valve acts in the same direction in which it is moving, and takes up all the lost motion in valve gear from the valve to the eccentrics with a sudden shock, the extent of which depends on the degree of lost motion, but which is apparent on any engine equipped with this form of piston valve.

Up to the time of writing diagrams from the other types of valves mentioned are not available, nor are diagrams at the higher speeds. It is hoped, however, that at some future meeting the writer will be in a position to contribute further data on this interesting subject.

Michigan Central Shop Improvements at Jackson, Mich.

In presenting a description of the improvements that the Michigan Central is making in its shops at Jackson, Mich., at the present time it is interesting to refer back to an article describing these shops published in

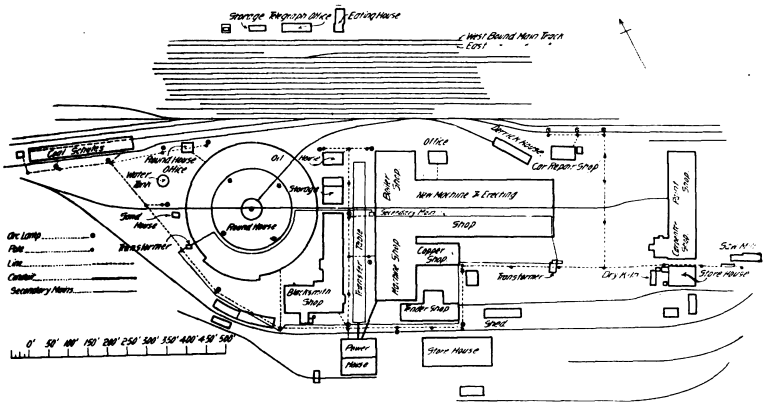

Fig. 1.—General Plan of Michigan Central Shops, Jackson, Mich.

the *Railroad Gazette* of April 23, 1897, from which an excellent idea may be obtained of the conditions and facilities then existing. It also serves to indicate the great difference existing between former and present-day practic in the design of railroad shop plants.

The extent of the present improvements, together with a brief outline of their nature, was given in our issue of Feb. 7, page 92. The old shop plant had four independent power plants, adjoining the machine shop, blacksmith shop, carpenter shop and roundhouse respectively. The new work consists in the elimination of these isolated plants by a new central power and lighting station, and the building of a large addition to the machine and erecting shop. In the plan of the shops which accompanied the 1897 article the blacksmith and boiler shops are shown as being in the same building, the one at present occupied by the blacksmith shop. By the new arrangement (Fig. 1) the boiler shop will be in the main building convenient to the machine and erecting departments.

The work at present under way is entirely under the supervision of Mr. C. H. Wilmerding, Consulting Engineer, Chicago. He has charge of the erection of the buildings as well as the rearrangement of the tools and the installation of the power, lighting and heating equipment from plans prepared by him.

Buildings.—The addition to the machine and erecting shop is at right angles to the old shop, and is carried through the latter to its east wall. It is of all-steel construction, having a central portion with a lean-to on each side. A half transverse section showing the construction of the building and location of machines is given in Fig. 2. The roof of each lean-to, as well as of the main or central part, is supported by steel columns, which in the case of the former are bricked into the walls. The width between columns of the central part is 72 ft. and each lean-to is 33 ft. wide, giving a total width of 138 ft. inside. The length of the new structure is 420 ft. The main columns carry the girders for two 60-ton cranes made by the Whiting Foundry Equipment Co., Harvey, Ill., which travel the full length of the building. The building foundations are concrete and the roof of the main portion is Ludowici tile, and the roofs of the lean-tos are expanded metal and concrete. The flooring of the central portion between crane columns is 2-in. yellow pine on 6 x 4-in. stringers; the remainder, from crane columns to walls, is floored with 6-in. cinder concrete. The power-house, 85 x 90 ft., is similar in construction to the main building. The roof is expanded metal and concrete on steel girders, and the floor is 6-in. cinder concrete. A monitor for ventilation of the boiler room runs along the crest of the roof; the engine room is ventilated by Pancoast ventilators.

Power Station.—A plan and elevation of the power station is shown in Fig. 3. Three Babcock and Wilcox boilers having each 2,640 sq. ft. of heating surface will furnish steam at 155 lbs. pressure, giving 150 lbs. at the engine throttles. Space is provided for a fourth boiler should future needs require it. Each boiler is equipped with a Green Engineering Co.'s chain grate, and will be hand-fired. The coal is stored in the bin shown along the south wall, there being a coal track along the outside of the building, and is drawn out on the floor through openings at the bottom of the bin. The plant is equipped with an induced-draft system, the draft being maintained by one of a duplicate set of fans built by the B. F. Sturtevant Co., and driven by independent engines controlled by a G. M. Davis fan-regulating valve. The breeching is built of ⅛-in. steel, with angle-iron stiffeners. A Green fuel economizer, having 2,400 sq. ft. capacity, and a Warren-Webster heater rated at 1,200 h.p. heat the feed water, which is supplied to the boilers by two Worthington duplex, 7½ x 4½ x 10-in. pumps, having outside valves. The economizer has capacity sufficient for the additional boiler above mentioned.

The engine room has three units for light and power. The engines, made by the Ball Engineering Co., are run compound, non-condensing. Two of them are 16 and 25 x 18 in., and the third 10 and 16 x 14 in. The two larger are direct-connected to General Electric 200-k.w., 60 cycle, three-phase generators giving 480 volts, and the smaller engine to a 75-k.w. generator of the same type. Each generator is provided with a compensating exciter, direct-geared to the shaft of the engine. The engines are also provided with synchronizing devices by which the speed of the engines may be brought into step.

The cables leading from the generators to the switchboard are carried in a trench, shown in the plan view,

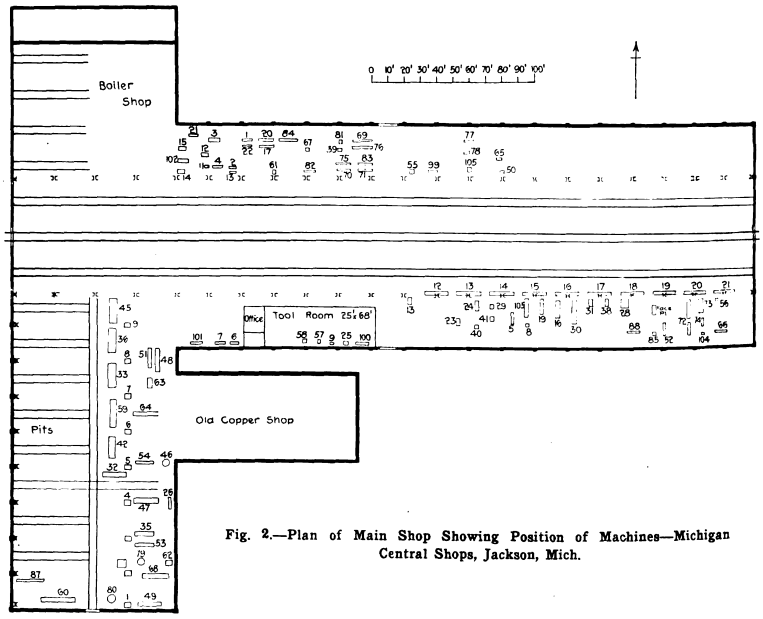

Fig. 2.—Plan of Main Shop Showing Position of Machines—Michigan Central Shops, Jackson, Mich.

under the floor to a pit behind the switchboard. This switchboard has eight panels and is built of 2-in. blue Vermont marble. The panels are apportioned as follows: Three for control of the generators; three for power feeders, governing 5 power circuits; and two for regulation of the lighting circuits, there being 2 to each panel. Two sets of bus-bars, one each for lighting and power are provided. Oil switches and recording wattmeters are included among the instruments, there being 2 of the latter, one for registering the power load and the other for the lighting load.

The old air compressor has been installed in the new station temporarily, it being the intention to replace it in the near future with a larger machine of modern type. At the time of the previous description of these shops, referred to in the beginning of this article, this compressor had but recently been installed and was described at some length. It is a Rand two-stage machine, with inter-cooler, having 10 x 16-in. steam cylinders and 7½ and 14 x 16-in. air cylinders. The delivery pressure is 120 lbs.

A 7½-ton hand-power crane having a span of 37 ft. 6 in., and a travel of the length of the room, facilitates handling the parts of the machines in case of repairs.

The steam piping is provided throughout with extra heavy fittings and Chapman valves. Connection to the 10-in. live-steam header from the boiler outlets is made with 8-in. long-sweep bends. From the header the steam passes through gate valves, steam separators and long-sweep bends to the engine throttles. An auxiliary high-pressure header, 3-in. in diameter and running above the middle of the battery, is so connected as to enable steam to be drawn from any single boiler to operate all of the auxiliary apparatus in the boiler room. Also a 4-in. line is run from the main header to the blacksmith shop for the steam hammers. The exhaust steam from the engines is led to a main-exhaust header located in a tunnel extending the entire length of the building and back of the engines. A 14-in. connection is made from this header through a branch tunnel into the boiler room, where connection is made to the feed-water heater and through a back-pressure valve to the exhaust head above the roof. Wherever possible the piping, with the exception of the main steam header and connections, is carried underground. The steam piping is covered with asbestos sponge-felted covering made by the H. W. Johns Mfg. Co.

Distribution.—The distribution of current for power and lighting is on overhead conductors except where the circuits lead out from the power station; lead-covered wires pass out from the pit behind the switchboard, already referred to, in underground conduits to poles a short distance away. It has been mentioned that there are 5 power circuits. One of these supplies the machine-tool motors in the locomotive and tender shop; another is for the operation of the cranes in the locomotive shop; a third supplies the motors in the carpenter shop, dry kiln and wood mill; a fourth, the transfer tables and turntables; while the fifth runs to the blacksmith shop and to the motor operating the coal chute. Three of the lighting feeders supply each a group of transformers, one of which is west of the roundhouse, a second west of the machine shop, and the third at the east end of the locomotive shop. The secondaries from these groups are interconnected. The fourth feeder supplies the passenger station, freight house and yards at Jackson with light. For this transmission of about a mile the current is transformed up to 2,200 volts at the power station and a pole line along the right of way of the company carries it to the points mentioned.

Locomotive Shop.—The old shop building is 375 ft. long by 103 ft. wide. The dimensions of the new portion have been given. The new shop has three longitudinal erecting pits, placed in the central portion. Those on each side of the center track are 350 ft. long, and a shorter one, in the center track, is 200 ft. long. Between the long erecting pits and the center track are two storage pits each 350 ft. long. These pits are intended to store the parts of the locomotives not needing repairs, and do away with racks and other arrangements that occupy needed floor space. The storage pits are provided

with removable sectional covers, resting on 4-in. I-beams spaced 6-ft. centers. The sides and bottoms of all of the pits are lined with cement, and in the bottom of the storage pits a 2-in. wooden flooring is spiked to 4 x4-in. sleepers imbedded in the cement. Sections of both pits are shown in Fig. 4. The new part of the shop will have a capacity for 14 locomotives a month, making the total for the entire shop about 24 a month.

In the new section all tools are located in the lean-tos. The old shop was very crowded, so that the rearrangement is simply a distribution of the tools already on hand over a greater territory, without the addition of any new tools. A few of the largest of these machines will be independent motor-driven. In the plans the rest are divided into groups, each group having a separate line-shaft and motor. These motors range from 5 to 30 h.p., while the independent motors range from 3 to 7½ h.p. As alternating - current motors run at a high speed, a considerable reduction to the tools is necessary. A single reduction by belting and pulleys requires driven pulleys of objectionably large diameters, and as such a reduction is necessary in a number of cases in this arrangement, it is intended to substitute Renold silent chain gear. The sprockets can be made much smaller than the pulleys that they will displace and at the same time there is no slippage, and the installation once made is practically permanent.

A 7½-ton electric crane is installed in the south section of the old machine shop and travels the length of this wing up to the 60-ton crane runway. The north section, used as a boiler shop, is served by a 15-ton crane.

Lighting.—The arc lamps for the general illumination of the yards are wired in three groups independently, from the three transformer groups already described. These groups may be turned on or off from the power-house by means of remote-control switches. There are to be altogether 104 enclosed-type arc lamps and about 800 incandescent lamps. In the locomotive shop Chapman wall sockets are provided at intervals and flexible cord connections with Chapman plugs will enable a light to be carried to any part of a locomotive or boiler.

Heating.—A hot-blast system, in connection with the Warren-Webster vacuum system, is to be used to heat the main building, while the other buildings are to be heated by direct radiation. The hot-blast system is to be installed by the National Blower Works, Milwaukee, Wis. Two sets of fans and heating coils are to be provided, one being located on a steel platform some 12 ft. above the floor in the old copper shop, and the other in a small addition on the north side of the new building. The first is to have a fan 12 ft. in diameter by 6 ft. wide driven by a 50-h.p. motor and drawing the air over heating coils containing 14,625 ft. of 1-in. pipe. The other fan is 10 ft. in diameter and 5 ft. wide, operated by a 40-h.p. motor and having heating coils of 10,600 ft. of 1-in. pipe. The distribution from these fans is made through galvanized iron piping 72 in. in diameter at the fans and gradually reducing as the distance from the fan increases. In the new shop the pipe is carried for the full length on each side, while in the old shop the ducts are swung just under the bottom members of the roof trusses.

The main exhaust header is to be used as a supply pipe to the heating system. It passes out of the building at each end of the tunnel in which it is run, and is provided at each end with a gate valve and an oil extractor. The return pipes from the heating system pass into this tunnel and are led to two Marsh vacuum pumps in the boiler room, adjacent to the feed water heater. Connection is made from the high-pressure steam header to the exhaust header for the purpose of supplying live steam to the heating system when necessary.

Tool List.

Groups with horse-power of motors for each.

Machine No.	Machine.	Horse-power of motor.
49.	Planer, 30 x 30 in.	
68.	Planer, 36 x 36 in.	
79.	Boring mill, 52 in.	
27.	Slotter, 12 in.	
62.	Drill.	
35.	Lathe, 36 in.	15
53.	Lathe, 30 in.	
47.	Lathe, 48 in.	
54.	Axle lathe.	
46.	Wheel for boring machine.	
26.	Milling machine.	
32.	Wheel press.	
42.	Quartering machine.	
59.	Wheel lathe, 76 in.	
33.	Wheel lathe, 76 in.	
36.	Wheel lathe, 76 in.	20
45.	Wheel lathe, 82 in.	
64.	Planer, 36 x 36 in.	
51.	Lathe, 36 in.	
48.	Lathe, 36 in.	
63.	Horizontal boring machine.	
80.	Boring mill, 80 in.	5
60.	Planer, 54 x 54 in.	7½
87.	Cylinder boring machine, 36 in.	5
76.	Lathe, 25 in.	
69.	Lathe, 30 in.	
71.	Lathe, 22 in.	
83.	Lathe, 20 in.	
70.	Lathe, 16 in.	
75.	Lathe, 20 in.	
39.	Milling machine.	
81.	Key slotter.	
14.	Bolt cutter.	
102.	Bolt cutter.	
15.	Bolt cutter.	
84.	Lathe, 34 in.	20
17.	Lathe, 16 in.	
20.	Lathe, 20 in.	
22.	Lathe, 16 in.	
1.	Lathe, 18 in.	
61.	Grindstone.	
18.	Bolt machine.	
2.	Lathe, 13 in.	
4.	Nut facer (lathe, 20 in.)	
11.	Bolt pointer.	
12.	Nut tapping machine.	
3.	Turret lathe, 14 in.	
21.	Turret lathe, 16 in.	

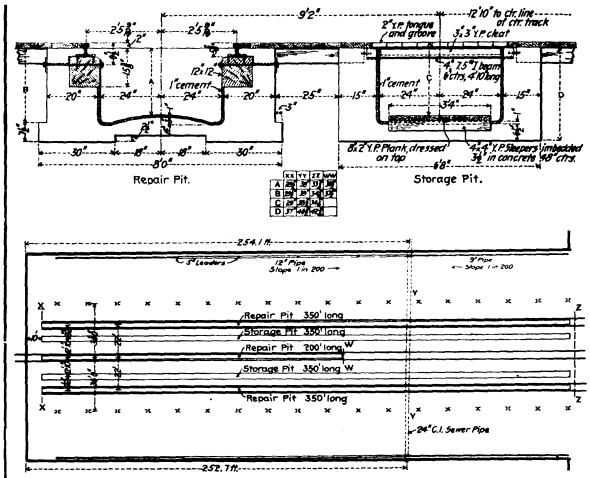

Fig. 4.—Plan and Sectional Elevations of Repair and Storage Pits—Michigan Central Shops, Jackson, Mich.

99.	Drill.	
55.	Drill.	
78.	Planer, 24 x 24 in.	
77.	Planer, 20 x 20 in.	15
50.	Planer, 30 x 30 in.	
65.	Shaper.	
67.	Planer, 25 x 25 in.	
105.	Grinder.	
66.	Planer, 24 x 24 in.	
56.	Drill.	5
104.	Shaper.	
74.	Lathe, 13 in.	
73.	Shaper.	
89.	Lathe, 32 in.	5
72.	Lathe, 16 in.	
52.	Lathe, 22 in.	
88.	Guide grinder.	
28.	Slotter, 12 in.	
38.	Vertical milling machine, 52 in.	30
31.	Grinder (water).	
30.	Milling machine, 30 x 30 in.	
16.	Drill.	
19.	Lathe, 24 in.	
8.	Grinder.	
103.	Lathe, 32 in.	
5.	Lathe, 20 in.	20
41.	Drill.	
20.	Drill.	
24.	Shaper, 16 in.	
40.	Shaper.	
23.	Shaper, 14 in.	
13.	Radial drill.	3
100.	Lathe, 18 in.	
25.	Milling machine.	5
9.	Grinder.	
57.	Grinder.	
58.	Grinder.	
6.	Lathe, 15 in.	
7.	Lathe, 20 in.	5
101.	Lathe, 19 in.	
	Total horse-power of motors in machine shop.	160½

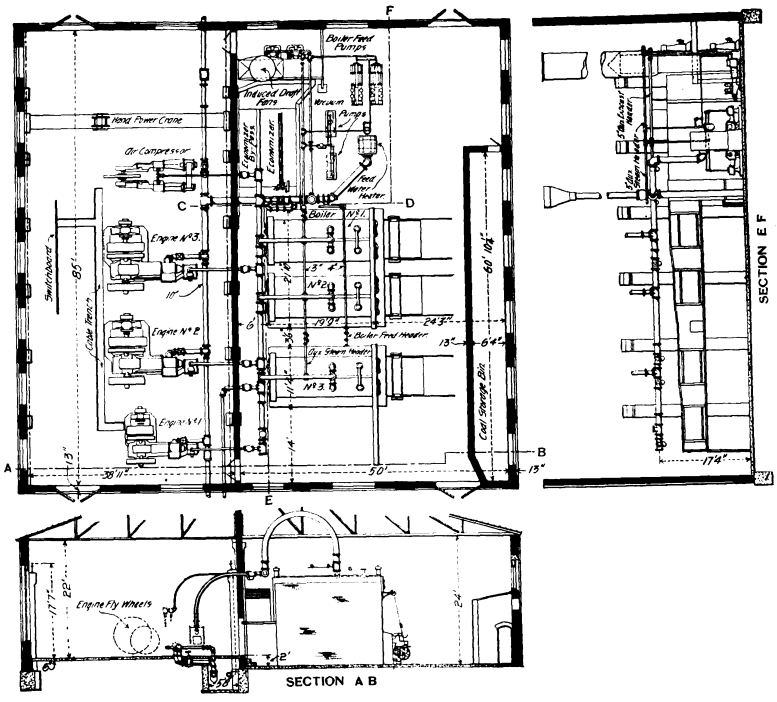

Fig. 3.—Plan and Section of Power Station—Michigan Central Shops, Jackson, Mich.

Norfolk & Western Improvements.

The annual report of the Norfolk & Western gives the following account of new work under way or proposed for next year:

To meet the growth of western traffic numerous long double passing sidings are being constructed between Vivian and Naugatuck, 93 miles, alignment being improved by reducing curvature, and eventually these long sidings will be connected and form a second track. Between Naugatuck and Kenova is 83 miles, with 15 miles of grade against the traffic. Instead of building a second track along the present line it has been decided to construct a new single-track line following the waters of the Big Sandy River from Naugatuck to Kenova, the distance by this line being some 60 miles. This new line will be used for heavy westbound traffic, the lighter eastbound traffic and empty cars using the old line. With this new line completed the company will have a line from the Pocahontas, Tug River, and Thacker coal fields to Portsmouth, Ohio, a distance of about 230 miles, without adverse grades. From Portsmouth to Columbus, Ohio, a distance of 100 miles, there will be no grades against the traffic exceeding 26 ft. to the mile when the improvements to that portion of the line now in progress are completed. With these improvements and with suitable yard facilities at Portsmouth, arrangements for which are now in progress, the company will be in a position to transport its heavy westbound traffic in maximum train loads at a minimum of cost.

To provide for the increasing traffic to the East and South, the work of reducing curvature and grades and constructing second track has for several years past been in progress, and, at the close of the year, out of a total distance of 145 miles between Vivian and the summit of the Blue Ridge, 90 miles of second track were completed and in operation and 20 miles under contract. When this is completed there will remain a gap of 35 miles on which there are now some five miles of long double passing sidings which will in time be used as second track, reducing the length of second track still to be placed under construction to 30 miles.