

**Junction switch at new branch connection together with signals, at Tyler, Tex., is controlled from dispatcher's office**

**View of junction layout with signal 2L in foreground and northbound main line train approaching**



## Remote Control on the St.L.S.W.

AT TYLER, Tex., on the main line of the St. Louis Southwestern, between St. Louis, Mo., and Waco, Tex., a single-track branch line diverges to the south and extends 88 mi. to Lufkin, Tex. This branch line handles two gas-electric passenger trains, and two freight trains daily, in addition to extra trains as required during peak movements of vegetables.

The Lufkin branch formerly connected with the main line 3,176 ft. west of the Tyler station, and the branch line extended through a part of a business and industrial section. In late years, one of the better residential sections of the city was built up along portions of this branch. A total of 12 street crossings were at grade, two of these streets carrying through highway traffic. Some consideration had been given to the construction of overhead grade separation structures at two or more of the street crossings. Furthermore, in part of the more recently developed residential section, the railroad right-of-way paralleled a street and interfered

with the logical development of the residential real estate.

After considerable study of the problem involved, it was decided that the most economical and effective solution to the problem was to build a new connection to route the Lufkin branch around the western limits of the city. Starting at a point on the Lufkin branch 2.5 mi. from Tyler, a new line 1.8 mi. long was constructed to connect with the main line at a point 1.5 mi. west of the previous junction. A short section of the old Lufkin branch was left in place for switching connection to industries. Eight of the 12 grade crossings were eliminated. However, in so far as through train movements are concerned, a total of 12 street crossings were eliminated.

The construction of the new line required the clearing and grubbing of 7.14 acres, 73,715 cu. yd. of road excavation; 1,095 cu. yd. of channel excavation, 79,206 cu. yd. of overhaul, and 412 cu. yd. of miscellaneous excavation. Concrete drainage pipe was in-

stalled as follows: 144 ft. of 15-in., 156 ft. of 24-in., 274 ft. of 36-in.; and 110 ft. of 36-in. extra strength reinforced concrete cradle. A total of 14,057 cu. yd. of gravel ballast was placed and 10,316 ft. of track, using 85-lb. rail, was laid.

In so far as the main line is concerned, the new junction switch is located near the crest of a 1 per cent grade about 3.5 miles long, ascending northbound, this being the ruling grade for the division. The main line freight trains, ranging from three to five each way daily, handle about 70 cars each, totaling 2,800 tons. If one of these trains is stopped on the ascending grade, considerable difficulty would be encountered in starting.

In order that Lufkin branch trains could be operated safely between Tyler and the new junction over the main line, and in order that the inbound branch train movements could be controlled so as not to stop northbound main line freights, it was decided that a power switch machine, to-

gether with signals for directing train movements, should be installed at the junction layout, and that the switch and signals be controlled remotely by a machine to be located in the dispatcher's office at Tyler, which is 1.47 mi. from the new junction. Prior to the improvements, three automatic signals had been in service as protection for track-occupancy and switch-position protection in the section of the main line south of the station. These signals were overhauled and continued in service, as formerly.

### Switch Layout and Signals

The new junction turnout is a No. 10, using 85-lb. A.S.C.E. rail. The switch is operated by a Model M-2 d-c. low-voltage electric switch machine, the usual arrangement of lock rods and a point detector being used. The switch layout includes 1-in. by 7-in. insulated gage plates on 3 ties, two of the plates being extended and connected to the switch machine to prevent lost motion.

The three home signals are the searchlight type. The southward signal on the main line has two operative units, the top unit governing for the through main-line route and the lower one for the diverging move to the Lufkin branch. The northward signal on the main line, as well as the one on the Lufkin branch, has an upper operative unit and a lower fixed unit showing red. A fixed distant signal of the HC-33 light type is provided in the approach to each of the northward home signals.

### Control Machine in Office

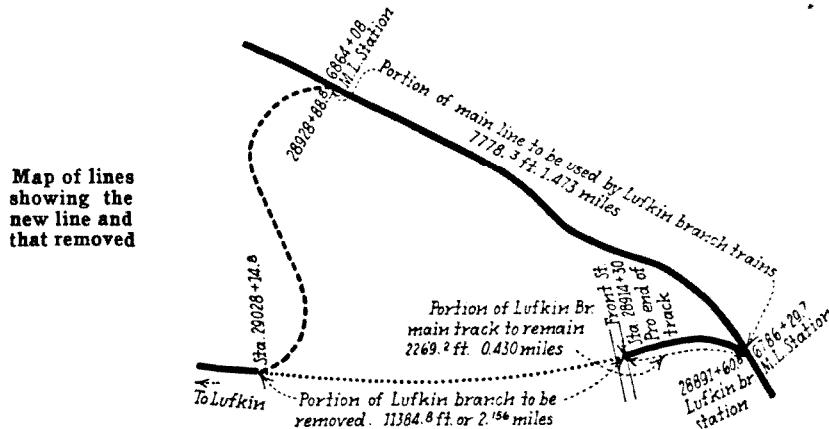
The control machine in the dispatcher's office is of the cabinet type, the panel being 17½ in. wide and 11½ in. high. Non-interlocked, miniature-type levers are used. One two-position lever controls the operation of the switch machine. One three-position lever, which normally stands on center, controls all of the four operative signal units at the junction home signals. When the lever is thrown to the right a northward signal is cleared, and when thrown to the left a southward signal clears. The position of the switch determines whether a main line or a Lufkin branch signal is to be cleared. A lamp above the switch lever is extinguished when the switch is in transit or when the switch is not in the position corresponding to the position of the lever or when the switch is electrically locked. A lamp above the signal lever is lighted when any one of the signals clear. Lamps in the track diagram are lighted to indicate track occupancy of

the section within the signal limits as well as occupancy of either of the three approaches. An annunciator bell rings when a train enters an approach circuit.

### Control Circuits of Special Interest

The control circuits used on this installation are of interest because they represent a good design to secure the

connected to CC, which is the split-battery common and is positive in relation to NL. The control circuit on left wire 1WR from the relay goes through a normally closed contact in the magnetic overload circuit breaker 1-OR, wire 1WR1 through front contact of 1TR, track relay for the track section within home signal limits, wire 1WR2, through a front normally-closed contact of relay 2LASR, ap-



maximum utility of a minimum number of line wires in a direct-wire control system. All of the protection is vested in the local circuits at the field location. No code apparatus is used. In brief, four wires, with a split-battery common connection extending between the control office and the junction, are utilized to control one switch, four searchlight home signal units and to send indications to the control machine concerning two positions of the switch, proceed aspects of three home signals, and to control three track-occupancy lights as well as to control an annunciator bell. In brief, wire 1WR10, which controls the operation of the switch, is used to bring in the signal indications, and wire 1WK1, controlling the signals, brings in the switch indications as well as the indication of the track occupancy of the track within the home signal limits. One wire 2RA-BPA1, brings in the indications of the two approach sections. An additional wire, 2LAK, was run from the control station to automatic signal 4, a distance of 3,176 ft. to bring in the indication of track occupancy for signal 5 block.

### Details of Typical Circuits

Referring to the diagram, in order to reverse the switch, the polarity of the relay 1WR, shown at the left of the diagram, must be reversed. This is accomplished by throwing the switch lever on the control panel to the R position, thus connecting NL rather than BL to that end of the circuit. Starting at relay 1WR, the right-hand wire from the relay is con-

proach locking relay for the 2LA signal unit, wire 1WR3, through a back normally closed contact of the corresponding thermal time-element relay 2LTER of the approach locking circuit, wire 1WR4, through front contact of 2LASR, wire 1WR5, through contacts in the approach locking relay 2RASR and its thermal time-element relay 2RTER, which applies for 2R signal units, wire 1WR8, through a normally closed back contact of signal control relay 2HR, wire 1WR9, through a front contact of relay 1TPSR, stick repeater relay for the track circuit inside the home signal limits, wire 1WR10, through a back contact of 2PR relay, wire 1WR11, through a back contact of 2HSR relay, and through a reverse contact on switch lever to NL. The circuit thus completed causes the switch control relay, 1WR, to reverse its polarity, causing polar contacts on this relay to reverse and close a circuit to operate and lock the switch in the reverse position. Before going further, it may be well to explain that relay 2PR is a slow-acting relay repeating the position of quick-acting relay 2HSR, which in turn cannot be energized as long as the signal lever is in the center position, the switch electrically locked by detector locking or the switch not in its extreme position and locked. Wire 1WR11 is taken through a back contact of 2HSR relay to check the fact that the signal lever is normal. The contact in 2PR relay in the 1WR10 wire is utilized to transfer the circuit from switch control to the signal indication relay 2HKR, as will be explained later.

With the switch moved to the reverse position, the next action is to send the switch indication to the control machine. When the switch is reversed and locked up, the circuit between terminals 4 and 9, in the rectangle representing the switch machine, is open, the circuit between terminals 1 and 8 is closed, and the polar armature on the WR relay is moved to the right. It will be seen that wire 1WK5 connects to BL through a front contact in relay 1TPSR, indicating that the track circuit within the home signal limits is not occupied. Wire 1WK5 then goes through the polar contact of 1WR relay reversed, wire 1WKA4, through the contact in the switch machine between terminals 8 and 1, now closed, wire 1WKA3, through back contact of signal relay 2HR, now closed, wire 1WK2, through front contact of switch control relay 1WR, wire 1WK1, through a back contact of 2PR relay to pick up relay 1WKR. A front contact in 1WKR relay closes circuit 1WK to light the lamp above the switch lever, thus indicating not only that the switch is over and locked in the position corresponding to that

thence through a contact on the signal lever closed in the L position to BL. This opens the circuit to 1WKR relay, releasing that relay and causing the switch indication lamp to be extinguished as information to the lever-man that the circumstances are such that nothing would be accomplished by moving the switch lever; (2) it transfers wire 1WR10 from the control circuit of the switch control relay 1WR to the signal indication relay 2HKR.

Now going to the left from the contact on 2PR relay to the wire 1WK1, the circuit is closed through the back contact on 1WR relay, which is down, to wire 2HR to pick up relay 2HR in the position to move its polar contacts to the left.

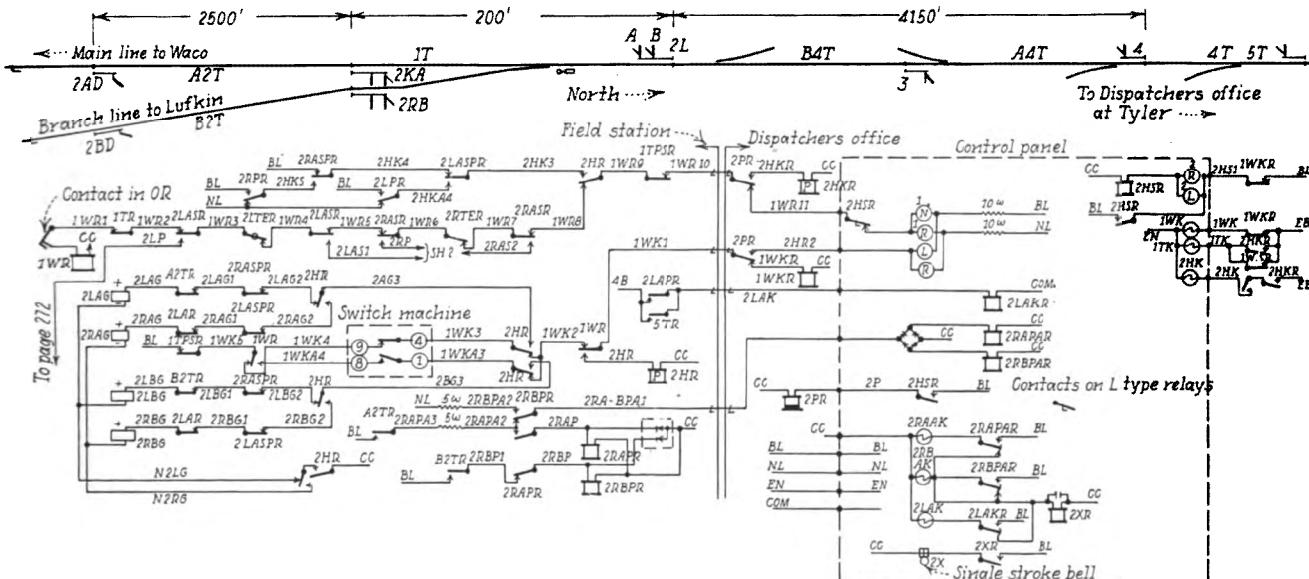
Refer now to the rectangle representing the searchlight signal mechanism 2LBG. The signal mechanism is energized by BL feeding through a front contact of 1TPSR relay just above and to the right of 2LBG. Relay 1TPSR repeats the track circuit within the home signal limits and is held up, after 2HR is picked up, by a stick circuit through a front contact on the relay and a front contact on

2LBG1, through a front contact on the advance track relay B2TR to signal mechanism 2LBG.

From the left of signal mechanism 2LBG, wire N2LG goes to a polar and neutral contact in 2HR relay to CC. The common side of the signal mechanism breaking through contacts in the 2HR relay provides double-wire, double-break protection for this circuit. A single cross or a ground on the signal control circuits on the runs to the signals or switch, or any place exterior to the instrument house, could not cause a signal to be energized.

## Signal Indication Circuits

When signal 2LB changed to display a proceed aspect, relays 2LASR and 2LASPR were de-energized. With relay 2LPR de-energized NL feeds through a back contact of 2LPR relay, wire 2HKA4, back contact of 2LASPR relay, wire 2HK3, front contact of 2HR relay, wire 1WR9, front contact of 1TPSR relay, wire 1WR10, back to the office and through front contact of 2PR relay, wire 2HKR, to energize relay 2HKR,



#### Diagram of track layout and circuits

of the lever, but also that the track section within the home signal limits is unoccupied.

The leverman is then ready to clear signal 2LB, and he throws lever 2 to the left. Referring to the upper right of the diagram, BL is connected through a contact of 1WKR relay to wire 2HS1, through the contact L of the lever 2 to pick up the 2HSR relay. When 2HSR relay picks up, slow-acting relay 2PR picks up and does two things: (1) It connects wire 1WK1 through a front contact to wire 2HR2,

1TR relay. The circuit for 2LBG continues as follows: Wire 1WK5, through the polar contact of 1WR, which is now to the right, wire 1WKA4, through contact between terminals 8 and 1 in the switch machine, which is closed because the switch is reversed, wire 1WKA3, through a front contact in 2HR relay, which is now closed, wire 2BG3, through a polar contact in 2HR relay in the left position, wire 2LBG2, through a front contact in approach locking repeater relay 2RASPR, wire

positioning the polar contacts to the right. This closes the circuit to light the signal indication lamp.

### Track-Occupancy Indications

The indication of the track occupancy of the section within home signal limits is a part of the control of the switch and signal indication circuit as explained previously, the interlocking track section indicator 1TK being illuminated with either 2HKR relay or 1WKR relay energized and

extinguished with both 2HKR and 1WKR relays de-energized. Indications of the occupancy of the northward approach section on the main line, track circuit A2T, as well as on the Lufkin branch track circuit B2T, are both taken to the control office over wire 2RA-BPA1. When a train enters track circuit A2T on the main line, BL is fed through a then closed back contact of A2TR relay, wire 2RAPA 2 and 3, back contact of 2RBPR relay, which is de-energized, and over line wire 2RA-BPA1 through the upper left section of the RS-5 rectifier and picks up relay 2RAPAR. When 2RAPAR relay picks up, track-occupancy lamp 2RAAK is lighted and operates a single stroke bell.

When a train on the Lufkin branch enters section B2T, BL feeds through a back contact of B2TR relay to pick up relay 2RBPR. Then NL feeds through a front contact on 2RBPR relay and over line wire 2RA-BPA1 through the lower left section of the RS-5 rectifier to pick up 2RBPAP relay, which causes track lamp 2RBAK to light and the bell to ring. If a train on the main line enters track circuit A2T while a branch line train is occupying track circuit B2T, then BL feeds through A2TR relay down, 2RBPR relay up, and energizes 2RAPAR relay. This starts a succession of energization and de-energization of these two relays. From this it will be seen that wire 2RA-BPA1 will alternately carry BL and NL. Relays 2RAPAR and 2RBPAP will be alternately energized. The RS-5 rectifier in addition to acting as a valve for the selection of the relays, also causes them to be slow-releasing so that the front contacts of the relays remain

closed over their open circuit period, thus causing the approach lights to burn steadily. The indication of the track occupancy of the southward approach section to 2L signal is con-

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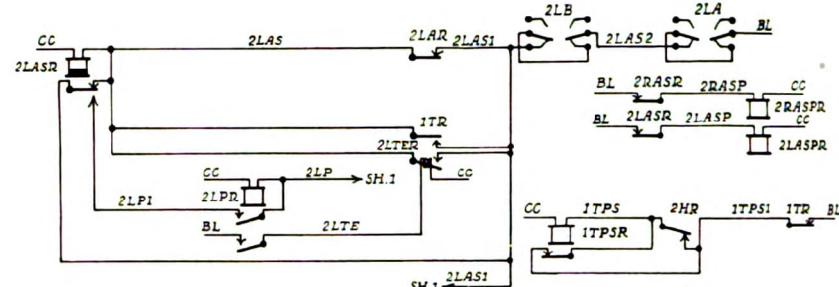


Diagram of approach locking circuits

trolled over line wire 2LAK, the circuit being completed by 5TR track relay down or 2LAPR relay down.

#### Locking Protection at the Junction

The approach and detector locking is effected at the field location. Starting at the right of the smaller diagram, BL feeds through normal contacts on searchlight signal units 2LA and 2LB, which are closed when the signals display the stop aspect, through a front contact of approach relay 2LAR, to stick relay 2LASR. This relay is normally energized but when either signal unit 2LA or 2LB is cleared, the relay is released, establishing approach locking protection and preventing the operation of the switch with a signal cleared. When the train passes the signal, it automatically changes to stop and remains so under stick signal control. With both signal units 2LA and 2LB in the stop

up by a stick circuit fed through its own front contact as long as both signal units 2LA and 2LB display stop aspects.

On the other hand, with the approach locking relay 2LASR released, if the leverman was to take a proceed signal away from a train approaching signal 2L, relay 2LASR could not be picked up until the thermal time-element relay 2LTER had operated to introduce a 2-min. time delay for the train, either to stop short of the home signal, or if too close to do this to enter the track section 1TR, which by the detector locking will prevent the operation of the switch. To operate the thermal time-element, relay 2LPR must be picked up. BL is fed over normal contacts 2LA and 2LB on the searchlight home signal, closed with the signals in the stop position, wire 2LAS2, back contacts of relays 2LASR and 2LTER, checking that these relays are in their de-energized

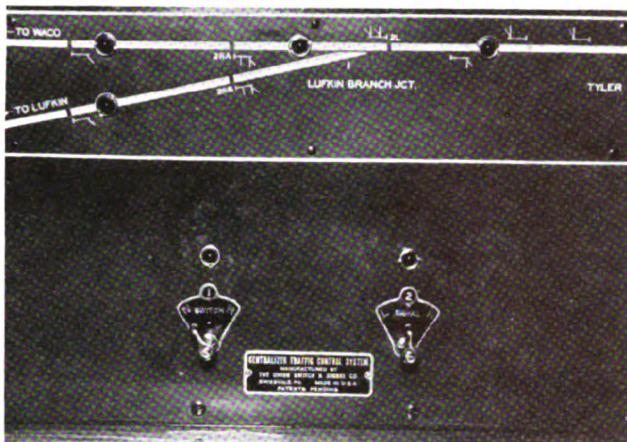


View of the new junction switch showing electric machine and the special plates and rail braces

position, and wire 2LP to pick up 2LPR relay. When this relay is up, BL is fed through a front contact to the heating element of 2LTER relay. After 40 sec., the front contact is closed to again pick up the approach-locking relay 2LASR. However, the

0.75 k.v.a., reducing the voltage to 230 volts to feed line distribution circuits on two No. 8 HD copper weather-proof line wires extending from the junction to include all the signal locations. A Type W-20 transformer feeds the signal lamps and an ANL-

The control panel in the dispatcher's office has an illuminated track diagram and two levers



2LTER back contact in the 1WR relay control circuit will not close until 80 sec. after the 2LASR is energized, thus providing a total of a 2-min. time interval for the approach-locking release of the switch.

The relays, main battery rectifiers, transformers, etc., at the junction layout, are located in a 5-ft. by 7-ft. welded sheet-metal house. The relays are the shelf type with spring shock absorbers. The track relays are the DN-11 type; relays A2TR and B2TR have 2-ohm coils, while the relays on track circuits 1T and B4T have 4-ohm coils. The Style DP-14 relay for the switch control 1WR relay has 250-ohm coils, while the Style DP-14 relay 2HR has 360-ohm coils.

Relays such as 2RAPR, 2RBPR, 2LAKR, 2RAPAR, and 2RBPAR, used for non-vital circuits, are the L-10 type rated at 280 ohms, the last three relays mentioned above being located in the control machine. The 2XR relay in the control cabinet is an L-10 type relay rated at 20 ohms. The thermal time-element relays, for the automatic release of approach locking, are the TH-10 type rated at 12 volts. The overload relay, in switch machine, is the OR-11 type rated at 12 volts. If the switch points are obstructed so that the motor stalls, this relay will open when the current increases to 12 amp. By reversing the lever, the OR-11 relay releases and the operator can reverse the switch.

#### Power Supply

Power at 2,300 volts, 60 cycles from a commercial source is furnished at the junction to feed a General Electric Type H line transformer rated at

30 power-off relay which switches this load to the battery in case of a power failure.

#### Types of Battery

The main battery, used primarily for operation of the switch machine, consists of twelve 80-a.h. Exide Type DMGO-9 storage cells. This battery is split and charged by two rectifiers, one RT-21 and one RT-42. Various signal and line circuits are fed from this split battery. At the dispatcher's office, a set of 12 cells of 72-a.h. battery is split as two batteries to feed line circuits. A W-10 transformer and a power-off relay are arranged the same as at the junction, the rectifiers and transformers being fed 110 volts from the freight station.

Each of the two distant signals 2AD and 2BD have a fixed single light unit which is lighted to display a yellow aspect when a train occupies the approach section. The 8-watt, 10-volt lamp in each of these signals is fed from a set of 12 cells of Edison 500 a.h. primary battery, the circuit being controlled through the back contacts of the track relay. Each track circuit on the installation is fed by 3 cells of Edison 500-a.h. primary battery.

The line wire for the control circuits is No. 10 H.D. copper weather-proof run on the existing pole line. The wiring between the instrument house at the junction and the home signals, and switch machine, as well as the track connections, is all in underground cable. Union bootleg outlets are used at the rail connections.

#### Plans and Installation

The remote control installation, which cost about \$10,000 complete, was a part of the project including the construction of the new cut-off. The total expense of the project was \$65,000, which was paid by the State of Texas, Department of Highways, from funds allocated by the Federal Aid for Grade Crossing Elimination. The City of Tyler paid \$12,000 for right-of-way property required for the new section of line. The new section of line was constructed by the Gifford-Hill Construction Company, Dallas, Tex., according to plans prepared under the direction of W. S. Hanley, chief engineer of the St. Louis Southwestern, who also had jurisdiction of the installation of the remote control interlocking, which was installed by railroad forces under the direction of B. J. Alford, signal foreman. The detail plans and the major items of equipment for the remote control interlocking were furnished by the Union Switch & Signal Company.



Interior of the sheet-metal instrument house at the junction