creases directly in proportion to the length of track in circuit, it would seem to be necessary, in increasing this length, to decrease the resistance of the relay in the same proportion in order to get the same amount of current through the coils.

Now a certain magneto-motive force is required to operate the armature of a relay, and as this is directly dependent upon the number of ampere-turns in the coils, it would be necessary, in order to keep this quantity constant in decreasing the resistance of the windings, to change the quantity of iron in the cores and to increase the size of the wire used.

But all this is troublesome and cannot well be carried out in practice.

The custom universally appears to be to make use of a relay of practicable size and adapt it, if possible, to track circuits of convenient length.

The smallest practicable unit of electrical energy, the gravity battery, is in use in track circuits almost everywhere, but the biggest portion of its output is not utilized in the relay, and the question which presents itself in this connection to the writer is, cannot some of this wasted energy be made use of and better results be obtained by proper care being taken in installing the track circuits and in determining upon a form of a relay having such a relation between magnet cores and core windings that its range of usefulness will be larger than with those at present in the market?

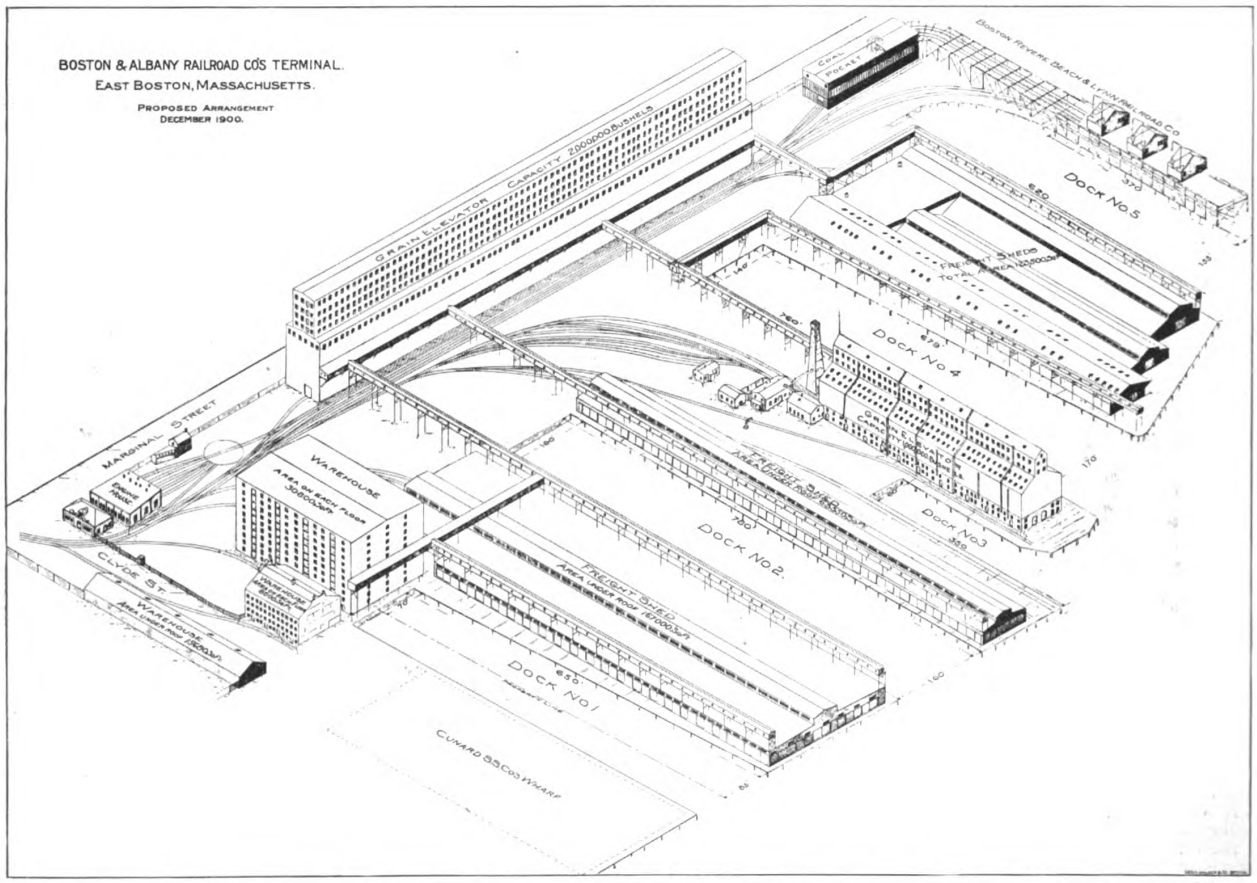
Western Railway Club.

The regular monthly meeting of the Western Railway Club will be held at the Auditorium Hotel, on May 21, 1901, at 2 o'clock p. m. Papers for discussion are: "Centerplate Friction and Its Effect on Wheel Flange Resistance," by Willis C. Squire, M. E., St Louis & San Francisco Railroad, Springfield, Mo., which paper was left over from the April meeting, owing to the lengthy discussion on the revision of the rules of interchange; "Some Characteristics of Waste Packing," by T. H. Symington. Baltimore, Md. The election of officers will take place after the discussion of the papers.

The Arkansas Railroad Commission has issued a circular inviting a conference with the legal representatives of all the railroads in that State at Little Rock on May 15 for the purpose of considering the feasibility of establishing, by common consent, joint rates of freight moving over two or more independent lines of railroad between stations within that State.

THE NEW YORK CENTRAL'S BOSTON TERMINAL.

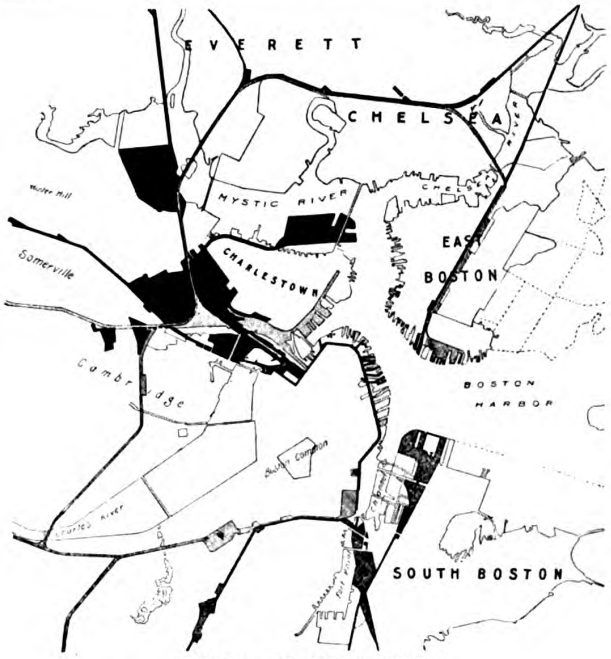
One of the conditions under which the Massachusetts Legislature authorized the lease of the Boston & Albany to the New York Central & Hudson River was that the lessee should expend from earnings or from the proceeds of bonds not less than $250,000 per annum, beginning not later than July 1 next, until $2,500,000 in all should be expended, in enlarging and improving the Boston & Albany's terminal facilities in Boston. In this requirement is included the double-tracking of the Grand Junction Railroad, which connects the main line of the Boston & Albany at Cottage Farm station, about 3 miles from the Boston terminal station, with the water front in East Boston. The Grand Junction road is about 10 miles long, and the estimated cost of this part of the work is about $500,000. The double-tracking will include the elimination of grade crossings. The remainder of the money will go chiefly into wharves, docks, warehouses, elevators, etc., and into approaches thereto, at the East Boston terminus. The route of the Grand Junction road and the location of the East Boston terminal ground were described at some length, with a comprehensive explanatory map, in The Railway Age of June 8, 1900. This map is republished herewith.



Upon the acceptance by the two companies interested of the terms prescribed by the State of Massachusetts, the elaboration of plans for carrying out the improvements demanded began immediately, under the direction of Mr. W. Shepard, chief engineer of the Boston & Albany. While many of the details are yet to be settled upon, sufficient progress has been made to indicate clearly the great magnitude of the undertaking. The project includes not only the improvement of the Boston & Albany's present terminal facilities, but also extensive additions to them. This will be gathered from the accompanying plan, showing the arrangement of the new terminals as adopted tentatively.

The elevator shown in the plan between dock No. 3 and dock No. 4 is the Boston & Albany's elevator now and for some

years in operation. This elevator and the adjacent freight sheds are reached by connecting tracks from the west, as indicated. It is not impossible that, in connection with the improvements now projected, the tracks may be brought into the terminal at the northeastern corner, instead of at the northwestern, as at present. So far the work of most importance actually in progress is the dredging of dock No. 2, the length of which is to be 780 feet and the width 160 feet. The improvements, as it will be observed, extend from the harbor line north to Marginal street, and cover the entire area between the Cunard Steamship



TERMINAL FACILITIES AT BOSTON.

Solid black, Boston & Maine.
Dotted black, Fitchburg.
Single line shade, Boston & Albany.
Double line shade, New York New Haven & Hartford.

Company's wharf on the west and the passenger terminal of the Boston Revere Beach & Lynn on the east.

Car Classification of the Boston & Maine.

The addition of the Fitchburg to the Boston & Maine made necessary a reclassification and renumbering of the passenger train equipment, and the system adopted is described as follows by the Boston & Maine Messenger:

A classification was decided upon which was divided into 10 classes of passenger coaches and numbering from 1 to 1799, according to length, and including a class each for parlor, vestibule, tourist, Orchard Beach and observation cars, with reserve numbers in each series for future demands. There are five classes of combination cars, grouped according to length, and numbered from 1800 to 2080. The four classes of mail cars have numbers between 2200 and 2214. The four classes of combination baggage and mail cars are located within the series 2300 to 2352, while full baggage cars are subdivided into six classes, according to length, and numbered from 2500 to 2765. Milk cars retain the same numbers as heretofore. Some passenger coaches are of the right length to retain the old number, but a new style of lettering has been introduced which is much smaller in size. This was necessary in order that the four figures of a number might be placed on two panels of the car. Out of 187 cars that went through the shops in December, 33 retained the old number. Because of the open grille work which comprises the riser to the steps on Fitchburg cars, the word "smoker" could not be placed there, hence the decision to put the word on the end panels of all smoking cars. A Roman type of letter has been adopted for letter boards on all the passenger equipment on the Boston & Maine system. The cost of labor in so doing is reduced about one-half; one-third less gold leaf is used and the result is much neater and far more attractive.

The Switchmen's Union of North America, of which Frank T. Hawley of Chicago is grand master, will hold its sixth annual convention at Milwaukee, Wis., beginning on Monday, May 20.

Communications.

Grade Reduction.

Saint Paul, Minn., May 6, 1901.

To the Editors:

In a very interesting article on grade reduction by Mr. E. Holbrook, published in your issue of May 3, I note the diagram (Figure 4 on page 494) showing an approximate method of establishing velocity grades. It is stated in the article that this method is only approximate, but the error is so large that its use may result in errors of great practical importance. In this diagram it is obviously assumed that the full velocity head corresponding to the speed of the train, is available for lifting it to an equivalent height, but as the final velocity would be at least 10 miles per hour, the equivalent velocity head of this speed (3.55 feet) should be deducted from the height "h."

The second error, which may affect the final result to an even greater degree, is the assumption that the full tractive cylinder power of the engine is available at all speeds, which is not true, as the cylinder traction diminishes very rapidly with increase in speed. The tractive power of a typical mogul engine at different speeds, in use on the Northern Pacific Railway, was ascertained by actual test to be as follows:

	Pounds.
Speed 10 miles per hour	17,850
Speed 15 miles per hour	14,300
Speed 20 miles per hour	11,150
Speed 25 miles per hour	8,900
Speed 30 miles per hour	7,400

If this engine were fully loaded on the maximum rate of grade at a speed of 10 miles per hour, it obviously would not exert the same tractive effort at higher speeds, and the rate of the virtual grade should not be greater than that equivalent to the tractive power of the engine at corresponding speeds. The virtual grade will accordingly approximate the form of a parabola, and its average rate will be determined by the mean tractive power of the engine.

The initial speed in the bottom of the sag, and the terminal speed at the top of the velocity grade being known or assumed, the problem can be most readily solved by the simple formula in use on the Northern Pacific system, $Sv = 1/20\,(\frac{T}{W} - R)$ in which Sv = the average virtual grade expressed in per cent: T = mean cylinder tractive power in pounds for given initial and terminal speed; W = weight of train in tons of 2,000 pounds, including engine and tender, and R = mean train resistance in pounds per ton of train. If the grade line so determined is produced from an elevation above the bottom of the sag, representing the difference between the initial and final velocity heads, the length of the velocity grade may be found by calculation from the formula: $1 \frac{d}{S\text{-}Sv}$ in which 1 = the length in stations of 100 feet; d = difference in velocity heads for the given initial and terminal speed; S = actual grade in per cent, and Sv = virtual grade, as found from the preceding formula; or its length may be found directly by construction, drawing the original grade from the initial point in the sag, to an intersection with the virtual grade previously established. The actual position or locus of the virtual grade may be found by computing successive sections, but it is generally more convenient to compute it as a straight grade of average rate.

The maximum virtual grade for a given trainload is found by inserting in the formula, the train resistance "R" and cylinder tractive power "T," for a minimum speed of 10 miles per hour.

The use of the diagram published in your preceding issue would result in fixing the top of the velocity grade very much above the limits which could be attained in practical operation.

E. H. McHENRY, Chief Engineer.

The Lake Shore & Michigan Southern has given notice that the rates of fare on its lines in Michigan will hereafter be 2 cents per mile. This applies to all classes of tickets and the order is in line with the recent court decisions on the validity of the 2-cent rate statute. Other roads have given similar notices.