the useless fatalities involved in present conditions and suggest that legislative action will not be taken except at the active insistence of railroad commissions. We have had carefully compiled the statutes prevailing in this country and the laws and customs of England, France and Germany and append these to this report to facilitate the preparation of proposed legislation.

"We cannot too strongly urge upon our associates, and upon the public, attention to this humane and important matter. A very great obstacle we apprehend will be the enforcement of such laws. The suggestion has occurred to us, and this is respectfully submitted, that police power might be given to section foremen as it is now given to conductors of trains, or to such persons as the railroad commission might appoint to enforce these laws. We think that these acts should provide that the railroad companies shall post them in all their depots and in places where the public are accustomed to use their tracks."

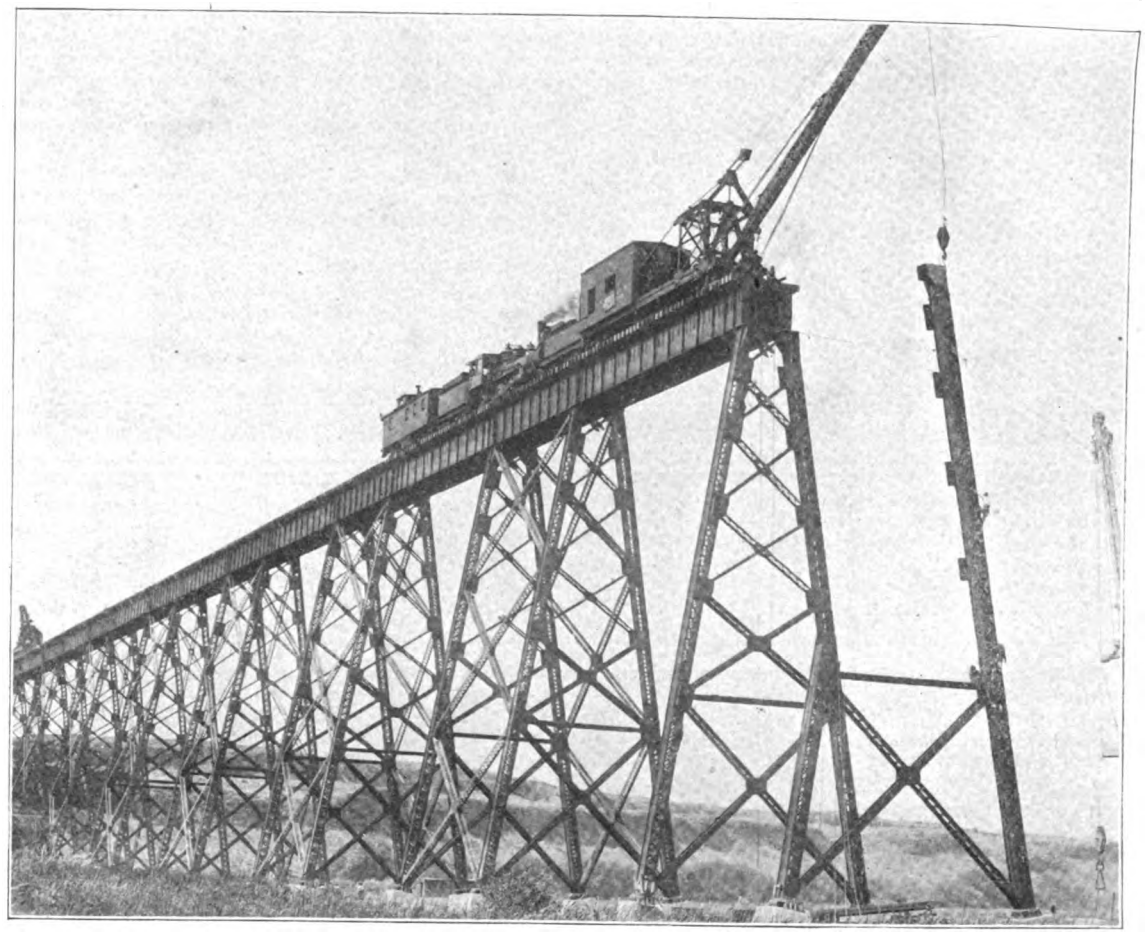
The committee on grade crossings was made up of W. J. Wood, B. A. Eckhart, J. C. Morris and G. W. Dickinson. The importance of eliminating grade crossings was first spoken of, and the chief obstacle to this movement was given as expense. Elimination of grade crossings affords an opportunity to rectify mistakes made at the time of construction, for which the railroads themselves, counties, cities and villages are alike responsible. Recognizing this joint responsibility, in some states the practice is established of dividing the expense of elimination between the railroad and the municipality or county. Each state has some legislation on this point, but the matter is largely in the hands of the railroads. The major part of the expense is placed upon the railroad. In some states, notably in the East, the state treasury defrays a part of the expense of grade crossing elimination. Much good is accomplished in this way by requiring each year the separation of grade in a certain number of cases. In New Hampshire which has but 1191 miles of road, during sixteen years past 376 dangerous grade crossings have been abolished at a total cost of $24,310,000, involving in many instances the elevation of a considerable length of track. The state and municipality here share 35 per cent of the cost of the change, the burden of the other 65 per cent being upon the railroads. The state of New York appropriates yearly about $200,000 for covering its share of this kind of work. The following extracts give the substance of the report as it received the formal endorsement of the association:

"Safety to travelers upon the streets and highways requires that where possible there should be a separation of grades. How shall this be accomplished? In the first place, such legislation should be secured as will not impose too heavy a burden upon any of the parties to be assessed. The railroad commissions should be clothed with the necessary authority to hear and determine applications for a separation of grades, and they should fix the division of expense within certain limits. Where the street or highway to be improved is occupied by an electric line, such electric line should be made to bear a just proportion of the expense. It is here suggested that the commissions in determining the necessity for such separation and the making of its order in that respect should within proper limits apportion the cost to the interested parties thereto. We make this recommendation because the benefits to each of the parties are not always equal. A fixed proportion of the expense, therefore, would not always be the most just or equitable. By leaving to the discretion of the commission the apportionment of the cost, these benefits may be ascertained as the basis for a proper and equitable division of the expense. The best reason for conferring this authority upon the railroad commission is that it would be far removed from local influences which too often affect such matters; and again, from the very nature of its business, it has the practical knowledge and the means for acquiring the same which is necessary to a proper and equitable determination of the questions involved. . . . The problem is to get rid of existing crossings. Future crossings at grade should not be tolerated except where it is a physical impossibility to avoid it. The power to determine the question of future crossings of highways with steam and electric roads should also be conferred upon the railroad commissions, for the same reasons as above assigned. . . . We repeat and emphasize the suggestion made above that grade crossings of either railroads with each other or of railroads and highways should not be permitted in the future. The laying out and construction of all such crossings should be under the supervision and direction of the railroad commissions."

A compilation of existing statutes of the several states is attached to the report to serve as reference in considering future legislation.

Heavy Bridge Work on the C., M. & St. P. Ry. Extension.

To give an idea of the character of some of the bridge work of the extension of the Chicago, Milwaukee & St. Paul Ry. to the Pacific coast, we show the Cow Creek viaduct in course of erection. This viaduct, which consists of heavy plate-girder spans on steel towers, is located 11 miles south of Ritzville, Wash. It crosses a valley 1600 ft. wide, and the hight of the track at the deepest point is upwards of 150 ft. The photograph was taken Nov. 20. It will be seen that the method of bridge erection standard with the C., M. & St. P. Ry. system on its eastern lines is employed here—a powerful derrick car is used for hoisting instead of the ordinary traveler.



Cow Creek Viaduct, on the Chicago, Milwaukee & St. Paul Ry. Extension in Washington.

The work of building the road through this part of the country abounds in deep cuts, long fills, high trestles and much tunneling, and is therefore of considerable interest from an engineering standpoint.

Great Northern Ry. Improvements.

On a recent visit to the Pacific coast Mr. James J. Hill, chairman of the board of directors of the Great Northern Ry., made a public address in Seattle, in the course of which he enumerated the physical improvements carried out by his company during the past three years on the western district. This covers the portion of the line west of Cutbank, Mont. Those improvements, some of which are still under way, are as follows:

Terminals at Seattle, consisting of new brick passenger station, which is used jointly by the Great Northern and Northern Pacific roads, and which is one of the best in the West, is reached by a double track tunnel nearly a mile long, lined with concrete and running directly under the heart of the business district of the city. Yard tracks 6¾ miles in length, and ample facilities for the care of passenger equipment, have been provided. Where necessary, substantial steel bridges have been erected to carry streets of the city over the tracks. This results in relieving the water front from the congestion of traffic occasioned by passenger and through freight trains and allows interchange of business between rail and ocean lines without interruption, a rearrangement of existing tracks and the construction of additional tracks having been made for this purpose.

New brick freight depot, 50x1000 ft., with necessary tracks, track scales and modern appliances for handling the local business promptly and properly.

To procure room for these extensive terminals and to provide somewhat for probable future growth, tide lands were purchased which required a large quantity of earth brought in for filling to fit them for use as terminal property. This filling amounted in one year alone to nearly 1,000,000 cubic yards.

Improvements have been made in the steamship terminals at Smith Cove, consisting of a detention house for Oriental passengers, additional yards tracks of an aggregate length of nearly four miles, an extension to the dock warehouse 100x560 ft. in size, with additional appliances and equipment for handling freight quickly and economically from vessels to cars, and dredging the slip to a uniform depth, sufficient to accommodate the big boats of the Great Northern Steamship Co.

These facilities have cost the railway company over $3,000,000, or an average expenditure of $1,000,000 per year for the period under consideration.

At Everett, Wash., ocean terminals have been constructed consisting of an ocean dock 196x810 ft., a grain warehouse, 144x792 ft. in size, and trackage of over a mile and a half, at an expense of approximately $200,000. In addition, work has been started upon a fine new passenger station at Everett, which will cost about $85,000.

Between Seattle and Everett, along the shore of Puget Sound, a stone sea wall is under construction, and for the period in question has been completed for a distance of about 6½ miles, at an expenditure of about $175,000.

In the same territory a second main track is being laid as rapidly as the completion of the sea wall allows the preparation of necessary roadbed,

and during the last three years about 12 miles have been completed.

At various other towns on Puget Sound new stations for the accommodation of the public and rearrangement of tracks for better convenience of handling business have been furnished, among which may be specially noted the following:

At Blaine, Wash., a new passenger depot and enlarged freight depot in a different and more convenient location than before; an immigration building, new side-tracks on the water front, with spurs to the docks, and a relocation of main line through the city.

At Anacortes the main line through the town has been relocated in compliance with city ordinances, and has been extended along the water front, with spur tracks to accommodate many industries, especially those in connection with fisheries.

At other stations facilities smaller in capacity, but adequate for the communities served, have been provided in the shape of new depots at 30 points, with additions to depots at various other places, as required by increasing business; also track scales, stock yards, fruit sheds and other similar structures.

Special mention may also be made of Wenatchee, Wash., where, to accommodate the growing business of the valley, chiefly the fruit industry, over 1 1-3 miles of additional side-tracks have been constructed, and a large icehouse erected to supply which ice is secured from lakes in the Cabinet Mountains in Montana, requiring a haul of 500 miles.

Train protection has been provided by the installation of a controlled manual block signal system between Everett and Seattle, interlocking plants at crossings with other railroad lines at Everett and Spokane, and an electric staff system

depot, all of which, with necessary additional right of way, have involved an expenditure of nearly $500,000.

Local train terminals have been enlarged and improved at Whitefish and Troy, Mont., and Leavenworth and Everettt, Wash., in the way of building additional roundhouse stalls, increasing the length of the existing roundhouse stalls; removing 60-ft. and 70-ft. turntables and installing in their places 80-ft. tables of increased strength, and operated by power instead of hand; improved water supply and coaling facilities, and additional yard tracks.

The net increase in side-track capacity has been over 70 miles, which has cost $650,000.

There have been extensive changes of line at Crater and Newport, Wash., and minor changes at several other points for the purpose of securing better alignment, easier grades, etc., to secure greater economy in the operation of trains.

At Crater the change involved the construction of a tunnel in rock 840 ft. long and resulted in a shortening of the line 786 ft., with the elimination of 113 degrees of curvature and reduction in maximum degree of curvature from 10 to 5 degrees.

At Newport the new line is 3.08 miles in length, as compared with 3.57 miles by the old line, and the change includes a new steel bridge 1100 ft. long over the Pend d'Oreille river. This change saves 490 degrees of curvature, reduces maximum curvature from 10 to 3 degrees, and reduces maximum grade from 0.66 per cent to 0.4 per cent. These two changes alone required an expenditure of nearly $500,000.

Main tracks have been relaid, or work of relaying is in progress: 159 miles with 90-lb. rail; 235 miles with 85-lb. rail; 42 miles with 80-lb.

New sheds have been constructed, principally in the Cascade mountains, at a cost of over $130,000. Thirty-three thousand dollars has been spent for new right of way fences.

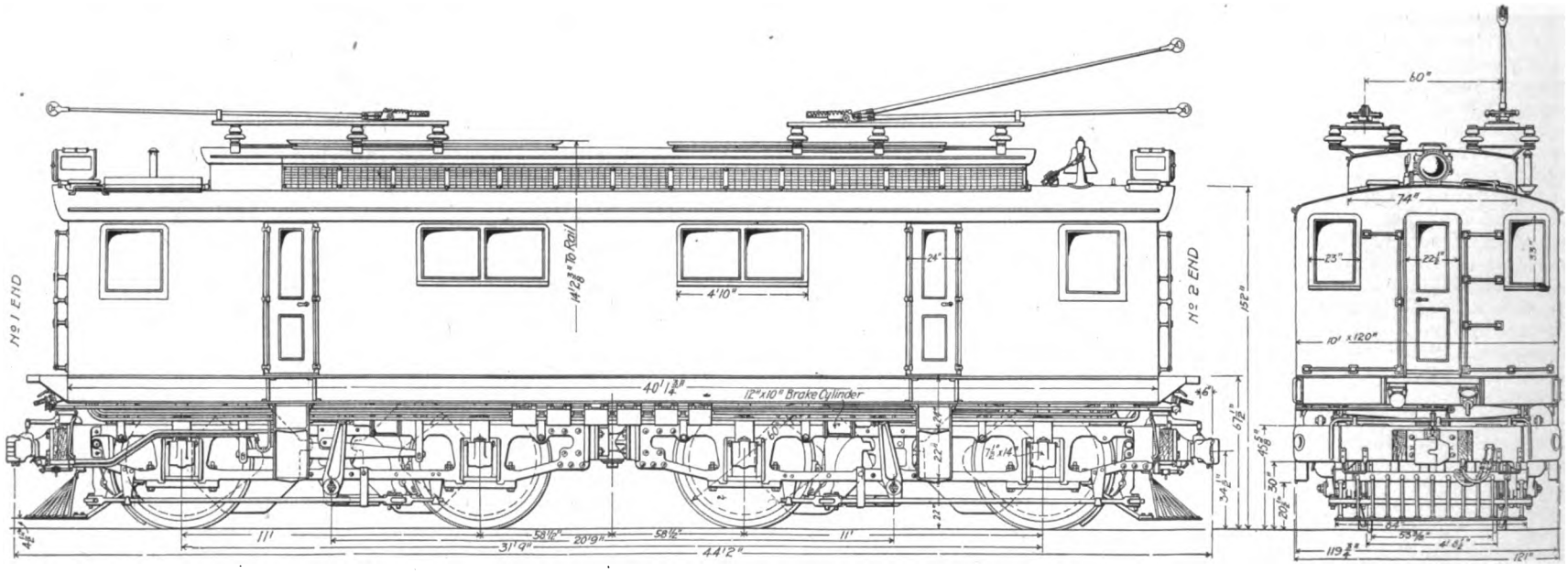
To furnish better accommodations for train and engine men at terminals, the company has erected a 16-room dormitory at Cutbank, Mont., a 20-room dormitory and 12 4-room cottages at Whitefish, Mont., and a boarding house at Essex, Mont.

Electrification work is being done in the Cascade mountains, consisting of the development of a 7500 h. p. hydro-electric plant in the Tumwater canyon along the Wenatchee river, about three miles west of Leavenworth, Wash.; transmission of this power about 30 miles to tunnel through the Cascade mountains; the electrification of 4.3 miles of main track and 2.6 miles of side-tracks in this tunnel and in the yards at each end thereof; and the furnishing of four 1000 h. p. electric locomotives.

The tunnel is 2.63 miles in length and the intention is to operate all trains through the same, as well as in the two yards at each end thereof, by electric power. The approximate cost of this entire electrification work is $1,250,000.

Electric Locomotives for the Great Northern Ry.

The Great Northern Ry. recently ordered four electric locomotives for operating its trains through the Cascade tunnel in the state of Washington. These locomotives, which have just been completed, were built by the American Locomotive Co. in conjunction with the General Electric Co. and under the supervision of Dr. Cary T. Hutchinson, the consulting engineer for the road. Each of the locomotives has a total weight in working order of 230,000 pounds, all of which is carried on



Side and End Elevation of Three-Phase Electric Locomotive for the Great Northern Ry.

governing the operation of trains through Cascade tunnel. At various places where there is liability of landslides, as through the Kootenai canyon, and on both slopes of the Cascades, combination registering and telephone systems have been installed to give means of communication for watchmen and track walkers, who patrol the line at the dangerous places.

At Spokane, and its freight terminal at Hillyard, extensive additions have been made to the yard and business facilities. An industrial spur about 7500 ft. long has been built on the north side of the Spokane river, crossing the river by a $50,000 bridge, connecting with the local freight yard; also other business tracks aggregating nearly a mile in length. At Hillyard there have been built new locomotive water supply, consisting of a 100,000 gallon capacity tank on a 40-ft. tower, with pipe lines and standpipes, and an electric pumping plant, new store, sand and oil houses, scrap bins, etc., for a fully equipped material supply station, yard tracks, with an aggregate net increase in length of over eight miles, and with over and under grade crossings to carry public highways, reduction in grade to 6-10 of 1 per cent maximum for a main track entering the yard from the east, with change of line for nearly 9000 ft.; an addition of fifteen stalls to the roundhouse; and an extension of 22 ft. to 15 existing stalls; new and improved cinder pit, and turntable replacing smaller ones, which had been outgrown on account of the increased size of locomotives, and a new

rail; 82 miles with 68-lb. rail. Only the value of the increased weight of the metal is charged up against the property, the remainder of the cost of the work being carried as operating expenses.

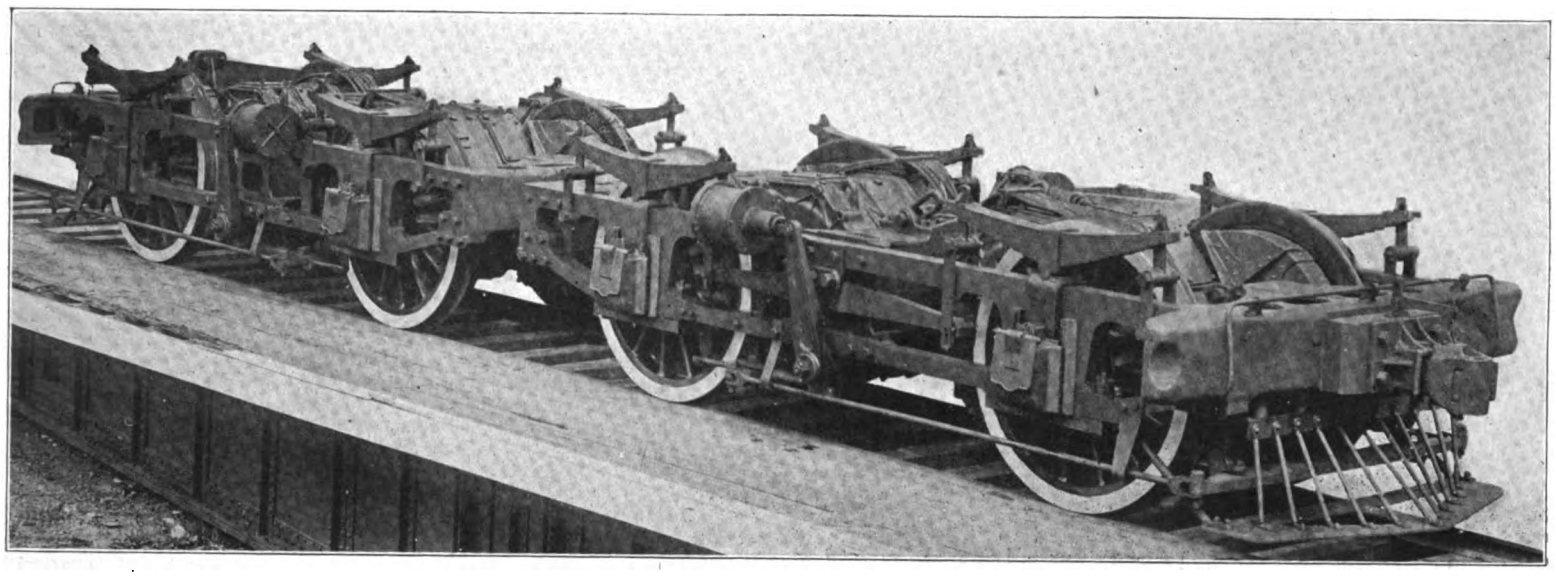
Much steam shovel work has been done to provide material for restoring and widening banks, raising sags, changing lines and grades, amounting in the aggregate for the three years to 2,500,000 cubic yards of gravel and dirt moved for the purposes named.

It is the policy of the company, as rapidly as existing structures require replacement, to do the work in a permanent manner, which has resulted in this period in placing 3232 tons of metal in new steel bridges 3700 lineal ft. in length, which have been erected in place of timber structures of a length in the aggregate of 9000 ft., the difference between old and new bridges being due to filling with earth, making solid embankments. Wherever the waterways allow it, masonry culverts are built and the balance of the opening filled with earth. In doing this there has been moved 190,000 cubic yards of material, by which 9000 lineal ft. of openings have been eliminated. In prosecuting these improvements the masonry put in for the period has cost about one-third of a million dollars, and about the same amount represents the cost of the new bridges.

About $400,000 has been expended for additional right of way, which does not include that already mentioned at Spokane, nor for the Seattle terminals, as previously described.

the drivers. The over-all length is 44 ft. 2 ins., the rigid wheel base is 11 ft. and the driving wheels are 60 ins. in diameter. A general description of this new equipment and illustrations from photographs were published in the Railway and Engineering Review on Nov. 14, but the drawings given herewith will serve to illustrate some details of construction that were not brought out at that time.

To touch upon the electrical features briefly, the motors are of the 3-phase, induction type with plain secondary circuit rheostatic control, and are capable of exerting a maximum torque of at least three times the guaranteed full load running torque, at any speed from standstill to within 2 per cent of synchronism. Each truck is equipped with two motors. The motors are wound for eight poles and when operated at 25 cycles have a synchronic speed of 375 revolutions per minute. The motors are geared to the axle, and on account of the large size a special form of drive is used, there being a pinion on each end of the motor shaft. These pinions engage gear bands shrunk on the extension of the driving wheel centers. The gear bands are cut in pairs and are set so that the teeth on the two wheels line up accurately, the pinions on the motor shaft, of course, being also set in accurate line. By this form of drive there is no tendency to tilt the motor as there is with the pinion on one end



Trucks of Electric Locomotive, Great Northern Ry.

of the motor shaft, and moreover the gears do not have an excessive width of face as the driving strain of each motor is divided between the two sets of gears. The gear ratio is 1-4.28. An idea of the construction is given in the accompanying illustration of the No. 1 end truck of the locomotive.

As far as the mechanical features are concerned, the design represents a distinct departure from previous practice in electric locomotive construction. It also represents the adaptability of steam locomotive practice to electric locomotive construction. The wheel arrangement is spoken of as a modification to suit the requirements of electric service of the builder's practice in the design of articulated steam locomotives. The locomotive is mounted on two 4-wheel trucks articulated by means of a center pivot connection located in the center of the engine, midway between the inside axles of the No. 1 and No. 2 truck. With this form of construction the distance between the center pins supporting the cab platform varies, of course, as the trucks pass over curves. One center pin, therefore, is so designed as to allow sufficient longitudinal movement to take care of this. The construction of the articulated feature and the center pin detail is shown in the drawings given in the accompanying illustrations.

The advantage of this articulated design is that all the draw-bar pull is thus directed through the truck frames, permitting of a much lighter construction of cab platform than in those designs where the pull is through the platform sills. Moreover, the only strain which this puts on the center pins, is that due to the weight of the cab and its equipment and the cab platform. The truck frames are of cast steel and those of the front and back trucks are made interchangeable. As all the pulling and buffing is done through the truck frames these are made unusually large and heavy. Some of the weight of the frames and all parts of the truck also is accounted for by the fact that it is necessary to add weight in order to obtain the necessary adhesion. A certain amount of ballast is used on the cab platform for this same purpose.

The method of weight equalization is also of interest. On the No. 1 end truck the weight on the drivers is carried by semi-elliptic springs resting on saddles on top of the journal boxes and straddling the frame. The two drivers on each side are equalized together by means of a wrought iron equalizing beam between the upper and lower rails of the frame, after the practice common in steam locomotive construction. The weight on the drivers of the No. 2 end truck is also carried on the same style springs, supported on the driving boxes in like manner, but in this case there is no equalizing beam between the two drivers on one side, but the two front drivers are equalized together by means of a cross equalizing beam. The truck bolsters are of cast steel of box construction, very rigidly connected to the frames and with center plates cast integral.

The cab, which carries the controlling apparatus as well as air compressors and other accessories, consists of angle iron framing with a covering of 1/8-in. sheet steel, all securely riveted together. The arrangement of car body and end hoods is such as to afford the engineman a clear view of the track.

These locomotives are now being tried out by a series of severe tests under service conditions. At present it is planned to use them through the Cascade tunnel only, which is somewhat less than three miles in length and has a uniform grade in one direction of about 1.7 per cent. In the electrification of this division, however, the probability of extending the zone to include at least two grades in the immediate neighborhood of the tunnel in the near future has been considered. The following are the principal dimensions of the locomotive here illustrated:

Total weight	230,000 lbs.
Length over all, inside to inside of knuckles	44 ft. 2 in.
Length over cab	40 ft. 1¾ in.
Hight over cab	14 ft.
Width over all	10 ft.
Total wheel base	31 ft. 9 in.
Rigid wheel base	11 ft.
Track gage	4 ft. 8½ in.

Appraisals of Railway Properties.*

The objects of making a careful and complete inventory and appraisal of an electric railway property at suitable intervals are manifold. I will mention several of them categorically. First, it gives the owner of the property a full knowledge of what the property consists, which can be obtained in no other manner that I know of. Book records, as I have pointed out, are valuable and necessary, but book records of operating plant inevitably become inaccurate or incomplete unless checked by an actual property inventory. It is obvious that the best results from the operation of any business cannot be obtained without a detailed knowledge of the characteristics of the property which is being handled to carry on the business; that is, without a detailed, full and accurate knowledge on the part of the management of the physical details pertaining to the property. An adequate knowledge of these can only be obtained, as far as I have ever been able to observe, by making an inventory at intervals; laying it down in black and white on paper, separately from the ordinary records of the accountant.

A second reason for an inventory and valuation being desirable lies in the fact that it gives an important part of the basis for determining the true value of service rendered. In few instances, where properties have been built up by consolidations and re-organizations (as at least in the West a great proportion of the electric railways have been built up), do the book values correspond with the actual property values. After such an operation as the consolidation of a lot of weakling properties, the book values as a rule are found to be less than the true property values after the system has been rehabilitated, and the actual property valuation cannot be determined until a careful inventory has been made.

There are two values of a plant which are of importance to know. The first is the actual first cost, or its nearest equivalent found by taking an inventory and estimating the cost of reproduction of the property new. The accountant's books seldom show the actual first cost in full, because small extensions are so commonly entered as current expenditures, and it is therefore commonly necessary to rely upon the estimated reproduction value for an understanding of the property cost.

The second value that I refer to is the present value of the property in consideration of its state of depreciation. You will remember that I spoke first of the value new; that is, what it would cost to build the property new. The present value, considering the depreciation, is the one which should be used for the taxable value, and taxes should be based on the actual physical property in hand, as it seems to me. I do not see how basing taxes upon the new cost can be justified, because it seems to me that the existing value (which may be 75 per cent of the new cost), the depreciated value, in other words, should be the taxable value. This ought to be recognized. It has not come to be generally recognized in those states that are taxing on actual values. Certain of the western states are having engineers' estimates made of steam roads, electric roads and other public service corporation property, but I think they have not fully appreciated the difference between the value new and the depreciated value, and they have not always recognized that the latter is that which corresponds to the assessed value of land and buildings, for instance, in the cities. The former (the new values) is what interest must be earned upon, because it is presumably what the stockholders paid their money for, but the depreciated value is the taxable value of the physical property.

There is another fact about the valuation new,—the duplication value new, or the first cost if you can find it,—and that is, that it is upon the valuation new that the reconstruction reserve, depreciation reserve, deferred maintenance reserve, or whatever you may chance to call it, should be based. Depreciation reserve, set aside in adequate sums of money each year, is as important to the stability of a property as the weekly payment of wages or the annual payment of taxes. The large steam railroad systems, and perhaps a few electric railway systems, have grown so large, and have such a diversity of property, and are so old, that the value of property that has come to the end of its useful life this year due to old age, obsolescence and the like, will practically correspond in value to the value of property that comes to the end of its useful life next year. Such corporations can take care of depreciation year by year at a fixed annual amount, just as they would take care of current repairs. They do not need to separate depreciation from current repairs. But almost all electric railway plants are in a different situation. They are neither so large nor so old that their properties have come to a settled rate of reconstruction, due to obsolescence and the like. It is therefore necessary to estimate what the average rate of depreciation will be, taking a period of 50 or 100 years, and setting aside an adjusted sum of money each year, if practicable, or the

*Extracts from a paper by Dugald C. Jackson before the New England Street Railway Club, Boston, Mass., Oct. 22, 1908.

like, in order that a fund may exist so that emergency reconstruction can be taken care of out of it without calling on the stockholders or taxing the gross receipts of that particular year unduly.

It seems to me that the payment to the reconstruction reserve is just as important for the ordinary street railway company as the payment of taxes, or the payment of wages. The estimate of the reserve should be based upon the cost of the physical property new. The proper value of a depreciation reserve cannot be satisfactorily determined in the way that is ordinarily done; that is, by making a guess at the entire property, including land, buildings, engines, dynamos, cars, track, poles, and so on. There is no man on earth, however good his judgment may be, who can guess properly at the depreciation percentage for any particular property. He may have figured on dozens of properties, and he will go and guess on another one and guess wrong. The only practical and right way is to consider the several parts separately. Taking an inventory and valuation of the different parts, an average life may be estimated for each individual part,—such as poles, wires, tracks, cars, car equipment, and so on,—the annual depreciation annuity for each one of the parts may then be computed and the aggregate of these computed reserves for the parts makes the payment that should go into the reserve fund for the whole. The property keeps changing in the ratios of value of the different parts, so if one makes an inventory at intervals of five years he must change his aggregate estimate of depreciation reserve at the same time he changes the valuation. That is the only way to arrive with safety at the amounts for payment to depreciation reserve, and I venture to say that, while few properties are now following the plan, they will all have to before the completion of another quarter of a century's experience. The electric railways have not yet had a quarter of a century experience, but when they have had that additional experience, they will have to follow the plan outlined for their own salvation.

The inventory is also of great importance in connection with rate making, and the many complex questions arising out of the control by commissions and the like. Most people have a very poor opinion of the accuracy of book values. That comes from their own personal experience, and also from a certain prejudice which may or may not be well founded in any particular instance. The only possible way to satisfy those who hold the opinion that book values are not right, cannot be right, and never will be right, is to have a full and complete inventory and appraisal made by unbiased and competent engineers. People seem to be willing to accept that sort of an appraisal. They are accepting it without objection in a number of the western states, and are satisfied that such values may be considered fair and reasonable. The work could be done in such a way that people would have as little faith in the results as they have in the book values, but the thing should be done so thoroughly, so fairly, that there can be no criticism.

I believe that an engineer who is called upon to inventory a property and place a value on it should get into that inventory every bit of property, big or small, that the corporation owns, which is usable, and which they do use; and that is equally his duty whether he is employed to make the appraisal by the corporation or by the public. If the company has a lot of useless material or apparatus this should be included in the inventory with the active property, but it should be put in at salvage value. In other words, the corporation should have the benefit of every dollar's worth of property which it owns, and not a dollar more. Everything of value should be included—every pole, cross arm and pin should be accounted for; not necessarily being put down as worth so much singly, but the aggregate numbers should be known, and the unit costs should be known, so that the total value can be accurately ascertained. When that is done people will say, "Yes, they have been very industrious in finding out every bit of property the corporation owns, but after all, I guess it is correct." I believe that plan is not only correct, but that it is fair. When such an appraisal is made there is no fair or honest reason why the corporation should not have the benefit of every dollar's worth of property it really owns and really uses in its business. If it has property it does not need in its business and will not need, this also must be accounted for at salvage value and the corporation can then dispose of it if it chooses.

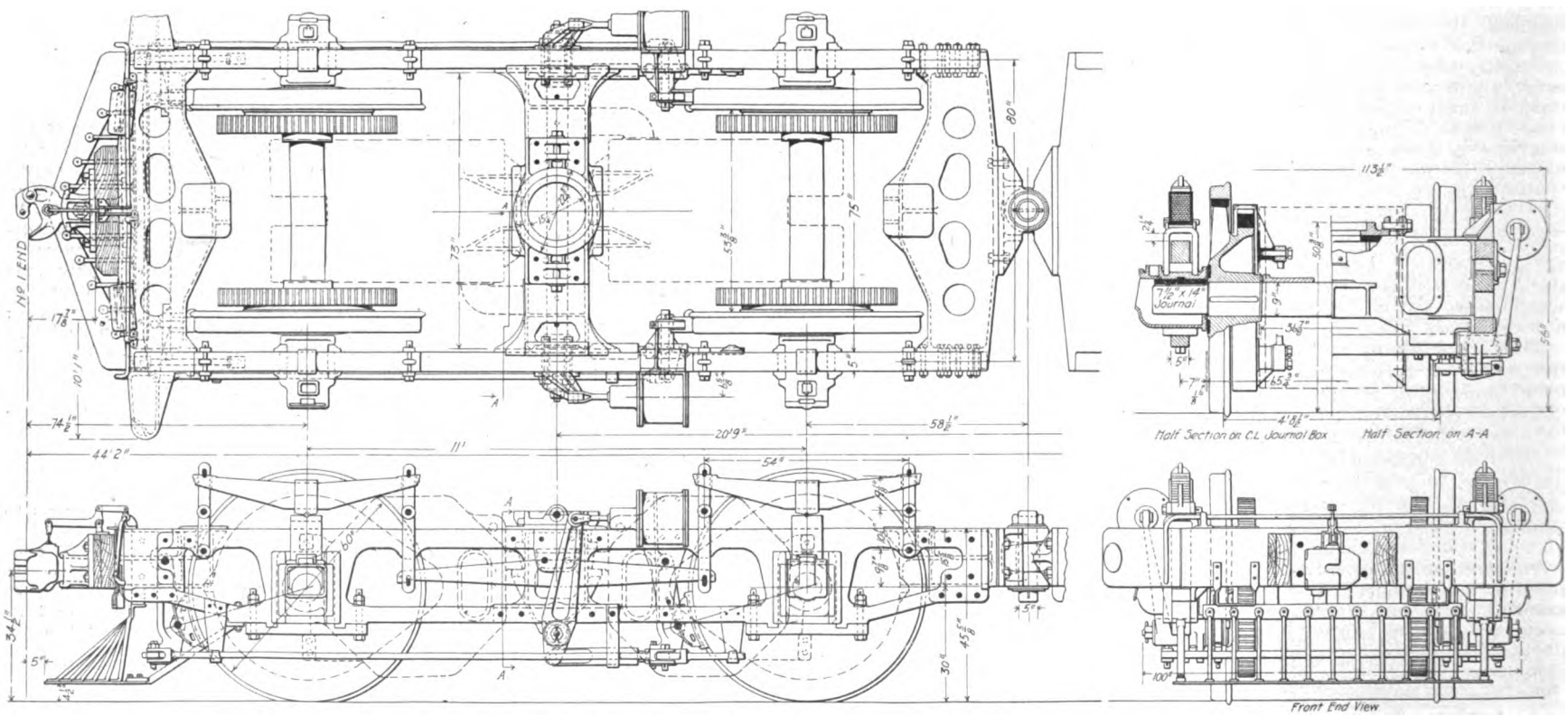
Among some of our states there is an advantage in corporations having careful appraisals of their properties made, which lies in the fact that public commissions are taking inventories, and it is judicious for the owners of the property to have a sound knowledge of its value in case any controversy should arise.

I will add one thing more to this hasty statement of various reasons why inventories are proving to be useful, and should be useful to every corporation. In connection with the rate question, queries arise about the relative earning capacity of different parts of the property, and answers to such queries cannot be made except on a basis of a knowledge of the costs of different divisions of the physical property. The books of electric railway companies are seldom kept so that the property costs of different divisions can be properly separated. It may or may not be proper to expect a public service corporation to make uniform earnings throughout its entire system. It probably is not proper, but questions relating to earnings of sections are constantly arising before legislative bodies and also before the courts.

I will now call your attention to some factors relating to the procedure in making an inventory and appraisal. Such work is never satisfactory unless it is executed with a complete organization, planned in advance for the purpose. You cannot do stock-taking satisfactorily without having the force organized to take stock, and you cannot successfully do stock-taking while business is going on without having a special force to do the stock-taking. Many manufacturers take stock with the factory shut down. Then they can take account of stock if the work is organized right, with their regular force, but if they keep their business going at full blast they must have a special force for stock-taking. An exact form for recording every type of apparatus, material, or other part of the property must be prepared in advance, and the prepared forms must be used. The men who do the work must have specific rules to follow, and they must follow the rules. If they do not follow them properly the result is likely to be chaos. Men who will not follow instructions fully and completely are very unsatisfactory for such work. Various forms of note-books can be used for the field notes. For small inventories, tight-leaf books may be used. For large inventories the blanks should be gotten up in separate sheet form and arranged for filing in loose-leaf books, so as to keep the records in proper order.

I earlier pointed out that every piece of property should be included, and I mean by that it should be practically seen and checked. Some of the steam railroad inventories that have been taken in the western states have comprised a reasonably thorough examination of the fixed property, like roadbed, bridges and buildings, accompanied by an examination of perhaps one-third of the rolling stock, or perhaps 50 per cent; accepting the company's book records of aggregate numbers of cars and locomotives owned and assuming those inspected to represent an average. I do not believe that is really satisfactory. I think the extra cost of going through the entire property is worth while. I do not believe a state like Michigan, Wisconsin or Texas can afford to do the thing by seeing only part of the property. The extra cost is relatively small, and the extra time also. I believe that every bit of property ought to be the subject of a slight record, except that which is actually under ground or under water, and the presence of that ought to be checked in some adequate fashion, so that the men who are taking stock shall be morally certain it is all in position as recorded on their report sheets.

Obtaining a fair duplication valuation of a plant after the inventory has been completed is not nearly so easy as you might suppose at first sight. There is considerable apparatus that is out of date in possession of many companies, and it is, relatively speaking, very difficult to determine the value of replacing it. Also, the current market prices cannot always be depended upon. For instance, there may be abnormal prices at the period of stock-taking. For instance, if stock had been taken in many plants not very many months ago, the abnormal price of copper would have made it improper to found a valuation on the then existing price of copper. It is necessary to determine what is a fair average price under existing circumstances. What price, in other words, would make it possible to rebuild such a plant. Nothing but good judgment and careful study will bring one to the proper values of property. In carrying out work of this kind it is essential to determine upon unit



Plan, Elevations and Section of Trucks, Great Northern Electric Locomotive.