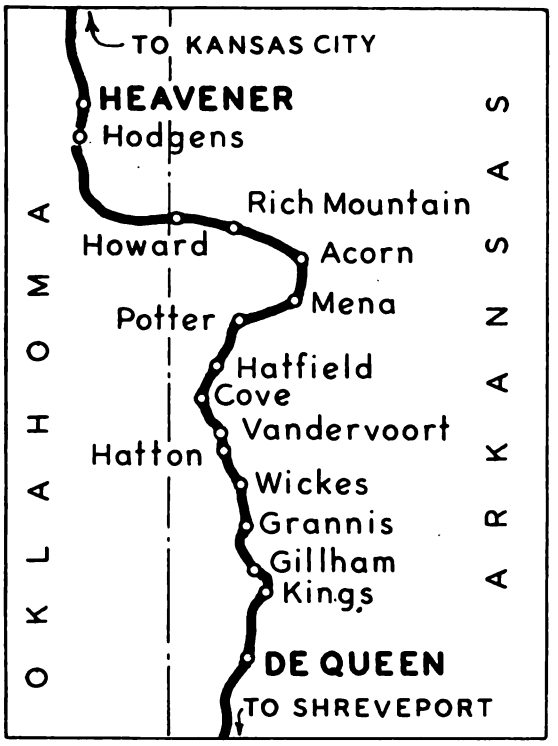



# CTC Moves Trains on Grades

**Kansas City Southern saves time on 95 miles of single track over the Ouachita mountains where grades 18 miles long range up to 1.8 per cent**

ON 95 MILES of single track, extending over heavy mountain grades between Heavener, Okla., and DeQueen, Ark., the Kansas City Southern has installed centralized traffic control as a means of increasing track capacity and reducing train delay. Previously, no signaling was in service on this territory; the siding switches were hand-thrown, and train movements were authorized by timetable and train orders. Now, the new power switch machines and signals at sidings are controlled by the CTC operator so that trains enter or leave without stopping, and train moves are authorized by signal indications so that meets are made on close time, in many instances without stopping, which is especially important on account of the grades.

Heavener, which is at the north end of the project, is 338 miles south of Kansas City on the 787-mile route to Port Arthur, Texas. Also, at Shreveport, La., connection is made with other KCS lines extending 313 miles to New Orleans.

### More Than 20 Trains Daily

The daily schedules on the Heavener-DeQueen section include six passenger trains, two fast merchandise trains, four manifest freights, and a local freight southward three days, and northward three days each week. Extras are operated so that the total number of trains varies from a minimum of 15 to a maximum of 20 to 25 daily.

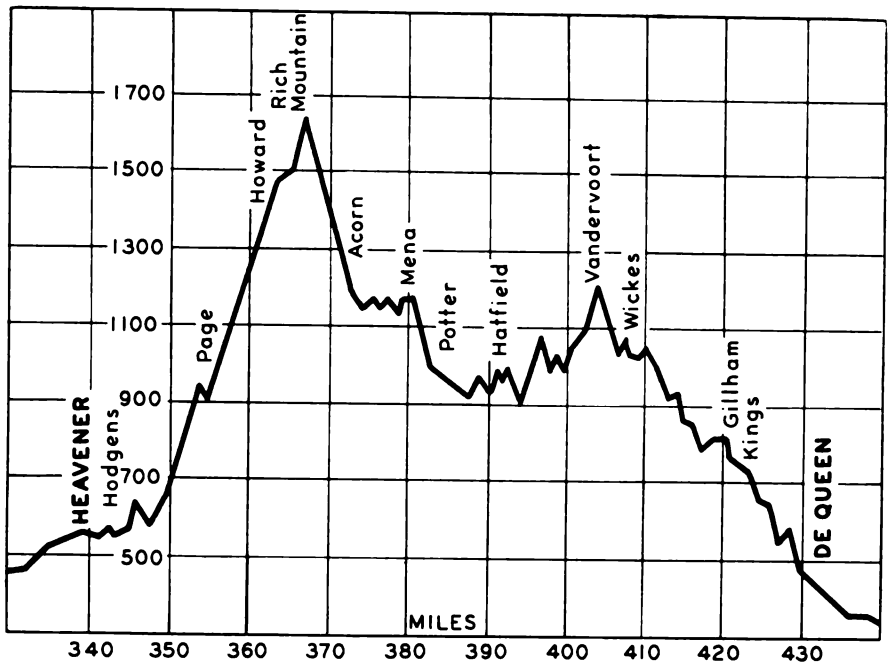
The Southern Belle, each way daily, is a modern, fast overnight train between Kansas City and New Orleans, making this 873 miles in 18 hours. Also, the KCS is noted for its fast freight service. The Merchandise Special, No. 77, which leaves Kansas City at 9:45 p.m. gives second morning delivery at Texarkana, Shreveport, Beaumont, Lake Charles and New Orleans, as well as second morning arrivals at Houston and Dallas.

Each of the 6000-horse power diesel locomotives, used on through freight trains, consists of 4 units, rated at 4,350 tons south between Heavener and Rich Mountain, where the overall ruling grade is 1.5 per cent; and at 4,700 tons northward between DeQueen and Rich Mountain where the ruling grade is 1.35 per cent. The speed limit for passenger trains is 58 m.p.h., and for freights the limit is 48 m.p.h. between Heavener and Mena, and 40 m.p.h. between Mena and DeQueen, except that the limit is 48 m.p.h. for the Merchandise Special No. 77. The Merchandise Special, with up to 4,350 tons can make the 95 miles either way between Heavener and DeQueen in about 3 hours and 15 minutes.

### How Time is Saved on Meets

Excluding the local freight, the 6 passenger trains and 6 through freights are scheduled to make a total of 12 meets each day at sidings between Heavener and DeQueen. Even a few extra trains increases the number of meets rapidly. Previously train movements were authorized by timetable and train order, with designated superiority. Because many of the sidings are on grades, the trains, when stopping and starting, lost considerable time to permit operation of hand-throw switch stands at sidings. If some trains lost more time than expected, other trains were needlessly delayed because the dispatcher could not get information, or could not issue new orders in time to advance other trains.

Inferior trains were required to clear the main track at least 10 minutes ahead of the time for a superior train. Trains either southbound or




**In the 95 miles between Heavener and DeQueen, the KCS goes over the main range of the Ouachita mountains. At Stapp, 11 miles south of Heavener, the line starts up grade; in the 18 miles on up to the crest at Rich Mountain the line rises from 600 ft. elevation to 1,650 ft. This section includes continuous grades of approximately 2½ miles of 1.2 per cent grade; 3½ miles of 1.38 per cent and 1½ miles of 1.5 with a short compensated grade of 1.86 per cent near the crest. From there south, the descending grade is a maximum of 1.35 per cent, with several breaks, and a hump at Vandervoort. The elevation at DeQueen is 500 ft. and goes on down to 300 ft. at Winthrop, 18 miles further. Thus the 95 miles between Heavener and DeQueen include a large percentage of the long, heavy grades on the entire KCS lines.**

northbound were required not to leave Rich Mountain within 15 minutes after the departure of a train in the same direction. Compliance with these rules consumed considerable time. Thus, on this 95 miles of heavy grades, the problem was to minimize the number of train stops and the standing delay time so that trains could keep moving at the maximum speeds consistent with grades and tonnage.

These desired results have now been accomplished by the centralized traffic control. The reduced number of train stops under CTC operation should materially minimize the changes of draw bar failures that are likely to occur in any territory involving heavy grades and tonnage trains. If trains are received behind schedule, they can be given preference so that they make up time. Extra trains can be handled without causing delay to scheduled trains more readily than previously. This is true because the CTC operator can see on his control board the position and progress of each train; he can control the switches and signals to advance trains for close meets, as well as give preference for uphill trains to hold the main.

## Sidings Improved

On this district, the sidings are not spaced equally, simply because they were located (where possible) at level spots or breaks in grade, so that the difficulty of stopping and starting trains, when entering or leaving such sidings, would be minimized. The distance from the south end of one siding to the north end of the next varies from a minimum of 2.5 miles between Gillham and Kings; to a maximum of 11 miles between Wickes and Gillham.

The sidings at Hodgens and Vandervoort are on 0.5 per cent; Howard is on 1.15 per cent, Potter is on 0.4 per cent, and Kings is on 0.2 per cent. Sidings at Rich Mountain and Mena include the crest descending grades both ways. The siding at Gillham is on a short section of level between grades. Sidings at Page, Acorn, Wickes and Hatfield are on short sections of rolling grades between long grades.

As part of the CTC project, new No. 16 turnouts, with 30-ft. points, were installed at both ends of the ten sidings named above, and at the south end of Heavener and the north end of DeQueen. These 26 power switches, and the signals for authorizing train movements at these switches are controlled by the CTC operator at Mena. Other short sidings, not ordinarily used for meeting or passing of trains, are located at Cove, Hatton and Grannis. As part of the CTC project, electric locks were installed on the hand-throw switches of these short sidings, and also at 11 other main track switches leading to industry spurs.

**TONNAGE MARKER lets trains pass intermediate signal without stopping**

## Controlled from Mena

The entire CTC territory is controlled by the machine in the office at Mena. On the illuminated track diagram, a red lamp repeats the track occupancy of each switch detector section. On the line represent-

**MAIN LINE DWARF saves expense of throwing siding to get clearance**

ing the main track between two sidings, there are two track-occupancy lamps, each of which repeats approximately half of the siding-to-siding distance. By means of these two separately controlled lamps, the dispatcher knows when a train is halfway between sidings.

When a signal has cleared, a white lamp is lighted in the face of the barrel of the corresponding signal lever. When a switch lever is thrown, a white lamp is lighted in the face of the barrel of the lever until the switch moves over to the position corresponding with that of the lever. The five electric locks on main track hand-throw switches in Mena are controlled by one lever on the machine. Other electric locks, such as at spurs, are controlled automatically by short track circuits at the switches.

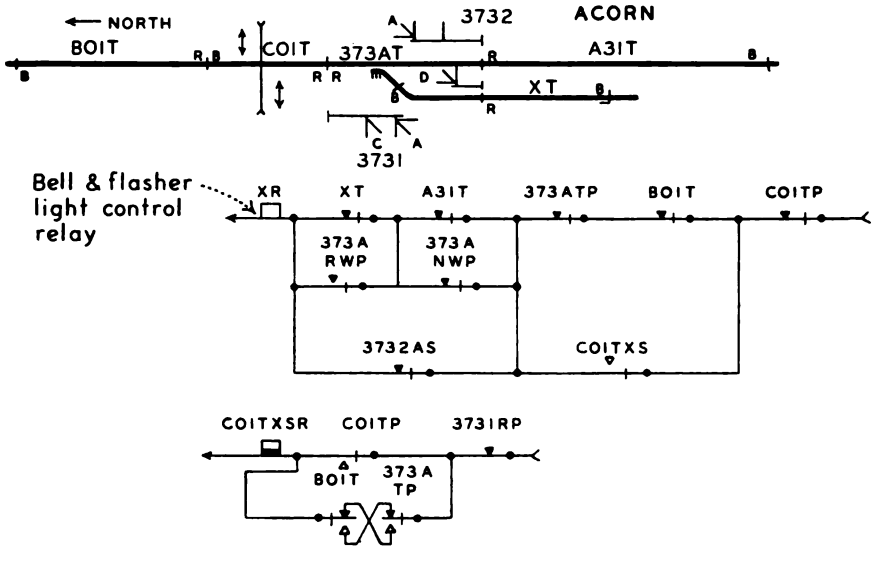
At the ends of sidings the signals are located in accordance with conventional practice. An unusual feature, however, is that main track station-leaving signals, between the main track and siding, are dwarfs, rather than high signals. This use of dwarfs avoided the expense of moving the siding over to 20-ft. centers to provide clearance for a high signal.

As a general rule, the intermediate signals are double locations. Three such doubles are located on the 10 miles between sidings at Hodgens and Page; three on the 10 miles between Wickes and Gillham; two on the 8.5 miles between Hatfield and Vandervoort; and three on the 6.5 miles between Vandervoort and Wickes. On the shorter siding-to-siding sections, ranging up to 4.5 miles, there is only one intermediate double location. Between Potter and Mena there is an ascending 1.35 per cent grade northward, and in this section of 4.5 miles there are two northward intermediate signals and one southward. Because trains run slower up the hill, the second northward signal is required to allow a second northward train to enter the siding-to-siding block.

The siding at Vandervoort is approximately 5,500 ft. long so that the distance on the main track from the station-entering signal to the station-leaving signal, in either direction, is less than train stopping distance. Therefore the signals in approach to Vandervoort, from both directions, are both controlled to display flashing-yellow, as the Approach-Medium aspect, when its corresponding station-entering signal displays yellow, Approach, and the switch is positioned for a main line movement.

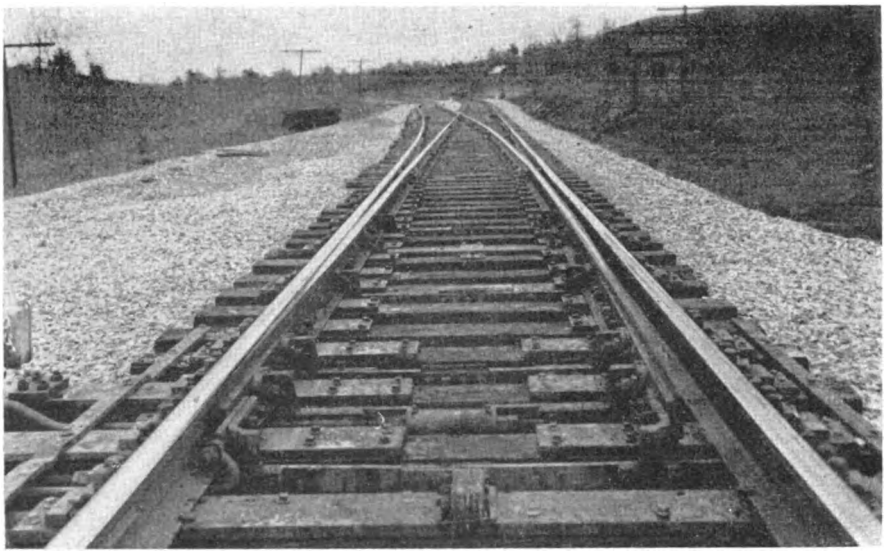
The distance from the south switch at Gillham to the north switch at Kings is only 2.33 miles, with one double location of intermediate signals, so that the siding-to-siding block is cut into two automatic blocks each about 6,000 ft. long. Southward from Gillham the grade descends at 1.06 per cent for approximately ½ mile, thus increasing the train stopping distance. Therefore, when the southward intermediate signal is displaying the Approach aspect, the main track station-leaving signal or the leave-siding dwarf, display the flashing-yellow aspect for Approach-Medium. In order to eliminate line circuits, the approach medium aspects are controlled by interrupting the signal circuits at their energy ends with contacts of a 75 rate code transmitter. Decoding relays or transformers are used at the approach medium signals to give the flashing-yellow aspects.

A highway, protected by automatically controlled flashing-light signals, crosses the track 100 ft. north of the power switch at the north end of the Acorn siding. For a northward train on the main track with the power switch normal, the long track circuit A31T is included in the control of the crossing signals. If the power switch is reversed for a northward train to leave the siding, the siding track circuit XT, rather than the longer main line track circuit A31T, is included in the controls. However, neither the A31T or the XT track circuit is included until a northward signal, either 3732 or the leave-siding dwarf, is cleared. The OS track circuit 373AT is a positive control of the crossing signals.




## High-Water Detectors

As part of the signaling system, high-water detectors are located between Mena and Potter, and between Hatton and Wickes at locations subject to flash floods. These are Western Railroad Supply Company Model 525OT detectors, similar to those illustrated on page 29 of the July 1954 issue. The float in each detector is a metal container, filled with cork.



**HEAVY PLATES, adjustable braces, modern rods used on power switches**

Therefore, even if a stray bullet punctures the container, the cork will rise with the level of flood water. Attached to the top of the float is a vertical rod which operates two 3-contact mercury tubes in the control box. These contacts are connected by No. 6 wire to the rails, in each direction from insulated rail joints at the detector. To minimize damage by lightning that might come in on the rails, each of these wires is connected to a No. 588 Raco equalizer, the ground posts being connected to a good ground rod. The polarity of the track circuit is staggered at these insulated rail joints at the detector. When the contactors are operated, the track circuit is not only opened but also shunted. In addition to placing signals red, (track occupied) is indicated on the CTC machine. Locations of high-water detectors are covered by General Notice to "all concerned" so that enginemen and dispatcher will know that the flood detector is one of the factors that can control certain signals to red.

The switch machines are the GRS Model 5D dual control type with 24-volt d.c. motors. A 1-in. by 10-in. insulated gage plate is used on the No. 0 tie. On the No. 1 and No. 2 ties, 1 in. by 10 in. tie plates extend and are attached to the switch machine, thus maintaining its position with reference to the rail. Adjustable rail braces, made by Ramapo Ajax, are used on eight ties. The front rod is a GRS hinged type, and the four switch rods are the Ramapo Ajax type M. Each switch includes a GRS roller bearing to ease the operation of the switch.

On this project coded track circuits are used between sidings. These track circuits are fed all the time. In the usual arrangement the feed is both directions from the center of each siding-to-siding section.

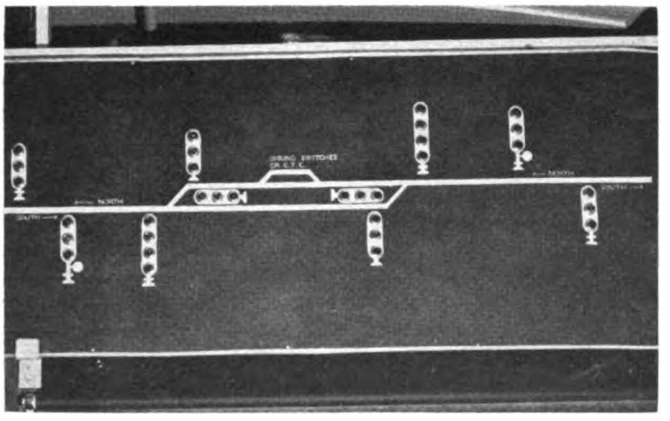
The rate of feed is 75 impulses per minute except where more than one set of intermediate signals are used between sidings. At these locations, in order to eliminate the additional line wires that would otherwise be required for repeating track relays, track circuits between the approach signal and siding end are fed either 120 or 75 rate code from the approach signal. If the track circuits in approach to approach signal are unoccupied, the 120 code rate is used, but if the approach circuit is occupied, 75 rate code is fed to the rails. The 75 or 120 code rate is then detected at the siding end and used to show block occupancy.

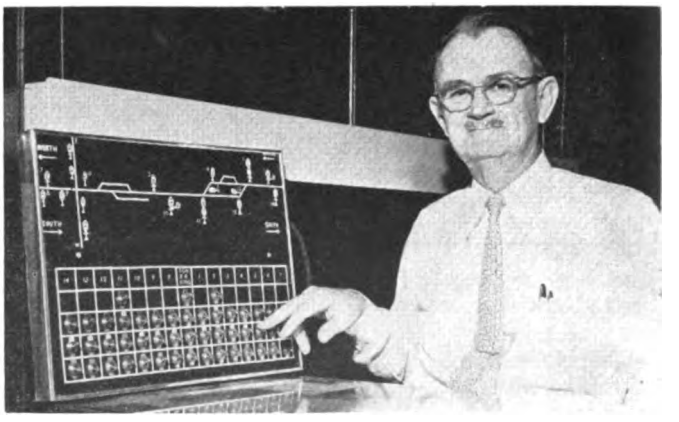
### Power Supply

The signal line wires are on the lower crossarm of a previously existing communications pole line. Two No. 6 Copperweld line wires are for the CTC code line circuit. The local signal line control circuit is on two No. 10 Copperweld wires. This pair of wires is used for the control of either the northward or southward signals between two sidings, depending on the direction set up by the CTC lever control.

Commercial supply a.c. power at

(*Continued on page* 40)





## Rules Instruction

*Installation of centralized traffic control on some sections of the Kansas City Southern created a problem in the training of engine and train crews. C. W. Bates, KCS rules examiner, noticed that the men seemed to grasp much faster, and to retain much better, instruction presented to them visually. He therefore designed and built the signal indication panel pictured herewith, which is now mounted in his instruction car. By manipulating switches on the control board at his desk, he can set up any kind of signal problem on the instruction panel, which is designed to represent about 20 miles of single-track railroad.*

*One unexpected result of use of this instruction panel has been that many students, once a given problem has been solved, are eager to learn how the movements of their train affect signals governing other trains in the vicinity, and the probable course of action to be taken in unusual circumstances.*

closed switch which is of the heavy-type ordinarily used as a motor control switch.

In this project the CTC codes are handled by the US&S 514 code system which provides for any desired number of controls and indications per field station. The control machine at Ft. Scott handles 21 field stations including not only the two-track section between Kansas City and Paola, but also 55.7 mi. of single track CTC between Paola and Ft. Scott.

### Pole Line Work

On this project the signaling line wires are on the bottom arm of a pole line used also for communications circuits.

The CTC code line and the 440-volt a.c. power distribution are each on a pair of No. 8 Copperweld wires with Duraline covering. The four pairs for local signal controls are on No. 12 Copperweld wire, weatherproof.

This CTC project was planned and constructed by railroad forces, under the direction of R. W. Troth, superintendent of communications and signals, the major items of equipment being furnished by Union Switch & Signal Division of Westinghouse Air Brake Co.

## Car Accounting

(*Continued from page* 33)

and adding telephone and telegraph carrier over existing pole lines, as well as by microwave installations. The communications departments of the railroads can furnish any service that the management might need.

Due to the nature and size of our railroad communication plants we are operating with economies that cannot be matched by other sources of communication services. The very nature of railroad operation is such that its communication facilities are an integral part of the overall system. In order to provide an integrated over-all efficient and economical railroad operation, the railroad itself must have absolute and instantaneous control of its communication facilities, not only to the extent of the installation, maintenance and operation, but in cases of emergency must be able to control their own destiny, so that they will not be dependent upon outside sources to tell them when they can restore their service and when they can move their trains.

Further, we have contracts with one or more labor organizations which must be taken into consideration when we approach the thought of reaching outside our highly trained groups for leased facilities. We must also think of the fact that those who would provide us with leased facilities can have labor troubles in which we have no participating part which could tie up our entire operation.

My opinion, as a member of the railroad communication fraternity, is that we can provide management with any type of communication facility that might be needed, at a long range cost far less than this service can be obtained from any other source. Not only that, due to our many years of railroad operating and communication experience, we feel that we can provide these facilities better than they can be obtained from other sources."

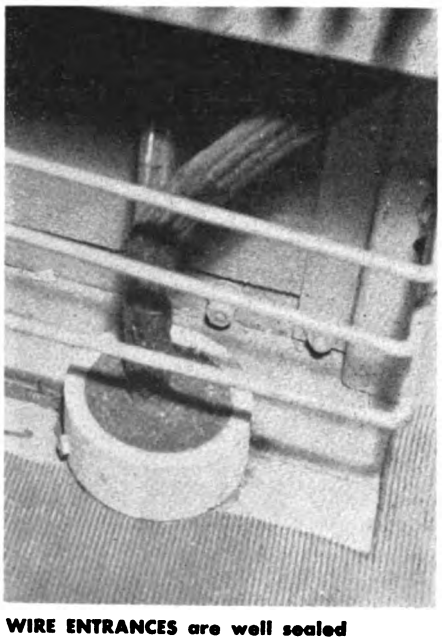
## CTC on KCS

(*Continued from page* 32)

110 volts is available at all the sidings, and is extended out to the intermediate signals on two No. 10 Copperweld wires. All these line wires have Habirlene plastic weatherproof covering.

At the control office, the CTC code line is fed by a set of 36 cells of Exide 8-a.h. type CME-3 storage battery. Local circuits are fed by 12 cells of 120-a.h. Exide lead battery. North of Mena the storage batteries are the Exide lead type using 12 cells of 60-a.h. battery at each power switch, and a set of 5 cells of 60-a.h. to feed each signal line control circuit and to act as standby for lamp feed. Where a.c. is available, each track circuit is fed by one 60-a.h. cell. South from Mena the storage batteries are the Edison nickel-iron type. A set of 18 cells of 160-a.h. capacity is used at each power switch, and a set of 8 cells of 80-a.h. capacity is used to feed each signal line control circuit and as standby for signal lamps. One 160-a.h. capacity cell is used to feed each track circuit where a.c. power is available.

**TRENCHING MACHINE** mounted on a jeep



**WIRE ENTRANCES** are well sealed

In the construction work on the Heavener-DeQueen installation, a jeep equipped with a winch and trenching machine was used to good advantage in digging trenches for the underground cable where the terrain would permit or where there was not too much rock to interfere with the trenching machine. The bulk of the signal materials, including foundations, etc., were unloaded at various passing tracks which could be reached from the highway. A great deal of the heavy materials were distributed from these locations by truck, which not only expedited the work, but also greatly minimized the train interference and hazards involved in the use of motor cars for this purpose. The truck used for distribution was a 1½ ton truck equipped with a winch which was especially valuable in the unloading and handling of heavy materials. There were some locations which were not accessible from the highway, and therefore motor cars had to be used in these cases.

This centralized traffic control was planned and installed by KCS forces under the direction of C. F. Grundy, signal engineer. The field construction work was under the supervision of R. E. Woodward, signal foreman, and of C. K. Woodward, signal supervisor. The principal items of signaling equipment were furnished by the General Railway Signal Company.