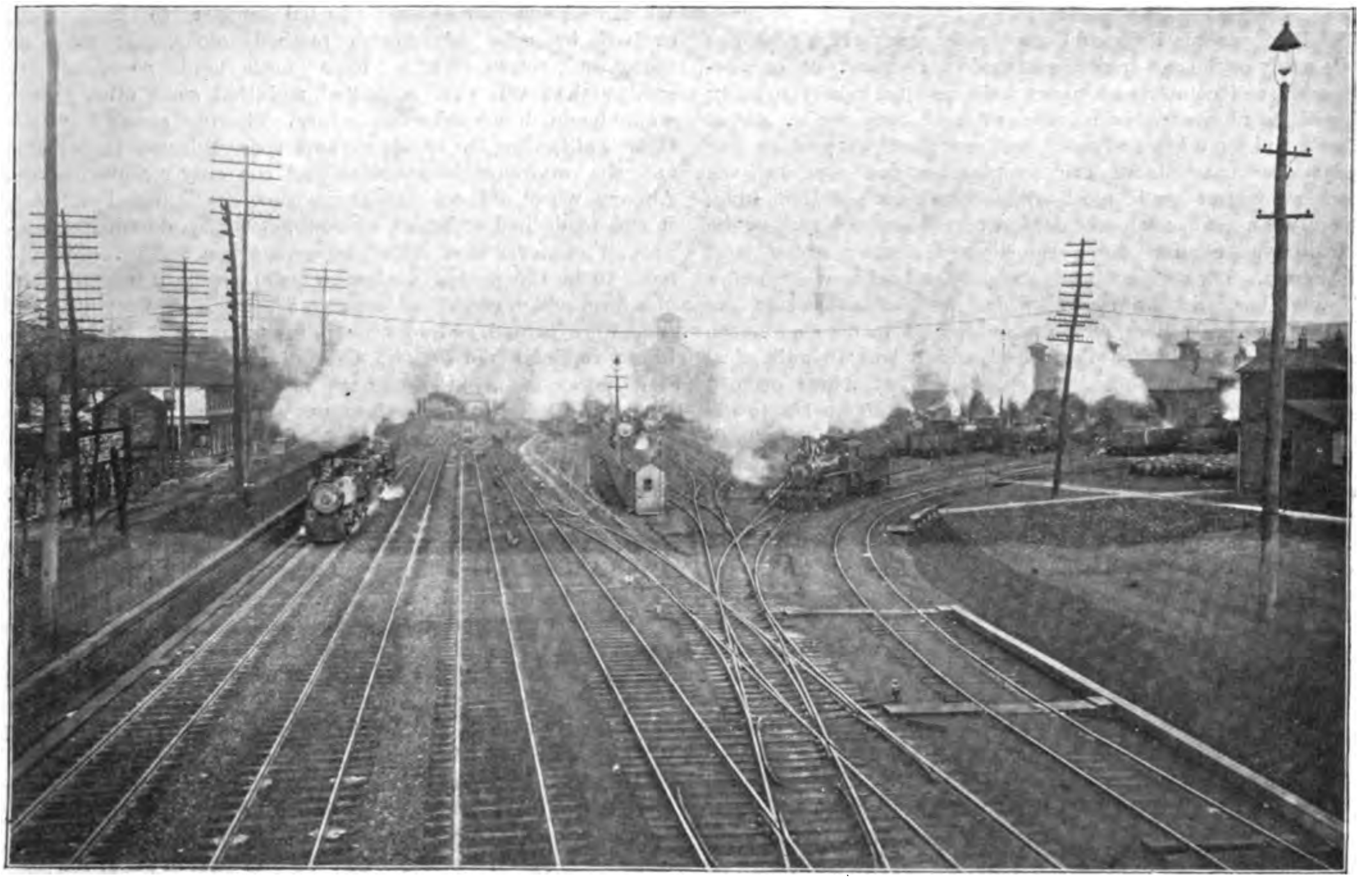
The entire area of the floors of all the shops is 854,980 square feet or 19.7 acres.

It would be very difficult to give a systematic account of all of these shops, and the many interesting processes and appliances which are carried on in them. Only a large book or many chapters would suffice for that purpose. No attempt will therefore be made to arrange our observations in any systematic order, but they will be noted as they were brought to the attention of the writer during a "personally conducted" ramble through these great establishments. Before doing this it will be explained that the engraving of two passenger locomotives on the double page illustration herewith represents the latest type or "Class L" engine built by this company, and also their "Class G" engine, which was built and was the standard type in 1873. The illustration and the following dimensions give a good idea of the increase in size of locomotives within the past twenty-two years.

	Class G.	Class L.
Diameter of driving wheels	56 inches	80 inches
Cylinders	15 by 22 inches	18½ by 26 inches
Weight	65,200 pounds	134,500 pounds
Pressure in boilers	125 pounds	185 pounds



JUNIATA SHOPS OF THE PENNSYLVANIA RAILROAD, ALTOONA, PA.



View of West End of Pennsylvania Yard, Altoona, Pa.

Car Shops of the Pennsvlvaria Railroad Altoona Pa.

We will have more to say about the "Class L" engine in a future article.

The Pennsylvania Railroad Company for many years past has made many of the cast-iron wheels used on its road. In connection with the locomotive shops is a well-equipped wheel foundry where large numbers of wheels are and have been made. Great pains have been taken and much skill exercised to procure the best possible materials for their manufacture, and to produce the strongest, safest and most durable wheels of that kind. Recently an expensive accident occurred on the road while a train was coming down the long and steep grade west of Altoona. The accident was caused by a broken wheel under a foreign car, the failure of which was attributed to the action of the brakeshoes, which were applied in descending the grade, and which heated the wheel, and it was thought thus cracked it. To throw some light on the subject, it was decided to make tests of wheels made by different manufacturers, to determine the effect of heating the tread. To do this the wheels were placed in a sand mould flatwise, with their flanges down and their axes vertical. Around the tread of the wheel a circumferential space was left 1¼ inches wide measured radially to the wheel, this space being surrounded with sand, the top of the mould being left open. Into this space molten cast-iron was poured, with the result that in many cases some of the ribs or brackets were cracked in about half a minute after the metal was poured, and the plates in about a minute after the molten metal came in contact with the tread. At the time of the writer's visit to the foundry, which is here reported, three new wheels were prepared for such a test; two of them manufactured by a reputable maker, and one of these two wheels was taken from those supplied by the manufacturer in the regular course of trade, and the other a special wheel furnished for the test, and said by the maker to be the best he could produce. The third was a new wheel made in the Altoona foundry. In one of the tests the molten iron was poured into the space around the tread of the wheel first described, so as to nearly fill it up to the edge of the rim. In forty seconds after the pouring ceased there was a sharp click indicating that one of the brackets was cracked, and in forty-five seconds the upper plate cracked with a report like that of a small pistol. The crack was a radial one through the rim, and it then extended circumferentially just inside the rim about one-sixth of the way around the hub. The second wheel, which was said by the maker to be the best that he could produce, cracked in the same way in the plate in two minutes after the iron was poured, the fractures being of somewhat less extent than the first. The Altoona wheel was then tested, but did not break when the melted iron poured around it had become black by cooling. Other tests have been made of wheels which had been in service with similar results. The Altoona wheels are reported to have stood the test in every case excepting one, while a large proportion of those made by manufacturers who sell wheels were broken. During a considerable part of the time after the iron was poured, when the tests which are described above were made, the wheel was so cool that a person could bear his hand in the inside of the rim, and the plate, excepting the portion near to the rim, was so cool during the whole test that a person's hand could be kept in contact with it without pain. A match moved slowly in contact with the plate from the hub toward the rim immediately after the test was not lighted until it was near the rim.

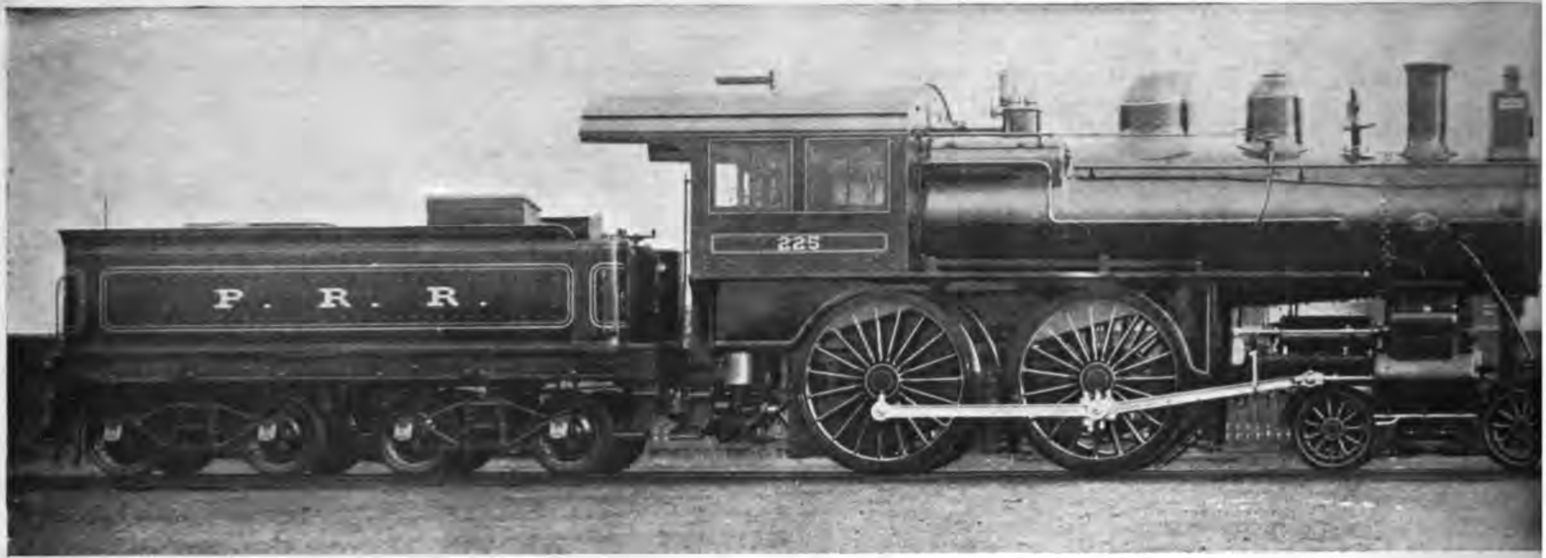
These tests are certainly very remarkable, important and somewhat alarming. If, as was shown, an ordinary cast-iron wheel is liable to break when its rim is heated to a comparatively low temperature, there is certainly very much more danger attending their use on long grades when the brakes must be applied for considerable periods than is generally supposed, and the responsibility for using cheap and inferior wheels is correspondingly great. The forms of the wheels which were tested were all alike and were of the ordinary double plate pattern, with curved ribs on the back, so that the capacity for withstanding the test in the one case and the failure in the other was probably due to the difference in quality of the material of which they were made. It may be that if the wheels made of inferior material had been of a different form they would not have broken, and this kind of tests supplies the means for determining what are the best forms for such wheels. Thus far those adopted appear to have been evolved by rule of thumb methods alone. It may be that the forms which have been used so long are weaker than was ever suspected, and that some other shapes would be much less liable to fracture. The test showed indubitably that heating the treads of the wheels subjected their plates and ribs to tremendous strains, and the only reason why the Altoona wheel did not break was that the material of which it was made had sufficient strength, elasticity, ductility, toughness, or whatever it is called, to resist these strains. It would seem to be the part of wisdom to make wheels, if it be possible, of a form which would not be subject to such strains when their treads are heated, as they were in the tests, or as they would be by the application of brakes. It would be interesting and possibly instructive to put wheels say in a lathe and apply brakes to them with the ordinary maximum pressure and then revolve the wheels at the speed with which they would probably turn in actual service. This would show whether the heating action of the brakeshoes has the same effect as the molten iron produces. This is an attractive field for investigation and one in which more knowledge is urgently needed.

The Altoona wheel foundry is well equipped with hydraulic cranes and other appliances. The wheels are now all made in contracting chill moulds which give a more uniform chill in the treads of the wheel than can be produced in any other way. The materials used for wheels are from 30 to 35 per cent. of charcoal iron, 15 per cent. of coke iron, 5 per cent. of steel and from 50 to 55 per cent. of old wheels. It is specified that the coke iron shall not have more than from 1 to 1.25 per cent. of silicon.

One machine in use in connection with the foundry was new to the writer. This was for brushing the sand from the wheels. It was made by the Northwestern Wheel and Foundry Company, of St. Paul, Minn., and consists of two iron discs of about the same diameter as the wheels, which are each mounted on the ends of horizontal shafts. Each disc overhangs the bearings of its shaft, which has a driving pulley and friction clutch for throwing in and out of gear. The discs face each other, and to the surfaces thus presented wire brushes are attached, and the wire strands project at right angles to the faces of the discs, the wires being parallel to the axis of the shafts. The latter have a certain amount of horizontal movement in their bearings, so that by means of levers the discs can be drawn apart and a wheel rolled between them. The discs are then made to revolve by belts on pulleys attached to the drafts, and the brushes are brought in contact with the two sides of the wheel, and all the sand is thus quickly brushed off from the exposed surfaces. That which adheres between the ribs is afterward brushed out by a cylindrical brush resembling somewhat a large paint brush attached to a flexible shaft driven by a pulley. The cost of cleaning wheels has been reduced three cents per wheel by the use of these machines.

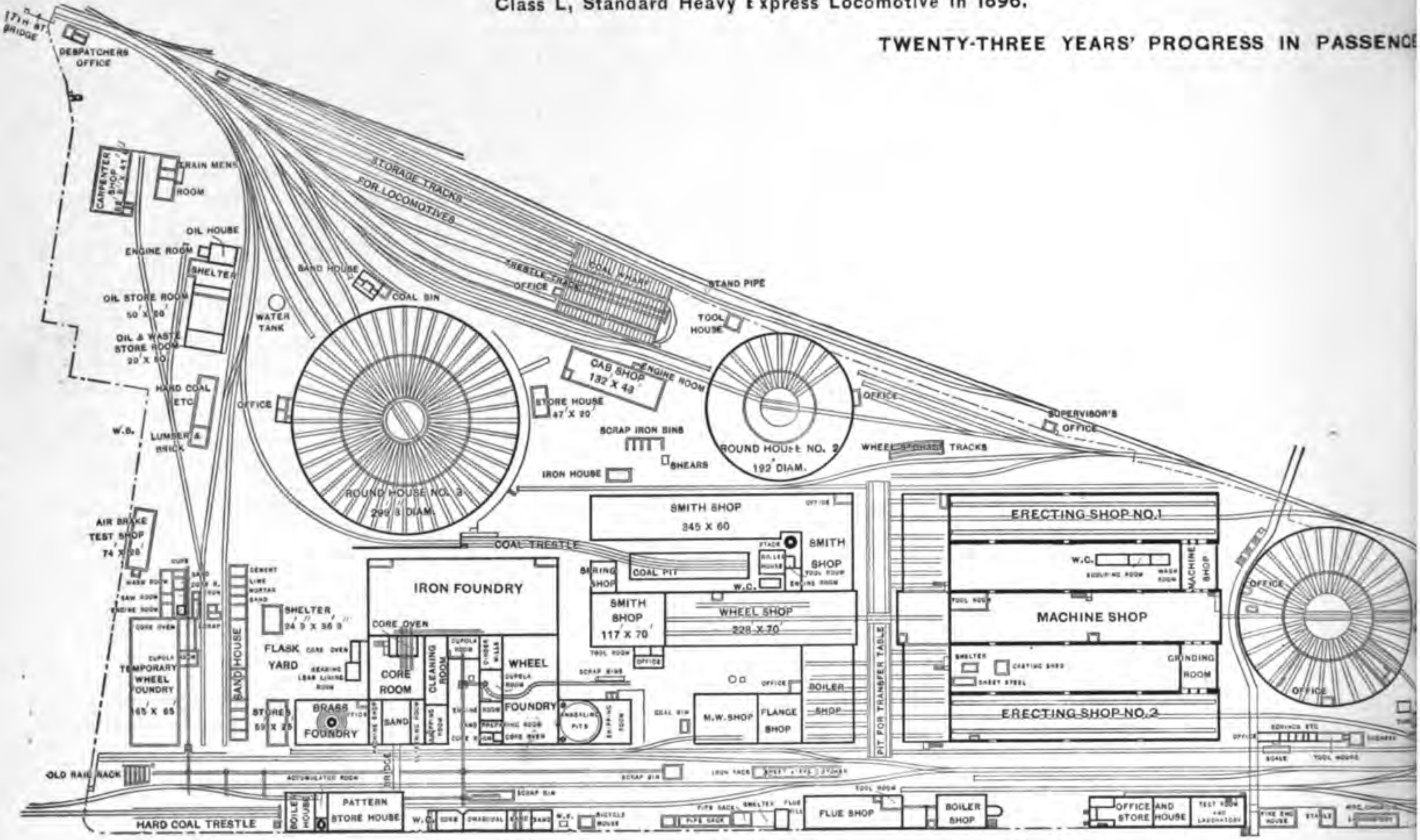
Another interesting machine is a sand sifter made by the Walker Manufacturing Company, of Cleveland, O. This consists of a rectangular box, about 3 by 5 ft. and a foot or 18 inches high or deep, and with a sieve forming the bottom. This box is suspended by inclined, loose-jointed links or rods about 2 feet long attached at each of the four corners. Over the middle of the box is a bearing which receives the pin of a crank attached to a vertical shaft over it and driven by a pulley or belt. As the crank revolves the bearing is of course carried in the path of its pin and the box is carried with it. The latter being suspended by the inclined links the horizontal oscillation of the lower ends of the latter causes the corners of the box to rise and fall in sequence, as it were, which with, the movement imparted by the crank, produces a sort of squirming or wriggling movement admirably adapted for sifting the sand which is put into the box.

The brass foundry is also an interesting place and is well arranged and designed. The building is 36 by 80 feet, with a central stack, or chimney, and with 18 furnaces arranged circularly around it. This building is admirably lighted and well ventilated, and has capacity for melting ten tons of metal per day. An adjoining room contains appliances for lining car journal bearings with lead. The bearing surfaces of these are first cleaned with

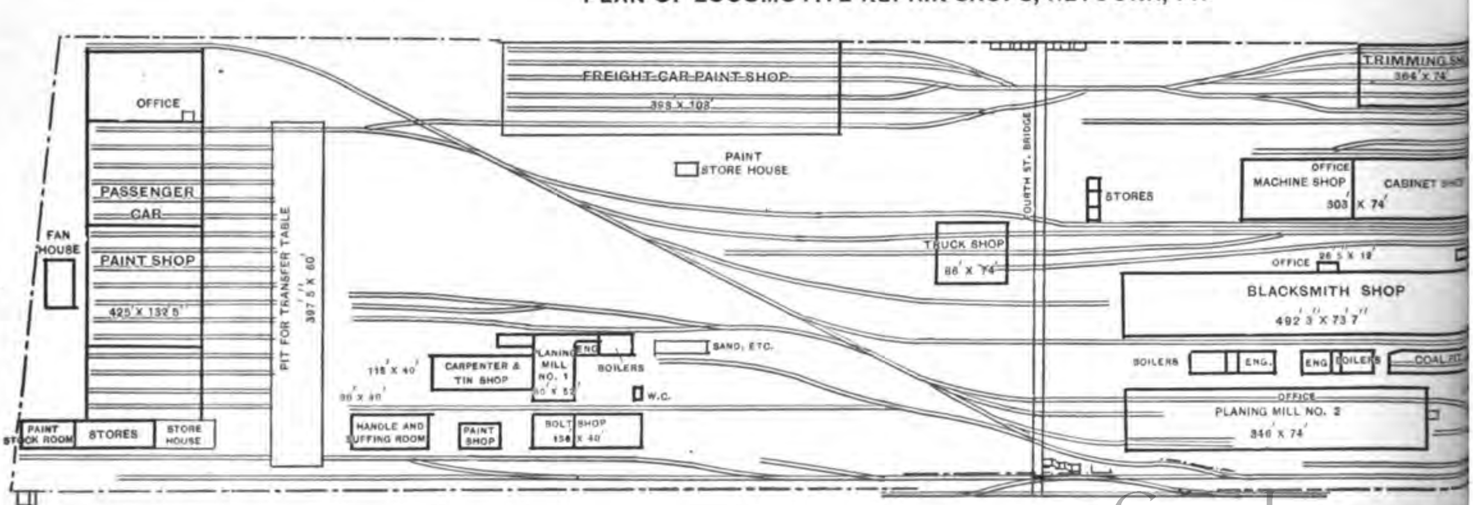


Class L, Standard Heavy Express Locomotive in 1896.

TWENTY-THREE YEARS' PROGRESS IN PASSENG



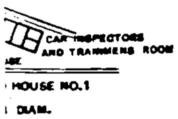
PLAN OF LOCOMOTIVE REPAIR SHOPS, ALTOONA, PA.

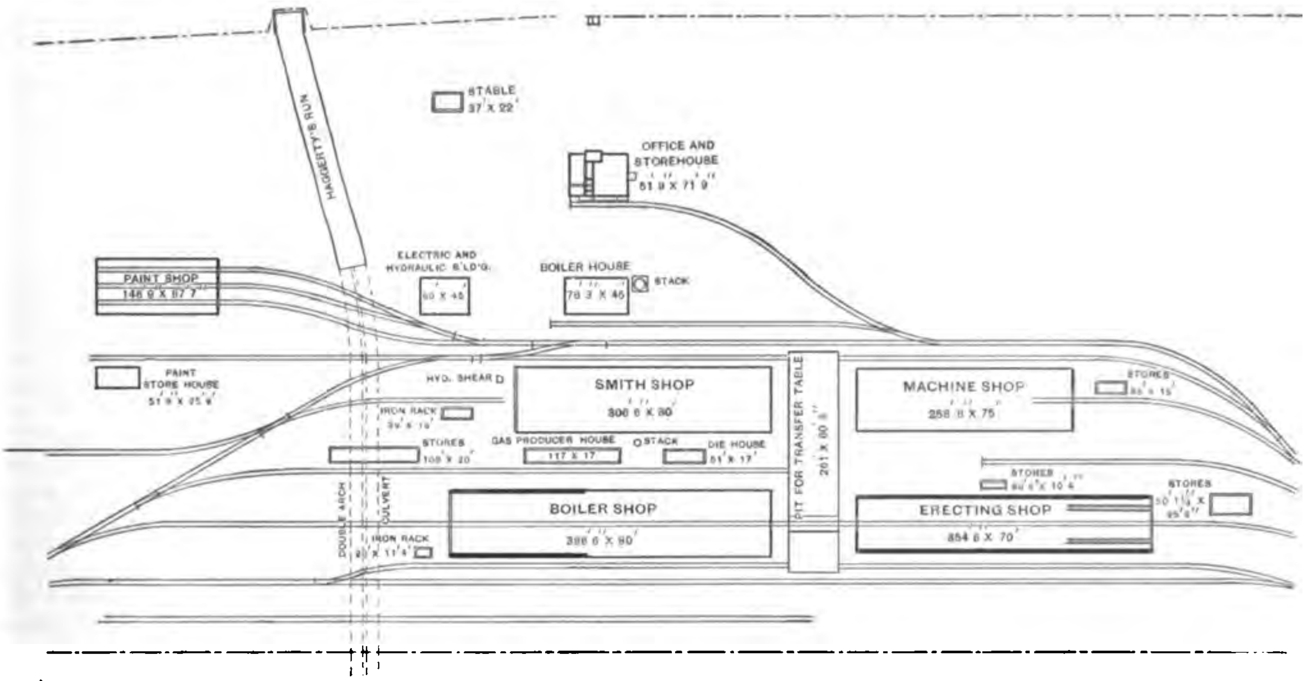


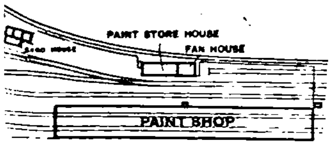
PLAN OF CAR SHOPS OF THE PENN

Class G, Standard Passenger Locomotive in 1873.

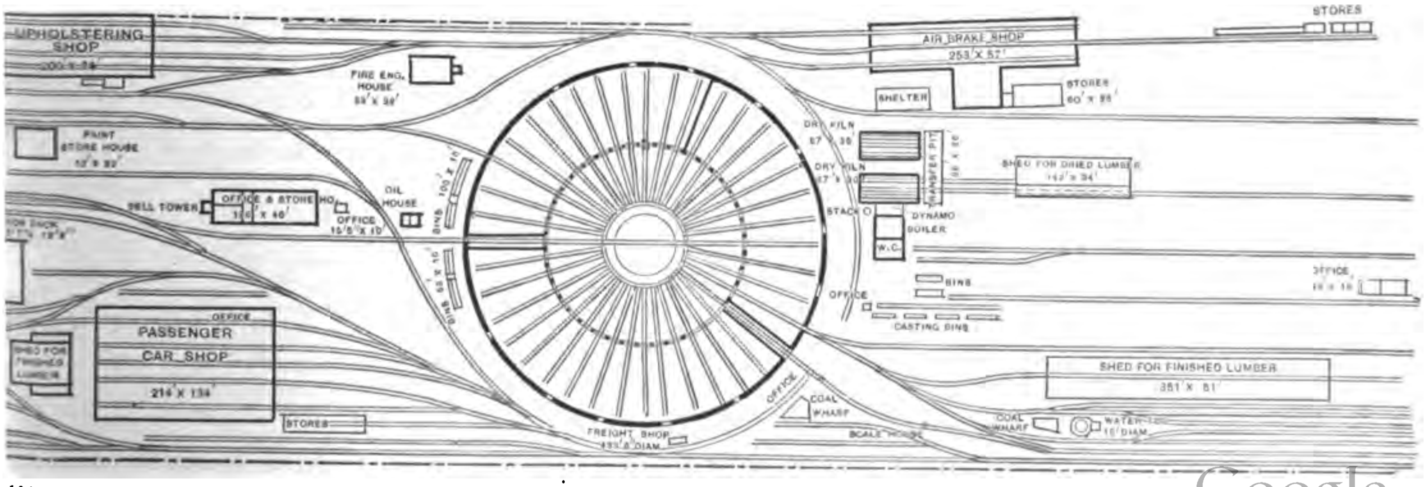
ENGINE CONSTRUCTION ON THE PENNSYLVANIA RAILROAD.



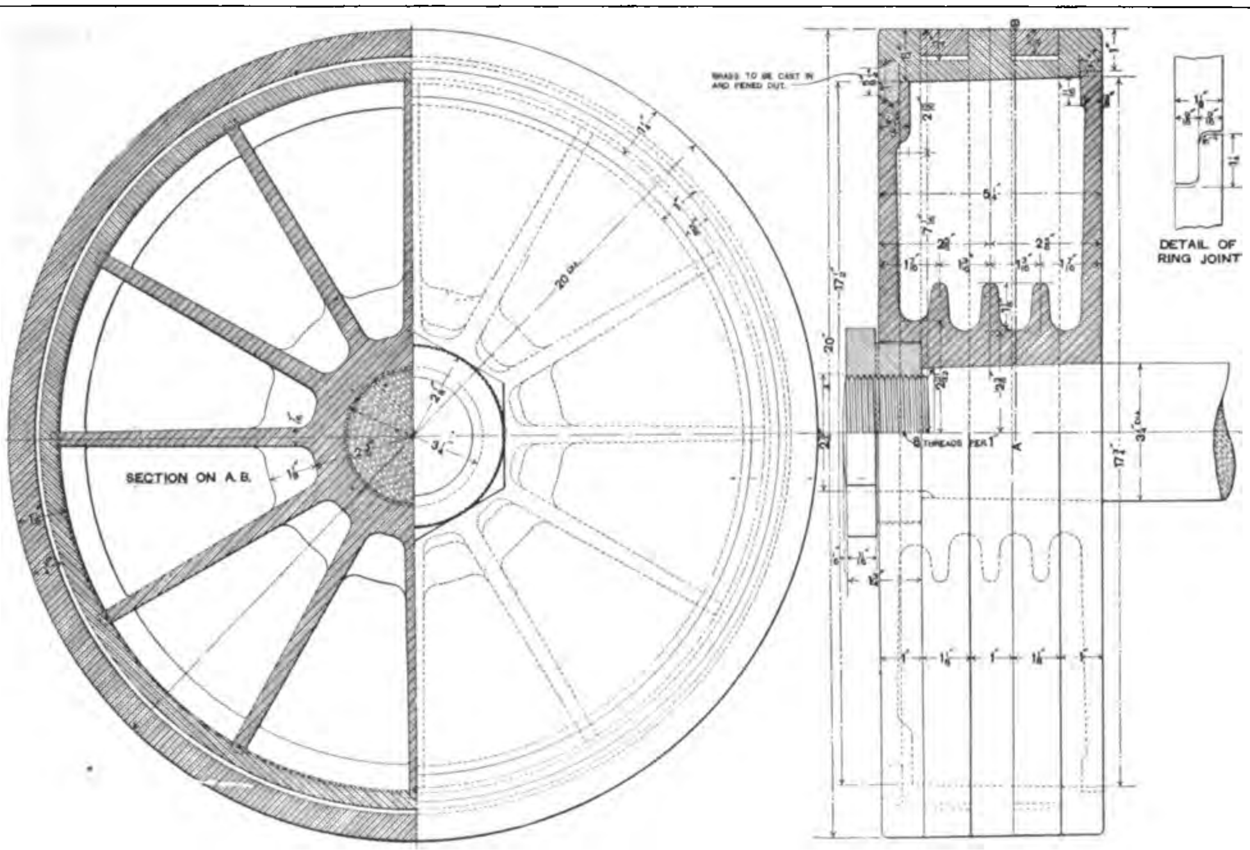




PLAN OF JUNIATA SHOPS, ALTOONA, PA.



VANIA RAILROAD, ALTOONA, PA.



Malleable Iron Piston—Norfolk & Western Railroad.

dilute acid, and are then tinned. After this operation they are clamped against a vertical cylindrical iron "core"—it may be called—having projections which leave a space of about one-eighth of an inch between it and the brass into which the melted lead is poured. As soon as the lead is set the fin, or superfluous metal, which projects is cut off by a kind of shear attached to the core. The whole process is quickly done. This lead lining is generally used on bearings for the Pennsylvania road.

In the use of brass bearings it was found that what may be called hard nodules were formed in the metal, which were not worn away with the other metal, but would often project from the surface and wear into and cut the journals. The formation of these nodules was finally attributed to oxidation on the surface of the melted brass while it was in the crucibles. A cure for the evil was found in sprinkling powdered charcoal over the surface of the molten metal while it is in the furnace.

An interesting annex to the foundry is the boiler room. In this three large Bellpaire boilers of the locomotive type have been installed, with room for an additional one. The level of the engine-room is about five feet below a track which extends into it and is supported on posts or trestle work. The track runs transversely to the boilers and is about eight or ten feet back of them—speaking in locomotive parlance. The coal is brought in on drop bottom cars and dumped on this trestle. It is then within convenient distance for firing the boilers, and is placed in that position without any other labor than that of running the cars in and dumping them. In front of the fireboxes of the boilers is a transverse pit, or what might be called a ditch, which has a bucket, which runs on a track on the bottom of the pit. This bucket can be placed in front of the ashpan of any of the boilers and the ashes can be raked directly into it. Between two of the boilers is a lift which consists of an inclined runway extending from the ashpit backward over the track on which the coal is brought in. This runway has a wire rope operated by a horizontal cylinder and pulley under the roof. To remove the ashes, a car is run in on the track to receive them, and the bucket is then filled and brought to the foot of the runway, the wire rope is attached to it, water is admitted to the cylinder; the bucket, which has a drop-bottom, is carried up and over the car, when it is dumped and the ashes deposited in it without any other labor than is here described. The hydraulic cylinder and piston is operated by a pump and accumulator in the usual way. Adjoining the boiler room there is also a Clayton air compressor which supplies air to various appliances inside and outside the foundry. One of them is an air lift or hoist for loading and unloading cars. This consists of two posts about twenty feet high and placed about thirty feet apart with a transverse beam on top, to which a vertical cylinder with about ten-feet stroke and perhaps twelve inches diameter. The piston rod can readily be attached to any object which is thus raised by the admission of air to the cylinder.

A steel rail breaker is also an appendage to the foundry. This consists of a large hydraulic cylinder, somewhat like those used for hydraulic riveting machines, the piston of which works horizontally. The rail is placed between the ram and suitable bearings, and when water pressure is admitted the rail is broken almost like a pipe stem. The rails are reduced to short pieces to facilitate putting them in the cupola when they are mixed with the iron for the manufacture of wheels.

(To be Continued.)

Malleable Iron Locomotive Piston.—Norfolk & Western Railroad.

The Norfolk & Western Railroad has recently put into service a number of locomotive pistons, in which the head is of malleable iron, with an outer rim of cast iron. Through the courtesy of Mr. R. H. Soule, Superintendent of motive power, we have received the working drawings from which the accompanying engravings were made.

The head proper consists of a single casting of malleable iron, having a central hub 4¾ inches in diameter, and front and back plates or walls ranging from ⅝ to $\frac{15}{32}$ inches thick. Twelve radial ribs, from $\frac{5}{16}$ to $\frac{7}{16}$ inches thick, extend from the hub outward and three circular ribs strengthen the hub. The casting resembles the ordinary "solid" piston except that it is open at the rim. This opening is closed by a cast-iron ring 1¼ inches thick, and the full width of the piston head, namely, 5¼ inches. The fit for this ring