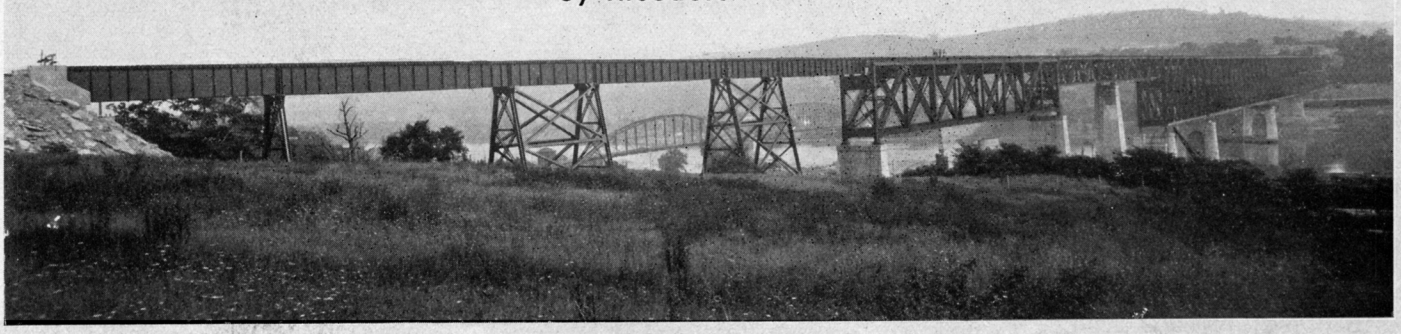
Building The Pittsburgh & West Virginia R. R. Extension

by Theodore Marvin



From a point eleven miles out of Pittsburgh, this new railroad extension runs 39.87 miles to Connellsville. En route, the line passes over the Monongahela River at Belle Vernon. The bridge is 2,610 ft. long. Its lower level will carry the tracks of the Pittsburgh Steel Company extension.

WITH THE DRIVING of the golden spike at Connellsville, Pennsylvania, on February 10, 1931, the 39.87-mile extension of the Pittsburgh & West Virginia Railway was officially declared open after twenty-five months of intensive construction work by the Vang Construction Company, of Pittsburgh. The Pittsburgh & West Virginia line from Cochrans Mill, in Allegheny County, to Connellsville involved, among others, the following factors:

1. Cost – $14,300,000.00.

2. Has two tunnels – Norris Tunnel, near Jacobs Creek (1,200 ft.), and Temple Tunnel (800 ft.), between Redds Mill and Maple Creek.

3. Three large bridges – over Monongahela River at Belle Vernon, and over Youghiogheny River at Jacobs Creek and Connellsville near the road end.

4. Forty-three viaducts and spans.

5. Grading excavation totalled 7,115,367 cu. yd.

6. Excavation for bridge foundations – 131,032 cu yd.

7. Total concrete used – 110,-432.47 cu. yd.

8. Tunnel excavation – 39,944 cu. yd.

9. 1,357,506 lb. of steel in tunnels; 57,542,525 lb. of structural steel on 34 bridges; and 3,739,056 lb. of reinforcing steel required.

10. Culvert pipe employed amounted to 11,471.1 lineal feet.

None of these figures include the work and material employed in constructing the 5.9-mile extension from the point on the new line near Van Voorhis to the Donora Southern Railroad, at Baird. Work on this latter section was practically finished in March. The total cost of this section was $1,600,000.00

What is unusual about the construction of this railroad? No one making even a casual inspection of the right-of-way of this line would ask that question twice. The route traverses an area of choppy hills and valleys which remind one of trying to walk on railroad ties—"one is too narrow and two are too wide." The result is a high line which involves tremendous cuts (one requiring 251,710 cu. yd. of excavation), huge fills, long and short spans of steel viaduct, and four tunnels (two of these being on the Donora Southern section).

In December, 1928, the Vang Construction Company received contracts covering the first part of the job. Before actual work could commence, it was necessary to cut new roads through woods, up and down steep hills, and over fields where wheeled vehicles never before had passed. In this difficultly-accessible region, Mr. Vang and his staff placed sub-contractors and attacked much of the job simultaneously. At one time 44 power shovels were gnawing along the right-of-way.

Near the junction of the Donora Southern connection is McCabe's Cut, one of the largest along the line. It was excavated by Jim McCabe, who used well drills and black blasting powder for drilling and blasting with great success.

Back of Gastonville a standard-size freight locomotive with tender and dirt spreader left the Baltimore & Ohio tracks and chugged for a mile over dirt roads and up a hill to a partially-finished piece of the new line.

Shifts were continuous. Large carbide lamps lighted open cuts during the night so that drill and shovel crews could operate on cuts and fills. The highest fill was about 140 ft.; one required a box culvert 650 ft. long to take care of drainage. Slides on several fills adjacent to highways occurred, but regardless of all obstacles, construction progress kept ahead of time specifications. To provide better footing for fills on side hills, trenches often were blasted.

Purpose of extension

THIS EXTENSION will link up and form another trunk line from the West to the Atlantic Seaboard. It

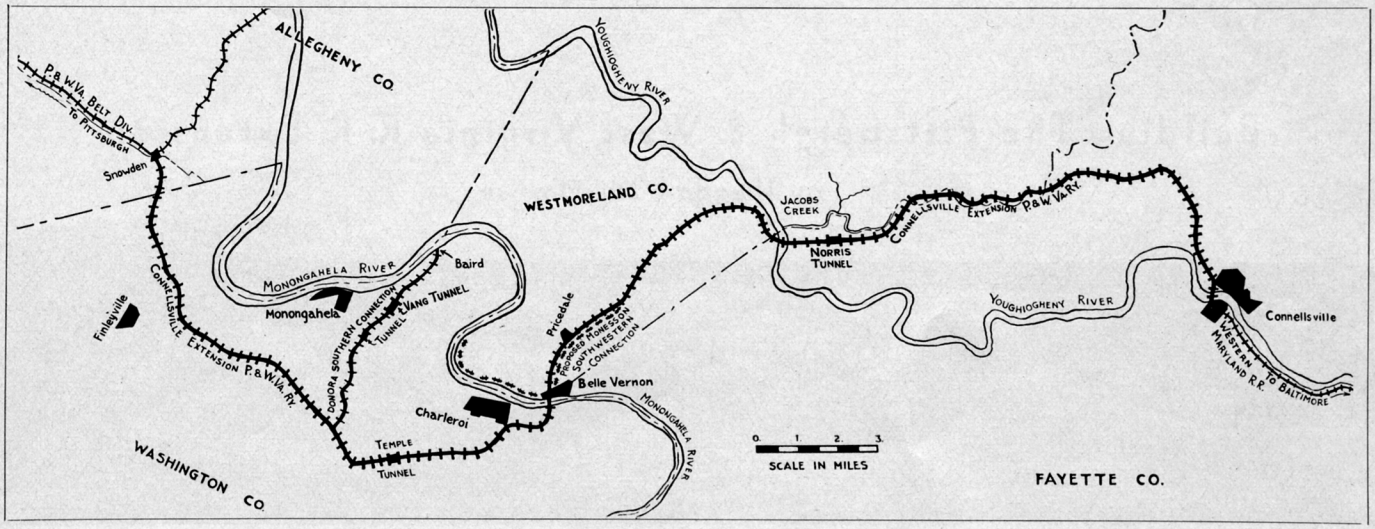


Figure 1: Following the Connellsville Extension from left to right, one leaves the point of contact with the Pittsburgh & West Virginia R. R. Belt Division near Snowden (Cochrans Mill) and passes Finleyville, the first Vang field-headquarters. Thence the line runs to the Donora Southern connection, skirting Monongahela and Charleroi, and crosses the Monongahela River at Belle Vernon where the proposed Monessen Southwestern R. R. will join. On to Connellsville, the road goes through Norris Tunnel, crosses Youghiogheny River, and enters Connellsville to connect with the Western Maryland R. R.

fits into a gap between a point about eleven miles south of Pittsburgh (joining the Pittsburgh & West Virginia) and another point on the Pittsburgh and Lake Erie tracks just outside of Connellsville. Traffic will proceed along 500 ft. of this P. & L. E. line to the right-of-way of the Western Maryland and thence to Baltimore. It is estimated that the route to the seacoast is reduced 70 miles by this extension.

Locally, the road will connect with manufacturing sites in Donora and Monongahela; the former will tap traffic of the American Steel & Wire Company. The Pittsburgh Steel Company is constructing a branch line which connects with the Connellsville Extension near Pricedale over the tracks of the Monessen Southwestern Railway. Local deposits of coal and non-metallics are expected to be opened as a result of these transportation facilities.

General construction data

GEOLOGICALLY, the strata along the routes of the different sections of this project are quite similar. Generally, overburden averages 15 ft. in thickness, with layers of shale, bedded sandstone, limestone, coal, and occasionally a few small deposits of iron ore being encountered. As the railroad grade is a maximum of 1 per cent, and the greatest curvature restricted to 6 degrees, construction involved heavy cutting, filling, tunneling, and bridging along the entire route.

All footings for viaducts and bridges were carefully diamond drilled. The wisdom of this procedure was demonstrated in one place where the holes broke into a coal mine. Concrete footings had to be built up from a tunnel floor in the mine.

Power shovels and caterpillar tractors proved the best means of moving the cut material. Trucks with double pneumatic tires and crawler wagons also were used. When track had been laid, dinky locomotives and air-dump equipment were brought in.

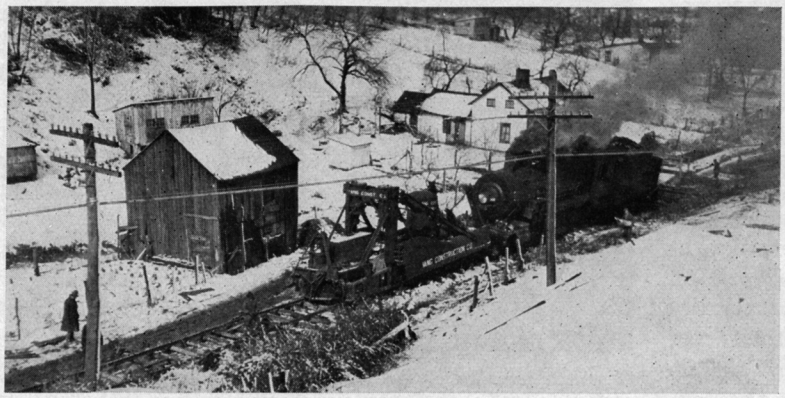
Blast holes were put down by well drills, tripods, or hand-held machines. Most of the rock was blasted with high explosives, although meritorious work with black blasting powder was accomplished by Jim McCabe in excavating McCabe's Cut.

Various types of power shovels were represented. Steam, gasoline, and Diesel-electric units all gave good accounts of themselves. In the several periods of extreme drought, however, water for the steam shovels had to be piped as far as 9,000 ft. to the job.

Not all the project was sub-let to other contractors, as the Vang Construction Company retained several tunnel sections and a number of the more difficult cuts and fills. The bridges and viaducts were fabricated and erected by the American Bridge Company, the McClintic-Marshall Company, and the Fort Pitt Bridge Works. Grading and construction of all masonry was included in the Vang contracts. Much of the concrete was mixed at center stations and transported to forms with fast trucks.

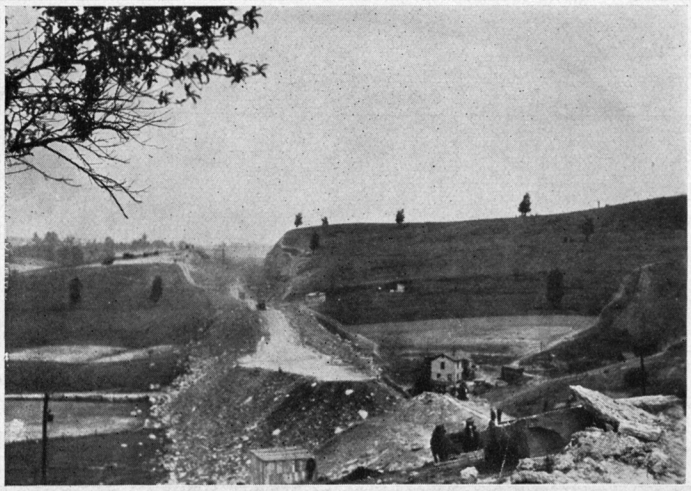
The largest cut encountered on the entire right-of-way was "1060," on the Belle Vernon-Connellsville section. This measured 251,710 cu. yd. of excavation over a 3,500 ft. length with a 6,800 ft. disposal haul. The Vang organization did this work, with Charles E. Schaidt in charge, and R. O. Shive as blaster. Explosives consumed amounted to 45 tons.

Gardner-Denver Model 17 lifter drills,



What would you think if you met a standard-size, freight locomotive with tender and dirt spreader chugging up a peaceful country road? Here's one en route to the rails of the first-laid section.

Majority of photographs obtained by courtesy of Dr. L. W. Hoon, Monongahela.



Cut and fill, tunnel and fill, bench and bridge, were all in the day's work, especially along the first half of the main extension and the spur to Baird.

Near Finleyville, this blast in one of the cuts included 3,450 lb. of 40% dynamite. The charge was loaded in well-drill holes of 18 ft. to 20 ft. in depth.

mounted on derrick rigs, put down the holes. There were three of these drills operating off two compressors. Steel measured 2 in. in diameter.

Holes were drilled 14 ft. deep and 6 ft. apart, with blasts including areas of about 30 ft. by 70 ft. No springing of holes was resorted to. The charges of one 2 in. by 8 in. cartridge of 40% Gelatin per foot of hole were loaded directly, holes securely tamped to the collar, connected in series, and fired by a blasting machine.

Circuits were always tested by galvanometer, and blasting machines occasionally were checked by rheostat. Following the adoption of caps with enamel leg wires, little difficulty with misfires was experienced. The primers on this job were placed near the top with the cap pointing towards the charge.

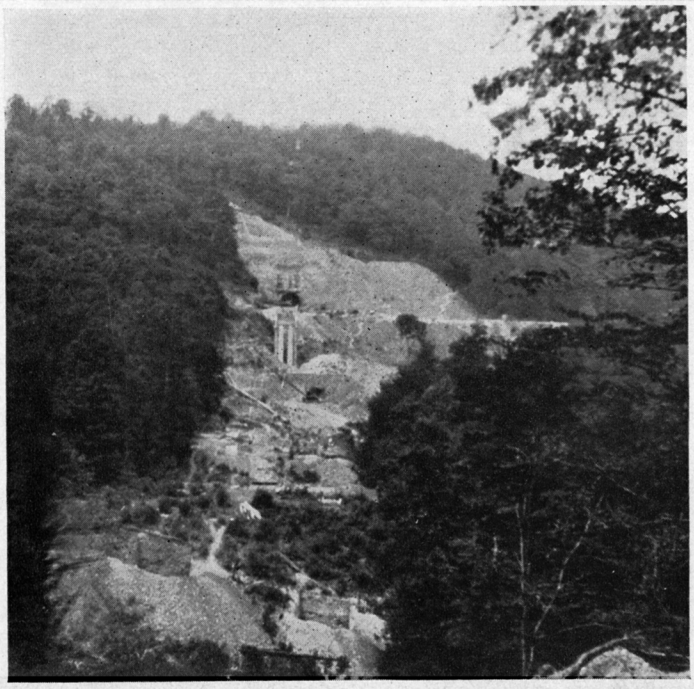
Porter locomotives hauled the excavated material away in 4-yd. capacity Western Wheeled Scraper dump cars. This material was used for fill.

Summit No. 2 cut

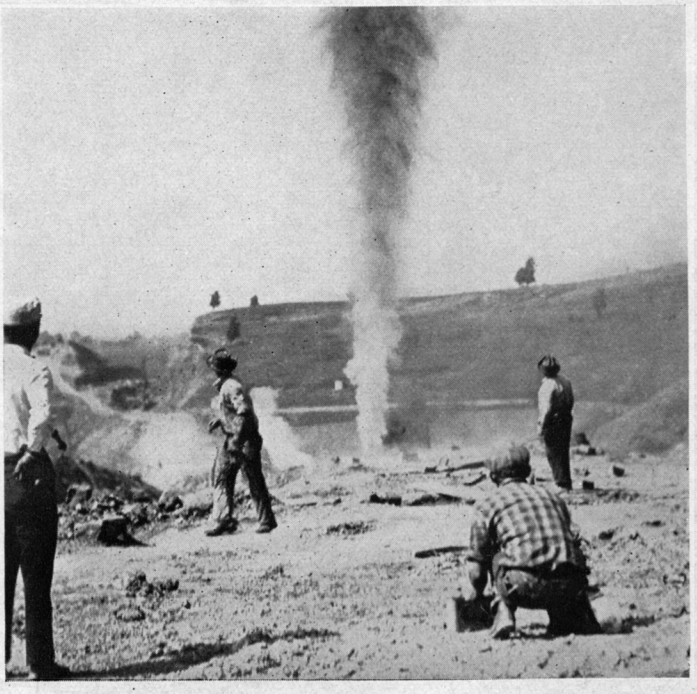
ANOTHER LARGE CUT measured 180,000 cu. yd. It was driven by Peterson and Voit, sub-contractors. This portion of the right-of-way was 3,300 ft. long, with a top width of 160 ft. and a maximum depth of 73 ft. to the road bed. Like all cuts, this measured 24 ft. wide at the bottom.

The contractors used only one small hand-held Gardner-Denver machine for drilling holes. A 220-Chicago Pneumatic compressor furnished air; 1-in. steel was employed.

Following the removal of top soil, the driller put down 14-ft. holes, 8 ft. apart. These were twelve to the row, staggered, with three rows usually in one shot. Practice was to spring three times, with springing charges averaging three cartridges of 40% Gelatin Extra L. F. Thirty cartridges of 40% Gelatin comprised the final load which was tamped to the collar. The charges were hooked-up in series and fired with a 50-hole blasting machine.



Off Norris Tunnel in the Jacobs Creek region, the precipitous topography necessitated an extremely long and high viaduct. Preparation of footings is shown here.



Some contractors sprung the holes used to blast cuts. Here's one in the section across the valley from McCabe's Cut looking towards Connellsville.

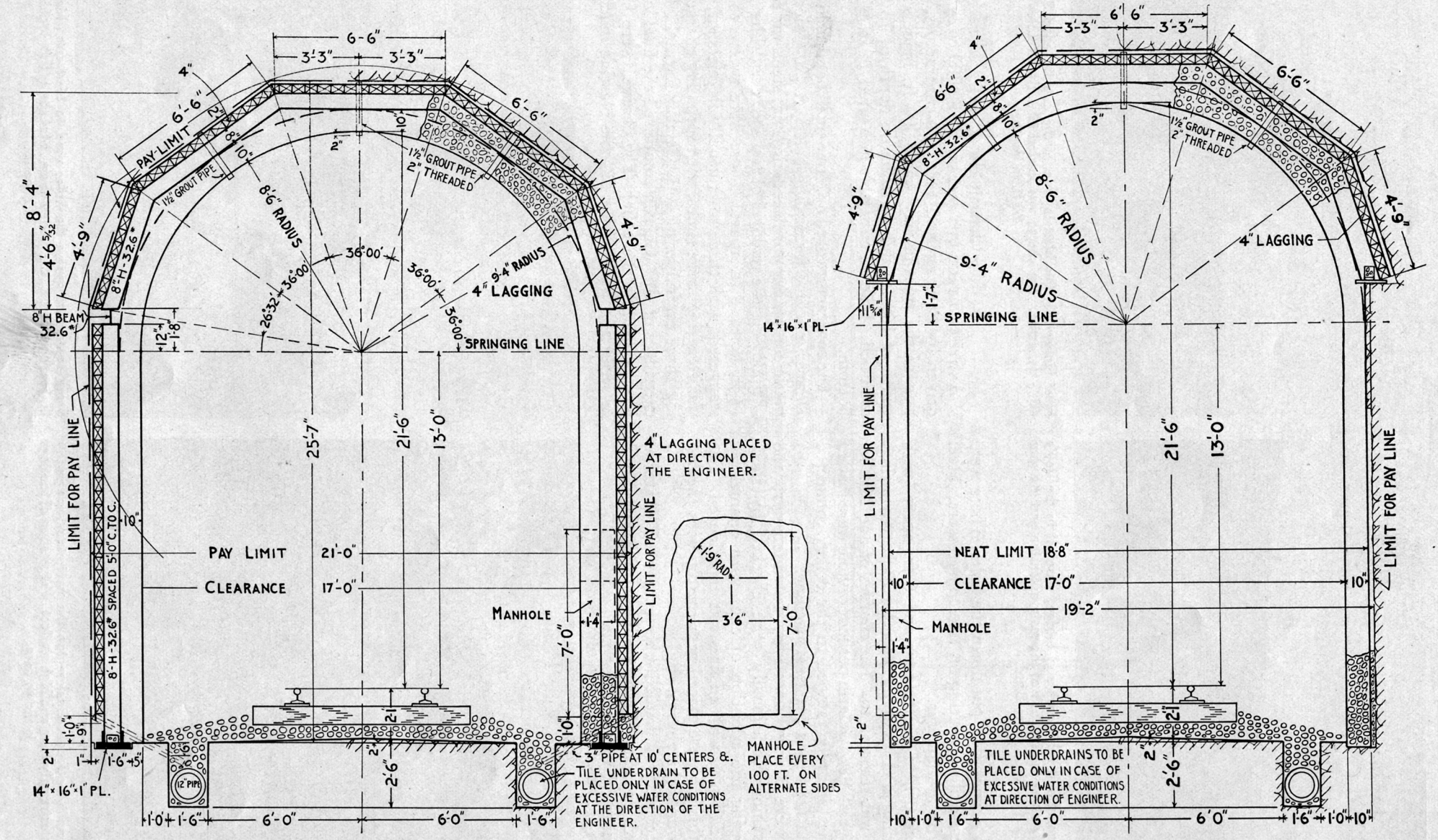


Figure 2: Dimensions and specifications covering timbering and concreting of Norris Tunnel vary because of changes in the rock through which the line ran. The left-hand diagram covers specifications for soft ground; the other refers to medium or hard rock sections. The type of bottom used in soft ground was changed to a completely-concreted section when necessary. In certain hard rock areas, lining could be omitted by direction of the railroad's engineer. Sam Polino drove Norris Tunnel, while the Faulker Construction Company had charge of Temple Tunnel.

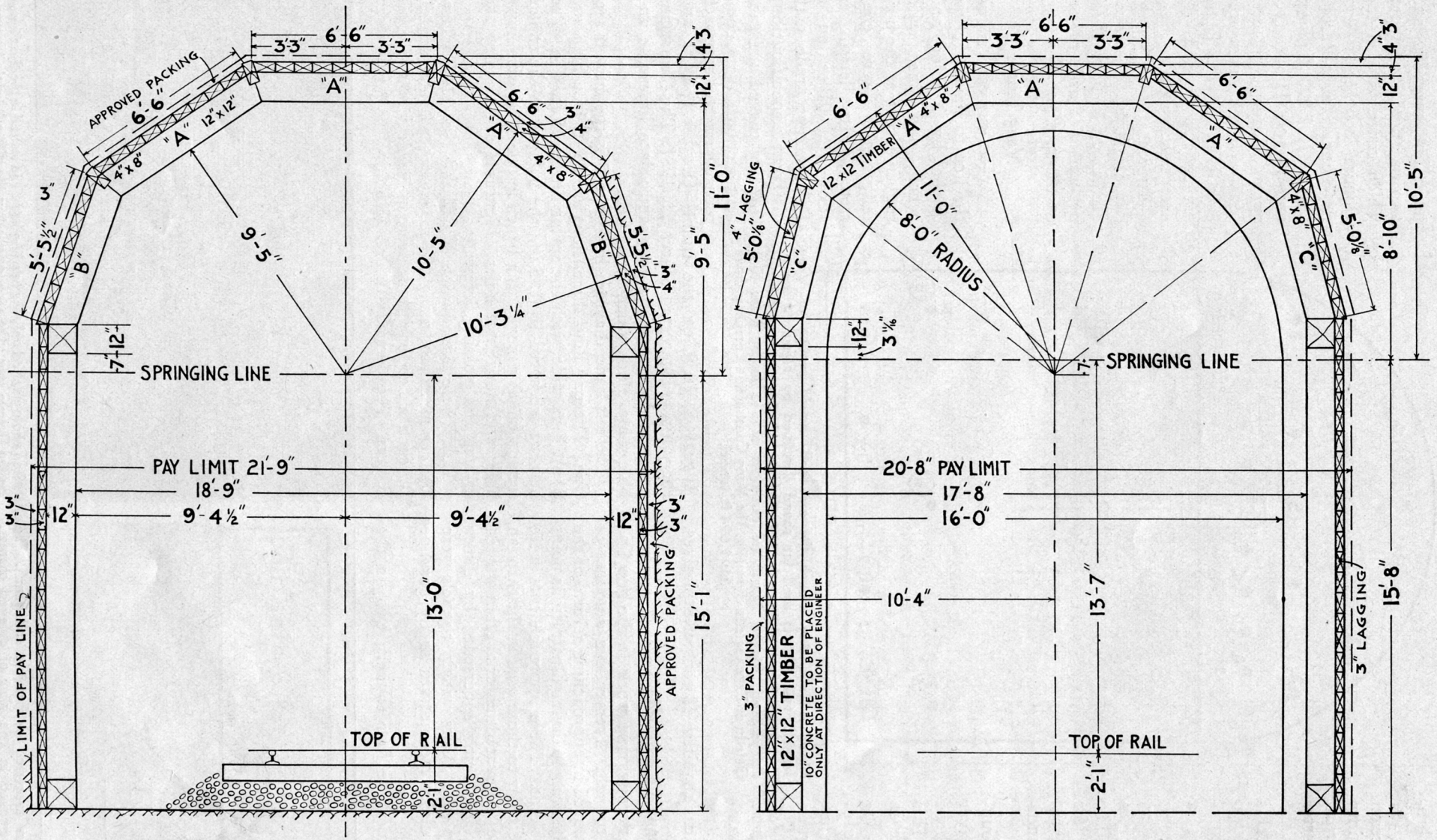


Figure 3: The Donora Southern connection tunnels required two sets of specifications—for curve (left) sections and for tangent (right) sections. These tunnels generally were not concrete-lined; instead the approved dry packing behind lagging was employed. Where directed, however, 10 inches of concrete was placed. Caps were of 12-in by 12-in. timber. "A" was 6 ft. 6 in. long at the top, and 5 ft. 10½ in. at the bottom, with bottom ends tapered 3¾ in. "B" timber was 5 ft. 5¼ in. at top, 4 ft. 9¼ in. at bottom, with ends cut 4¼ in. and 3¾ in. "C" timber measured 4 ft. 11¾ in. at top, 4 ft. 3¾ in. at bottom, with tapers of 3 in. and 5 in. at the bottom. Figures 4, 5, and 6 describe drilling and blasting methods used in shooting these Donora tunnels.

Excavation of the broken rock was with a 1¾ cu. yd. Marion Steam Shovel, dumping into trucks or into railroad cars hauled by a Porter dinky.

The progress of this cut was slowed down considerably by accumulation of water in a closed portion of the upper end and which later, with mud, flowed into the working area. The extremely long haul for disposing of the excavated material also handicapped the work.

In the strata encountered was one hard layer of limestone of about 4 ft. in thickness. This came at a bad place in the series of benches, being above the hole-pocket level, yet below the collar. The charges, in exploding, cracked the stratum into large ledges, requiring considerable secondary breaking. This entire cut required 48 tons of explosives.

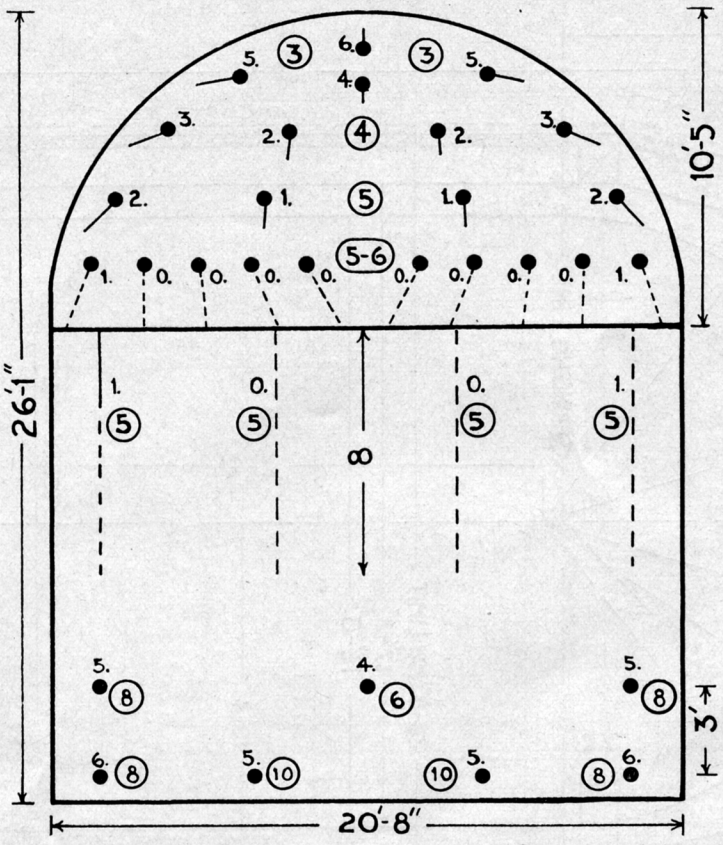


Figure 4: In driving through the east end, curved section of Vang Tunnel, Frank Weaver used the round described by Figures 4 and 5. The dotted figures indicate the instant electric blasting caps and different delays used. Ringed figures are cartridges of 1¼ in. by 8 in. 40% Gelatin or Extra Gelatin dynamite. The Vang Construction Company drove this 1,694 ft. tunnel.

Tunneling methods

SOME OF THE MOST INTERESTING work on the new line centered around the tunnels. Tremendous amounts of material had to be removed in approaching several of the tunnel portal sites. The accompanying illustrations point out the involved problems. These approach cuts were opened with methods similar to those used in the through cuts. Transportation of excavated material often started with truck haulage, later being superseded by dinky locomotives and dump cars. Cars within tunnels were moved by the same dinky locomotives or by gasoline locomotives.

It was necessary to drive four tunnels, two on the main line extension and two on the 5.9-mile spur which connects with the Donora Southern. Norris Tunnel (near Jacobs Creek) is 1,200 ft. long, and Temple Tunnel (between Redds Mill and Maple Creek) measures 800 ft. in length. These are on the Connellsville extension.

Typical of the methods employed are those used to drive Vang Tunnel and a fourth tunnel on the spur line.

Vang Tunnel

VANG TUNNEL is on the line to Baird. It was driven by heading and bench, and lined with timber except at the portals, which were concreted. Its length is 1,694 ft., driven on a 1 per cent grade with different specifications covering curved and tangent sections. Work commenced on the approach August 5, 1930, on the tunnel October 1, 1930, and the job was completed March 21, 1931. The formations penetrated were mainly gray sandy slate, limestone, and blue shale, all of which broke well.

The left-hand diagram in Figure 3 is the curved section. The pay limit dimensions are 26 ft. 1 in. high and 21 ft. 9 in. wide, with the spring line at 15 ft. 1 in. The heading measured 10 ft. 5 in., the balance of the tunnel section being removed as a bench in one shot, with down holes and horizontal holes. Figures 4 and 5 carry the drilling and blasting details.

Holes were drilled with No. 7 and No. 11 Gardner-Denver machines, using 1¼-in. diameter Crucible steel. On such a heading round were three drillers and three helpers. They usually drilled 22 holes in a heading sec-

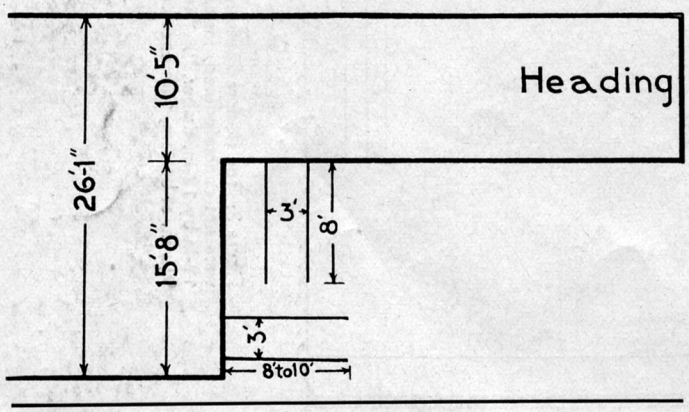
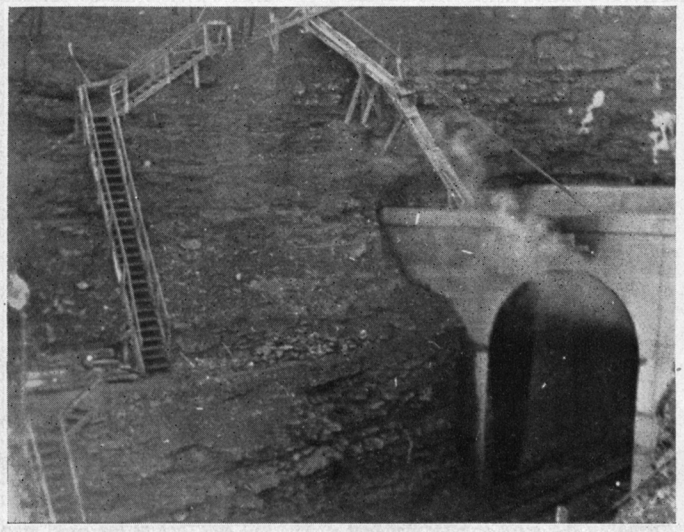


Figure 5: Vang Tunnel was excavated by heading and bench. The entire bench round was removed in one blast of delayed charges.

When photographed only the heading had been started in the short tunnel on the Donora spur. The view emphasizes the difficult terrain traversed.



Going through this portal of Vang Tunnel, one proceeds towards the junction with the main line extension. The approach to this portal involved the excavation of 35,000 cu. yd. of material.

How timbers were set in the main line tunnels is revealed by this view out a portal. To the left is one of the shovels employed in mucking bench material.

tion. These were 5 ft. to 6 ft. deep and carried three to six 1¼-in. by 8 in. cartridges of 40% Gelatin or Extra Gelatin with No. 6 electric blasting caps and No. 6 delay electric blasting caps as the detonating agents.

All charges were loaded by machine men and fired by the drill boss at the end of each 12-hour shift. Rounds were hooked-up in series and fired from a 110 A.C. power line.

A bench round consisted of two rows of 8-ft. down holes drilled four across, and 3 ft. between rows and the face. The horizontal 8 ft. to 10 ft. bottom holes included four in the toe and three in a row 3 ft. from the bottom. Down holes each carried five cartridges of 40% Gelatin, while the bottom ones were charged with six to ten cartridges of the same explosive. Rounds were primed with No. 6 electrics and electric delays, and fired in series from the 110 A.C. power line. Misfires were handled by re-shooting under the direction of the drill boss.

In the heading, hammer cuts and wedge cuts were used, which pulled 5 ft. to 6 ft.; the whole round advanced 4 ft. Actual cubic yards per lineal foot advanced on curved sections were: heading – 6.6; bench – 12.7; tangent: heading – 6.25; bench – 12.3.

Following clearing of powder smoke by air blowing from drill lines, crews commenced loading. In the heading Hoar shovels loaded into 1-yd. cars which were hand-trammed to the bench edge and dumped. Bench excavation was with an Erie and Marion air shovel, loading into 3-yd. and 4-yd. dump cars. Separate batteries of portable air compressors furnished much of the air on most of the job.

Headings progressed ahead at the average daily rate of 15 ft. Benches were pushed 18 ft. a day when desired.

On this tunnel, No. 11 Gardner-Denver machines were used in the heading and for bench down holes. No. 7 drifter machines of the same company put in the bench horizontal holes. Compressors were G. D. and Ingersoll-Rand; steel – Crucible; sharpeners – I. R.; dump cars – Western Wheeled Scraper; haulage – hand, mules, and Porter dinkies; and loading machines – Hoar, Marion, and Erie.

This part of the project was constructed by the Vang organization under the tunnel superintendent, Frank Weaver.

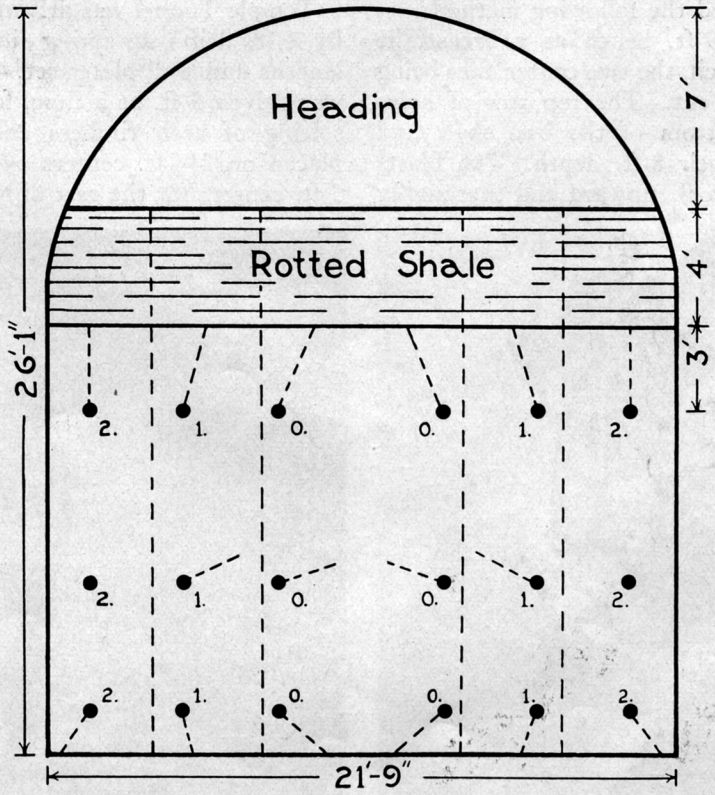
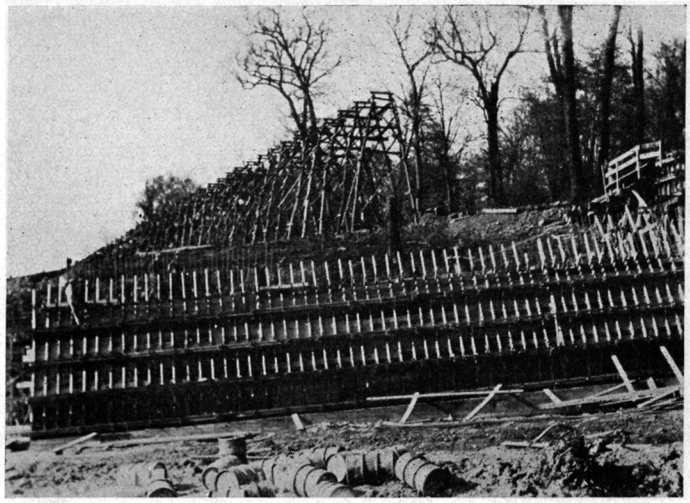


Figure 6: Excavation of the Donora 550-ft. tunnel (by Sam Polino Construction Co.) was complicated by the presence of a layer of rotted shale. David Kline, tunnel superintendent, put in up-holes under the shale and then V-cut the entire bench. Wedge cut, relievers, rib and top holes pulled the heading. Bench holes were 8 ft. long and carried a cartridge of 40% Extra L. F. Gelatin per foot. The holes pulled the round in vertical slices.

Rock conditions determine special round on shorter tunnel

AN UNUSUALLY INTERESTING PROBLEM in tunneling met David Kline, tunnel superintendent for Sam Polino, on the 550-ft. tunnel on the Donora Southern Spur. This bore, the shorter of the two on this part of the job, was driven by



Large fills involved, besides drainage facilities, underpasses for highways and railroads. Making a fill by trestle was one method employed. The lower structure is the concrete form for a railroad underpass. Some drainage culverts were over 400 ft. long.

Probably the most spectacular part of this job was that of the steel men in erecting viaducts and bridges. A side plate on the viaduct over Maple Creek is sliding into place, directed by McClintic-Marshall bridge men.

full heading and bench. The roof was bad, making timbering necessary right up to the face of the heading while the balance of timbering followed closely behind bench blasting operations.

The heading was excavated by putting in a regular wedge cut, followed by relievers and rib and top holes. This heading, being about 7 ft. high, left a bench of 19 ft. The top 4 ft. of this bench was of horizontally-lying shale which was badly laminated by horizontal rotting. As charges in down holes in this material would break the rock in large ledges too big for the Hoar shovel to handle, Mr. Kline adopted the following method:

Considering the entire 19-ft. bench as a breast, he used three rows of 6 holes each, the two center ones being leaned-in to form a wedge cut. The top row of holes started 3 ft. below the bottom of the bad shale and reached it at the end of their 8-ft. depth. The blasts thrust the upper layer of rock upward and thoroughly broke it. The center holes were horizontal, while the bottom ones inclined to reach grade at 8 ft.

In firing, the center holes went first; the others followed and took out entire slices of the bench. Figure 6 shows the bench round.

Charges consisted of a cartridge of 40% Extra Gelatin per foot of hole and No. 6 electric or delay electric blasting caps. All holes were stemmed with fine rockdust or clay. Charges were hooked up in series and fired from a 110-volt A.C. line.

Gardner-Denver No. 7's were used on the bench holes with No. 11's in the heading.

Tunnel timbering and lining

THE TWO SHORTER TUNNELS on the main line of the extension were lined with concrete. Timber lining and dry packing behind lagging were employed in the other bores, although their portals were concreted in to solid rock.

Temple Tunnel was driven in soft material. Two 4-ft. by 4-ft. drifts at spring line were advanced in 10-ft. lengths and wall plates set. The complete heading then was driven 5 ft. at a time, followed immediately by the setting of arch timbers and lagging. H-beams were placed on 2½-ft. centers over 260 ft. of length and on 5-ft. centers for the rest of the bore.

Forms were erected and concrete placed following complete excavation. Concrete was centrally mixed in Monongahela for this and much of the first 17 miles of work. Trucks delivered to the point of demand.

Both main line tunnels were lined alike except that the longer one (Norris) had a ballast bottom, the other being fully concreted. The different

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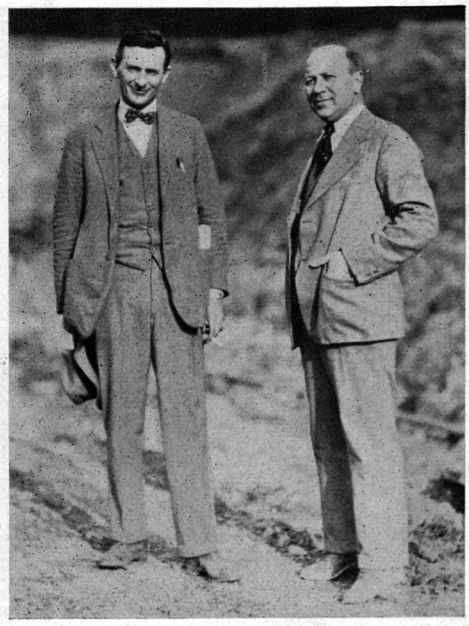
H. H. Temple, chief engineer of the Pittsburgh & West Virginia R. R., has just driven the golden spike at Connellsville which symbolized the railroad's completion.



L. E. Goerder (left), general manager of Vang Construction Company, and W. C. Kline, assistant construction engineer for the Pittsburgh & West Virginia R. R., are pleased with the job's progress.