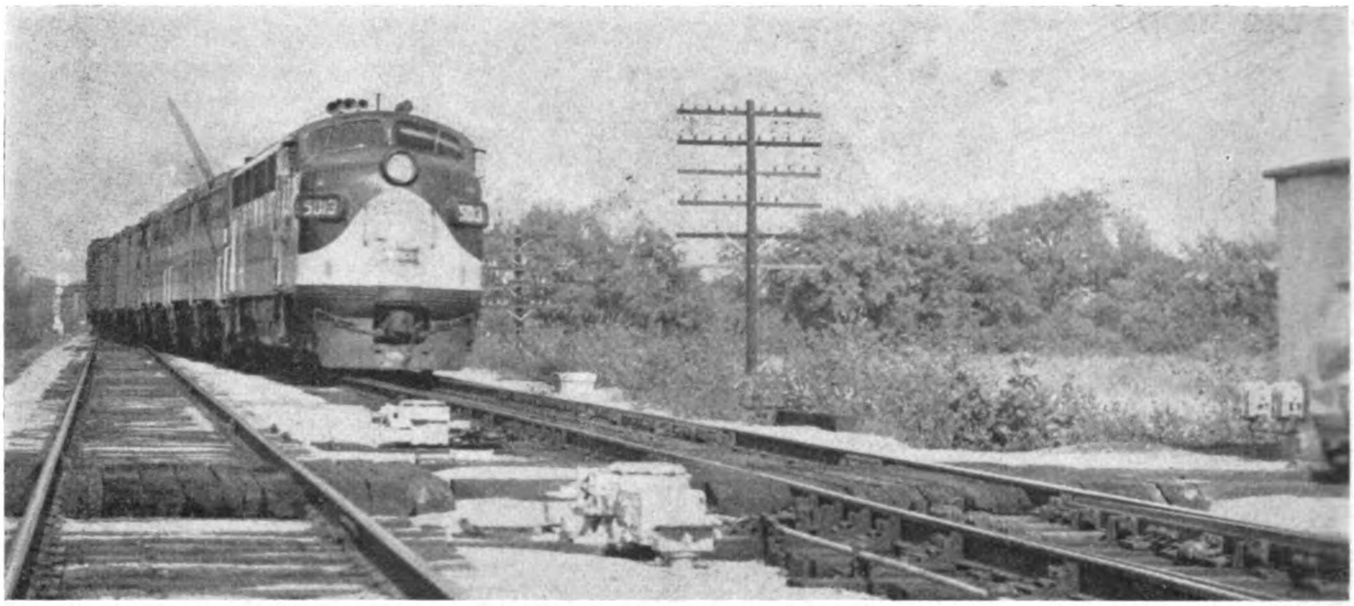


FREIGHT TRAIN CROSSES OVER from right-hand to left-hand track in run-around move

Both Ways on Both Tracks with CTC

Frisco increases track capacity; eliminates train delays; reduces track maintenance expenses and eliminates sidings by installing crossovers with power switches and signals controlled by dispatcher

ON 40 MILES of double track between Kansas City, Mo., and Paola, Kan., the St. Louis-San Francisco has installed power-operated crossovers and signals, in a centralized traffic control system, by means of which trains now run both ways on both tracks, the same as on two single-track main lines, side-by-side. With double crossovers about 11 mi. apart, faster trains are run around slower ones, thus keeping all trains moving, rather than allowing slower ones to lose time on sidings, or to wait in the yard. Trains are authorized to make diverging moves over the crossovers at speeds up to 50 mph. As 60 mph is maximum permissible speed anywhere on the division for freight trains these trains lose very little time when making a diverging move from one main track to the other, compared with running through on the "straight" track route. An added benefit, of the new signal system, is that large mechanized track crews can work uninterrupted for an entire eight-hours on a section of track between two crossover locations, while trains are routed over the other track.

Why On This Section

This 40-mile section handles heavy traffic, ranging from 30 to 40 trains daily. The peaks are northbound in the early morning, and southbound in the evening. This territory is part of two routes on the Frisco (1) Kansas City through Ft. Scott to Tulsa, Oklahoma City, Ft. Worth and Dallas, and (2) Kansas City through Ft. Scott to Memphis, Birmingham and points in Florida.

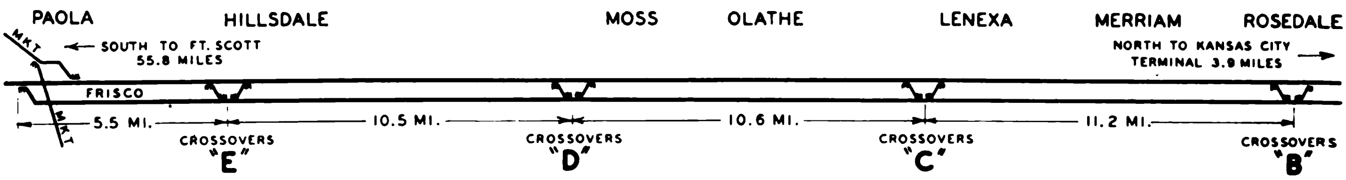
In addition to Frisco trains the Kansas City-Paola section also handles four passenger trains and at least eight freight trains daily for the Missouri-Kansas-Texas, and two passenger trains for the Missouri Pacific. Thus the total daily traffic includes 12 passenger trains and about 18 to 22 freight trains daily. Counting extra trains the total may range from 30 to 40 train movements daily.

Heavy Grade for Southbound Trains

From MP4 in Kansas City the grade ascends southward most of the way to MP13 near Lenexa, ranging up to 1 percent, with curves ranging up to about 4 deg. From Lenexa south to Paola, 29 miles, the railroad traverses prairie with short rolling grades most of which are less than 0.8 per cent.

Three Sidings Previously—None Now

Previously there was a southbound siding at Lenexa, which is just south of the crest of the 9 miles of southbound ascending grade. At Moss a siding was located between the main tracks, with switches at both ends connected to both tracks. The same kind of a siding was located at Hillsdale. The switches at these sidings



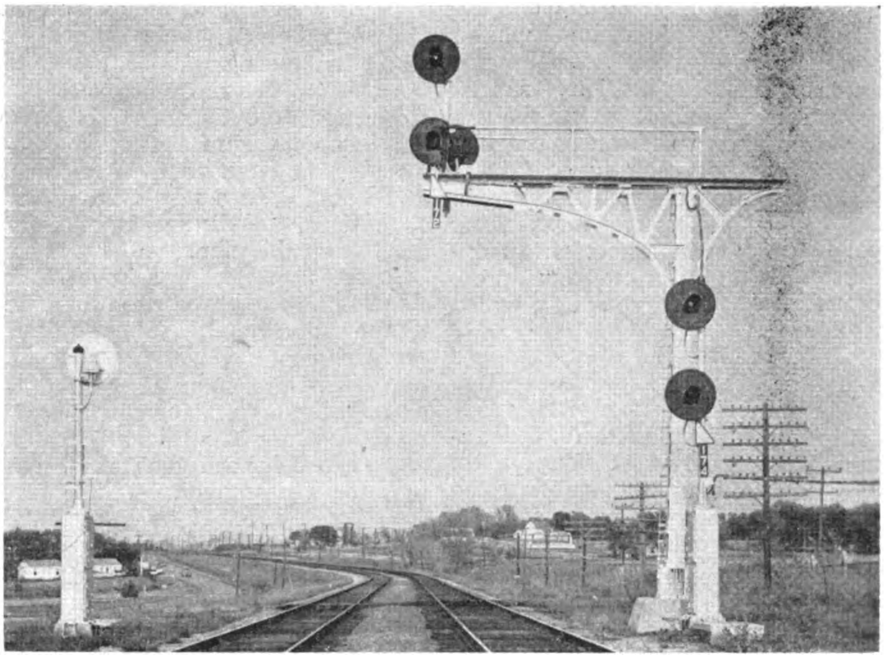
were operated by hand-throw stands. As explained by the dispatcher, he usually figured about 10 minutes for a freight train to slow down; stop; and enter a siding. About the same time was required for a train to depart from one of these hand-throw sidings. Therefore, if a freight took siding, it lost 30 to 40 minutes or more. A further complication was that, under timetable and train order operation, the dispatcher had no ready means of knowing whether a freight train had entered one siding, or was proceeding to another siding to get out of the way of a following train.

The difficulties were increased because the bulk of the trains are operated in two peaks, north in the morning and south in the evening. Four of the southbound passenger trains leave Kansas City between 9:10 p.m. and 11:25 p.m. Ordinarily a southbound freight train should run from the Kansas City yards to the crest of the grade in about 40 minutes. If such a freight had difficulty ascending this hill, under the previous method of operation, some of the following passenger trains would be delayed. In a great many instances, southbound freights were held in the yard at Kansas City, rather than run them out ahead of passenger trains.

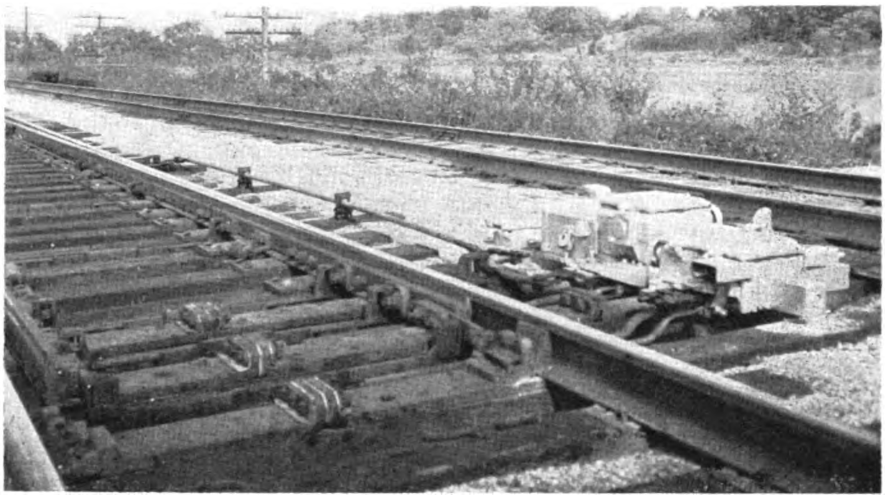
Similarly four northbound passenger trains are due in Kansas City between 6:40 a.m. and 8:25 a.m. Therefore the dispatcher often had to decide whether to run northbound freights ahead of passenger trains and thus take chances of delays to the passenger trains, or to hold the freights at Paola and take the consequences for delays to these freights. Thus the previous practice of double track operations, right-hand running, with hand-throw sidings and train operation by timetable and train orders, was not satisfactory because of numerous train delays.

A study showed that the track capacity could be increased and train delays eliminated by installing crossovers, and centralized traffic control including power switches and signals for authorizing train movements by signal indication. Now the dispatcher does not hold the freights at Kansas City or Paola but lets them go when ready to depart. He runs them ahead of passenger trains, and then crosses them over to the other track to let the passenger trains go by. Or, he runs the freight out on one track and the passengers on the other. Thus all trains keep moving, rather than wasting time on sidings or in yards.

The system is so flexible that there is no need for sidings to be used by through trains. Therefore no power switches or CTC signals were installed at the previous sidings at Lenexa, Moss and Hillsdale. If and when these sidings are not needed for storage or as house tracks, they can be removed.



EACH TRACK is signaled both ways just like two single tracks



A HELPER is connected to mid section of the long switch points

50 MPH Crossovers

In order to operate this system successfully, the crossovers must be designed so that trains can diverge from one main track to the other without losing much, if any, time because of reductions in speed. In this territory the maximum speed for freight trains is 60 mph, and for passenger trains 70 mph. The new No. 20 crossovers are 386 ft. long, and include 39-ft. curved switch points. Trains make diverging moves over these crossovers at 50 mph, and there is no objectionable sway of cars in either the freight or passenger trains.

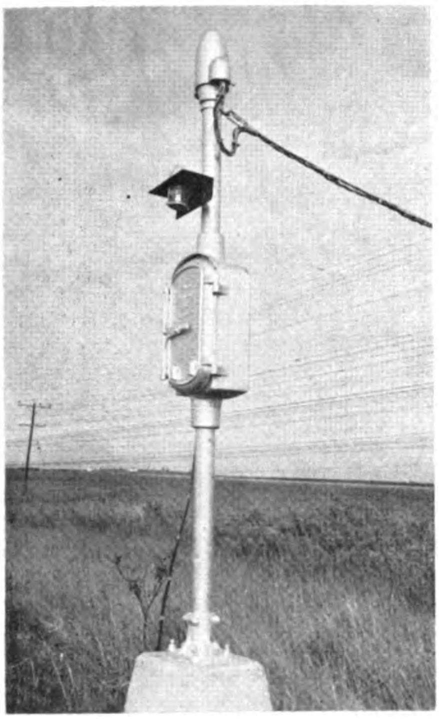
Up To and Through, at Speed

It is one thing to provide crossovers for 50 mph, and it is something else to provide signaling to direct an engineman to bring his train up to and through such a crossover at the full speed for which it was designed. The Frisco solved this problem by adopting a very simple variation from standard practice. When a crossover is reversed for a train to diverge from one track to the other, the "home" signal displays the Diverging Clear aspect, red-over-green, and the signal in approach displays the Approach-Limited aspect, yellow-over-green over a triangle. This triangle is a special marker consisting of a piece of sheet metal in the shape of a triangle and painted aluminum with a 1 in. black stripe around the edge. This special marker, in combination with the yellow-over-green, tells the engineman that he may approach the next signal at limited speed, which is 50 mph. Without such a special marker, the yellow-over-green aspect on an approach signal means approach the next signal at medium speed, which is 30 mph.

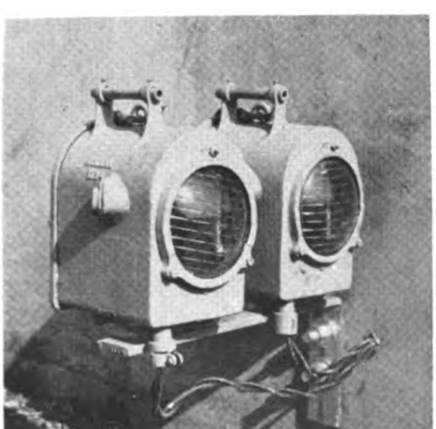
Where Crossovers Were Located

Several important factors determined the location of the four all new double crossover layouts. If no other factors were involved, the crossover layouts most logically should be spaced at an equal distance if the track were level; or on an equal time-distance basis where grades and curves affect speeds. However there are other factors that result in shifting the locations; for example, to get the crossover off a curve and onto tangent track. Also the locations were shifted in some instances to avoid highway crossings and bridges. As a result of all considerations, the distances are as indicated on the plan.

After the project was in service a short time, the dispatcher soon determined the running time on different sections, and was able to plan moves on close timing. For example, 40 minutes B to C for a freight, or 20 minutes for a passanger; 15 minutes C to B for a freight, or 10 minutes for a passenger.



MOTOR CAR INDICATOR on post



DOUBLE INDICATOR at crossover

Saves Money on Track Maintenance

On this division the track maintenance is done by district gangs, equipped with on-track machines. In order to utilize these machines efficiently they should be allowed to work continuously for 8 hours each day without being required to clear the track to allow trains to pass. This was not practicable with the previous method of train operation. The track machines had to clear the main track, and the trains were required to reduce speed to 10 mph, which for freights meant that they had to stop first, then proceed.

Now with the new system, a section of track between two power crossovers can be given over for 8 hours to a mechanized track crew, and in the meantime all trains of both directions are routed over the other track. Thus the track machines are used much more efficiently, and the trains encounter less delay because of track work than before.

Good Protection for Motor Cars

Previously the men on motor cars knew that southbound trains would be on the southward track, and northbound trains on the northward track, and the dispatcher could issue fairly good information concerning when to expect each train. However in the new system the operations of trains is flexible. The dispatcher, by watching his illuminated diagram, can see the progress made by each train, and on this minute-to-minute information he lines up routes on one track or the other as required to keep all trains moving. For these reasons a complete system of motor car indicators was installed as part of the signal system.

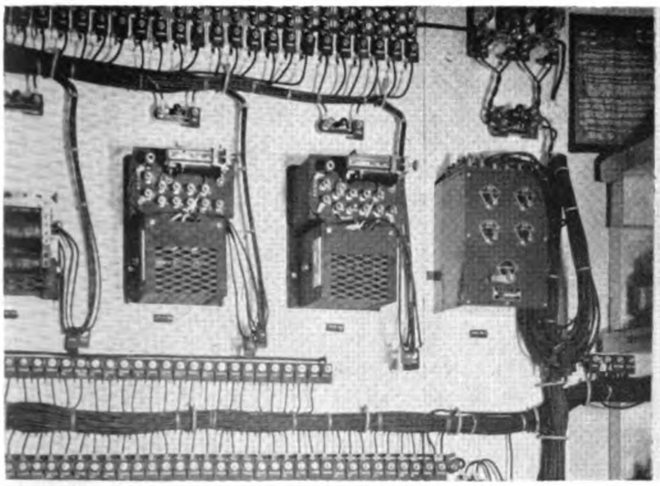
Between crossover locations there is a separate set of motor car indicators for each track. These indicators are the light type mounted in front of a black-metal background on a pipe mast as shown in one of the pictures. In each indicator the electric lamp is inside a fresnel lens so that the lamp can be seen from the track or from any direction along the tracks. The lamp is lighted when no train is approaching or is dark when a train is approaching. The indicators applying for the right-hand track going north are on the east side; and those for the other track are on the west side. The indicators are spaced so that a man on a motor car is seldom out of sight of an indicator except on straight track. If the indicator shows that a train is approaching, he has time to get his motor car off the track before the train would arrive. Thus the motor car indicator system, including a total of 116 indicators, may be said to be "continuous" because it is effective all the time for trains in both main tracks on the entire territory. A motor car "set-off" is located at each indicator, and at each set-off there is a platform to move a car from one track to the other.

When approaching a layout of power-operated crossovers, a man on a motor car must know (1) that no train is approaching on the track which he is on, and (2) that no line up has been set up to route a train from the other track to the one he is on. This requires that there be, at each double crossover layout, two indicators facing south and two indicators facing north. These indicators, as shown in one of the pictures, are made of discarded electric semaphore lamps using special horizontal wide-angle clear glass lenses.

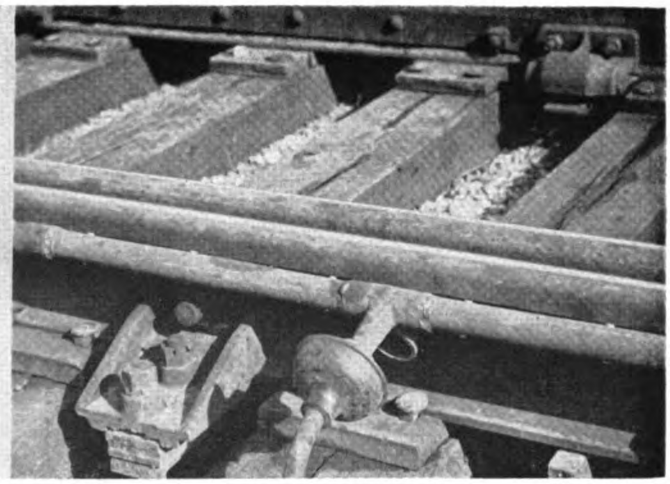
In general the automatic controls for indicators extend from one power crossover layout to the next, with directional controls to permit an indicator to clear behind a preceding train. In addition to automatic controls, the indicators are controlled when the dispatcher clears a signal for a train to enter a section from one power-operated crossover layout to the next one.

The lamp in each indicator is rated at 25 watts, 110 volts, and is normally fed from a transformer connected to the a.c. power supply.

The eight new crossovers include No. 20 turnouts with 39-ft. curved switch points all constructed with new 115-lb. rail. Two pairs of roller bearings ease the operation of each switch. A pipe connection, known as a booster, or mid-drive, extends from the operating rod to a connection on the fifth switch rod which is 13 ft. from the point. This booster insures that the entire length of the point



LOCOL CONTROL PANEL in instrument house



SNOW MELTERS on switches burn gas

moves over properly before the switch machine will lock up. The switch plates are lubricated with Dixon's graphito applied by using enough naptha to make a paste. The advantage compared with oil is that the graphite stays on longer, will not wash off by rain, and loose dust will blow off rather than stick to the plates.

Each switch is equipped with gas burning switch heaters to melt snow. These heaters burn propane gas furnished from a tank at each crossover layout.

In each switch the front rod is the Ramapo Ajax type MF and the four switch rods are the type MJ made by the same company. Insulated gage plates 1 in. thick and 8 in. wide are used on the No. 0, No. 1, and No. 2 ties. Ramapo Ajax adjustable rail braces are used on these three ties as well as on ties No. 3, 6, 9, 12 and 15.

Two of the gage plates extend and are attached to the switch machine, thus maintaining the position of the machine with respect to the rail.

The switch machines are the Model M-23A dual control, with 20-volt d.c. motors. The main line signals on the entire project are the H-2 searchlight type. The track circuits are the conventional d.c. type, using neutral relays. On long circuits 4,000 ft. to 6,200 ft., the relays are 2-ohm. For short circuits below 4,000 ft. the relays are 4-ohm.

Each track between groups of power operated crossovers is divided into two sections and each section has a lamp on the dispatcher's control machine track diagram for track occupancy indication. Separate control for each lamp is secured in the field by means of block indication relays at each end of a section, each of which control through one half of each block.

At various towns, ranging from 15 to 20 mi. apart, the Frisco buys commercial a.c. power to feed the signal power distribution line. At each of the feed locations, there is a 2-kva power transformer. These transformers, which have a normal rating to feed 440 volts to the distribution line, also have taps to step the output voltage up or down in units of 10 volts.

Each of these transformers is protected by General Electric arresters and Line Material Company fused cutouts. From each of these power transformer locations a two-wire 440-volt a.c. signal power distribution circuit extends in both directions for about 7 to 10 mi. From the end of one such feed to the end of the next, there is a gap the length of a track circuit, thus saving line wire.

At each power switch and at intermediate locations, there is a 0.5 kva transformer. These transformers are the air-cooled type made by General Electric Company. Each such transformer is protected by GE arresters and LM fused disconnect cutouts. The feed from the 110-volt is through Westinghouse quick-lag circuit breakers, rather than through fuses. The rectifiers for charging batteries operate on 110-volts a.c.

At each crossover location the four switch machines are fed from three sets of 20 cells of 120-a.h. Edison storage battery; one set at the relay house at the center of the crossovers and one set at the far end of each crossover. Each short track circuit is fed by four cells of 500 a.h. Edison primary battery. Longer circuits are fed by one 80 a.h. Edison storage cell using a Fansteel Selenium type rectifier. Some track circuits, ranging up to 2,000 ft., are fed by two cells of primary using a Selenium automatic rectifier.

At the control office in Ft. Scott, the machine battery consists of eight 120-a.h. cells of Exide lead battery. If the incoming a.c. fails, this battery also operates a tuned alternator to feed the rectifier which feeds the CTC code line. The storage batteries for the control machine are on floating charge through a US&S Co. RP 61 rectifier.

Better Telephone Service

A telephone is located at each of the two home signals at each of the four crossover layouts as well as at each of the hand-throw switches at house tracks and spurs, all of which are equipped with electric locks.

On this division there was, and still is, a telephone train dispatcher's system which operates on two No. 9 copper line wires. Also as part of the new signaling system, a telephone circuit was superimposed on the two CTC code line wires. This system has no ringing for calling. When an employee at an outlying phone booth wants to talk to the dispatcher, he blows or whistles into the telephone transmitter. This operates a voice-actuated relay in the office which lights an indication lamp and sounds a buzzer on the dispatcher's machine. Then the dispatcher plugs in his telephone set to answer.

In each phone booth, there is a three-way switch of the heavy duty type ordinarily used as a meter control switch by means of which the phone can be: (1) left off the line; (2) connected to the regular dispatcher's telephone line; or (3) connected to the telephone circuit that is superimposed on the CTC code line. For this purpose, the Frisco previously used conventional porcelain based three-way knife switches. However, trainmen and other employees handled these switches so roughly that too much telephone trouble resulted. To prevent such damage, the Frisco is now connecting the phone circuits into an enclosed 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."

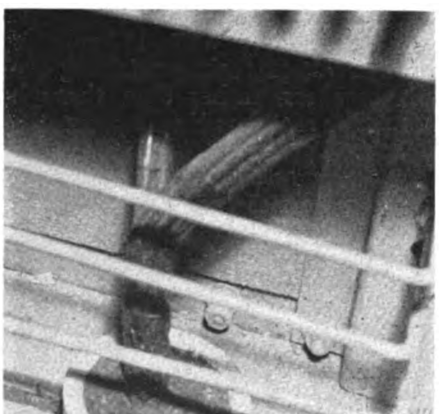
CTC on KCS

(*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.