the throttle valve, which is so arranged that it only takes steam through the top. The dry pipe leading to the forward section and superheater passes along the top center line of the boiler on the outside.

The two flexible boilers embody decided innovations in locomotive construction in their design. An articulated boiler with a single ball joint, as designed at Topeka, was described in the article by M. H. Haig, mechanical engineer of the Santa Fe, in the *Railway Age Gazette* of February 10, 1911, page 278. In one of the Baldwin designs the principle is somewhat the same, except that there are two ball joints, one on each section of the boiler, with long overlapping sleeves and packing rings near the edge. A detail of this design is here illustrated. The ball joints are kept tight by rings of soft metallic packing, which may be adjusted by set screws. The two boiler sections may thus move in any direction relative to one another, full provision being made for expansion and contraction. The other flexible joint shown is that designed by Mr. Vauclain, of the Baldwin Locomotive Works, and is called the Bellows type connection. This joint consists of 60 rings, of high carbon steel, No. 14 gage thick, 10 in. wide and 75½ in. outside diameter. They are made with a set, so that when placed adjacent to each other they form a series of V-shaped joints. The adjacent rings are riveted together at the inside and bolted at the outside; the whole flexible connection is bolted in place between the front and rear sections. The products of combustion traverse this connection through a cylindrical flue 44 in. in diameter, which is riveted to the rear boiler section and prevents cinders from lodging in the crevices between the connecting rings.

It is, of course, necessary in these engines with flexible boilers to place flexible joints in all pipes which pass the articulated connection in the boiler. This, however, introduces no important complication. The steam piping is simplified, as no flexible joints are required in the exhaust connection between the low pressure cylinder and the smokebox. There is also a distinct advantage in the avoidance of sliding supports under the forward boiler section, and the stability of the locomotive on curves is not impaired by the lateral displacement of the boiler on the front frames, which necessarily occurs in a Mallet locomotive as usually built. Both the high and low pressure pistons are packed with cast iron rings sprung in. The high pressure piston head, 24 in. in diameter, is made of cast iron in one piece. The body of the low pressure piston is made of cast steel, and a cast iron bearing ring measuring 8 in. in width at the bottom is bolted to it. Tire flange oilers are applied to the leading driving wheels of the front group, which should prove of value in reducing flange wear, as the road has curves of 16 deg. on sidings and 10 deg. on the main line.

Record No. 69, recently issued by the Baldwin Locomotive Works, and from which this article was compiled, gives a more detailed account of the locomotives. Following are the principal dimensions and ratios:

General Data.	
Type	Mallet
Service	Freight
Fuel	Soft coal
Tractive effort	61,500 lbs.
Weight in working order	392,300 lbs.
Weight on drivers	317,300 lbs.
Weight of engine and tender in working order	562,000 lbs.
Wheel base, driving	37 ft. 10 in.
Wheel base, rigid	13 ft. 8 in.
Wheel base, total	56 ft. 5 in.
Wheel base, engine and tender	89 ft. 3 in.
Ratios.	
Total weight ÷ tractive effort	6.38
Weight on drivers ÷ tractive effort	5.15
Tractive effort × diam. drivers ÷ total heating surface†.	771
Tractive effort × diam. drivers ÷ total equivalent heating surface*	657
Total heating surface† ÷ grate area	105
Total equivalent heating surface* ÷ grate area	123
Firebox heating surface ÷ total heating surface,† per cent.	3.64
Firebox heating surface ÷ total equivalent heating surface,* per cent	3.10
Ratios.	
Weight on drivers ÷ total heating surface†	57.6
Weight on drivers ÷ total equivalent heating surface*	49.1
Total weight ÷ total heating surface†	71.3
Total weight ÷ total equivalent heating surface*	60.8
Volume equivalent simple cylinders, cu. ft	20.60
Total heating surface† ÷ vol. cylinders	267.5
Total equivalent heating surface* ÷ vol. cylinders	313.5
Grate area ÷ vol. cylinders	2.55
Cylinders.	
Kind	Compound
Diameter	24 in. and 38 in.
Stroke	28 in.
Valves.	
Kind	Bal. piston
Wheels.	
Driving, diameter over tire	69 in.
Driving, thickness of tire	3½ in.
Driving, journals, main, diameter	10 in. x 12 in.
Driving, journals, others, diameter	9 in. x 12 in.
Engine truck, diameter	31¼ in.
Engine truck, journals	6½ in. x 12 in.
Trailing truck, diameter	40 in.
Trailing truck, journals	8 in. x 14 in.
Boiler.	
Style	Straight
Working pressure	220 lbs.
Outside diameter of first ring	70 in.
Firebox, width and length	63¾ in. x 119⅝ in.
Firebox, plates, thickness	5/16 in., 3/8 in., and 9/16 in.
Firebox, water space	5 in. and 5½ in.
Tubes, number and diameter	294—2¼ in.
Tubes, length	19 ft. 7 in.
Heating surface, tubes	3,376 sq. ft.
Heating surface, firebox	200 sq. ft.
Heating surface, firebrick tubes	34 sq. ft.
Heating surface, feed-water heater	1,893 sq. ft.
Heating surface, total, including feed-water heater	5,503 sq. ft.
Heating surface, reheater	650 sq. ft.
Heating surface, superheater	300 sq. ft.
Heating surface, total equivalent	6,453 sq. ft.
Grate area	52.5 sq. ft.
Tender.	
Tank, style	Water bottom
Wheels, diameter	34¼ in.
Journals	5½ in. x 10 in.
Water capacity	9,000 gals.
Coal capacity	12 tons

†Total heating surface includes feed-water heating surface.

*Total equivalent heating surface equals total heating surface plus reheating and superheating surface.

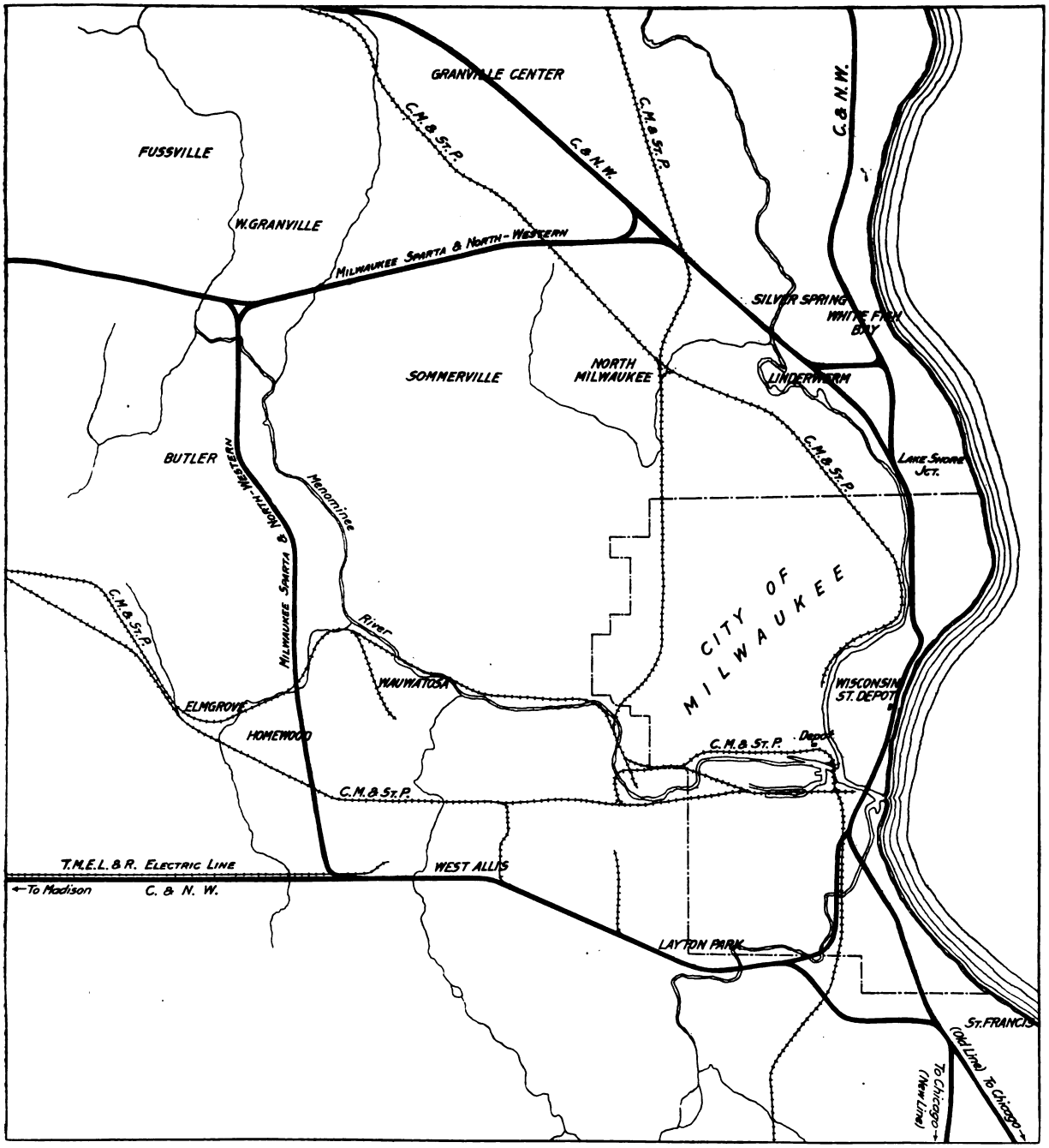
BELT LINES OF THE CHICAGO & NORTH WESTERN AT CHICAGO AND MILWAUKEE.

There has been much discussion by railway officers in recent years of the need for belt lines outside of the congested parts of large cities, over which through traffic originating at and destined to points other than these large cities themselves could be routed. The Chicago & North Western is one road whose management has not only been talking about this needed improvement, but has been making it. The North Western has been building outer belt lines at both Chicago and Milwaukee.

Its Des Plaines Valley Railway intersects, above Northfield, Ill., the two double track lines of the North Western running from Chicago to Milwaukee. From Northfield, as shown by one of the accompanying maps, it runs southwest to Des Plaines, Ill., where it intersects the Wisconsin division of the North Western. Southwest of Des Plaines it turns directly south and runs to a connection with the Galena division at Proviso, Ill. The line is 12 miles from the congested part of Chicago and is 22 miles long. At Proviso the yards have been enlarged, large engine houses have been built, cooling plants have been erected, etc. At this point the Des Plaines Valley connects with the Indiana Harbor Belt, and here the switching of through cars in connection with the making up of trains will be done, which heretofore has been done in the city. This will give the North

Western an opportunity to exchange with other roads via the Indiana Harbor line, in addition to using the facilities now afforded by the Belt Railway, and with the constant increase in business it will probably mean additional traffic for both the belt lines mentioned; and will also result satisfactorily from the standpoint of time required to effect transfers. Besides expe-

struction of the Des Plaines Valley Railway will give the North Western for handling freight traffic at Chicago, a further enlargement of facilities will result from the construction of its new passenger terminals in that city and the use of the tracks now employed in passenger service for the handling of freight business.

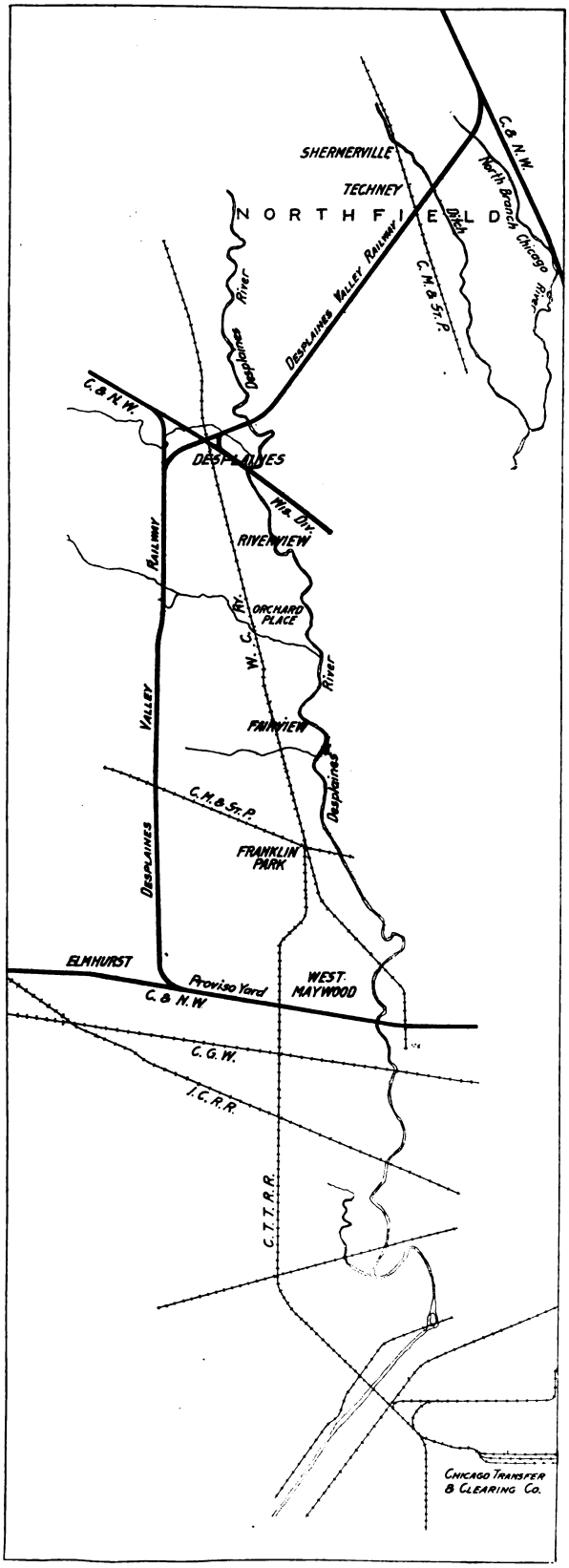


Chicago & North Western Lines Around Milwaukee.

diting the handling of existing traffic, the new line will open up an extensive territory where facilities can be provided for the location of new industries which will afford additional traffic.

In addition to the large terminal facilities which the con-

The other map herewith shows both the old lines of the Chicago & North Western through Milwaukee and its new belt line, the Milwaukee, Sparta & Northwestern. Formerly through traffic was routed through the city from Lake Shore Junction as far around as West Allis, all the business, both local and



Des Plaines Valley Line of the Chicago & North Western.

through, passing through a narrow throat in the city along the lake front. Now all business originating at and destined to points beyond Milwaukee will be moved via the Milwaukee, Sparta & Northwestern, which will eliminate the congestion incidental to the mixture of local and through traffic and make it practicable both to better serve the industries already located on the North Western and to open up a large territory suitable to industrial development.

The Milwaukee, Sparta & Northwestern is a new low grade line from Lindwerm, Wis., about eight miles north of Milwaukee, to Sparta, Wis., a distance of about 169 miles, exclusive of the belt connections around Milwaukee shown on the map. The new line connects with the Chicago, St. Paul, Minneapolis & Omaha at Wyeville, and gives the North Western an opportunity to handle its heavy tonnage for the Twin Cities and Duluth, and connecting traffic for the Omaha line over a direct low grade road, which will enable engines to pull larger units without sacrificing time. This line, in connection with the Milwaukee belt, will also provide the North Western with means to run some of its through passenger trains to Duluth and the Twin Cities through Milwaukee. It now has direct connections from Milwaukee to Lake Superior and Minnesota by its Waukesha and Madison lines, but the new road will be more direct.

The construction of these belt lines is in line with the policy which Marvin Hughitt, chairman of the Chicago & North Western, has pursued of developing home industries.

THE GENEALOGY OF THE NEW HAVEN.

[WITH AN INSET.]

The New York & New Haven Railroad, the base on which the New York, New Haven & Hartford system was built up, was chartered in 1844, but not fully opened until five years later, after much difficulty in raising its original capital of $2,500,000. The basic line from New Haven to a junction with the Harlem tracks was then, as now, about 64 miles. Its beginnings, of course, were meager. There were no night trains on the line and but two freight trains per day; yet it paid dividends almost from the first from earnings that then had better been used in improvements. Ere long it suffered two costly calamities. One was the famous "Schuyler fraud"—the issue of spurious shares for nearly $2,000,000 by Robert Schuyler, president and stock transfer agent of the corporation. The story of that dramatic crime with its rich harvest of litigation and which the company did not outlive for 14 years will be found on page 317 of the *Railroad Gazette* of April 29, 1904. The other calamity was the Norwalk drawbridge disaster, May 6, 1853, in which 46 persons lost their lives.

It is a striking fact that the present system has been built up during two decades and under two presidents—C. P. Clark and C. S. Mellen—the earlier history of the road being ultra-conservative. Not until 1872, or 23 years after its opening, did it take in the New Haven, Hartford & Springfield line, the natural extension into Massachusetts. The important acquisition under intermediate presidents, G. W. Watrous and J. M. Hall, who for a brief time succeeded President Clark, were the New Haven & Northampton; the old Shore Line between New Haven and New London; and the more important New York & New England, reaching from the Hudson river to Boston—a line of checkered and sensational history. But under President Clark consolidation went on by leaps and bounds. It included the Housatonic group; the Naugatuck; the Boston Air Line; the large Old Colony and the New York, Providence & Boston, with their several allied Sound boat lines; the beginnings of trolley purchase; and along with these the development of the Harlem terminal and the four-tracking of the main line between New Haven and New York.

Big and swift as were President Clark's mergers he has been surpassed in the development of the system by his successor.