to the same volume and nature of traffic. A study of the actual figures reveals the fact that the sizes of waiting rooms vary from 0.1 to 5.0 sq. ft. per passenger using the station. Apparently, therefore, there is a large amount of guess work entering into the design of station buildings.

Electric Operation.—The electrification of railways in terminal zones has done more than any other single circumstance to alter and improve the conditions existing in large passenger stations. The abolition of smoke and steam, together with their resulting dirt, not only improves the whole atmosphere, but also leads to brighter, cleaner and generally better conditions of all the various parts of the station. Apart from the improved atmospheric conditions, electric operation has made possible a type of terminal in which the tracks are entirely underground, or at any rate, covered over by the station building or offices. The importance of this possibility is that large areas of valuable city real estate need not be entirely

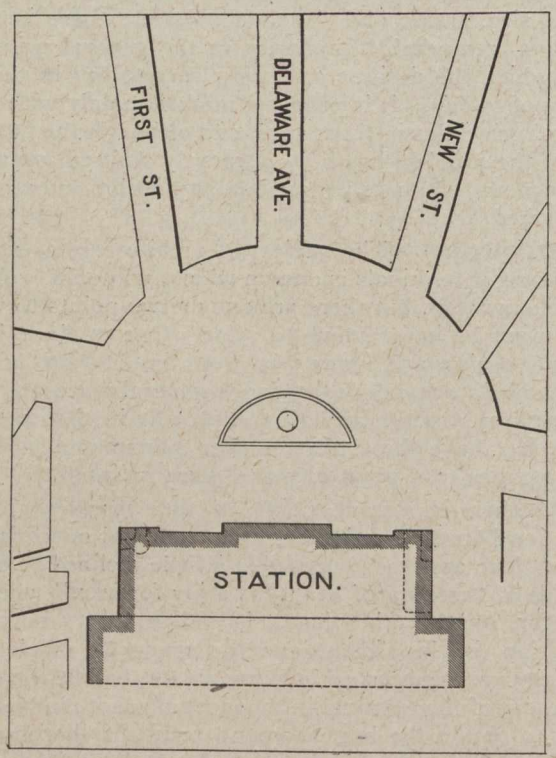

Fig. 1.—Plan of Approaches to Washington Union Station.

devoted to trackage, but can also be used for revenue-producing purposes, such as offices, hotels, etc. A terminal such as the Grand Central in New York would have been an impossibility without the use of electric power.

In addition to this feature there are others of equal importance developed by the use of the electric locomotive. For example, the greater acceleration of this type of engine compared with the steam engine results in the general speeding up of the train and switching movements in the yards, which is a great benefit at any large traffic centre. It is also often possible to utilize steeper grades when electric locomotives are used, this feature again being illustrated in the Grand Central, New York, where there are grades of 3% leading to the suburban level. The operation of a terminal with electric power is also frequently simplified by the fact that only one type of locomotive is used for all the various movements, whether they are empty drafts, long distance trains, or only switching services.

Trainsheds.—There has been a marked change in the standard form of trainshed, the old type of large single-span roof being more or less obsolete as far as the modern terminal is concerned. This type had a number of disadvantages which are mostly overcome by the improved form of umbrella shed now used. That this idea is not new, however, is shown by the following item taken from a copy of "Engineering News" nearly twenty years ago:—

"An arrangement to facilitate the ventilation of and the carrying off of smoke and steam from the interior of train sheds is proposed by Geo. C. Croker, of Boston. It is more particularly applicable to low roofs of moderate span, and consists of a continuous ventilator or chimney over the middle of each track, and running the whole length of the track. Whatever may be the desired height of the ceiling or roof this ventilator extends down nearly to the top of the smokestack."

The use of this type of shed at the Windsor Street Station, Montreal, the Central Station, Ottawa, and at many other important stations, has made it so familiar that no further description is necessary. Apart from the abolition of the smoke nuisance they have the advantage over the large span roof in that they are less costly to erect, less costly to maintain, and also safer. The condition of the air which accumulates in the top of the dome-like structure of the single-span roof has been proved to shorten the life of the steel very considerably.

Site.—In selecting the site, good judgment has to be used in order that undue restrictions will not occur, such as might be caused by streets, valuable properties and natural conditions. It has often happened that restrictions of this nature have occurred to such an extent as to be actually obstructive to the construction of an efficient lay-out of the tracks and buildings.

Neighboring Conditions.—It is not only the natural controlling features within the station site that affect the layout of any terminal, but it is also necessary to make a complete study of the immediate neighborhood, both with regard to the railway, and also with regard to the adjoining part of the city. One feature playing a prominent part in any design is the elevation of the tracks, in relation to the natural ground level, as terminals with the approach tracks either above or below the latter will usually be of a very different type to those where the tracks are at grade. Terminals with two or more stories are far more common than they used to be owing to the fact that it is often difficult to approach a terminal on the ground level without having a number of grade crossings, which to-day will not be countenanced. In some cities, however, the natural features favor the adoption of a layout with the tracks level with the adjoining streets, without any grade crossings, but the two-story terminal has a number of advantages, such as economy of ground space, facility of handling baggage at a separate level from the platforms, and the segregation of traffic. The relative location of the station, the coach yards and engine sheds have an important bearing on the final layout of the terminal on account of the switching movements necessary for the moving of the empty trains. When the coach yards are located at some distance from the terminal the road engine usually makes an independent run, while the empties are handled by yard engines, making it desirable that a means should be provided for running the engine around the train, otherwise it will be tied up for a lengthy period in the platform. As an alternative the train may be pushed into the trainshed backwards, but this method is not considered to be good practice if the distance is at all great. A large number of the movements involved in these forms of operation are eliminated in the case where the coach yard is adjacent to the terminal, and the road engine can hitch on to its train and back it into the trainshed.