where every part of an engine goes. If he does not in that time, he had better learn the baker trade. Should he show some mechanical ability then put him on the machine side of the shop. Should a drill press fall to his lot first, he will know the importance of having a hole drilled where it is laid out and not a 1-16-inch out of the way. Should a bolt cutter come next he will know whether the bolt should be cut a loose or tight fit for the nuts.

If he is given a frame bolt to make next he will know where to find the hole to fit that bolt to and how it should be fitted.

As he passes along down from one machine to another for the next two years he will at the end of his apprenticeship be able to do any of the ordinary jobs on the engine, and his employer will find that he is of some use to him, and not merely a machine capable of doing but one thing.

During the apprentice time the boy should be taught to say I can. Be made to see that there is always room at the top of the ladder. That there is always a place waiting to be filled by men of experience and new ideas. That he can not reach them by sitting down and saying "I can't. I have no one to push me along," but he must be shown that he must improve every spare moment. If he has not the advantage of a night school take up one of the many correspondence schools that may be had.

Let him know that he is being watched and if he spends his time hanging around street corners, pool rooms or dance halls, try to show him the folly of such thing.

If it is possible to organize a class as a great many of our shops are doing, make it an evening that they will look forward to. Have them make the evening profitable by having questions to ask, don't always try to answer them that evening, put over, have them study on them and come prepared at the next meeting to answer them; by so doing they will remember them a great deal longer. It is knowledge gained by actual work which can never be lost. Show him, though he may be black and greasy for ten hours a day, that it is an honest and noble calling, and it is better to be the son of toil than a nabob waiting for dead men's shoes. Teach him economy, not to spend all of his wages. and that by saying a small portion each month, at the end of his time he may be able to take a course in some well established mechanical school; thus combining the practical and technical work and making a man that in after years his first employers can point to with pride.

Yours truly,

H. A. Beech,

Foreman Locomotive Department, Ann Arbor R. R.

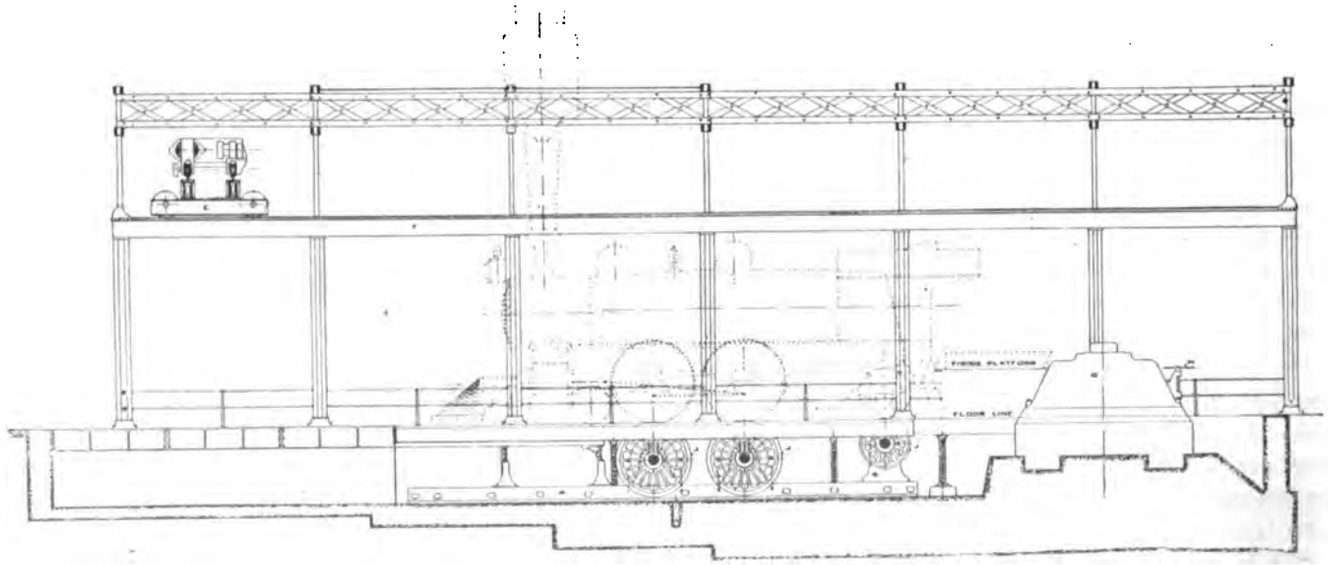
Owasso, Mich.

Locomotive Testing Plant at The Louisiana Purchase Exposition

THE first locomotive to be tested on the plant established at the Louisiana Purchase Exposition as a part of the exhibit of the Pennsylvania Railroad was placed on the plant early in May and was run daily for the purpose of breaking in the apparatus. The plant was placed in regular service on May 10th and has since been running smoothly. The principal features of the plant have been described in Bulletin No. 2, issued by the Pennsylvania. From this bulletin we take the following, together with the illustrations of the plant:

The Pennsylvania Railroad System has been assigned a space in the Transportation building of the Louisiana Purchase Exposition, three hundred feet in length and ninety feet in width, a portion of which will be devoted to the locomotive testing plant. Located in the second bay from the south side of the building and facing one of the wide entrance of its western exposure, this space is easily accessible for the locomotives which will be tested.

The general arrangement of the plant is shown on



LOCOMOTIVE TESTING PLANT AT THE LOUISIANA PURCHASE EXPOSITION—SIDE VIEW.

three plates forming a part of the bulletin, in end elevation, side elevation and in plan. The letters designating the essential parts are the same on each plate.

The locomotive under test is carried on supporting wheels whose axles are extended to receive absorption brakes. The turning of the driving wheels causes the supporting wheels to revolve, but these are retarded by the brakes to any extent desired.

The work actually done by the locomotive consists in overcoming the frictional resistance of the supporting wheels and brakes, the resulting force exerted at the drawbar being measured by a traction dynamometer.

The upper faces of the supporting wheels "J" are at the level of the tracks and of the floor of the building, with a pit of sufficient depth for these wheels and their supports.

The base of the plant consists of two longitudinal bed plates, "A," of cast iron, secured to concrete foundations of ample depth for the weight to be carried, and to resist the shocks transmitted from the locomotive driving wheels when revolving at high velocities. The bed plates are provided with T slots running longitudinally, and by means of suitable bolts the pedestals, "B," are secured to them, thus permitting adjustment lengthwise, in order that the supporting wheels may be located to correspond with the spacing of the driving wheels of the locomotive to be tested.

There will be two sets of supporting wheels, one consisting of three pairs, 72 inches in diameter, for use under passenger types of locomotives having large driving wheels, and one set of five pairs, 50 inches in diameter, to be used under locomotives with smaller wheels and designed for freight service. The pedestals will be of two heights; the lower ones for the supporting wheels of larger diameter, the higher ones for the smaller supporting wheels.

The journal boxes carried in the pedestals are self-adjusting so as to secure uniform support for the journals. The lower half of the box contains a bronze bearing of suitable composition, while the upper half, which acts only as a cap and carries no weight, is made of cast iron. The bearing surface is ample for the weight to be carried, but in order to provide against any possibility of heating, the journal boxes are cored out and arranged for cooling by water circulation. The lubrication is accomplished by two chains over each journal dipping into a bath of oil.

On the ends of each supporting shaft are the absorption brakes "C," which form the resistance which the locomotive must overcome, in order to exert its tractive effort at the drawbar. They are designed on a plan which enables them to work with perfect smoothness, to be used with ease and convenience and to have a large capacity. This type of brake was first used as a dynamometer at the Worcester Polytechnic Institute, and is the invention of Mr. G. I. Alden, M. M. E., formerly a member of the institute faculty.

The brake in its simplest form consists of:

1st. A smooth, circular, revolvable cast iron disk, with radial grooves, keyed to the shaft which transmits the power to be absorbed.

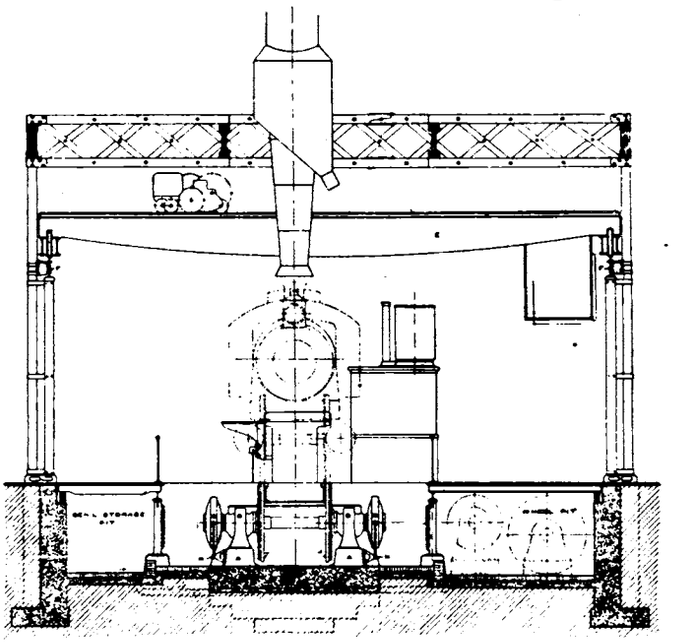
2d. A non-revolvable housing having its bearings upon the hub of the revolvable disk.

3d. A pair of thin copper plates fastened to the housing, one face to each copper plate being close and parallel to the sides of the revolvable disk, the other face of each plate having back of it a chamber in the housing.

4th. A system of piping and connections by means of which water under pressure can be circulated through the chambers between the copper plates and the housing.

5th. A system of piping and connections by means of which oil is circulated in such manner as to insure perfect lubrication of the copper plates which are next to the revolvable cast iron disk.

To insure sufficient capacity, each brake is provided with two disks revolving inside of each housing with an



LOCOMOTIVE TESTING PLANT AT THE LOUISIANA PURCHASE EXPOSITION—END VIEW.

arrangement of copper plates and water chambers, to allow pressure to be exerted on both sides of each disk.

Oil for lubrication between the revolving surfaces enters near the hub of the disks and is carried by centrifugal force along the radial grooves in their sides and out to their peripheries, completing the circuit through external tubes.

The housings of the brakes are secured against turning by rods attached to brackets "K," which in turn are held to the sides of the bed plates by bolts in T slots.

The seats on the supporting shafts for the hubs of the brake disks are tapered, as shown at "D," keys being placed in the shaft and hub to prevent turning. Nuts on the smaller end hold the hubs in position. Eight absorption brakes are provided, and may be used either on the shafts having the 72-inch supporting wheels, or on the shafts with the 50-inch supporting wheels, means for removing the brakes readily being provided by the taper fit, already mentioned, and a nut at the large end of the taper, so that the hub of the brake can be backed off without difficulty or delay.

When the brakes are in use, water under pressure flows through the chambers in the housings pressing the copper plates against the sides of the revolving disks and causing resistance to their rotation. The pressure of the water is regulated by valves controlling both the inlet and outlet independently. The water thus performs the double function of supplying by its pressure, the required friction, and by its rate of flow means of carrying off the heat generated.

The pipes leading to and discharging from the brakes are brought together at one point where all the valves will be located, so that the pressure and rate of flow, can be readily adjusted to the work being done.

To keep the speed of the locomotive constant, would ordinarily require hand manipulation of the valves controlling the ingoing and outflowing water, but in order to secure as nearly as possible constant speed, there is a by-pass around the main valve controlling the supply of water for all the brakes, and in this by-pass is an automatic valve controlled by the speed of the locomotive. If the speed increases beyond the desired number of revolutions per minute, the by-pass valve opens, so as to increase the pressure on the brakes, and if, on the other hand, the speed of the locomotive falls below that desired, the automatic valve closes, and decreases the pressure on the brakes.

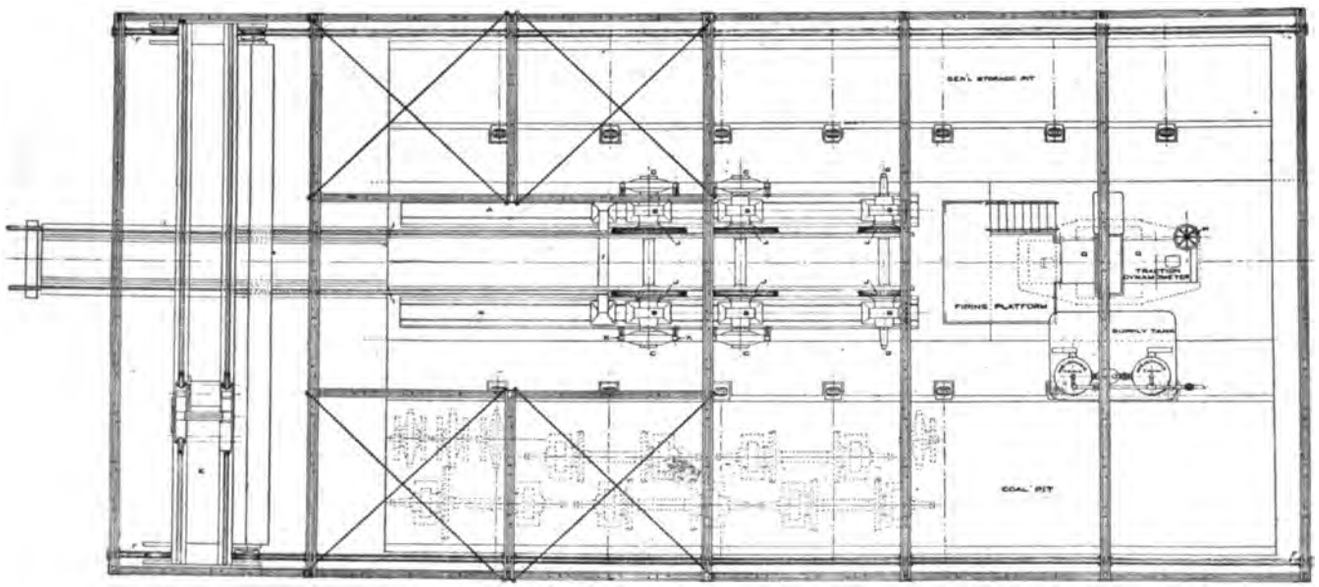
The supporting wheels resemble in form, the usual locomotive driving wheels, having cast steel centers with tires shrunk on, and held in addition by retaining rings.

The contour of the tire is approximately that of the head of a rail, but provided with means of keeping away from its bearing surface the oil which will necessarily drip from the locomotive while running.

The pit containing the parts already mentioned is extended sufficiently to provide room for the storage of the supporting wheels, axles, brakes and pedestals which are not in use, and provides storage for such other supplies and appliances as will be necessary for the operation of the plant. The floor covering this portion of the pit, is made in sections, so that it can be removed as occasion may require. The central portion of the pit, however, will be entirely open with the exception of sufficient platform to enable those taking part in the tests to secure indicator cards, make observations of temperatures and obtain other information of this character.

A traveling electric crane "E" of 10 tons capacity, and having a span of 43 feet between centers or runways "F," serves the entire space occupied by the testing plant, also sufficient space beyond the pilot of the longest locomotive to be tested, to reach the cars loaded with supplies for the plant. The crane will be used for handling the supporting wheels, axles, brakes, pedestals and other parts, when necessary to change their setting and, further, for handling all of the coal used during the tests.

The water required for locomotives under test will be weighed in two tanks, filled alternately, and run from these into a third tank, from which it will be taken by piping to the connections for the injectors. As a check on the weights thus obtained, the whole supply used will be metered and readings taken at such intervals as will enable the amount shown by weighing to be compared.



LOCOMOTIVE TESTING PLANT AT THE LOUISIANA PURCHASE EXPOSITION—PLAN.

The traction dynamometer "G" which measures the drawbar pull of the locomotive is of the lever type and is constructed on the "Emery" principle, in which flexible steel plates take the place of knife edges used in ordinary scales. The weight of each lever is taken by a vertical plate in a plane intersecting that of the receiving fulcrum plates at their center of rotation, thus relieving these plates of all transverse load. The yoke embracing the dynamometer and to which the drawbar is attached is also mounted on flexible plates and braced by long and flexible rods, to insure frictionless motion in the horizontal plane only.

The total motion of this yoke and drawbar, due to the leverage of the machine and to stress of parts when under full load, does not exceed four one-hundredths of an inch, so that a locomotive exerting a drawbar pull equal to the full capacity of the dynamometer, will not move forward

on the supporting wheels more than the amount specified. The drawbar is provided with a ball joint, to allow for any side motion of the locomotive, or motion of the locomotive on its springs.

Near the base of the dynamometer, the oscillating motion of the ends of the last levers is transformed into a rotary motion by means of steel belts wrapped around a drum and kept in constant tension by suitable clamping devices. The belt drum is mounted on a tube guided in ball bearings, and inside of it is a rod, the upper part of which is securely fastened to the tube, the lower end being firmly attached to the frame of the machine. It will thus be seen that when the belt drum is rotated, the rod inside of the tube is in torsion, and this resistance forms part of the total resistance of the machine, and is constant for the same travel of the recording pen.

To the upper end of the tube already mentioned are secured two radial arms, the extreme ends of which are finished to a circle having its center at the center of the tube. The angular motion at the end of one arm imparts straight line motion to a carriage, guided by a grooved track and carrying the recording pen. The opposite arm is coupled by steel belts to a rotary oil dash pot, to reduce violent oscillations of the recording pen, the extent of which can be controlled as desired. The principal resistances in the dynamometer are flat springs, placed under the second levers and deflected by the motion of these levers. There are three sets of these springs, varying in resistance so that a travel of eight inches of the recording pen, corresponds to a drawbar pull of either 80,000 pounds, 40,000 pounds or 16,000 pounds, as may be desired. The drawbar pull is traced upon a strip of paper 18 inches wides, made to travel at a known rate of each mile run by the locomotive, and this will form the permanent record of the drawbar pull in each test.

The yoke and drawbar of the dynamometer can be adjusted vertically through a range of 12 inches by means of a wheel "H," in order that the different heights of locomotive drawbars can be accommodated.

The smoke from the locomotive will be carried out of the building by a stack, which can be moved longitudinally of the plant to any position required, and the lower portion of which will be made telescopic, so that it can be raised and lowered for adjustment, and permit the passage of the electric crane, when necessary. The stack has deflectors, so that the sparks discharged by the locomotives can be caught, weighed and form a part of the data obtained.

The instruments necessary to get full information for the tests will consist, in addition to the dynamometer, of steam engine indicators, gauges for steam pressures, draft gages for smoke box, fire box and ash pan, thermometers for temperatures in the smoke box, calorimeters for getting the quality of the steam, a revolution counter and a tachometer for showing the speed in revolutions per minute.

Means for bringing the locomotive safely to its position on the plant form a most important part of the installation. The supporting wheels have been placed in position corresponding to the spacing of the drivers, I beams resting on the supporting shafts, and extending the full length of the pit, will be bolted securely to the inside faces of the supporting wheels. Supports at the ends of the pit and at as many intermediate points as may be necessary will be provided. On the upper flange of the I beams is riveted a grooved rail, so located that the flanges of the driving wheels will run in this groove; in other words, the locomotive will be moved to its position on the plant by being run on the flanges of its driving wheels, leaving the treads free to come into position upon upon the supporting wheels. When in place, the special rails and I beams will be disconnected, from the supporting wheels and removed, so as not to interfere with the operation of the plant. Provision will also be made for taking care of the driving wheels without flanges, which will be run over the same grooved rails, the grooves being filled by a suitable section of rolled steel.

A director of tests will be in direct charge of the plant, and of all the tests made. Under him, will be an assistant, and a foreman, who will give his attention to the machinery, care of the intruments and other necessary work of this character. There will be a large staff of observers for the coal and water used, for taking indicator cards, temperatures and readings from all the instruments forming the equipment of the plant.

In order that all of the data obtained may be worked up promptly, computers will be employed, so that the data coming from the observers on suitable blanks, will be tabulated and final results for comparison completed for each test, before similar data for the next run comes to the computing room. A force of 25 men will be constantly employed. All apparatus has been carefully selected and the most approved methods will be used to insure accuracy; the results will be put in a form convenient for reference.

Equalizer Truck for Freight Cars

THE sides and transoms of this truck consist of 13-in. rolled steel channel beams cut to the required lengths and united by gusset plates and connection angles. The ends of the side pieces are notched out to receive light cast metal pedestals with flanges which guide the journal boxes. The equalizers are of cast metal and support U-shaped hangers, one leg of each hanger passing through a hole in the web of a side piece. The springs rest upon cast metal seats located beneath the side pieces and the latter are supported upon the springs. To adjust the frame and car body so as to bring the draw bar and coupler to the required distance above the track it is necessary only to turn the nuts upon the hangers.

An equalizer truck for freight cars has long been a desideratum, but the excessive first cost of the ordinary types has heretofore prevented its general adoption. A