of action; that the men selected may not be safely trusted with so much authority. The answer would be to get only the best, well-tried men obtainable, and then pay them as much as their type of services will command in any market outside of the railroad service. In this way the men selected will be anxious to do their best and to become fixtures with the company, instead of constantly hoping an opportunity will present itself in some other place to get a salary more commensurate with the services required and given. The knowledge of a man's past accomplishments should be a reasonable assurance of his future possibilities.

On this basis build an organization which will be noted for permanency of office and which will make a point of taking in young men of promising character and ability and of educating and developing them in their line of work so that after a period of five, ten or more years the necessity of looking outside for strong men to fill advanced positions will be obviated, by having at home welltrained and efficient men, thoroughly imbued with the fundamental principles on which the progress of the company was founded years before. In this way stability can be assured, strong railroad men educated and the highest type of results obtained. In this country, happily, there can be seen at least one or more examples of the results of over two decades of organized development on these lines, which speaks for itself.

In the past there has been a tendency on the part of railroad companies to so restrict the salaries paid chief officers in many departments as to make them unable to obtain and retain the high class of ability needed in many of their most important lines of service. It is an undoubted fact that the railroads have been losing to outside manufacturing and engineering companies many of their strongest men, due to there being insufficient inducement, either in salaries paid or in prospects for future advancement, to warrant them in entering or remaining in the railroad service. There is perhaps no industry or profession that calls for higher skill and talent in the engineering or mechanical lines than our great railroad systems. To prepare for positions of high responsibility in these lines at the present time requires not only years of study on technical lines, but a practical experience and education that can only be obtained by many years of exacting work at a small remuneration. In Europe these facts are recognized and the heads of these two important departments of railroading have a recognition that is rarely accorded in America, but which goes a long way toward making the positions sought for by a high type of men.

One very noticeable and questionable policy prevails on the railroads in the United States which is seemingly not considered wise or feasible in European railroad practice. It is the tendency of officials who are not versed either in theory or practice along the two engineering lines of the service to interfere and interpose their ideas in preference to the knowledge born of study and long experience, of those who have given their lives to the pursuit of their particular line of work. In England a general manager or a board of directors would look to the chief mechanical engineer for advice as to the class of equipment which ought to be purchased and would not think of setting up his own preconceived notions as superior to the knowledge and skill of an officer whom his company had employed to give his time to the especial study of such matters; neither would he pretend to say how he should operate his department as to its men, methods or standards.

In America such interference is too frequently attempted, to the discouragement of the department chief, and to the demoralization of the department organization and progress. It is, on the face of it, absurd to think that a chief executive officer or a board of directors can wisely assume to know more about technical department details than those who have made such matters a life study. If such an occurrence happens it is evidence either that there is an incapable man at the head of the department, or that those in superior authority are taking the best means possible to disrupt organized work and good discipline. A happy medium would be for chief executive officers not to arbitrarily decide on department questions, but to outline the general policy desired to be pursued and the results wished for and then leave the experts in the respective lines to indicate what is needed to fill the requirements; the responsibility being fully placed on them as well as the authority to go ahead. If the head of the department is not to be trusted with so much authority a new man should be selected who is competent and worthy of trust in full. Expert heads of departments should be allowed full freedom in their own departments, both as to methods, men, organization and the qaulities of materials and devices used.

Unfortunate results are often forced on a department by the unwise practice of directors or officers who are quite ignorant of the possible effects of their requests forcing the adoption of methods, materials, or the employment of men in places where expert knowledge would show that bad results were sure to follow. This is wrong in principle and in the end is bound to produce bad results. When such bad results do follow the ones really responsible are very loath to accept the blame, but the operating officer who carries out their ideas is in most cases loaded with the criticism which properly belongs higher up.

One serious lack on the railroad systems of the country is the almost total want of a definition of duties and responsibilities of the various departments and of the different officers operating in such departments. . We find not infrequently "books of rules" for some of the depart-

ments in a few of which rules are incorporated carefully outlining the duties and jurisdictions of minor officers in such departments. On most roads there is a lamentable indefiniteness as to the extent of the jurisdiction of the various departments and as to the range of jurisdiction of the various vice-presidents, general managers, general superintendents, chief engineers, superintendents of motive power, purchasing agents, etc., resulting in some cases in certain officers assuming to claim jurisdiction over everything in sight, with much resultant friction, unpleasant feeling, interference, delay and general disorganizing results.

On some roads a purchasing agent in the absence of specific definition of duties to the contrary, will assume that he is competent and is authorized to decide as to the quality and kind of material to be used by the various departments, instead of simply being delegated to purchase the supplies called for on requisitions on the best possible terms, and keeping in touch with the heads of departments, advising them of possible ways of saving money in the purchase of supplies for their use; he thereby puts himself at loggerheads with and as superior to the ones at the head of the special departments, who are being paid to study and to know about such matters, Hundreds of illustrations of this kind will present themselves to railroad officers, and there are many cases where the purchasing agent's saving (?) had to be expended many times over, to repair the bad results consequent upon his unwise assumption of superior technical and practical knowledge.

The history of some of the largest and most successful manufacturing concerns shows the beneficial results attained by the selection and appointment of a competent, high-salaried chief operating officer who has been given complete control of the affairs of the company; the president and the directors keeping their hands off, and allowing the manager full and free authority and jurisdiction, subject to their control only so far as financial matters involving great outlay were concerned. It must not be considered that everything depends upon the man in charge of the operations, for unless such a man is supported and backed financially it may be impossible for him to lift a company out of the ruts of old practices and lack of progress and place it on the hard road bed of success and advancement. A mistake too often made is to withhold financial aid until too late. Many a railroad company has suffered and is suffering to-day from withholding a liberal expenditure of money for modern facilities to provide up-to-date methods and adequate provisions for rapid-growing business, because it could not bring itself to make the needed appropriations until after much lost time, when a period of business depression had arrived and lessened earnings had put a seal on continued lack of proper facilities to conduct the work in an economical manner for perhaps many years to come.

A very interesting feature in English railroad practice, which could be imitated with advantage in this country, is the custom of holding monthly meetings of the heads of all departments with the general manager. These meetings are not a matter of convenience simply, but they are regularly scheduled gatherings which are considered as fixed and as important as the regular meetings of the board of directors, and they serve to put each department in actual touch monthly with every other department and enable matters of importance to be talked over and understood by every department chief.

Much might be said and written as to the two distinctive plans of general organization for railroads, examples of which, together with modifications of each, are readily seen and studied. The "departmental" plan and the "divisional" plan each has its advocates. As railroad

systems are assuming such large proportions now there seems to be a leaning toward the departmental plan as being more conducive to rapid results in developing a good strong system organization from a heterogeneous one, which was the result of merging of several differently

organized railroad companies.

In such departmental organization the tendency can be avoided of loading on any one division officer the burden of details of various departments, any one of which could be handled well, but responsibility for all of them causes some to be slighted. In a divisional organization the division has to be made a department organization, and there are many who believe it is better to keep each department separate, maintaining harmony between the various departments by the intercourse and conferences of the general department chiefs rather than by trying to keep all in harmony through many divisional department heads. The writer knows that some who for years have advocated and practiced the divisional system are now convinced of the superiority of the departmental system for large and widely spread interests. The general organization as established and developed by our national government seems to combine features best calculated to successfully administer the regulation and direction of the business of a large railroad system.

The above suggestions may be summarized as follows:

1. Departmental system of organization the best for large railroad systems.

2. The board of directors should direct the financial matters of the system and select the best obtainable men to handle the various phases of administration.

3. The executive and administrative officers should be ably and promptly supported in all reasonable calls for financial help to properly equip and organize the system.

4. The board of directors to be divided into small committees, who will meet at stated times, at least monthly, with the head of the department which is especially assigned to them, and keep in touch with the developments and financial needs of that department, granting proper special appropriations for its improvement and development, in harmony with the generally approved policy of improvement agreed upon at the general meetings between the general executive officer and the heads of departments.

5. Select the best expert heads of various departments who will combine executive and organizing ability with technical knowledge of their special department work, and who will command the respect and absolute confidence of the directors and the chief executive.

6. Grant freedom of action to department heads in matters pertaining to the specific details of their department organization, men, methods and quality of materials

7. Chief executive officers and department chiefs to have a sufficient staff of able men to relieve them from routine and detail work and also to have a corps of assistants who are free from confining routine work who can be assigned to special investigations of important matters in department work.

8. Able department heads having been selected, leave them unfettered in the government of matters pertaining to their departments, except that they should be kept in harmony with other department work and with the general policy of the company.

9. Pay salaries which will give the system the pick of the best men in the country in their respective lines for department chiefs, and which will retain high-grade men in the service.

10. Place full responsibility and authority on the department officers and let their continuance in office hinge upon their producing successful results.

11. Have a carefully prepared and comprehensive printed schedule defining the jurisdiction of the various departments and the authority and duties of all the officers of the company.

12. Have regular monthly meetings of the department chiefs and the chief executive officer of the company for the discussion of all questions of mutual interest and policy, and for the clearing up of difficulties which may have arisen.

13. With a foundation laid as outlined, plan to attract and educate young men so that there may be regular advancement in the service and a corps of men may be developed from which to fill all vacancies in the official staff from those who have grown up in the company's service.

14. Get good men; practice good methods; use good materials, and establish as a fundamental principle the maxim that "Whatever is worth doing is worth doing well."

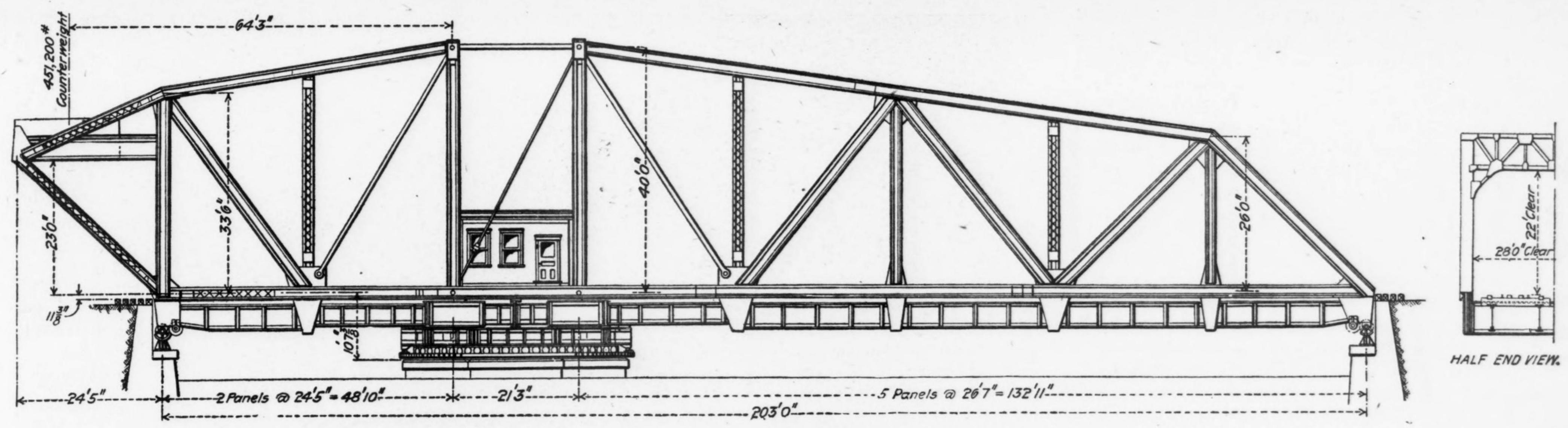
## Counterbalanced Draw Span on the Chicago, Milwaukee & St. Paul.

The Menominee River runs through the City of Milwaukee. Wis., from west to east. Extending south from the river is a system of canals which furnish shipping facilities to elevators and industrial plants occupying a considerable tract along the river. As a result there is a large and constantly growing traffic on the river between its mouth, or confluence with the Milwaukee River, and these canals. The Chicago, Milwaukee & St. Paul Railroad crosses the Menominee on a swing drawbridge at a point quite close to its mouth. It is a 203-ft., doubletrack, rim-bearing structure, built in 1886 by the Edgemore Bridge Company, and crosses the river at a skew of about 63 degs., allowing a clear channel of 50 ft. The bridge is in first-class condition and fully equal to the demands of present traffic, but the increasing river traffic made a widening of the channel to 75 ft. necessary, requiring the replacement of the bridge by one of increased channel span.

The new structure will have the same length as the old, the increased channel width obtained by a change in location of the center pier to a point 42 ft. nearer the south shore, as shown on the erection plan. The new bridge will therefore be of the counterbalanced swing type, with a long arm 132 ft. 11 in. long, divided into five equal panels, and the short arm 48 ft. 10 in. long, divided into two equal panels. This does not include the portion carrying the counterweight, which extends 24 ft. 5 in. beyond the short arm. The structure is designed to carry on each track two 1771/2-ton locomotives followed by 5,000 lbs. per lineal foot of track. Other designs, including bascule types, were considered, but the counterbalanced swing design was adopted because of its simplicity and less first cost. Furthermore, the local conditions are such that none of the adjacent property can be used for wharf purposes, requiring no sacrifice of valuable dock frontage. Also, the abutments of the old bridge can be used, requiring only a new center pier.

The small distance between base of rail and high water made the matter of obtaining a satisfactory design for loading the drum, one of considerable difficulty. In the scheme adopted, the load is taken from the tower posts to loading girders, one end of which rests on the drum, the other being connected to a cross girder, as shown in the diagram of method of loading. The weight of the structure, exclusive of counterweight, will be about 650 tons. The counterweight, which will be concrete, will weigh approximately 450,000 lbs. It is placed over the track and projects beyond the end of the bearing, increasing the lever arm and therefore materially reducing the amount of weight needed.

The new center pier is concrete, resting on 4 ft. of

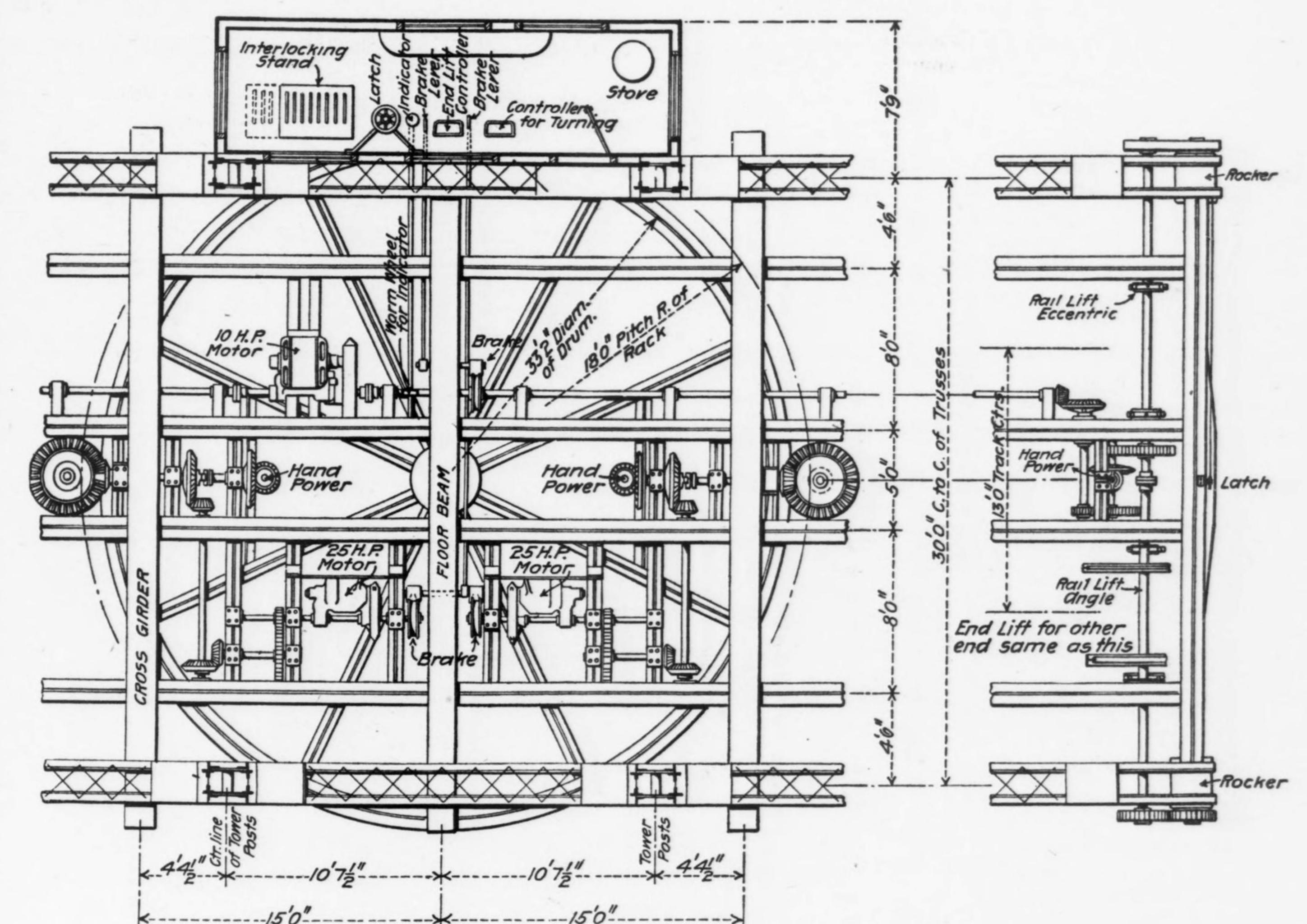


Elevation and Half End View of Counterbalanced Swing Draw Bridge, C., M. & St. P., at Milwaukee.

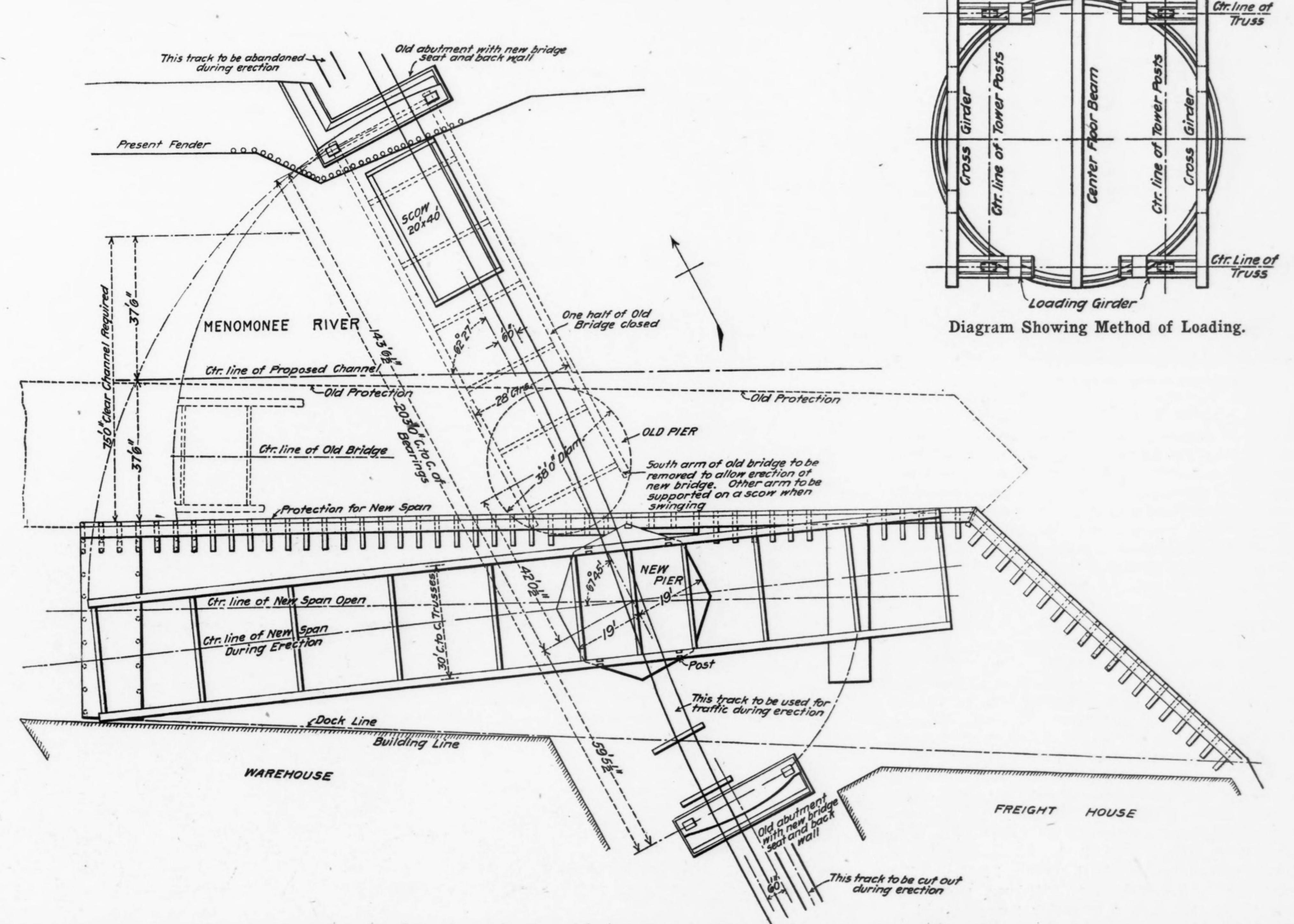
grillage on piles. These piles, which were 75 ft. long, were cut off 16 ft. below the surface of the water and about 8 ft. above the river bottom. Rip rap was placed about them to within 2 ft. of the cut-off. The caisson was assembled in a slip some distance up the river, and after putting in enough concrete to sink the grillage to within about 18 in. of the cut-offs, it was floated down the river, anchored in position and the remainedr of the concrete put in place.

The erection of the new structure presented a difficult and interesting problem, it being necessary to do the work without interfering with either railroad or river traffic. The bridge is only a few blocks from the Union station and the switching and passenger traffic on this part of the line is heavy and continuous. The Menominee River at this point is kept open for the passage of boats the entire year, and a good idea of the amount of river traffic is afforded from the statement that this bridge was opened 9,000 times in 1902—oftener than any other drawbridge on the road.

One of the illustrations outlines the method to be used in erection. Falsework for a single track will be put in between the south abutment and the new center pier and across the latter. The bridge will then be swung clear of the river channel and the north half blocked up on a scow. The south half will then be jacked up, and after placing it on rollers, it will be cut at the bridge center and moved far enough to allow the north arm to be closed. The north arm, with the falsework, will carry the single track which the trains will use during the erection of the new structure. The erection of the new span will be done on falsework parallel to the river channel and the bridge will be in place on its pier, as shown in the plan, the trains passing through its center panel. When erection is complete the north arm of the old span will be swung to the east, jacked up from the protection,



Plan of Turning and End-Lift Mechanism.



Erecting Plan of New Counterbalanced Swing Draw Bridge, C., M. & St. P., at Milwaukee.

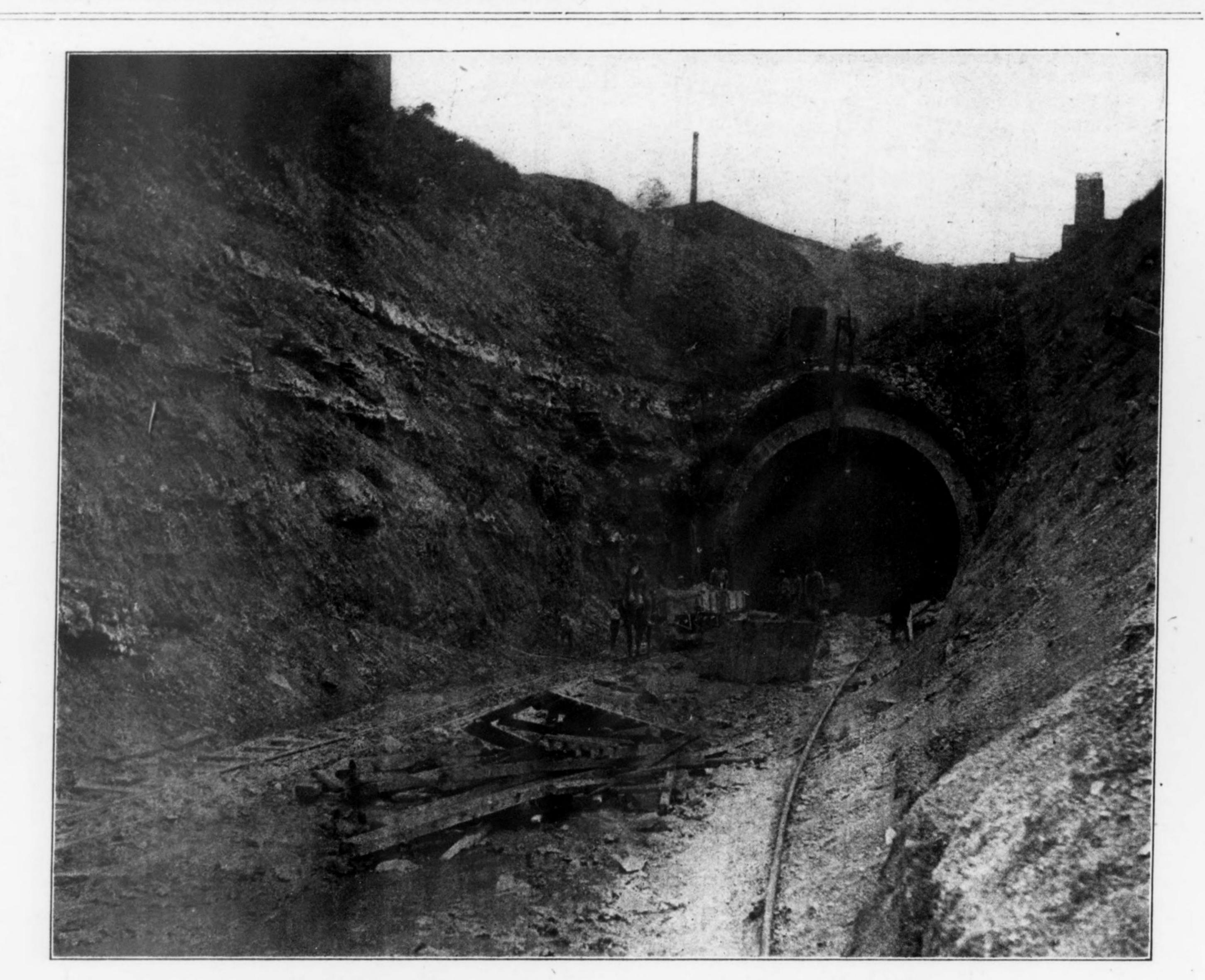
placed on rollers and moved far enough to allow the new bridge to close. It is expected to be able to do this between the passage of trains.

The new bridge will be electrically operated. There will be two General Electric 25-H.-P. street railway continuous-current motors for turning, and one 10-H.-P. motor, located in the center, for operating the rail and end lifts. A plan showing the turning and end-lift mechanisms is included in the engravings.

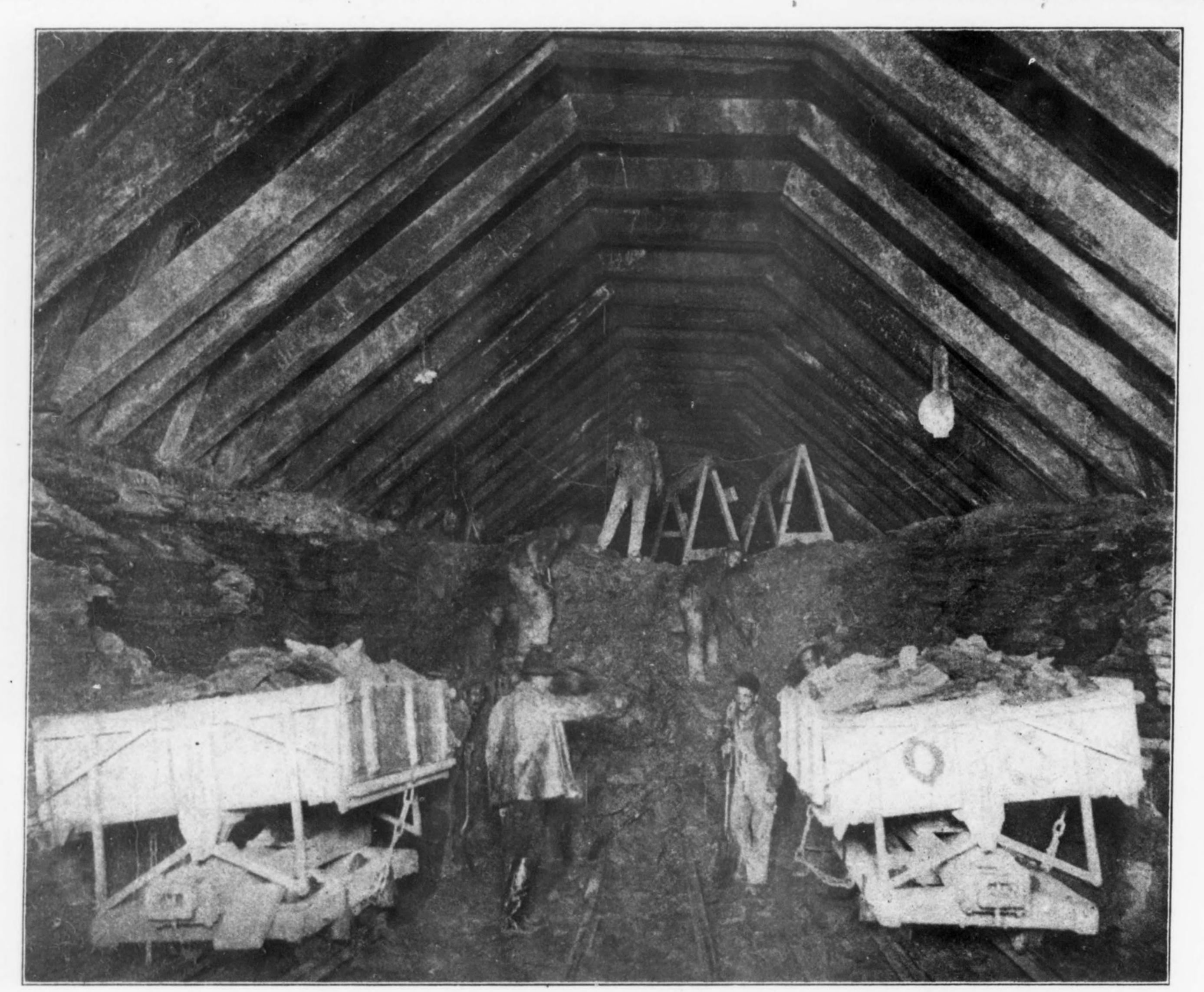
Work on the center pier is under way and is being done by the company under the supervision of Mr. J. C. Hain, Engineer of Masonry Construction; the company will also erect the superstructure. The steel work is being furnished by the Lassig plant of the American Birdge Company. The plans, both general and detail, were made by the railroad company under the supervision of Mr. J. J. Harding, Assistant Engineer. All of the work is in direct charge of Mr. C. F. Loweth, Engineer and Superintendent of Bridges and Buildings.

## The Wabash Extension Into Pittsburg.

The position of the Wabash in years past has been that of a railroad reaching important points in the central West-Chicago, Buffalo, Toledo, St. Louis and Kansas City, but somewhat bottled up by the fact that at each of its important terminal points it has been confronted by exceedingly sharp competition at the hands of rivals with better outlets and inlets in the direction of traffic. In striking at Pittsburg, another route was made into the sharpest kind of competitive territory. The tidewater extension east from Pittsburg would afford the necessary traffic lever, but there is still considerable uncertainty as to the way in which this latter part of the plan will work out. At present, however, the Pittsburg extension opens up a very prolific and valuable local field, and also puts weight behind the desire of the company to secure additional business at other points. Besieged by rivals, arraigned by the city, delayed by the



East Portal, Greentree Tunnel, showing Approach and Brick Lining.



Reinforced Timbering, Mt. Washington Tunnel.

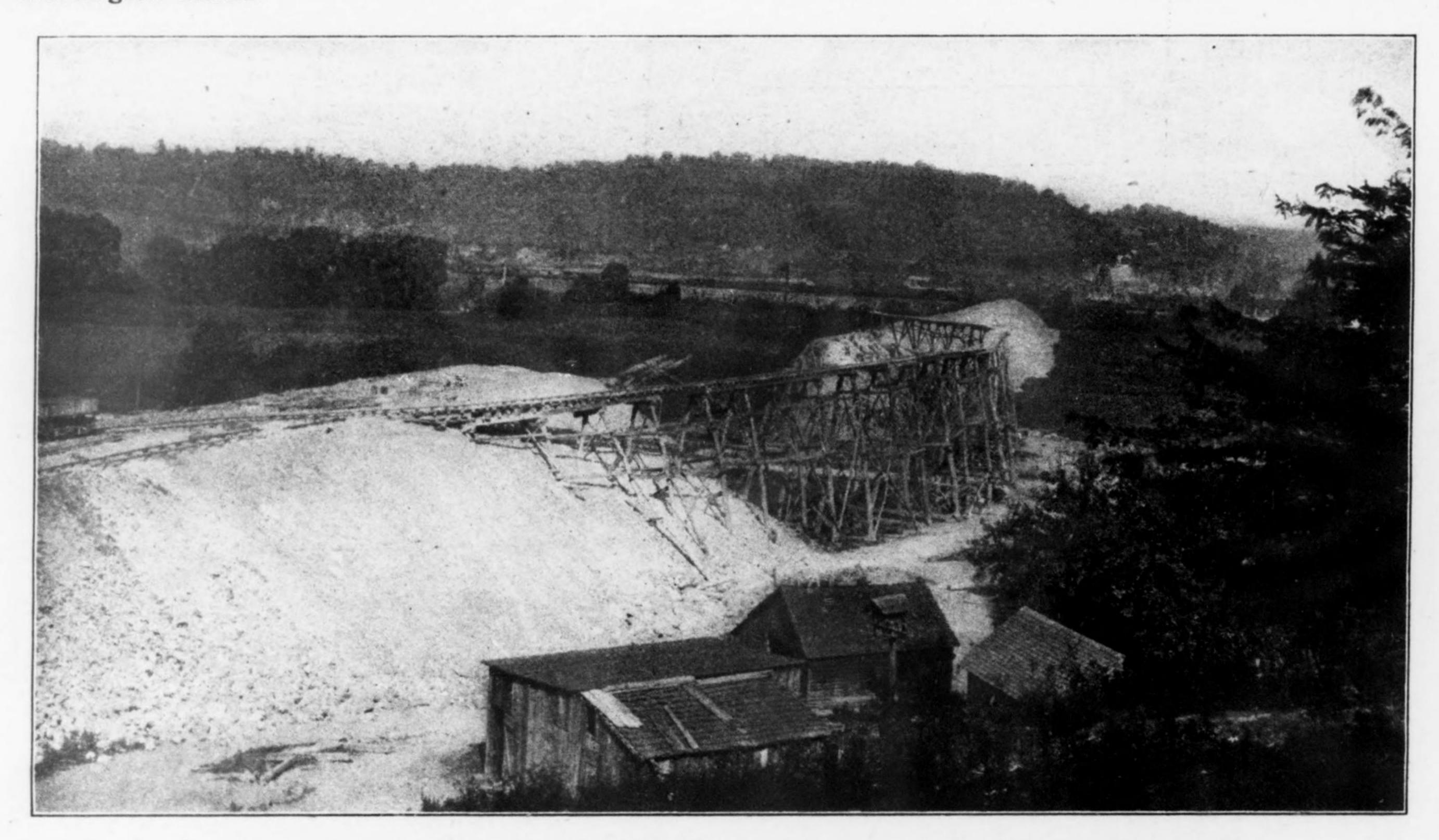
politics of municipal councils, hindered by unexpected natural obstacles and by accidents and strikes, and even peremptorily stopped by the Supreme Court of Pennsylvania, an entrance into Pittsburg has been effected by means of a line 60 miles long to Jewett, Ohio, through extremely difficult country, and the present outlook is that the extension will be open for passenger, express and light freight service about May 1st, or possibly as early as April 15.

The extension from a connection with the Wheeling & Lake Erie at Jewett, Ohio, to Pittsburg, has been built under the name of the Pittsburg, Carnegie & Western. About 40 miles of track has now been laid, the Monongahela River bridge is practically completed, and the Pittsburg terminal passenger station is well under way. There remain to be built the cantilever span of the Ohio River bridge at Mingo Junction, the elevated line and train shed between the Monongahela River bridge and the passenger station, the tracking of the Greentree and Mt. Washington tunnels and the installation of the telegraph and signal systems. 'The way stations, trestle filling and other similar work will be done after the line is opened, as will also the construction of the freight branch lines within the terminal limits. With the extension of the Wabash to Pittsburg, the Pacific Express Company's eastern operating terminus will be at that city, while the Wabash extension to Baltimore

will give the Pacific Express a transcontinental operating basis.

When Mr. Ramsey was chief engineer of the Pittsburg, Chartiers & Youghiogheny, in 1882, he made a personal survey of a route from Pittsburg to the Ohio River. That was as far as the matter went at that time, however. Late in 1900 the Wheeling & Lake Erie was offered for sale. The Pennsylvania railroad interests were approached in the matter of its purchase, but they refused, seeing no especial advantage because they had already networked the same territory with lines. The Wabash interests took an option on the property, and there was immediately introduced into the Fifty-sixth Congress, then in the closing days of its last session, a joint resolution by the Pittsburg & Mansfield Railroad Company for a bridge across the Monongahela River, within the City of Pittsburg. It was proposed for a railroad upon which electricity was to be the motive power. Fortunately-one might almost say, providentially-the resolution passed both branches. This gave an inlet to Pittsburg for the Ramsey route. That this bridge was intended for the Wabash interests was wholly undreamed of except by those who knew the inside facts of the case. Early in 1901 the Wheeling & Lake Erie deal was closed and work at once began on the extension of this road to Pittsburg, Ramsey and Patterson walking over the original Ramsey route and on from Mingo Junction to Jewett, which portion required a new survey.

The first direct intimation the public had that Wabash interests were backing a project for a new line into the city was an ordinance introduced into Pittsburg City Councils, asking for the right to cross certain streets in the Point and Mt. Washington districts. While this was startling, the dilatory City Councils paid little or no attention to the ordinance, referring it to the "air-tight" corporation committee, where the measure rested undisturbed for almost two years. Meanwhile, the Pittsburg, Carnegie & Western was formed by consolidating the Pittsburg & Mansfield and Washington County Railroad



Fill West of Ohio River, P. T. & W. Ohio River Tunnel (W. Va.) in Background.