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THE CONSTRUCTION OF A SMALL TUNNEL.

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INTRODUCTION.

The West Virginia & Pittsburgh R.R., a feeder of the B. & O. system, was built to open up the sparsely settled and formerly inaccessible counties of Central West Virginia. Topographically, these counties show series of heavy narrow parallel ridges with deep dividing valleys; these ridges run roughly east and west, and are some of the many chains of mountains comprising the great Alleghany range; the valleys are drained by tributaries of the Great Kanawha River, one of the main feeders of the Ohio. The slopes of these ridges are short and rough, and the line in its general course due southward cut directly across them, necessitating a difficult location with heavy grades and expensive work. At the divide between the Little Kanawha and Elk River valleys, it was found impossible to locate over the summit while maintaining the desired maximum grade of 1.5 per 100, and the tunnel whose construction is described in this paper was needed to pass this point.

The railroad was built by the West Virginia Improvement Co., of which Mr. J. A. Fickinger was Chief Engineer and Manager, and the contract for this work was let in January, 1891, to T. J. Steers & Co. of Weston, W. Va.

LOCATION.

As finally located, the line passes through the north approach cut and into the tunnel on a $7^{\circ} 30'$ curve, the P.T. of which lies some 40 ft. beyond the portal; the remainder of the tunnel and the south approach cut are on the tangent to this curve. The tunnel is built on a 0.25 per 100 grade falling to the southward, and is on the summit between two 1.50 per 100 grades. The portals were laid out so that the cut on centre line at the head of the portal slope would be 50 feet, the distance between them being 624 feet.

MATERIAL.

The material through which the tunnel was driven was a soft blue clay shale, nearly dry, and showing little stratification. This shale rapidly disintegrated on exposure to the air, and tunneling through it without timbering would have been dangerous if not impossible. The company not being prepared to line the tunnel throughout with masonry at the time of construction, it was necessary to use a system of timbering amply strong for several years' service and large enough to contain the masonry when it should be built. The unusually large excavation section shown in Fig 1 (18.77 cub. yds. per lin. ft.) was rendered necessary by this double lining. The shale was overlaid with beds of heavy and strong sandstone dipping slightly toward the north and so low that near the north portal some of the sandstone had to be blown down to make room for the timbering.